

ZCAS UNIVERSITY



**DETERMINANTS OF A CENTRAL BANK DIGITAL
CURRENCY AS A PAYMENT SYSTEM PLATFORM:
A CASE OF ZAMBIA**

BY

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF
DOCTORATE IN BUSINESS ADMINISTRATION (DBA) OF ZCAS
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I, the undersigned, declare that this has not previously been submitted in candidature for any degree. The dissertation is the result of my own work and investigations, except where otherwise stated. Other sources are acknowledged by giving explicit references. A complete list of references is appended herewith.

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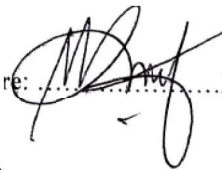
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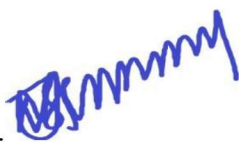
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iii. DEDICATION

I wish to give praise and thanks to our Lord God Almighty for giving me good health, understanding and many other uncountable blessings during my study. I am extremely grateful to my wife, Mwaka Mukwiza Kaponda and my daughters Tekela Kaponda and Chelelwa Kaponda for their patience, tolerance, love and encouragement throughout the duration of my studies.

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viii. LIST OF ACRONYMS

4IR	Fourth Industrial Revolution
7NDP	Seventh National Development Plan
ACH	Automated Clearing House
AFI	Alliance for Financial Inclusion
AML	Anti-Money Laundering
B2B	Business-to-Business
B2P	Business-to-Person
BIS	Bank for International Settlements
BoZ	Bank of Zambia
CBDC	Central Bank Digital Currencies
CDD	Customer Due Diligence
CiC	Cash in Circulation
CIC	Cheque Image Clearing
CFT	Countering Financing of Terrorism or Combating the Financing of Terrorism
CPMI	Committee on Payments and Market Infrastructures
DFS	Digital Financial Services
DSA	Digital Signature Algorithm
ECDSA	Elliptic Curve Digital Signature Algorithm
EdDSA	Edwards-curve Digital Signature Algorithm
EFTPOS	Electronic Funds Transfer at Point of Sale
FinTech	Financial Technologies
eMoney	Electronic Money
eKYC	Electronic Know Your Customer
eWallet	Electronic Wallet
FATF	Financial Action Task Force
FMI	Financial Markets Infrastructure
FSB	Financial Stability Board
FATF	Financial Action Task Force
G20	Group of 20
G2G	Government-to-Government
G2P	Government-to-Person
GPFI	Global Partnership for Financial Inclusion
ICT	Information and Communication Technology
IOSCO	International Organization of Securities Commissions

KYC	Know Your Customer
mCBDC	Multiple Central Bank Digital Currency
LVPS	Large Value Payment System
MFI	Micro Finance Institutions
MNO	Mobile Network Operator
NER	Norminal Exchange Rate
NPS	National Payments System
NFS	National Financial Switch
P2P	Person-to-Person (or Peer-to-Peer)
P2G	Person-to-Government
PSP	Payment Systems Providers
PAFI	Payment Aspects of Financial Inclusion
PFIP	Pacific Financial Inclusion Programme
POS	Point of Sale
PSO	Payment Service Operator
rCBDC	Retail Central Bank Digital Currency
RegTech	Regulatory Technologies
RSA	Rivest–Shamir–Adleman
RTGS	Real Time Gross Settlement
SupTech	Supervisory Technology
wCBDC	Wholesale Central Bank Digital Currency
ZECHL	Zambia Electronic Clearing House Limited

ix. ABSTRACT

This study investigated the determinants of a Central Bank Digital Currency (CBDC) as a payment systems platform in Zambia. The study adopted a two-tier model of a CBDC and employed the methodology of using time series monthly data to ascertain if the introduction of a CBDC payment systems platform could improve the efficiency of payments systems, make a stronger national defense against AML/CFT, ensure non-discriminatory access to domestic financial services through financial inclusion and play a role in mitigating the high cost of processing currency. Covering a period of eleven-years, the study also reviewed the main determinants of a CBDC and their significance in a developing economy like Zambia. Using unit root tests, cointegration tests and ordinary least squares (OLS) regression, the statistical tests were conducted at level and first difference to stabilize the time series and the EViews econometric package was deployed to avoid spurious results. The preliminary empirical results depicted the existence of a significance in the relationship between a CBDC and payment systems efficiency, national defense against AML/CFT and non-discriminatory access to formal financial services. The relationship between CBDC and the high cost of processing currency was found to be inversely proportional to CBDC and insignificant. This was partially due to the fact that the CBDC was introduced in a phased approach where the initial cost of currency processing still exists and the CBDC runs in parallel with fiat currency.

The model also showed great flexibility and was generalized to scenarios which included other motivations for the determinants of Central Bank Digital Currency such as retaining monetary sovereignty, enhancing monetary policy transmission and a CBDC to contribute to financial stability. Lastly, the study concluded that statistically there is significant evidence to validate all the study objectives and that the Zambian jurisdiction could indeed issue a CBDC payment system platform for the economic benefit of the country.

Keywords: Payment Systems, Central Bank Digital Currencies (CBDC), Financial Inclusion, Cost of Currency, Payment efficiency, AML/CFT, Zambia

1.0 CHAPTER ONE: INTRODUCTION

1.1. Introduction

This study investigated the determinants of a Central Bank Digital Currency (CBDC) as a payment systems platform and the possibility of its introduction in Zambia. To cast this subject in context, the study first reviewed the history of currency and payment systems platforms in the pre and post independence era in the country, and then went on to contrast the determinants of these traditional payment methods against virtual currencies. The study looked at the major prevailing determinants for the introduction of a CBDC in Zambia, and how such a platform could improve the existing efficiency of payments systems, make a stronger national defense against AML/CFT, foster non-discriminatory access to domestic financial services and mitigate the high costs associated with processing cash in Zambia. From the findings of the study, it was evident that although there were considerable risks posed by virtual currencies on the payments systems landscape, there were nonetheless many financial and economic benefits and characteristics which the introduction of a CBDC payment system regime could bring to bear on these risks (BOZ, 2017). Some of the potential advantages of a CBDC payment systems platform include the introduction of innovation in the payment systems landscape, lowering the cost of cross border payments, increasing financial inclusion, and providing insights on how to safeguard and secure a stable and sound financial system which would in turn foster sustainable economic development in the country (BOZ, 2020). The study was, therefore, found to be beneficial to the government of the Republic of Zambia, the ministry of finance, the monetary authorities, financial regulators and financial conduct authorities in Zambia and the Sub-Saharan Africa region.

In reaching these conclusions, the study relied on time series data from 2010Q1 to 2021Q4 in the methodology and used EViews econometric package to find the relationships among the variables. The key variables included: the cash in circulation (CiC), internet penetration (IP), mobile subscription rates (MS), narrow money (M0, M1), broad money (M2, M3) and the nominal exchange rate (NER). The study concluded with highlights on the effects of the major determinants of CBDC, and provided policy recommendations and guidelines on how a CBDC payments system regime could effectively mitigate the risks associated with virtual currencies.

Sometimes referred to as cryptocurrencies or crypto assets virtual currencies are a form of Financial Technology (FinTech) innovation and digital asset which have the potential to disrupt the way financial services currently operate (BIS, 2019). They are already having an impact on

the global financial systems as a payments system platform and their unique properties make them function as a form of electronic money and forms of digital assets which can be used for payments and investments. They bring about secure, always available, peer-to-peer and decentralized payment methods that have some distinct advantages over the traditional methods of payments (Auer, Raphael; Böhme, Rainer, 2021). According to the Financial Stability Board, FinTech is defined as the financial technology that is applied to financial services, resulting in new business models, applications, processes, products and services with an associated disruptive effect on financial markets and institutions (FSB, 2019). This definition emphasizes the focus on technology-driven innovations which could potentially reshape how the financial services industry in developing countries such as Zambia operates and eventually evolves into several platforms, as depicted in Figure 1.1. Given the wide range of innovations across financial services, the existing regulatory architecture should be assessed to determine its appropriateness and effectiveness and, if not, propose any required changes. Various other studies also show that the current rapid rate of technological innovation is running ahead of regulation and that the regulation being developed to address this rapid growth should not stifle and slow down the innovation (Ahmed, 2020); (Ammous, 2019); (Ji, Bouri, Keung, & David , 2019).

Developing economies around the world, in Africa and Zambia, in particular, have seen a rapid rise in the use of crypto-asset platforms. This, together with many other Mobile and Digital Financial Services (MFS/DFS), has not only revolutionized access to digital financial services for the poor but also allowed them access to other financial products such as microloans, digital credit, savings and insurance products from their mobile devices. Virtual assets are a recent phenomenon that is receiving significant attention from monetary authorities all over the world. On the one hand, they are based on fundamentally new technologies such as blockchain and Distributed Ledger Technologies (DLT) and the full potential of these new technologies is still not clearly understood by the many authorities that regulate them. Furthermore, at least in their current form, these digital financial services technologies fulfill similar functions as other, more traditional monetary assets. The new virtual technologies, products, and related services have the potential to spur financial innovation and payment systems efficiency and improve financial inclusion and financial health for citizens around the globe, but they also create new opportunities for criminals and terrorists to launder their proceeds or finance their illicit activities through the use of these tools. To mitigate the risk of these new technologies, the Central Bank of Zambia are exploring options of leveraging the properties of stable forms of digital currencies which are a digital representation of sovereign fiat currency and appears on

the liability side of the monetary authority's balance sheet in form of a Central Bank Digital Currency (CBDC).

This study also adopted a two-tier model and architecture of a CBDC where benefits of a tiered architecture for the distribution of retail CBDC through commercial banks and payment service providers (PSP) alike working together to distribute CBDC. The study uses the two-tier model as a simplified abstraction of reality which incorporates the central bank and all the financial institutions such as banks, non-bank financial institutions (NBFIs), payment systems providers (PSPs) and all other financial services providers (FSPs). These in turn service the individuals, households and organizations that could have a CBDC account with FSPs. The model assumes that the CBDC can coexist with cash and serve as legal tender and be used as the medium of exchange, a unit of account and store of value for all financial agents in the Zambian financial landscape. The empirical analysis looks at the main variables as the main determinates of issuing a CBDC by comparing with the efficiency of payments systems platforms, CBDC as a stronger national defense against AML/CFT, non-discriminatory access to domestic financial services and CBDC as a mitigant to the cost of processing cash. The study further uses high-frequency monthly time series data for both narrow money (M0, M1) and broad money (M2, M3), the cash in circulation (CiC), the exchange rate between cross boarder CBDC (NER), individual mobile subscribers and internet penetration rates. From the research analysis and results, the study explored the main prevailing determinants for introducing a Central Bank Digital Currency (CBDC) in Zambia addressing and the research results concluded that the CBDC should interoperate with other already existing payment system platforms. This interoperability should include both retail and large value payment systems (LVPS) on the Real-Time Gross Settlement (RTGS) and the retail payment systems on all the other payment systems platforms including cash, electronic funds transfers (EFT), Point of Sale (PoS), Automated Teller Machines (ATM), Mobile Financial Services (MFS), Digital Financial Services (DFS) and Cheque Image Clearing (CIC). The study finally ascertained that the introduction of a CBDC could bring about a stronger national defense against AML/CFT, and non-discriminatory access to domestic financial services and lead to financial inclusion. The study also reviewed that the introduction of a CBDC initially does not mitigate the high cost of processing currency in Zambia. Over time, however, the cost of processing currency decreases as CBDC payments increases.

Over the last 2000 years Africa has witnessed the evolution of different items as methods of trade and currency. In the Sahara desert, salt was the standard currency throughout the Middle

Ages, exchanged for gold dust from West Africa (Mark Cartwright, 2019). Salt was transported via camel caravans and by boat along such rivers as the Niger and Senegal, and exchanged at trading centres like Koumbi Saleh, Niani, and Timbuktu, where it was either passed further south or exchanged for other goods such as ivory, hides, copper, iron, and cereals. In Yorubaland, the cowrie currency was used (Further south of the continent, Iron Age societies in much of central Africa have long been associated with the use of copper ingots and wire as media of exchange (Michael S. Bisson, 1975). Although the Bantu peoples also used cloth, beads, and brass as currencies, the position of copper was unique because it was locally produced in response to internal rather than external demand. In precolonial Zambia, salt and copper were both used as modes of exchange. According to research (Killick, 2017), Ing'ombe Ilede, an archaeological site located on the hills of southern province near the convergence of the Zambezi and Lusitu rivers, is thought to have been a busy small commercial state around the 16th century whose chief item of trade was salt. Ing'ombe Ilede received various goods from the hinterland of south-central Africa, such as, HXR-style copper ingots, slaves, gold and ivory (Killick, 2017). The creation of Northern Rhodesia (Zambia) in 1911 by the British South Africa Company (BSAComp), nevertheless, paved the way for the introduction of physical coins and notes as a medium of exchange in the country. In the early 1980s, the Internet was created, and with it came various technologies and applications which affected the growth trajectory of products and services offerings in the banking industry. In the modern day Zambia, therefore, the rapid rate of innovation on financial technologies (Fintech), payment systems and applications has evolved mainly around the mobile financial services (MFS) and the national financial switch (NFS) which facilitates payments from online banking accounts to mobile accounts, mobile wallets and vice versa. The various financial technologies in the country are characterized by the growing number of platforms including mobile payments, mobile to bank services, instant micro mobile loans on USSD (Unstructured Supplementary Service Data) and smart applications, virtual payments on the blockchain technologies, online savings, instant mobile loans, village banking and crowdfunding initiatives, as depicted in Figure 1.1. All these payment systems platforms make up the Fintech ecosystem in the Zambian jurisdiction and continue to grow. Some of these innovations are using virtual currency as the underlying technologies and hence the need to be researched and understood by the monetary authorities that regulate them.

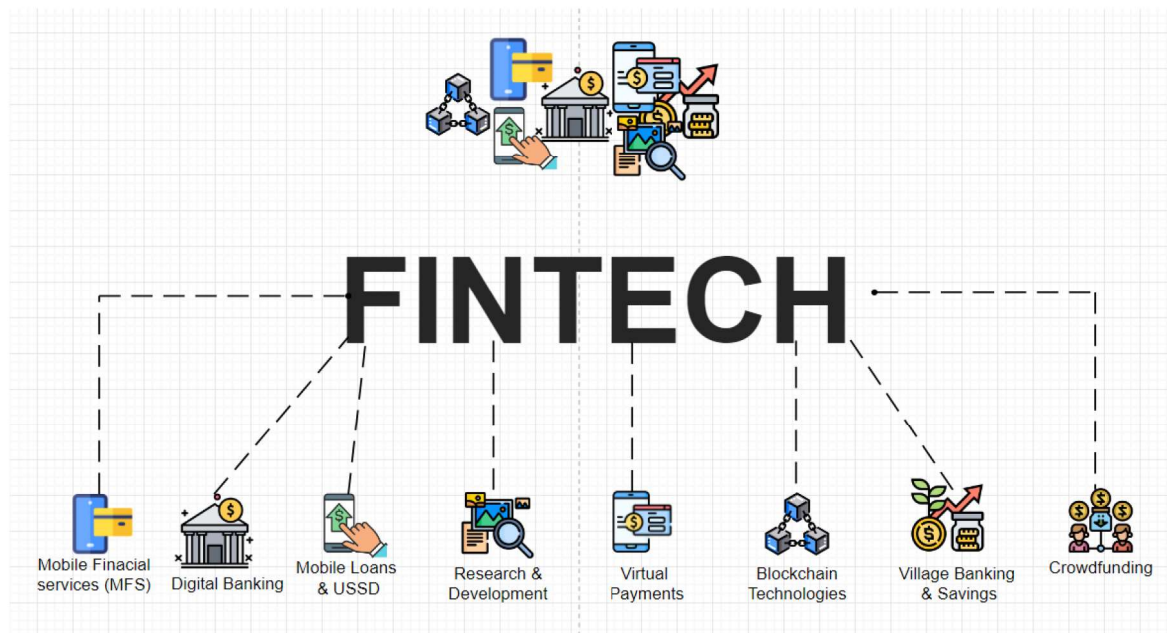


Figure 1.1: Zambia's Financial Technologies Ecosystem 2021 (Source: Authors Construct)

Research by (ChainAlysis, 2021) shows the increasing use of virtual currency for peer-to-peer transactions in the SADC region. The study also illustrates the increasing innovations around the blockchain technologies that securely and efficiently create tamper-proof solutions for remittances, exchanges, distributed finance (DeFi), P2P payments and digital identity. Virtual Currencies (VCs) are a variant of digital assets that are designed to operate as a medium of exchange and make use of very strong encryption and cryptographic algorithms (Peters, Panayi, & Chapelle, 2017). This is to secure financial transactions at lower transaction fees and to eliminate the need for a central intermediary such as an exchange, a commercial bank, a central bank, a settlement agency or a clearinghouse. Central Banks are aware of this risk and this study looked at how these cryptocurrencies and their variants can be evaluated and further developed into a Central Bank Digital Currency (CBDC) model as a prototype payments systems platform focusing on the case of the monetary authority in Zambia. Further research demonstrates that cryptocurrencies are regarded as an innovation which could materially affect financial services, since many view them as a new form of money or currency, albeit privately issued, and may have a direct impact on economic activities such as payments, investments and capital raising, among other things (BOE, 2020). On the other hand, some scholars describe cryptocurrencies as a form of Fintech innovation that may disrupt the international financial sector and change the way of doing business in the world (IFWG, 2020); (Thakor, 2019); (Adhami, Giudici, & Martinazz, 2018). Despite many other studies showing the relationship between cryptocurrencies and how CBDC can inherit some properties, other digital financial services are being enhanced by enabling supporting policies and regulations

around the world, there remain many gaps which need to be filled in this new financial technology space of digital financial services and particularly cryptocurrencies (Hughes, Park, Kietzmann, & Archer-Brown, 2019); (Shanaeva, Sharma, Ghimirea, & Shuraeva, 2019); (Silva, Klotzle, LimaGomes, & Pinto, 2019).

Further, cryptocurrencies are mainly operating in unregulated environments and currently, there are no specific regulations in the Sub-Saharan region and Zambia in particular. Many regulators including the central Bank of Zambia (BOZ) are currently playing catch up and only issuing cautionary statements to their citizens on the risk of these cryptocurrencies, instead of exploring exhaustive research and development to get the most out of these technologies. Globally, central banks have raised concerns about the virtual currencies' spillover effects to the formal financial services industry and the eventual effects of these currencies on guiding monetary policies and how to repair and mitigate these eventual risks (SARB, 2014); (Borri & Shakhnov, 2019); (Kosc, Sakowski, & Ślepaczuk, 2019). Meanwhile, the technology keeps growing and the technology-aware generation is actively using it and the various activities associated with this innovation can no longer remain outside of the regulatory perimeter. This demands for clear policy stances around many jurisdictions on the variety of emerging use cases and appropriate action must be taken in order to deepen regulatory certainty.

Furthermore, cryptocurrency transactions are anonymous and some sections of society associate such trades with illegal vices such as money laundering, drug and human trafficking or payments for any illegal transactions (Yi, Xu, & Wang, 2018); (Makarova & Schoar). Consequently, some countries such as China have issued communications declaring restrictions or a downright ban on the use of crypto assets. Others have stated that they regard cryptocurrencies as intangible assets exempt from tax, whilst others have issued statements indicating that crypto assets are not recognized forms of legal tender, without categorically declaring them to be illegal. In the case of peer-to-peer trades, the financial transactions are concluded using blockchain technology without the need for third-party intermediaries (Lee J. Y., 2019); (Chua, Zhang, & Chan, 2019). Consequently, cryptocurrencies may also become systemic, as interest, investment and participation in cryptocurrency transactions and trading continually grow to even include financial institutions, new technology firms and big technology (Big tech) organizations. Research indicates that there are already more than 4,300 different crypto coins and tokens at the time of this study in circulation globally and this number keeps increasing as new schemes, through initial coin offerings (ICOs), are continually launched (BIS, 2019); (CoinMarketCap, 2020); (Baumöhl, 2018). Thus commodity based payment systems such as salt, copper ingot, cloth, ivory and gold dust have since evolved to

fiat money and now digital forms of money, as depicted in the evolution of money tree in Appendix B.

Following the announcement by the American technology and social media giant, Facebook and the launch of a single global currency called Libra which was later renamed to Diem (Libra, 2019), the regulators around the world have been awakened and accelerated their works on the possible uses of Central Bank issued digital currency (CBDC). After the publication of this white paper on Libra by Facebook, the global calls for Central Bank issued digital currency (CBDC) were intensified. However, the launch of Libra as a global digital currency was met with a lot of regulatory concerns across major economies in the US and Europe. This white paper was not very unique in its problem statement, but it did state that 1.7 billion adults globally remained outside of the financial system and that Libra would help connect the world in a unified financial ecosystem (Libra, 2019). The paper further claimed that moving money around the world should be as easy and cheap as sending a message regardless of where one lived, what they did and how much they earned. On December 1, 2020, the Libra Association was renamed to Diem Association and the white paper, originally published by the Libra Association in June 2019 and then re-issued as a stand-alone update in April 2020, replaced all the previous versions published by the Association (Diem Association, 2020). Libra is a digital currency that is built on the foundation of blockchain technology. The goal of the Libra Blockchain is to serve as a foundation for financial services, including a new global payment system that meets the daily financial needs of billions of people. Through the process of evaluating existing options, Libra decided to build a new blockchain based on the scalability to billions of already existing 2.8 billion Facebook accounts, which requires high transaction throughput, low latency, and an efficient, high-capacity storage system, secure and flexible, so that it can power future innovation in financial services.

Central Banks globally need to mitigate this risk of virtual currencies and in Zambia, there are currently a lot of virtual currencies publicity and trading activities according to the local bitcoin trading in 2020 (LocalBitcoin, 2021). LocalBitcoins.com is a startup company based in Helsinki, Finland which facilitates the trading of local currency for bitcoins. Users post advertisements on the website, where they state exchange rates and payment methods for buying or selling bitcoins. Several individuals in Zambia are involved in the trade of Bitcoins and other cryptocurrencies. Citizens are currently trading in these virtual currencies through peer-to-peer using social media platforms and websites. Regrettably, the illiteracy surrounding virtual currencies is not just typical of the general public but also those individuals charged

with the mandate of regulating the financial systems landscape and fighting cybercrimes which may have their origin in the utilization and misappropriation of these cryptocurrencies. The regulators are currently playing catch up and only issuing advisory statements to citizens on the risk of these virtual currencies instead of exploring exhaustive research and development to get the most out of these technologies. This research is, however, aimed at closing this knowledge gap by evaluating the critical determinants of the CBDC as a payment systems platform, assessing their effects on the payment systems landscape and, based on the research findings, proposing the feasibility of a CBDC on the Zambian jurisdiction.

1.2. Background of the Study

The history of money can be traced to ancient times on the Yap islands group which are part of Micronesia and had one of the earliest currencies in the form of a stone. The stone money was also known as “Rai” and were made up of large stone disks, sometimes measuring up to 4 meters, with a hole in the middle that was used for carrying them from one place to another. It was and still is used as a trading currency there today (Fitzpatrick, 2008).

Yet the as the world moves into the fourth industrial revolution (4IR), globalization and technology are transforming our economies, workplaces, communities and families around the globe. According to studies by the World Economic Forum (WEF, 2019), the 4IR is forcing our generation to rethink how countries should develop, trade, exchange currencies and grow, and how organizations should create value - and what it means to be human and our purpose for existence. The 4IR also compels us to question the fundamental meaning of the global major currencies, digital financial services (DFS) and the implications on global financial inclusion. To be sure, the twin forces of globalization and technology have enabled growth and development on an international scale, but at the same time, the inequalities in the distribution of income and wealth have risen in all parts of the world, including both the developed and developing economies such as Zambia. According to a report by Oxfam on the day before the World Economic Forum meetings which were held in Davos, it was reported that almost 4 of every 5 dollars in the increase of global wealth in the year 2017 accrued to the top 1 percent after the 2008 Global Financial Crisis (GFC) (WEF, 2019). The changes in regulation and the technological developments, following the crisis, GFC are still fundamentally altering the nature of virtual currencies, digital financial services and the overall financial markets around the world. Furthermore, the technological evolution has also brought with it the phenomena of regulatory technology - called ‘RegTech’, which is the use of information technology for regulatory monitoring, financial reporting and compliance to global financial rules including

the rules on cryptocurrencies. Digital financial services including cryptocurrencies have thrived and their use is being greatly encouraged around the world because they have the potential to help billions of poor and underprivileged people without access to formal financial services to become financially included.

According to the World Bank's Universal Financial Access (UFA) 2020 report, of the 1.2 billion people on the planet who have opened and have access to bank accounts since 2011, there are still a projected 1.7 billion adults globally who are financially excluded. This makes up 31% of adults who do not have access to a basic financial service or any other form of financial account (UFA, 2019). The world over, above two-thirds of adults who do not have a bank account point to a lack of money as a key reason for not having an account. This further implies that the financial services being offered are not yet affordable and are not designed to suit the needs of the poor who are the low-income users. The other hurdles to accessing formal financial services include the long distances to the financial service provider, the lack of infrastructure and the necessary documentation such as national identity for know your customer (KYC), identification and verification and lack of trust in financial systems. In some cases, though, some people do not access formal financial services because they find it more preferable to keep their money in their homes than in the bank.

In Zambia, the payment systems landscape has evolved since independence in 1964 - with the players both on the demand side and supply side. Payment systems are used to settle financial transactions through the transfer of monetary value and consist of various mechanisms which facilitate the transfer of money from one party called the payer to another party called the payee. Literature from the Bank of Zambia (BOZ, 2018), indicate that payment systems are comprised of the demand side factors from the individual clients, households, merchants and organizations whereas the supply side is made up of the Central Bank of Zambia, the commercial banks, the electronic money issues (EMIs), the payment systems providers (PSP) and financial services providers (FSP) as depicted in Figure 1.2, respectively. The latter facilitate Large Value Payment Systems (LVPS) on the Real Time Gross Settlement (RTGS) or Zambia Interbank Payment and Settlement System (ZIPSS), and the global virtual currencies service providers which are currently unregulated. The Retail Payment Systems (RPS) make up all the other payment systems platforms including cash in fiat currency, Electronic Funds Transfers (EFT), Point of Sale (PoS), Automated Teller Machines (ATM), Mobile Financial Services (MFS), Digital Financial Services (DFS) and Cheque Image Clearing (CIC). In 2018, the BOZ as the monetary authority issued guidelines to allow for electronic money issuance

(e-money) which has allowed for the growth of mobile financial Services (BOZ, 2018) in the country.

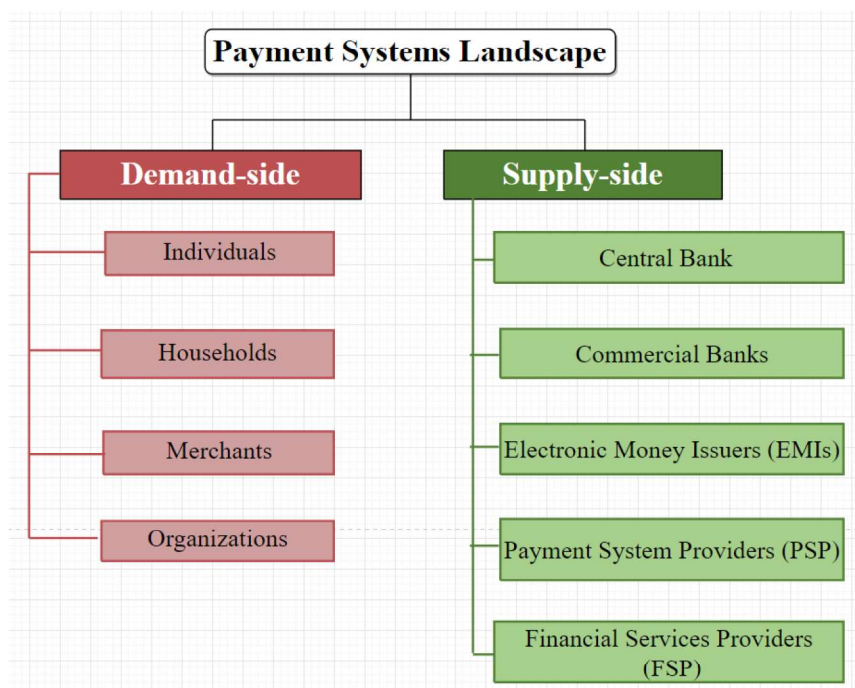


Figure 1.2: Payment Systems Landscape (Source: Authors Construct)

From the diagram, it is evident that the demand and supply sides of the payments systems landscape form the main part of the payments ecosystem in Zambia. There is, on the other hand, increasing statistical evidence from the Zambia Financial Intelligence Center (FIC, 2019), of illicit activities on these platforms. These illegal activities include anti-money laundering and combating financial terrorism and proliferations (AML/CFTP), especially with politically exposed persons (PEP) who are captured on the Suspicious Transaction Reports (STRs) showing illegal irregular transactions which are most of the time concealed under virtual currency trading. One of the motivations for the introduction of a Central Bank Digital Currency is to make a stronger national defense against AML/CFT in the country. Based on the growing number of this evidence, the Financial Intelligence Center of Zambia recommends that the reporting entities, in particular financial institutions, should enhance their customer due diligence (CDD) processes at account opening and perform enhanced due diligence on high-risk customers such as PEP. Further, FIC recommends that the country should put in place a legal and institutional framework to supervise Virtual Assets such as crypto currency and Virtual Assets Service Providers (VASPs) such as virtual currency exchanges. Table 1.1 below shows the Money Laundering and Terrorist Financing Trends and the trends which link to virtual assets that have been increasing since 2017 (FIC, 2019). The table depicts the reason for suspicious transactions in millions of Zambian Kwacha (ZMW) and a large number of unusual outward remittances. The table also shows transactions which avoid reporting

obligations, sudden unexpected activity on previous dormant transactions in virtual currencies and these keep increasing from 2 million in 2017 to 417.4 million on 2019 showing the increasing transactions in virtual currencies and phishing fraud on electronic payment systems platforms.

Table 1.1: Money Laundering and Terrorist Financing Trends (Source: (FIC, 2019))

Reason for Suspicion	No. of Reports	Amount in ZMW (Millions)	No. of Reports	Amount in ZMW (Millions)	No. of Reports	Amount in ZMW (Millions)
	2019		2018		2017	
Large or unusual outward remittance	24	187.1	27	131	68	221.1
Avoiding reporting obligations	23	16	14	259.1	16	3
Sudden unexpected activity on previous dormant (virtual currencies)	16	417.4	0	0	5	2
Phishing (Electronic Fraud)	9	1	11	0	0	-
Watch listed	8	0	10	0	19	-
Other	12	2.5	17	1	0	-
Totals	748	2,415	724	1027.1	969	931.7

1.2.1. History of Zambian Currency

Literature from the Bank of Zambia (BOZ, 2020), reviews that the Zambian Kwacha is a decimal type of currency with K1 being made up 100 ngwee. Before Zambia's independence in 1964, the country then known as Northern Rhodesia used the British pound as legal tender before migrating to the Kwacha in 1965. The Currency Act of 1967 completely replaced the British pound with the Zambian Kwacha banknotes and the ngwee coins. Since 1967 the Kwacha has undergone several structural changes aimed at ensuring that it supports economic activities while maintaining public confidence in the national currency. Some of the notable changes in the Zambian currency have been summarized in Table 1.3 below. The table outlines the payment systems and currency evolution matrix in Zambia starting from the post-

independence days in 1968 to 1974 when the country used fiat currency denominations of bank notes and coins, the economic and currency structures and the regulations and the legal frameworks that guide them. The landscape changed drastically from 2010 to date and evolved to include the use of Electronic Funds Transfers (EFT), Point of Sale (PoS), Automated Teller Machines (ATM) and, after gazetting the National Payment Systems Directives on Electronic Money Issuance (EMIs) in 2015, gave rise to Mobile Financial Services (MFS) and an increase in the use of Digital Financial Services (DFS). The other payment platforms which matured after 2015 include the Cheque Image Clearing (CIC), Real Time Gross Settlement (RTGS) or Zambia Interbank Payment and Settlement System (ZIPSS). In addition, other notable, global changes especially after the 2008 bitcoin white paper by Satoshi Nakamoto (Nakamoto, 2008), include the introduction of a decentralized blockchain technology on which virtual currencies operate on online platforms. The paper also introduced the world to a decentralized financial system such as Bitcoin, Ethereum, Ripple and many others that eliminated the need for intermediaries such as central clearing house and Central Banks. At the time of writing this thesis, the central bank of Zambia does not have any regulations for these virtual currencies.

Table 1.3 also further shows that since Zambia's independence in 1964, the currency has undergone several structural changes aimed at ensuring that it supports economic activities while maintaining public confidence in the national currency. During this period the Zambian pound circulated alongside the Zambian Kwacha until 31st January 1974 when the withdrawal process was completed, and the sole legal tender became the Kwacha and ngwee. The official rate of the Kwacha was one-half of the old unit (pound) and or US\$1.40. The new K1 was equivalent to the old 10s, while the £5 (Five pound) banknotes was equivalent to the K10, the £1 was equivalent to the K2 and the old 5s was replaced by the newly introduced 50 ngwee paper note.

Table 1.2: Payment Systems and Currency Evolution Matrix in Zambia (Source: Authors Construct)

Period	Fiat Currency Denominations (Notes and Coins)	Payment Systems Platforms	Economic and Currency Structures	Regulations/Legal Frameworks
1968 -1974	Notes (Kwacha): K2, K10 Coins (Ngwee): 1N, 2N, 5N, 10N, 20N, 50N, 100N	Cash Payments (Fiat Currency)	The official rate of the Kwacha was one-half of the old unit (pound) and or US\$1.40. The new K1 was equivalent to the old 10s, while the £5 (Five pounds) banknote was equivalent to the K10, the £1 was equivalent to the K2 and the old 5s was replaced by the newly introduced 50 ngwee paper note.	The Currency Act of 1967 - Birth of the Zambian Kwacha and ngwee replacing the Zambian pound, shilling and pence in 1968
1975 – 1986	Notes (Kwacha): K1, K2, K10 and K20 Coins (Ngwee): 1N, 2N, 5N, 10N, 20N, 50N, 100N	Cash Payments (Fiat Currency)	The rate of the Kwacha was then fixed at K1.7094 being equivalent to £1.00. In December 1971 Zambia broke her currency ties with the British pound.	The Currency Act of 1967
1987 – 1991	Notes (Kwacha): K10, K20, K50, K100 Coins (Ngwee): 1N, 2N, 5N, 10N, 20N, 50N, 100N	Cash Payments (Fiat Currency)	Low copper prices and continued increased fuel prices on the world market were some of the major contributing factors to the declining economy. Inflation from the mid 1980s to the early 1990s continued to gallop at 3 digits. K1 was replaced with a coin of the same denomination while the K2 paper note ceased to exist	The Currency Act of 1967
1992 – 2000	Notes (Kwacha): K20, K50, K100, K1,000, K5,000, K10,000 Replacement of the K5 and K10 paper notes with coins in the same denomination	Cash Payments (Fiat Currency)	The advent of multiparty politics ushered in the Third Republic and an era of economic liberalization. Changing of the features of the Zambian currency from bearing the portrait of the Head of State to the current features which bear the famous fish eagle.	The Currency Act of 1967 Bank of Zambia Act (1996) National Payment Systems Act (2007)

				May 1996 BOZ introduced K1,000, K5,000 and K10,000	
			Cash Payments (Fiat Currency)	An exponential increase in currency in circulation (CiC) during the period from K65.4 billion in 1994 to K671 billion in 2003 (i.e. representing a 926 percent increase). Mid-1990s the Kwacha's depreciation against the US dollar had worsened with approximately K1,000 equivalent to US\$1.	
2001 – 2009	Notes (Kwacha): K20, K50, K100, K500, K1,000, K5,000, K10,000, K20,000, K50,000		Cash Payments (Fiat Currency)	BOZ introduced two more denominations to the family of the Zambian currency, i.e. the K20, 000 and K50, 000. The family of Zambian currency now had nine (9) banknotes. BOZ introduced two polymer banknotes in the K1000 and K500 denominations. The change in the substrate was intended to extend the circulation lifespan of these two high-velocity banknotes. GRZ approved the recommendation of the BOZ Board to re-denominate the national currency on 23rd January 2012. In coinage, though not in circulation, there were five (5) denominations as follows: 25ngwee, 50ngwee, K1, K5 and K10.	Currency Act No. 8 of 2012 National Payment Systems Act 2007 Re-Denomination of Currency
2010 – 2021 2013 (Currency Rebasing)	Notes (Kwacha): K2, K5, K10, K20, K50, K100 Coins (Kwacha&Ngwee): 5N, 10N, 50N, K1 Electronic Money circulations (e-Money)		Electronic Funds Transfers (EFT) Point of Sale (PoS) Automated Teller Machines (ATM) Mobile Financial Services (MFS) Digital Financial Services (DFS) Cheque Image Clearing (CIC) Real-Time Gross Settlement (RTGS) or Zambia Interbank Payment and Settlement System (ZIPSS), Global Virtual currencies	The objective of re-denominating the Zambian Kwacha was, mainly to address costs associated with an accumulated loss in value of the currency that undermined its basic function as a store of value, medium of exchange and measure of value. The Currency Rebasing exercise entailed dividing all denominational values by a denominator (1,000) and this resulted in the	Currency Act No. 8 of 2012 National Payment Systems Directives on Electronic Money Issuance 2015 Circular 13/2014 - EuroPay, MasterCard and VISA Standard Compliance

			replacement of all Zambian banknotes and coins. Main Reasons for Rebasing: Inconveniences and risks inherent in carrying large sums of money for transactions; Increased difficulties in maintaining book-keeping and statistical records and ensuring compatibility with data processing software; Higher costs on the payments system.	Circular 10/2015 - Operationalization of the ZIPSS Rules National Payment Systems Directives on Electronic Money Issuance of 2018, (BOZ, 2018) Directive on the National Financial Switch (NFS) Implementation [2015-02-13] Directive on Electronic Money Issuance [2018-04-27] Directive on Processing of DDAC and Funds Transfers on ZIPSS [2018-08-31] Directive on Domestic Automated Teller Machine, Point of Sale, Internet Transactions and Mobile Payments [2020-02-07] Guidelines for Conducting Regulatory Sandbox [2021-04-01] Directives on Money Transfer Services [2021-09-10]
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Table 1.3: Market Analysis - Payment Systems Activities in Zambia (Source: BoZ (2019); ChainAnalysis(2021))

Period	Electronic Funds Transfers (EFT) in ZMW		Point of Sale (PoS) in ZMW		Automated Teller Machines (ATM) in ZMW		Mobile Financial Services (MFS) in ZMW		Cash in Circulation (Cic) in ZMW		Real-Time Gross Settlement (RTGS) in ZMW		Virtual Currencies (VC) in ZMW (Bitcoin)	
	Values	Volumes	Values	Volumes	Values	Volumes	Values	Volumes	Volumes	Volumes	Values	Volumes	Values	Volumes
1968 -2000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No Data	No Data
2000-2010	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No Data	No Data
2010	2,182,542	6,352,903,607,251.21	805,358	337,575,938,148.84	23,866,329	10,684,107,410,432.70	N/A	N/A	N/A	N/A	170,513	6,518,543,956.54	No Data	No Data
2011	3,140,140	8,888,103,897,635.14	1,234,494	506,661,186,788.06	27,560,714	13,208,820,605,570.80	N/A	N/A	N/A	N/A	198,586	339,770,837,777,140.00	No Data	No Data
2012	4,027,061	12,750,728,030,548.30	1,677,179	790,635,101,269.02	34,152,340	18,134,079,597,355.20	17,430,411	1,163,628,529,007.97	N/A	N/A	240,564	388,322,512,200,203.00	No Data	No Data
2013 (Currency Rebasng)	4,643,599	17,104,236,164.81	1,983,089	885,260,596.44	38,152,320	21,855,371,015.68	24,412,326	957,288,216.42	4,610,488.35	4,610,488.35	294,503	528,950,656,977.99	No Data	No Data
2014	4,955,572	20,908,102,798.09	2,937,453	1,551,778,747.21	43,926,555	28,403,654,271.19	35,457,948	1,574,394,938.15	5,737,538.57	5,737,538.57	319,836	657,203,209,593.43	No Data	No Data
2015	5,171,982	21,829,181,426.19	4,996,917	3,043,386,789.06	46,790,504	32,787,169,255.41	62,516,656	2,069,611,070.71	6,449,795.95	6,449,795.95	374,661	887,544,362,938.34	2,646	984,234,568,059.67
2016	5,297,462	24,451,111,785.32	8,103,127	4,948,392,739.17	47,081,469	38,066,446,940.39	105,934,181	3,561,121,959.25	6,554,140.98	6,554,140.98	388,176	723,489,366,524.20	2,883	1,095,923,729,950.87
2017	5,895,397	38,863,582,478.08	12,193,060	8,008,167,972.59	49,726,580	42,113,653,556.22	172,429,911	7,287,745,101.44	7,417,861.87	7,417,861.87	493,964	799,745,024,513.94	3,790	1,440,084,140,306.41
2018	6,952,305	59,689,041,381.32	18,409,724	13,459,269,179.45	44,726,867	45,582,482,396.65	303,955,243	22,191,565,753.86	8,283,006.71	8,283,006.71	573,071	968,305,994,241.36	3,962	1,872,358,512,940.54

2019	7,800,720	67,812,852,435.14	26,942,944	20,094,818,765.55	41,773,995	48,054,879,768.75	552,638,552	49,445,749,890.78	8,627,032.49	607,114	975,282,865,173.10	4,850	2,328,662,089,155.60
2020	8,181,743	78,017,350,607.47	33,981,488	35,234,902,464.71	37,038,762	50,112,672,456.67	750,514,157	105,815,050,439.76	12,391,883.77	708,946	1,053,189,356,994.53	9,659	3,232,859,791,560.59
2021	6,892,790	79,428,385,720.03	31,728,699	39,697,881,296.33	27,212,965	41,985,740,429.90	582,926,712	122,532,256,364.09	13,555,337.93	70,869	116,063,654,925.47	10,659	4,333,879,791,550.99

Table 1.3 above shows a market analysis of already existing payment systems platforms and activities whose total combined direct credits and direct debit transactions for each of the different payment systems platforms has been increasing every year. According to data from (CoinMarketCap, 2020), more than 6,000 variants of cryptocurrencies are in existence as of January 2022 and the trading of cryptocurrencies with high market capitalization is also on the rise. Though many of these cryptocurrencies have insignificant trading volumes, some enjoy immense popularity among dedicated communities of backers and investors. Among all these variants of cryptocurrencies, Bitcoin still returns the highest market capitalization, and this paper uses the values and volumes of Bitcoin cryptocurrency. Now since there is evidence of the growing use of cryptocurrencies (LocalBitcoin, 2021) in Zambia, this calls for the regulatory authorities to constantly monitor this usage, test these platforms in regulatory sand boxes and prepare for any adoption of cryptocurrencies if the risks could be adequately mitigated. Data from (ChainAlysis, 2021) also shows that Bitcoin has always been a highly volatile commodity. In truth, cryptocurrencies are one of the most volatile non-derivative financial assets on the market and every day Bitcoin, for example, swings by more than 0.83% on average.

The table also further shows that Zambia's political landscape changed and gave birth to the "One Party Participatory Democracy in 1973". To commemorate this historic event in country's political history the Bank of Zambia issued a commemorative 50 Ngwee coin to join the rest of the nation in celebrating the birth of the Second Republic on 13th December 1973. Other currency changes included changing the colour of the 50 Ngwee banknote to eliminate the confusion which appeared to exist between the 50 Ngwee banknotes and the new K5 banknotes; hence the multi-coloured 50 Ngwee banknote made its first appearance in April 1974 but was later phased out of circulation. The rebasing of the currency Act No. 8 of 2012, resulted in several benefits including but not limited to the following:

1. Rebasings facilitated easier business transactions because it led to the use of smaller units of money.
2. Rebasings simplified accounting and the ease of expressing monetary values, thereby minimizing errors associated with the input of financial data and time spent to review such data.
3. Rebasings achieved more efficient use of calculation and accounting record systems. Thus, rebasing simplified book-keeping and reduced the drudgery in transactions, record keeping and banking transactions.

4. Rebasing also created greater confidence in the currency in that when there are many zeros or digits, people may lose confidence in the local currency.
5. Rebasing reduced the cost often incurred when customizing standard packages that are purchased by entities. This is because most of the current accounting packages are developed in jurisdictions where values, at a maximum, tend to be in millions.
6. Rebasing facilitated the introduction of efficient payments systems and encouraged the use of mechanisms such as pay phones, vending machines, car parking meters and other related technologies.
7. Rebasing re-introduced a culture of using coins that are more durable than notes.

Payment systems in Zambia are used to settle financial transactions through the transfer of monetary value and consist of various mechanisms which facilitate the transfer of money from one party called the payer to another party called the payee. Payment systems include the participant institutions and the users in form of customers or clients, the rules and frameworks which guide its operation and the standards and technologies on which the system operates. A well-designed and well-functioning payment system positively contributes to the financial stability of the country and to the well-being of the country's economy. As it is, Zambia is already using electronic payments and there is the feasibility of adopting digital payments in the future. The payment system is composed of Large Value Payment Systems (LVPS) on the Real Time Gross Settlement (RTGS) or Zambia Interbank Payment and Settlement System (ZIPSS), and the global virtual currencies which are unregulated and Retail Payment Systems (RPS) on all the other payment systems platforms including cash, Electronic Funds Transfers (EFT), Point of Sale (PoS), Automated Teller Machines (ATM), Mobile Financial Services (MFS), Digital Financial Services (DFS) and Cheque Image Clearing (CIC). The role of the Bank of Zambia, therefore, is to ensure that Zambian payment systems are not only safe but secure, reliable, efficient and hence the research into CBDC. According to the report by the Bank for International Settlements (Boar, Codruta; Wehrli, Andreas, 2021), almost 86% of the central banks in the survey are exploring the benefits and risks of CBDCs, with 60% of central banks conducting experiments or proofs-of-concept on CBDC - an increase of 42% from 2019 - while 14% are in the process of developing and prototyping stage of CBDC. The report further suggests that the primary motivations for emerging and developing economies to consider the introduction of CBDCs are mainly financial inclusion, payment efficiency, and payment safety, whereas the primary motivations for advanced economies to consider the use of CBDCs are mainly for payment efficiency and payment safety. In general, the Central banks represent a fifth of the world's population and they are likely to issue a retail CBDC in the next three years.

1.3. Payment Systems Service Providers

Research by the Bank for International Settlement indicates that the Bank of Zambia is responsible for the designation and licensing of Payment Systems, Payment System Participants and payment system businesses in the Zambian jurisdiction (BIS.Org, 2019). Table 1.5 below shows the landscape of the designated payment system entities in the country and the type of payment system platform used. The country has 18 commercial banks which utilize various payment systems platforms such as the High Value Payments using Real-Time Gross Settlement System (RTGS), locally called the Zambia Interbank Payment and Settlement System (ZIPS). Other payment systems platforms used by the commercial banks in the country include the Cheque Image Clearing (CIC), Direct Debit and Credit Clearing (DDACC) via the Zambia Electronic Clearing House (ZECHL), the point of sale (POS) and the electronic fund's transfer, respectively. The table also shows the growing number of low value payments provided by the non-bank financial institutions (NBFI), payment systems providers (PSP), financial services providers and now financial technologies (Fintech) service providers. The table also illustrates that there is currently no regulations for virtual currencies that are being traded online. Further research by the BIS also recommends that any CBDC consideration should interoperate with other existing digital and mobile financial services such as the platforms shown in table 1.4 below.

Table 1.4: Payment Systems Provider Platforms and State of Regulation (Source: Authors Construct)

Item #	# of Payment Systems Providers	Type of Business	Type of Payment Systems Platform	Location	Regulated/ Framework
1	3	Mobile Network Operators (MNO)	Mobile Financial Services (Mobile Payment Services and Money Transmission Services)	Local	Yes
2	18	Commercial Banks	CIC, DDACC & ZIPSS/RTGS	Local and International	Yes
3	48	NBFI, PSP, FSP, FinTech	E-money Issuer and Money Transfer Services	Local	Yes
4	12	NBFI, PSP, FSP, FinTech	Mobile Payment Services and Money Transmission Services	Local	Yes
5	Not Known (Online)	Virtual currencies and Virtual currencies service providers	Virtual currencies Transmission and Virtual Assets Service Providers (VASP)	International and Online	No

1.4. Central Bank Digital Currency (CBDC) Global Landscape

Literature demonstrates that the global calls for Central Banks to issue digital currency (CBDC) were intensified when it emerged in May of 2019 that Facebook, or Meta, as the social media technology giant is now called, in conjunction with other major players in the financial services industry such as Mastercard, Visa, PayPal, Stripe, Coinbase and other development partners, collaborated to launch a digital currency called Libra in late 2020 (Zetzsche, Buckley, & Arner, 2019). The white paper from Libra outlined plans for a new decentralized blockchain, a low-volatility cryptocurrency, and a smart contract platform that together aimed at creating a new opportunity for responsible financial services innovation (Libra Association, 2019). Libra was renamed “Diem” in 2020 and due to regulatory concerns and probing from the United States of America, European Union and United Kingdom regulators, the project has since been put on hold and discontinued.

1.4.1. Universal Central Bank Digital Currency Efforts

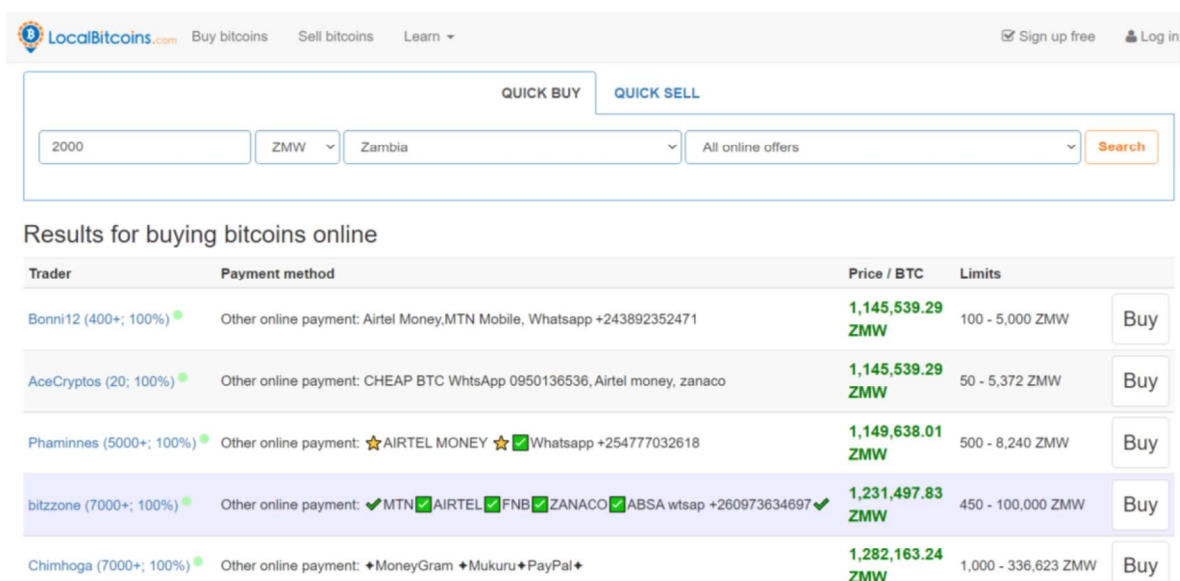
Reports from the European Central Bank (ECB, 2019), state that after two weeks of Facebook's Libra Association issuing the white paper, many of the world's most influential financial regulators, including the Financial Stability Board (FSB), the U.S. Federal Reserve, the Bank of England (BOE), the Bundesbank and the Bank of France, issued statements to the effect that their respective institutions would cautiously examine the Libra concept, and apply tough regulatory standards to guide its implementation. The Group of Seven (G7) nations led by the European Central Bank immediately set up high-level forums to examine the risks posed to the formal financial system by digital currencies, while the U.S. House of Representatives Committee on Financial Services requested on 2nd July 2019 that, “Facebook and its partners immediately agree to a moratorium on any movement forward on Libra” (Zetzsche, Buckley, & Arner, 2019), (Reuters, 2019). This very high level of consideration and regulatory attention is understandable because Facebook already has over 2.3 billion active users globally. This can easily scale and the main question for regulators is how, not whether, to regulate emerging virtual currency platforms such as Libra or any other stable coins that might come up in the future (Statista, 2020).

1.4.2. Virtual Assets (VA) activities in the Zambian Jurisdiction

Evidence from global cryptocurrency platforms (ChainAlysis, 2021) shows that there is a lot of virtual currencies trading and activity going on in the SADC region, particularly Zambia,

and citizens are currently trading in these virtual currencies peer-to-peer using several online platforms such as <https://paxful.com/>, <https://www.remitano.com>, <https://www.coinmama.com>, <https://www.localbitcoins.com> and many other available global online platforms (CryptoCompare, 2021). Regrettably, the illiteracy surrounding the virtual currency not only affects the general public but also those who are assigned with the responsibility of regulating the financial services landscape. This category of ignorant citizens includes, ironically, individuals fighting cybercrime but who, had they possessed some knowledge of virtual currencies, might have applied it in their work since a considerable proportion of cybercrime originates in the use or misapplication of virtual currencies. The regulators are currently playing catch up and only issuing cautionary statements to the citizens on the risks of using virtual currencies, instead of getting the most out of this technology by exploring through research and development.

The digital financial services (DFS) and the specific virtual currency platforms form part of the overall financial services infrastructure in Zambia which is under the regulation of the Information Communications Technology (ICT) and telecommunications regulator called the Zambia Information and Communications Authority (ZICTA). The communications platforms are composed of the terrestrial networks owned by Internet Service Providers (ISP's) and connect base stations and communications towers in different locations around the country. This is an essential and fundamental underlying infrastructure which facilitates and allows for the use of virtual assets or currencies as a medium of exchange. Figure 1.3 below shows the trading of virtual assets in the Zambian jurisdiction on live online platforms such as localcitcoin.com.



Trader	Payment method	Price / BTC	Limits	
Bonni12 (400+; 100%)	Other online payment: Airtel Money, MTN Mobile, Whatsapp +243892352471	1,145,539.29 ZMW	100 - 5,000 ZMW	Buy
AceCryptos (20; 100%)	Other online payment: CHEAP BTC WhtsApp 0950136536, Airtel money, zanaco	1,145,539.29 ZMW	50 - 5,372 ZMW	Buy
Phaminnes (5000+; 100%)	Other online payment: ★ AIRTEL MONEY ★ WhatsApp +254777032618	1,149,638.01 ZMW	500 - 8,240 ZMW	Buy
bitzzone (7000+; 100%)	Other online payment: ✓ MTN ✓ AIRTEL ✓ FNB ✓ ZANACO ✓ ABSA wtsap +260973634697 ✓	1,231,497.83 ZMW	450 - 100,000 ZMW	Buy
Chimhoga (7000+; 100%)	Other online payment: ★ MoneyGram ★ Mukuru ★ PayPal ★	1,282,163.24 ZMW	1,000 - 336,623 ZMW	Buy

Figure 1.3: Evidence of Virtual Asset Trading (Source: (Localbitcoins, 2021))

Further, research by ChainAlysis shows the growing use of cryptocurrencies in the Sub-Saharan region and the SADC region in particular. The study shows the analysis of Geographic Trends in cryptocurrency adoption and usage in 2021 (ChainAlysis, 2021). Figure 1.4 shows the transaction volumes shared by transfer in Africa compare with other regions over a year period from July 2020 to June 2021.

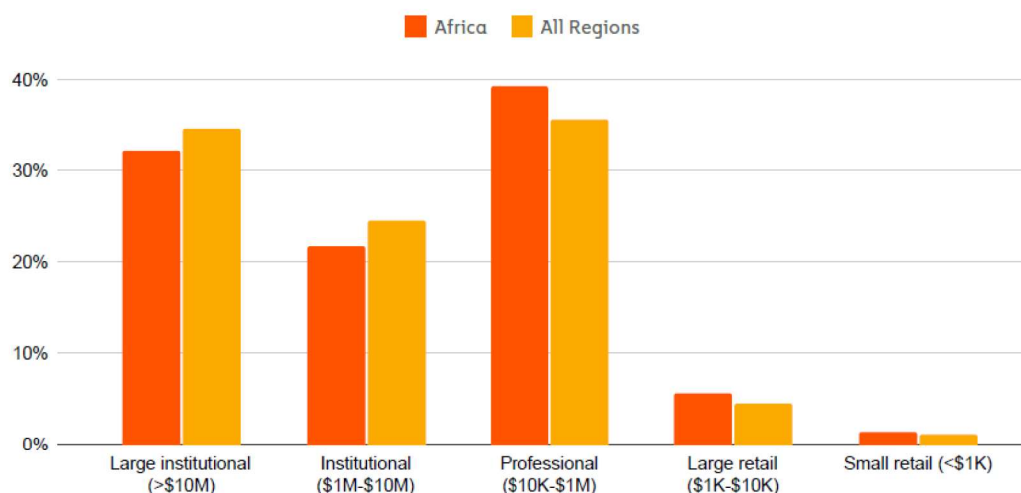
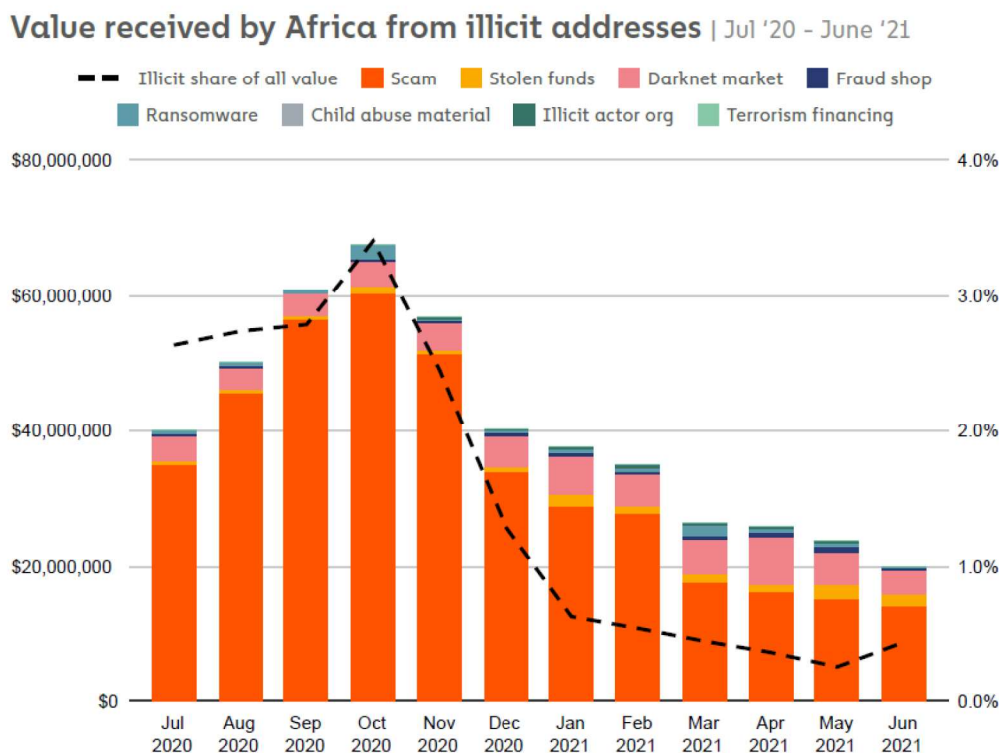


Figure 1.4: Transaction Volumes Shared by transfer in Africa Vs. Other Regions (Source: (ChainAlysis, 2021)).

Figure 1.5 further shows the value of cryptocurrencies received by Africa from illicit addresses over a year from July 2020 to June 2021.



1.4.3. Risks Posed by Virtual Assets (VA) in the Zambian Jurisdiction

The financial services regulator have witnessed a fast rise in the number of rip-offs which are being committed by fraudsters pretending to be dealing in virtual currencies. These fraud cases are dealt with by the combined efforts of the Central Bank of Zambia in partnership with the Anti-Corruption Commission (ACC), the Zambia Police (ZP), the Drug Enforcement Commission (DEC) and the Financial Intelligence Center (FIC), respectively. Most of these mushrooming platforms are promising investors returns on their investment which in other cases are being calculated on the basis of 1.5% per day, or on an assurance to triple investors investment within the period of one month.

Unfortunately, these fraudsters have been hastily subscribed to by the Zambian public as a get rich quick scheme and the catch from the fraudsters being that the depositors' money would be invested in virtual currencies. Since the dynamics of these currencies are largely unknown and the prospective investors do not fully understand how virtual currencies operate, these investors are easily lured by “techno-mysticism” and for this reason, the investors feel no compulsion to find out more about the underlying economic activity which would bring about such returns and thus give them the comfort of having made a prudent investment decision. These virtual currency scams are being distributed largely through social marketing by the would-be investors getting on board members of their communities, friends, family and religious groupings. The scams seem to remain in these informal circles and are not even advertised on public media such as radio, television or national newspapers. For the regulators and law enforcement officers, therefore, the development of these virtual currency technologies has facilitated organized crime and many times, the criminals are faster on the uptake and tend to understand the way in which to use these innovative products and services to swindle unsuspecting customers. Most of the times, the criminals pounce long before the capacity and capability to regulate and provide guidance by central banks have been effected. This is largely because technology is now bringing with it new products and services in the market at such a fast pace that regulations and laws, remain behind and only playing catch-up with the fraudsters. In this era of fast-changing technology, it has become very important for financial service regulators, law enforcement agencies, digital crime investigators, law enforcers, and prosecutors alike to purposefully and frequently refresh their knowledge so that they bridge the

gap and become better placed to react and respond to the challenges which technological innovation brings.

Additionally, these scams are likened to Ponzi schemes and mostly guarantee access to finances because they are resistant to censorship - meaning that law enforcers and authorities cannot freeze the perpetrator's virtual currency accounts. One recent case in Zambia was a company trading as Heritage Coin Resources Limited, which was operating in the financial services sector and provided services to the general public without a license, by collecting deposits from the public disguised as partnership fees to be invested into virtual currencies whilst conducting and participating in money circulation schemes involving ZMW 28,346,800.00. Three Directors of Heritage Coin Resources Limited were arrested and jointly charged by the Drug Enforcement Commission (DEC) for money laundering, conducting and participating in a money circulation scheme, and for obtaining money from the public by false pretences. The trio purported that the company was investing the money collected as partnership fees from the public into virtual currency trade on the web on behalf of the partners when in fact not. The authorities seized all the remaining property which remained in the country and the funds available were only able to payback up to 53 percent of the depositors' money. The Zambian courts of law issued an order on January 2019 that a total sum of ZMW 15,312,182.40 was seized by the drug enforcement commission from Heritage Coin Resources Limited to be paid out to the depositors and that the financial services regulator was to supervise the repayment process (BOZ, 2018). This brought about a lot of problems for those who initially had to borrow or use all their savings in order to fund their Heritage Coin Limited investments. Some investors remained depressed and in some cases ended their own lives due to failure to pay the debts used to finance these virtual currency investments.

The other stand out fraud case involved a company called Mineral Pay. This company also promised an investor that it was investing in virtual currencies and was offering financial services by collecting deposits from members of the public. The authorities issued a joint statement through the financial services regulator on January 17th, 2019, stating that Mineral Pay was trading against the Prohibition and Prevention of the Money Laundering Acts. The authorities further warned the public to desist from getting involved in activities of such nature and to be very cautious with any such investments which were promising huge returns in a very short period of time without any underlying economic activity (BOZ, 2019). Further, the public was urged to only deal with financial service providers licensed by the financial services

regulators, the Securities and Exchange Commission, and the Pensions and Insurance Authority.

These virtual currencies related fraud cases will continue to mushroom and while the authorities should concentrate on crackdowns, the Zambian authorities should also focus on continuous sensitization on the nature of virtual currencies and the risks associated with them. There should be concerted efforts from the financial service regulator (BOZ), Pensions and Insurance Authority (PIA), Securities and Exchange regulator (SEC) and the Competition and Consumer Protection Commission (CCPC) to embark on massive continuous countrywide sensitization programmes on radio, television, and through social media platforms such as Facebook, Twitter, Youtube, Instagram etc. and translated in all local languages on the merits, demerits and all possible risk associated with cryptocurrencies.

The authorities need to continuously inform the public that caution needs to be taken with regard to the rising number of scams which fraudsters are using to lure people to invest in virtual currencies with a promise of high returns. These scams normally operate as Ponzi schemes. A Ponzi scheme is an investment scam where fraudsters pay the 'promised high returns' from funds contributed by new investors or individuals. The fraudsters do not invest the money in virtual currencies or legal investment facilities but focus on bringing in new people whose funds are used to pay the 'high returns' to those that invested previously. The fraudsters normally siphon the money out of the scheme and disappear once the scheme reaches a certain threshold or size at which point all the people that invested in the scheme lose all their money. The general public should therefore be advised on what to look out for in order to avoid being defrauded through these Ponzi schemes. Some of the tail-tail signs which members of the public should always look out for before investing in any virtual currency investment include:

1. Checking for a valid regulation licenses from the authorities which should be displayed for every would-be investor to verify. To confirm with the relevant authorities on whether the individual or firm offering the investment opportunity is licensed or regulated. People are encouraged to conduct financial transactions using licensed institutions.
2. Customers should look out for formal registration documents and be able to review them and be skeptical when excuses are given for not making formal documentation available such as licenses, permits, receipts etc.
3. Lookout for the promise of high returns with little or no risk and to beware of promised high returns or profits with little or no risk. High returns typically have high risk.

4. Returns or profits paid within a short period of time. Fraudsters in Ponzi schemes will normally pay out ‘the high returns and profits’ at short intervals so as to attract new members or people.
5. Customers should aware of complex investment and products and avoid investing in complex products that they do not understand or where customers do not get complete or adequate information.
6. Customers to be aware of Information on the investment opportunity that comes through known persons. Fraudsters usually take advantage of groups (including religious grouping), family members, friends, leaders or prominent people knowingly or unknowingly to bring in new members or share information on the investment opportunity.

The CBDCs continue to rise to prominence across the globe after the Libra white paper that was released in June of 2018 (Libra, 2019). The white paper claimed that moving money around the globe should be as easy and cheap as sending a message regardless of where one lived, what they did and how much they earned. In the past two years after the Libra white paper by the Libra Association which, was later changed to Diem Association in December 2020, the subject of Central Bank Digital Currency (CBDC) has gained a lot of interest amongst most Central Banks in the world (Diem Association, 2020). This has further been inspired by advances in financial technologies such as Bitcoin, Ethereum and Ripple. The Bank for International Settlements (BIS) defines CBDC as a digital form of central bank money that is different from balances in traditional reserve or settlement accounts, issued and regulated by the central bank, denominated in the national unit of account as a direct liability of the issuing central bank. (BIS, 2020). Several central banks are exploring the idea of CBDC, albeit at different stages in their efforts. A recent survey by the BIS found that 86% of central banks are engaged in investigating CBDC and half have progressed past conceptual research to experimenting and running pilot projects. In assessing the suitability, feasibility and acceptability of introducing a CBDC in Zambia, a central Bank paper adopted the use of the Alliance for Financial Inclusion (AFI) FinTech framework which is based on the following four major pillars below:

1: Digital ID and e-KYC for identification and simplified account opening: The primary customer identification documents in Zambia are the National Registration Card (NRC), and the Driver’s License and Passport. In the past, customer identification was mainly conducted through a physical presentation of an identity document by the customer and retention of copies of the identity documents. However, following the requirement for SIM registration issued by

the Zambia Information and Communications Technology Authority (ZICTA), and the resultant customer databases created by the Mobile Network Operators (MNO), a number of financial services providers are relying on these databases for customer identification.

The challenge that has been presented by the MNO databases is that they do not represent a national collection of KYC, and the KYC records kept by the MNOs have not undergone comprehensive verification for the correctness of the KYC data. The lack of a central digital ID system in Zambia may inhibit the introduction of technologies such as a general purpose CBDC and other Fintech products and services which would require a central digital ID system for automated customer identification. In this regard, the Zambian government has determined that a biometric national ID system would be the optimal approach. However, this approach requires a huge financial outlay.

2: Open electronic payment systems, infrastructure and an enabling regulatory and policy environment: This would facilitate the digital flow of funds from both traditional financial intermediaries and new market entrants. The policy of the Bank of Zambia is to encourage interoperability of various payment systems to make it easier to make and receive payments to anyone and to receive payments from anyone safely, reliably, efficiently, quickly and at reasonable prices cheaply. The Financial Service Providers (FSP) welcome interoperability initiatives because of the high business opportunities presented by the increased transaction volumes.

A number of interoperability initiatives have taken place in Zambia, including the following:

1. Regulations mandating interoperability such as the National Payment System Directives on the Implementation of the National Financial Switch Project and the e-money directives.
2. Use of Application Programming Interfaces by service providers for bilateral agreements.
3. Regional integration initiatives through SADC RTGS (Real-time Gross Settlement), COMESA REPSS (Regional Payments and settlement system) and SADC Transaction Cleared on Immediate Basis (TCIB).
4. Access to key infrastructures such as the National Financial Switch (NFS) and other Zambia Electronic Clearing House Limited (ZECHL) clearing systems by non-bank entities; and
5. Approval of products and services that promote partnerships.

In addition to the projects regarding interoperability, Zambia has undertaken a number of key digital infrastructure projects such as the countrywide laying of the fiber optic infrastructure

in all provincial centers and the creation of state-of-the-art Tier 3 data centers. These developments have created a good foundation for future digital projects. Based on the various initiatives undertaken by the Bank such as the National Financial Switch (NFS) project and SADC RTGS, and digital projects such as optic fiber optic, Tier 3 data centers and the countrywide installation network towers, the groundwork for digital transformation is evident. Further, significant progress has been made in creating interoperable payment systems. However, it is still too early to determine the success or otherwise of some key projects such as the NFS.

3: Account opening initiatives and electronic provision of government services, providing vital tools to access services and save: Many Financial Service Providers (FSPs) are now providing automatic account opening initiatives by relying on MNO KYC databases. Concerning the digitization of government payments, the digital economy diagnostic for Zambia reports substantial progress in digitizing salary and pension payments, government to business payments. However, several payment systems have just initiated their digitization journey, and most government payments for social cash transfers and subsidies are not yet digitized. The Zambian government is taking steps to use digital tools to increase the efficiency of government services. The government has launched internal systems for internal government administration, and government-to-person (G2P), and government-to-business (G2B) services are increasingly digitized. However, interoperability between systems is often lacking, thus reducing their benefit to citizens, businesses and government. Usage and usability of these systems are not consistently monitored, and some systems suffer from a limited scale of implementation or deterioration.

4: Design of digital financial market infrastructure and systems: These systems support value-added financial services and products and deepen access, usage and stability. Many reports such as the ZICTA ICT survey of 2019 (ZICTA, 2021) and the Digital economy diagnostic report issued in 2020 (World Bank, 2020) by the World Bank have noted the low level of digital skills amongst most citizens in Zambia. In order for Zambia to use digital technologies such as CBDC, individuals, businesses and government must have the requisite digital skills. Further, the lack of integration between financial market infrastructures and identification systems results in the inability to authenticate the identity of customers.

1.5. Motivations and Policy Goals for Issuing CBDC

Several central banks have different motivations and policy goals to consider research on CBDC, some of which are to mitigate the cost of processing the cash cycle (CBN, 2021);

(BOG, 2021); (CBE, 2020). Traditionally, the process of minting notes and coins, distributing currency in the country starts from the design of the notes, the printing of the notes, incorporating the security enhancements and braille features for the visually impaired, the management of cash in transit (CIT) up to the destruction of all the unfit and soiled notes is very costly for the country. The central Bank of Zambia estimates that almost 21% of the central Banks annual budget is dedicated to the above process of cash management (BoZ, 2020). The other incentives for the CBDC are to provide a solution that reduces the cost of handling currency, and better management of AML/CFT by taking advantage of the digital currency properties for a CBDC such as convenience, traceability, transparency, immutability, elimination of counterfeit notes, portability and instant and inclusive payment platforms and supporting a resilient payments landscape in the country.

Furthermore, the Bank for International Settlements (BIS) through the journal article of the monetary and economic department also published the results of the third BIS survey on the work on Central Bank Digital Currency across the globe (Boar, Codruta; Wehrli, Andreas, 2021). The survey reviews the use of stable virtual currencies for domestic payments, the use for cross border payments and the ongoing analysis of the potential impact on the monetary and financial stability of stable coins (Boar, Codruta; Wehrli, Andreas, 2021). Figure 1.7 below shows the Bank for International Settlements results for the survey on Central Bank Digital Currencies.

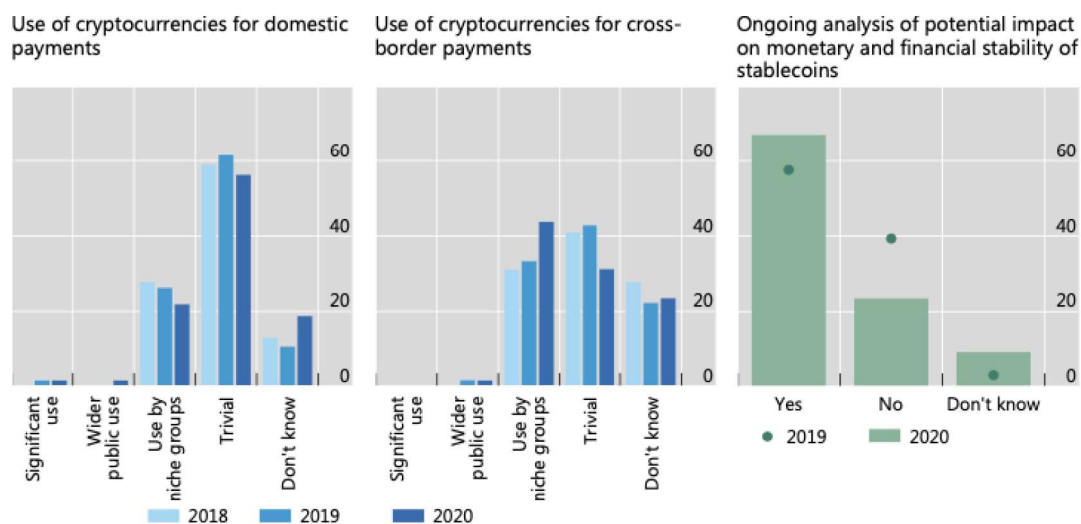


Figure 1.6: BIS Survey on Central Banks Digital Currencies (Source: BIS)

The alternative use of virtual currencies and the proposed use of Central Bank Digital Currencies (CBDC) is also on the global increase and these are the types of virtual currencies which need to be regulated and made available in electronic forms. These currencies are stored and traded on platforms that make use of designated software using the underlying blockchain technologies. Digital devices such as tablets, laptops, desktops, smart mobile phones, feature

phones, using computer applications and dedicated digital wallets are used and the financial transactions take place over and are settled using consensus mechanisms via the internet through secure, encrypted and dedicated networks. These cryptocurrencies have also been widely adopted across Africa and there has been increased usage in the country among the technology savvy individuals who are mostly the youth. The use of cryptocurrencies in combination with mobile platforms has increased financial inclusion globally, in Africa and Zambia in particular. Various reports (Reuters, 2019); (Taskinsoy, 2019) have indicated that there are number of advantages of issuing CBDC. Other reports (Reuters, 2019); (Taskinsoy, 2019) also point out some factors which motivate countries to issue CBDC in any jurisdiction. These motivations differ depending on the status of an economy – whether it is higher income country (HICs), a developing country, or a low-Income Countries (LIC), respectively. Below are the motivations for the Central Bank Digital Currency (CBDC).

1. To make the payment system landscape more efficient and resilient.
2. To retain monetary sovereignty for any jurisdiction and to mitigate the risk of privately issued virtual currencies and global stable coins adoption and improved distribution of government-to-peer (G2P) direct payments to households such as welfare or social cash transfers.
3. To make a stronger national defense against AML/CFT and other semi-anonymous nature of virtual currency transactions. The defense is against a host of infamous activities and illicit activities, such as money laundering, terrorism financing, illegal arms dealing, human, child, sex trafficking, and tax evasion from the authorities.
4. Ensure non-discriminatory access to domestic financial services and facilitate access for all citizens in a selected jurisdiction.
5. The high cost of currency, physical currency processing approximated an average of 21% of the Central Banks' Budgets (BIS, 2019).
6. Improving monetary policy effectiveness to implement targeted policy or tap more granular payment data to enhance macroeconomic projections.
7. Enhancing monetary policy transmission by an interest bearing CBDC and improving monetary policy effectiveness, supervisory policies, access granular real-time payments with interest-bearing CBDC, breaking the policy rate zero lower bound.
8. To enhance financial inclusion and financial digitization to facilitate fast, instant efficient and traceable payments platforms.
9. Improving traction of local currency as means of payments in jurisdictions that are attempting to reduce dollarization.

10. Distributing fiscal stimulus distributing to the unbanked including incorporating helicopter or hot money features to increase spending velocity. This provides efficient transmission of social benefits, welfare and all other social services for the citizens that are provided by the government.

This study focused on four main motivations which are summarized in Figure 1.7 below, and the literature review was based on these four motivations.



Figure 1.7: Summary Motivation of the Study (Source: Authors Construct).

Efficient Payment Systems

The Bank of International Settlements (BIS, 2017), describes a payment system as any financial system that is used to settle financial transactions through the transfer of monetary value from one party to another. This includes transfers between institutions, instruments, people, rules, procedures, standards, and technologies that make the exchange of value possible. The BIS further states that payment systems need to be efficient, secure and reliable as they act as a lifeblood of modern monetary economies; payment systems are the financial markets circulation system. An economic modeling journal on the optimal online-payment security system and the role of liability sharing (Berg & Kim, 2022), further reviews that payment systems need to exhibit strong properties of security, reliability, immutability, scalability, anonymity, acceptability, customer base, flexibility, convertibility, efficiency, ease of integration with applications and ease of use. Emerging economies such as Zambia can make use of CBDC as payment systems platforms to allow for an efficient, secure and reliable payment system for enhanced economic development and to reduce the cost of exchanging goods and services. Economic efficiency also implies an economic state in which every resource is optimally allocated to serve each individual or entity in the best way while minimizing waste and inefficiency. When an economy is economically efficient, any changes made to assist one entity would harm another. An efficient system infrastructure is also a very important and essential tool for the effective implementation of monetary policy, and the smooth functioning of money and capital markets. For an economy to attain an efficient

payment system platform, needs specific business policies which need improvement by monitoring and measuring different aspects of payment systems, payment conversions, successful transactions, fraud, and provided actionable data that can be used to make targeted changes in the payment systems ecosystem (BIS, 2017). The study further highlights the following key performance indicators measuring efficiency including payments conversion rates, conversion rates by the financial services providers (FSP), conversion rates by the payment methods and card type, reported fraud rates on all DFS and mobile financial services and measuring of downtime of payment systems platforms.

Stronger defense against AML/CFT

The Financial Action Task Force (FATF, 2020), defines anti-money laundering (AML) as a web of global laws, regulations, and procedures aimed at uncovering efforts to hide and disguise illicit funds as legitimate income. Money laundering seeks to conceal crimes ranging from tax evasion, human, child trafficking, drug trafficking, illicit activity funding and public corruption and the financing of groups designated as terrorist organizations. FATF further outlines that Combating the Financing of Terrorism (CFT) is a set of government laws, regulations, and other practices that are intended to restrict access to funding and financial services for those whom the government designates as terrorists. By tracking down the source of the funds which support terrorist activities, law enforcement may be able to prevent some of those activities from occurring. Global efforts through the UN national assembly supported by the UN office on drugs and crime (UNODC, 2020) and the FATF recommendations of 2012 and later updated 2022 (FATF, 2022), enhanced the AML/CFT guidelines and countries including Zambia have ratified to the international standards on AML/CFT. These global initiatives against money laundering and financial terrorism criminalize the financing of terrorism, allow for reporting suspicious transactions related to terrorism, international cooperation on AML/CFT. A study on the potential applications of the associated money laundering properties (Arner, Douglas W; Auer, Raphael ; Frost, Jon, 2020), can also be adopted by Central Bank Digital Currency designs to present strong and effective Anti-Money Laundering and Financing of Terrorism (AML/CFT) frameworks in order to promote financial integrity by making it difficult to conceal illegal activities. Further, the global AML/CFT properties can be adopted for secure CBDC designed with AML/CFT properties to also prevent the provision of financial services for the development of weapons of mass destruction and their means of delivery, and also mitigate financing for individual shipments related to weapons of mass destruction proliferation.

Non-discriminatory access to Domestic Financial Services (Financial Inclusion)

Some publications by the Alliance for Financial Inclusion, Digital Financial Services Working Group (DFS WG, 2019) access to domestic financial services is also commonly known as financial inclusion as the availability and equality of opportunities to access financial services by citizens. It also refers to a process by which individuals, households, firms and businesses can access appropriate, affordable, and timely financial products and services for an improved quality of life. These services include banking, loan, mobile micro loans, equity, and insurance products which every individual should have an opportunity to access. According to the top-level findings on the Zambian FinScope survey of 2020 (FinScope, 2020), access to financial services through financial inclusion increased by 10.1 percentage points to 69.4% from 59.3% in 2015. This increase was mainly attributed to the growth in the use of mobile financial services and other mobile financial platforms. Further research on the implementation of Central Bank Digital Currency lessons learned and key insights indicate that any CBDC initiative should supplement all the other digital financial services that have contributed to financial inclusion (Morales-Resendiz, Raúl; Ponce, Jorge; Picardo, Pablo; Chen, Bobby; Velasco, Andrés; Guiborg, Gabriela; Sanz, León, 2021). CBDC should incorporate open standards, open protocols and application programmable interfaces (API) to allow interoperability with other digital and mobile financial services to meet the financial inclusion agenda.

The thesis further suggests that financial inclusion can be measured in three dimensions including the access to financial services, the usage of financial services and the quality of the products and the service delivery that are offered in a market. The study postulates that the degree of financial inclusion is determined by three dimensions - mainly the usage of digital financial services, the barriers and the access to digital financial systems. Another study from the World Bank (Douglas & Claudia Ruiz, 2017) also indicates that to effectively measure financial inclusion, jurisdictions should qualify the number of automated teller machines per specific number of adults, the number of bank branches per specific number of adults, the deposit accounts with commercial banks per specific number of adults, the borrowers from commercial banks per specific number of adults and sometimes consider the digital insurance transactions in a specific area. All these measures may be inherited by a central bank digital currency making financial inclusion a compelling motivation to issue CBDC.

High cost of Currency Processing

Literature from the Reserve Bank of South Africa (SARB, 2021) estimates that the cost of handling currency makes up about 0.3% of the total GDP in the country. The accumulative cost of processing fiat currency in circulation (CiC) also includes the actual cost of printing the currency, currency management and the cost of cash processing machines such as the BPS M7, DLR7000 high-speed banknote processing machine, BPS, C5 and C4 desktop processing machines, glory FS-300 and FS-120 machines, Kisan smart K3 machines and Nota packs. The process also includes the costs associated with currency recycling which makes use of currency shredding machines such as online bracketing (OBS) machines that perform the mutilated and soiled notes management and reissuing back for public circulation. The cumulative cost of cash processing is therefore associated with the simple model (Ramos , Garratt, & Arauz, 2021) which assumes that we let the total cash in circulation (CiC) include all the costs of processing fiat currency. Figure 1.8 below shows a summary of the complete currency processing cycle from the Bank of Zambia.

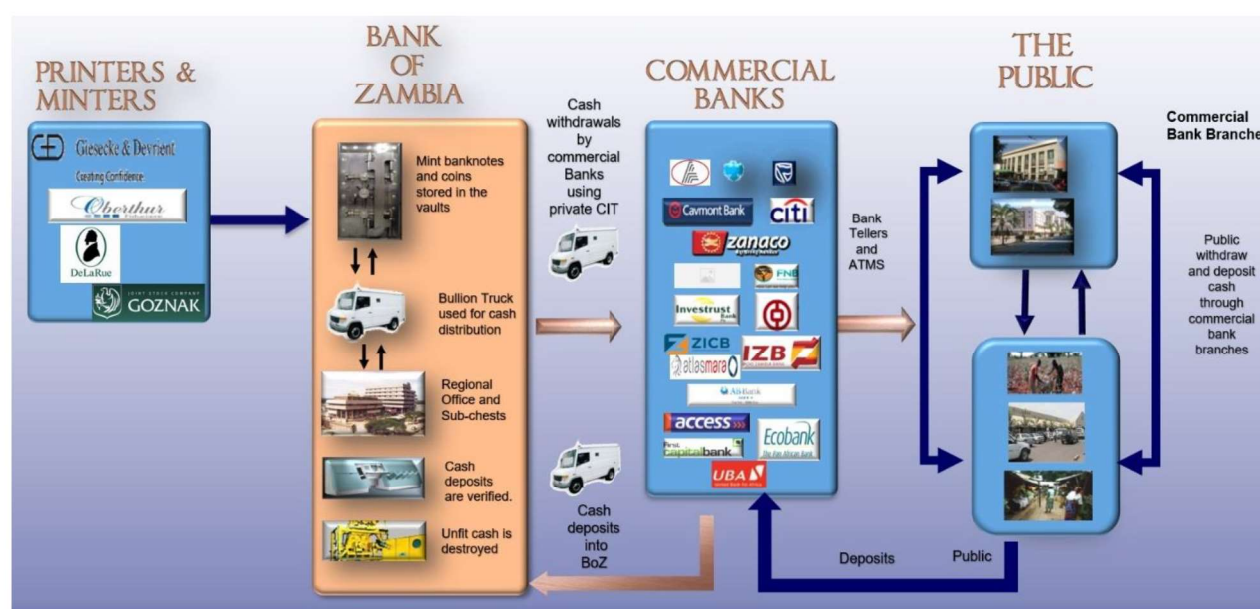


Figure 1.8: Cost of Processing Cash (Source: (BoZ,2020))

Despite some considerable improvements in the process in the recent past and sometimes accelerated by the need to prevent the person-to-person transmission of COVID-19, several mobile financial services have been adopted to reduce the use of cash. This cumulative cost is mainly attributed to the following costs that are associated with processing fiat currency from printing and minting, distribution through commercial Banks, day to day use by all economic agents and the recycling of soiled or unfit notes. Below is the summary currency circle:

1. The cost of printing currency including the recurring cost of cash templates, security features to prevent counterfeit notes.
2. The cost of currency management that makes use of BPS M7 high-speed banknote processing machines, DLR7000 high-speed banknote processing machines, BPS, C4

desktop banknote processing machine, currency desktop sorters, currency glory FS-300 and FS-120 machines and kisan smart K3 machines.

3. The costs of currency distribution that uses armored bulletproof cash trucks.
4. Cost of Security services for Transporting cash to all sub chests.
5. The cost of currency electronic management and Security systems including connectivity and maintenance to sub chests, technology, ICT and CCTV Equipment at main sites and sub chested.
6. The cost of human capital for cash processing the whole cash cycle.
7. The cost of currency recycling of removing soiled notes from circulation, currency shredding machines, online Bricketing System (OBS) and equipment and the soiled notes management and reissuing.

It is assumed that the above cost of processing fiat currency can be mitigated by the introduction of a Central Bank Digital Currency (CBDC) which comes with risks and is depicted in Section 1.6 below.

1.6. The Risks of Issuing CBDC

Research by (Statista, 2020), (Agur, Itai; Ari, Anil; Dell’Ariccia, Giovanni, 2021) summarizes the main risks of issuing CBDC and includes the following:

1. CBDC could affect financial stability and banking intermediation if it competes with bank deposits. This will keep retail CBDC and Banks from losing out on deposits resulting in the risk of disintermediation.
2. The risk of cyber security attacks, data privacy and data protection risks may cause disruption of CBDC operations and may lead to follow-on effects that may pose broader risks to financial markets, economies, and currency-issuing.
3. CBDC could enhance the transmission of monetary policy by central banks.
4. Commercial Banks could increase their reliance on wholesale funding, but with implications for funding cost and stability, and market discipline.
5. CBDC could bring about the risk of holding limits and restricted conversion modalities that could be imposed.
6. Central banks could recycle funds back to banks, but this could bring about the risk of a drastic step away from typical central bank mandates.
7. CBDC may increase bank run risk by offering a readily available, safe, and liquid alternative to deposits, depending on the CBDC’s design.

8. CBDC of reserve currency countries available across borders could increase currency substitution and bring about the risk of dollarization.

1.7. Problem Statement

Further evidence from global cryptocurrency platforms (Chainalysis, 2021) illustrates that there is a lot of virtual currency (VC) trading and activity going on in the SADC region, particularly in Zambia. Although this is the case, there is a serious problem because these virtual currencies are not recognized by monetary authorities and still not yet legal tender in the country. To this extent, the Central Bank of Zambia has to date issued only a mere cautionary statement advising citizens to trade and transact in VCs at their own risk (BOZ, 2018) as shown in Appendix 8.3. This lacuna has created a problem as the assets are now being traded illegally on the unregulated black markets and underground markets that impact on the money supply of notes and coins. These cryptocurrencies are not issued by the monetary authority and are not part of the formal money supply, but can be obtained from crypto mining, peer-to-peer trading or can be bought from the VASP (CoinMarketCap, 2020). This problem distorts monetary policies, financial stability and money supply by means of which the kwacha is lost to VC's and is at the risk of being suffocated by the growing illegal market which also poses the risk of AML/CFT. This problem, however, can be addressed by adopting some form of centralized currency in form of a CBDC that will deal with the risk of suffocating the kwacha and could facilitate instant, inclusive, interoperable and secure and trusted payment platforms that will be regulated, supervised and monitored (FSB, 2020).

Furthermore, there is currently no known regulation of these VA's that have been passed and the global financial industry is working tirelessly to putting in place guidelines and regulations which will guide the regulated use of these technologies. Various other studies also show that the current rapid rate of innovations are running ahead of regulations and bring up the need to develop regulatory frameworks that can address this rapid growth, risks and challenges and at the same time should not stifle and slow down new and cutting edge innovations in the financial services industry (Ahmed, 2020); (Ammous, 2019); (Borri & Shakhnov, 2019). If nothing is done about these risks and challenges posed by VC's their development will negatively affect the regulations on financial services and may pose a risk of another global financial meltdown (Kuang-Chieh & Hui-Pei, 2020).

In essence, then, many financial regulators including the BoZ are currently playing catch up and only issuing cautioning statements (BOZ, 2018); (SEC, 2018) to citizens on the risk of these cryptocurrencies instead of exploring exhaustive research and development to get the most out of these technologies. Globally, Central Banks have raised concerns of the

cryptocurrencies' spillover effects to the formal financial services industry and the eventual effects of these currencies on guiding monetary policies and how to repair and mitigate these eventual risks (SARB, 2014); (Borri & Shakhnov, 2019); (Kosc, Sakowski , & Ślepaczuk, 2019). Meanwhile, the technology keeps growing and the technology-aware generation is actively using it and the various activities associated with this innovation can no longer remain outside of the regulatory perimeter. Consequently, some countries have issued communications declaring restrictions or a downright ban on the use of crypto assets. Others have stated that they regard cryptocurrencies as intangible assets exempt from tax, whereas others have issued statements indicating that crypto assets are not recognized forms of legal tender, without outrightly declaring them to be illegal.

1.8. Significance of the Study

The motivation behind this study is that in many developing countries, access to basic financial services is a major challenge and Zambia is not an exception. Many people do not even have access to financial services such as bank accounts or any other financial services to allow them to send and receive money for their immediate use such as family upkeep, medical emergencies and education for their children. Nonetheless, several studies have shown that the mobile telecommunications platforms facilitated by mobile network operators (MNOs) have provided this platform in the last decade and this has improved the basic financial access for all (Nyundo, 2016); (Mvula, Phiri, & Tembo, 2020). These platforms together with the cryptocurrency space still require enabling regulation of financial services, the ICT communications networks and the general financial markets infrastructure (FMI) on which these cryptocurrencies, mobile financial services and all the other digital financial services operate (Thakor, 2019). This study, therefore, is important because by leveraging on the determinants of a Central Bank Digital Currencies (CBDC) prototype as a payment's systems platform, it proposes to build a new payments systems model which will interoperate and harness the advantages of mobile money, virtual currencies and other digital payment channels such as the internet. By focusing on the case of the monetary authority of Zambia and the determinants of a CBDC, the study demonstrates how a more functional, harmonized and well-regulated digital financial services industry in Zambia can be realized. This will further enhance the national efforts for financial inclusion, promote savings, reduction of poverty and for better emergency planning for Zambian families according to the national financial inclusion strategy (MOF, 2017). A well-regulated financial service will also allow for the use of virtual currencies at lower transaction costs and allow for good financial security in order to reduce transaction costs, enhance the culture of saving and improve overall financial inclusion for the Zambian people.

1.9. Research Objectives and Research Questions

1.9.1. Research Objectives

This research was be guided and directed by the following research objectives:

Main Research Objective:

1. RO1 - To explore the prevailing determinants for introducing a Central Bank Digital Currency in Zambia.

Specific Research Objectives:

2. RO2 - To determine if the introduction of a Central Bank Digital Currency can bring about the efficiency of payments systems platforms in Zambia.
3. RO3 - To examine if the introduction of a Central Bank Digital Currency can make result into national defense against AML/CFT in Zambia.
4. RO4 – To demonstrate whether CBDC can ensure nondiscriminatory access to domestic financial services in Zambia.
5. RO5 - To evaluate whether the introduction of a Central Bank Digital Currency can mitigate the cost of processing cash in Zambia.

This research adopted the W and H model (Blaikie & Priest, 2000) of asking questions and was guided and directed by the following main overarching question which provided guidance to have the greatest strength of evidence and was enforced by some subsidiary questions: Below are the research questions.

1.9.2. Research Questions

1. RQ1 – What are the prevailing determinants for introducing a Central Bank Digital Currency in Zambia? (Overarching research question)
2. RQ2 – In what ways does the introduction of a Central Bank Digital Currency improve the efficiency of payments systems platforms in Zambia?
3. RQ3 – How does the introduction of a Central Bank Digital Currency make national defense against AML/CFT in Zambia.?
4. RQ4 – In what ways does the introduction of a Central Bank Digital Currency ensure nondiscriminatory access to domestic financial services in Zambia?
5. RQ5 – How does the introduction of a Central Bank Digital Currency mitigate the cost of processing cash in Zambia.

1.9.3. Dissertation Layout and Structure

This dissertation has been arranged into appropriate sections, that formed the main charters of the study. The study is comprised of chapter one (i) which is the introduction to the study and provided background information, motivations of the study, the significance of the study, research questions and the main and specific research objectives of the study. Chapter two (ii) presents the review of the literature focusing on Central Bank Digital Currency (CBDC) global efforts and efforts by specific Central Banks in developing economies. The chapter also brings out the risks associated with issuing CBDC and outlines the conceptual and theoretical reviews and outlines the main gaps in the literature review.

Chapter three (iii) of the study focuses on the methodology that was used in the study including the research design and methods, the research philosophy and approach, the methodological steps and the methodological choice used in the research. Further, the chapter sets out the research design and strategy, data types and data sources used in the study and finally the validation and reliability of the data. Chapter four (iv) presents the research data analysis and the presentation and discussion of the results. The final chapter five (v) is the summary, conclusion and the policy recommendations on the determinations of Central Bank Digital Currency as a payment systems platform focusing on the case of the Zambia jurisdiction. The research ends by providing a list of publications, options for future research and references.

1.9.4. Chapter Summary

The first chapter of this thesis report is the introduction to the study on the determinants of Central Bank Digital Currencies (CBDC) as a Payment Systems Platform, a case focusing on the Zambian jurisdiction. The chapter starts with the background of the study, provides the motivations, the purpose and significance of this study. The chapter goes on to look at the theories used in the study, and the research objectives and questions to be addressed in the study.

The chapter further looks at the universal CBDC landscape and reviews the initiatives of CBDC in the Sub-Saharan African (SSA) region and focuses on the evolution of currency in Zambia. The chapter also looks at the specific virtual assets activities in Zambia and the inherent risks of issuing a CBDC in Zambia and provides the general layout of this study.

2.0 CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

The second chapter of this study presents the literature and all the works related to the study that was reviewed. Firstly, the thesis explored an extensive review of the global CBDC initiatives and the regulatory challenges across the globe. The study further considered developing countries in Sub-Saharan Africa (SSA) and the determinant for Zambia in particular, to issue a CBDC. The review starts by critically looking at the available literature on Central Banks Digital Currencies (CBDC) determinants and initiatives outside Africa and further focuses on the African continent and concludes with the Zambian jurisdiction. The chapter closes by looking at frameworks and the model adopted by the study in order to determine factors to be taken into consideration for any possible implementation of a successful CBDC platform in the country.

According to the report by the Bank for International Settlements (Boar, Codruta; Wehrli, Andreas, 2021), almost 86% of the Central Banks around the globe surveyed are exploring some work on the motivations, benefits and risks of implementing CBDCs, while 60% of central banks are now conducting experiments and proofs-of-concept on CBDCs with an increase of 42% from 2019. In addition, 14% of these central banks are in the process of developing concepts and prototypes of CBDCs. The BIS report further reviews that the primary motivations for emerging markets and developing economies (EMDEs) for CBDCs are mainly around mitigating the high costs of processing fiat currency, introducing stronger AML/CFT compliance, increasing financial inclusion, enhancing payment systems efficiency and safety. Other literature (Mohammadreza & Hosseini, 2018), (Brunnermeiera & Niepelt, 2019) suggests that the primary motivations for advanced economies differ from those of developing economies and mainly include advancing the digital economy agenda, promoting cashless societies, increasing payment systems efficiency and safety (BIS, 2020). The BIS study further concludes that Central Banks representing a fifth of the world's population are likely to issue a retail CBDC in the next three years from the time of this study. The study further goes on to review that CBDCs present an opportunity for central banks in developing and emerging economies to modernize their payment infrastructure and make central bank money available to retail users, taking advantage of advances in technology such as distributed ledger technologies such as blockchain (BIS, 2020). Depending on the design choices, CBDCs have the potential to improve efficiency and the cost of remittances and enhance financial

inclusion and should be designed with mobile financial services which have increased financial inclusion in Sub-Saharan Africa, according to the world bank FinScope survey (FinScope, 2020). The study (BIS, 2020) further enhances the need for a CBDC to interoperate with mobile financial services and outlines the risks posed by CBDC and the need to carefully design them to fit a country's specific needs and how CBDCs could result in reputational risks for the central bank.

2.2.Mobile Financial Services in Sub-Saharan Africa

As recently as 2011, more than 2.5 billion adults globally did not have a formal financial account. Since then, an astonishing 1.2 billion adults have obtained an account with a bank or mobile money service, representing great strides in escaping poverty and boosting prosperity. Progress has been most notable in Sub-Saharan Africa, where account ownership increased from 23% in 2011 to 43% in 2017. This great achievement can be attributed in large part to the incredible growth of mobile money. Mobile money has emerged as the mainstay of financial inclusion in Sub-Saharan Africa. According to the latest Findex report, the share of adults with a financial institution account excluding mobile money across Sub-Saharan Africa had risen by a modest four percentage points between 2014 and 2017, while the share with a mobile money account had grown twice as fast, increasing by nine percentage points. With 21 % of adults in the region having a mobile money account, Sub-Saharan Africa is the global leader in the use of mobile money. This finding is confirmed by the GSMA's own supply-side data on mobile money, which shows that Sub-Saharan Africa remains the epicenter of mobile money.

In Africa and Zambia, in particular, financial inclusion has been boosted by the dominance of Mobile Network operated (MNO) mobile platforms (GSMA, 2022), (GSMA, 2019). This has facilitated and allowed for access to financial services for poor people which cannot be enabled by the traditional "Brick and Motor" models of Banking where there are a lot of costs associated with setting up the infrastructure, the human capital resources and maintenance costs which are high and always passed on to ordinary customers. In Zambia, the motivation and discussions around Central Bank Digital Currencies started from the Central Banks vision of promoting a modernized, efficient and inclusive domestic and regional payment system, especially in the era of the COVID-19 pandemic where there was a lot of advocacy to avoid using cash and effectively promote the use of digital payments channels and be cash light in the Zambian. This position is contained in a publication by the central Bank of Zambia (BoZ) on the measures to mitigate the impact of the COVID-19 Pandemic and the reduction in cash handling and to go

cash light (BOZ, 2020). The monetary authority announced a set of measures aimed at reducing cash transactions and facilitating the increase in the use of digital financial services and mobile money platforms with the main objective of reducing the risk of transmission of COVID-19 through the reduction in the handling of cash (BOZ, 2020).

According to the Zambia Statistics Agency led FinScope survey of 2020, the total population of Zambia stands at 17.9 million with the total adult population accounting for just over 9.5 million. 53.4% of adults currently live in rural areas, while 46.6% live in urban areas with 52.6% of the adults being female and 47.4% are male, respectively. The FinScope survey saw the financial inclusion increased by 10.1 percentage points to 69.4% from the 59.3% which was recorded five years previously in 2015. The survey further shows that 71.2% of males are financially included compared to 67.9% of females of which 83.8% of adults in urban areas are financially included compared to 56.9% of their rural counterparts with formal financial inclusion increasing to 61.3% from 38.2% in 2015 (FinScope, 2020). Despite the improved use of DFS in Zambia, virtual currencies are not yet legal tender in the country and the Central Bank of Zambia has to date just issued a cautionary statement advising citizens to trade and transact in virtual currencies at their own risk (BOZ, 2018). However, there is still a lot to be done to make full use of digital financial services and virtual currencies to further improve the living standards of the ordinary poor people in the country. It is against this background that this research will focus on the determinants of the CBDC as a payment systems platform in the Zambian economy. The study will also consider the CBDC effects on the general payment systems jurisdiction and their potential applications on Central Bank Digital Currencies (CBDC) in the country. This study will also focus on exploring the possibility of issuing retail CBDC by the Central Bank of Zambia.

The digital financial services (DFS) and the specific virtual currency platforms form part of the overall financial services infrastructure in Zambia which is under the regulation of the ICT and telecommunications regulator called Zambia Information and Communications Authority (ZICTA). The communications platforms are composed of the terrestrial networks owned by Internet Service Providers (ISP's) and connect base stations and communications towers in different locations around the country. These base stations communicate with the subscriber identity module (SIM) cards which reside on the mobile handset providing both GSM and internet service connectivity for mobile devices such as laptops, tablets, and smartphones. This is an essential and fundamental underlying infrastructure that facilitates and allows for the use of virtual currencies as a medium of exchange. Figure 2.1 shows the overall ISP owned fibre optic terrestrial and both the wired and wireless mobile network infrastructure.

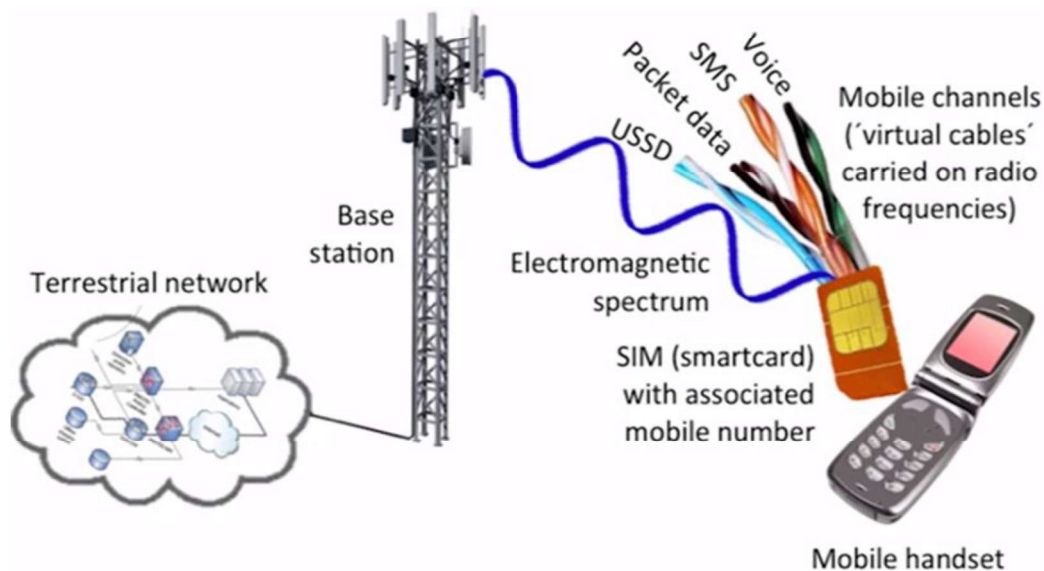


Figure 2.1: Mobile Telecommunications Infrastructure (Source: (ITU, 2014))

Financial service providers have envisaged the use of internet on smart phones and tablets which make use of mobile telecommunications as a complementary channel for virtual currency services. This brings up a larger mass of customers to use Mobile Banking and also encourages the use of Financial Inclusion even for customers with low literacy levels using the second and third generation (2G and 3G) text-based feature phones for basic unstructured service set identifier (USSD) communications which are feature phone properties that can also process CBDC to allow for interoperability with mobile financial platforms.

2.3. Central Bank Digital Currency Global Landscape

The global calls for central bank issued digital currency (CBDC) were intensified and accelerated when it emerged in May 2019 that Facebook rebranded to Meta platforms, the social media technology company in conjunction with other major players in the financial services industry including Mastercard, Visa, PayPal, Stripe, Coinbase and other development partners would collaborate to launch a digital currency called Libra in late 2020 (Zetsche, Buckley, & Arner, 2019). The literature further reviews that most of these CBDC efforts by central banks were meant to mitigate the risks posed by a growing number of proposed global currencies in order to protect and retain national monetary sovereignty and maintain financial stability. The white paper from Libra also outlined the plans for a new decentralized blockchain, a low-volatility cryptocurrency, and a smart contract platform which together aimed to create a new opportunity for responsible financial services innovation (Libra Association, 2019). Libra was later rebranded to Diem in 2020 and continued its efforts on a global digital currency. At the time of writing this paper the currency was still being developed and had not yet been released.

Further evidence also shows that there have been a lot of discussions in the last five years about the potential effects of introducing Central Bank Digital Currencies (CBDC) into economies and whether physical cash should be completely eliminated (Mohammadreza & Hosseini, 2018), (Kumhof & Noone, 2021). These discussions are different depending on the use cases and the motivations for the various economic jurisdictions around the globe. Some central banks have started the decision making process on whether to introduce a CBDC into their respective economies. The literature also reviews that the launch of the world's first central bank digital currency (CBDC) was the Sand Dollar which was issued by the central bank of the Bahamas in October 2020 (Fernández-Villaverd, Sanches, Schilling, & Uhlig, 2020). Sweden's Riksbank has also already started testing a retail CBDC which is called the e-krona and has been piloted to the general public (Miedema, Minwalla, Warren, & Shah, 2020). The central bank of China has also expressed its desire to issue its own sovereign digital currency as a way of supporting its digital economy and consolidate its already thriving electronic money economy which is being run by the private sector on the WeChat and Alipay platforms. In Africa, Nigeria became the first country on the continent to introduce a Central Bank Digital Currency called the eNaira on October 25th, 2021 (CBN, 2021). For the Zambian jurisdiction, important research questions arise and need to be addressed by this study. To address these questions, this study adopted the framework of (Lagos & Wright, 2005) to build a model in which two means of payment systems platforms could co-exist and be available for use in form of fiat currency as cash and a Central Bank Digital Currency (CBDC). The research further reviews the development of CBDC incentives in different jurisdictions around the world.

2.4.Developments in the CBDC Landscape

Several Central Banks in many jurisdictions have been considering the feasibility of a Central Bank Digital Currencies (CBDCs) and there has been increasing attention in the recent past. Both developed and emerging and developing economies are accelerating their CBDC research, pilot and launch efforts. They are moving from theoretical research to proof of concept and pilot projects. The Bank for International Settlements (BIS, 2018) survey on central bank digital currency estimates that 86% of central banks are engaging in some form of CBDC work. This is a response to mitigate the risks posed by virtual currencies, the changing market and consumer needs, driven mostly by advances in technology. Already, surveys show more than 86% of central banks are researching CBDCs, with some working on proofs of concept that could eventually lead to the introduction of fully functional CBDCs. In addition, the report indicates that out of the surveyed central banks, 10% plan to offer a retail version of

a CBDC in the next three years, with another 20% set to make the move in under six years. The following are the jurisdictions that are actively working on CBDCs.

2.4.1. People's Bank of China (PBoC)

Research by (Jinze & Etienne, 2019), in the paper on the overview of the expected characteristics from China's CBDC, contends that in 2009 the People's Bank of China allowed cross-border trade to be settled in RMB on a trial basis in Shanghai and Beijing, which was arguably the starting point for the currency's internationalization. It was the first CBDC to be announced from a major economy and since then, several additional initiatives have been deployed to help bolster trust in the Chinese currency (RMB) and increase its usage. Subsequently, the People's Bank of China began researching a digital RMB (e-CNY) in 2014 and six years later, in April 2020, the central bank said its CBDC which was called the digital currency electronic payment (DC/EP) was ready to launch. The initial pilot programs were then established in major cities including Shanghai, Chengdu and Beijing.

Further, the People's Bank of China (PBoC) working group on e-CNY published a white paper on its e-CNY retail CBDC (PBoC, 2021) that confirmed that e-CNY would be issued by the PBOC and distributed by commercial banks. The white paper also states that the e-CNY was initially designed for domestic use and was later tested and proved to be usable across borders, while acknowledging monetary sovereignty issues (PBoC, 2021). Furthermore, PBoC acknowledges the challenges that came with the internationalization of CBDCs though digital currencies more generally have multiple benefits. For example, they provide financial inclusion for those who do not have access to bank accounts and have the potential to lower the cost and increase the speed of domestic and international payments. In October 2020, the People's Bank of China also published a draft law laying out the legal foundations of the DC/EP, which gives the CBDC the same legal status as RMB. As a result, it is deemed legal tender, and refusing it as a means of payment is, therefore, illegal in China. Currently, the DC/EP is being issued through a two-tier system, whereby the People's Bank of China has authorized eight banks, including the six largest state-owned banks, to distribute it.

The study by (Kumhofa & Nooneb, 2021) outlines the challenge of the DC/EP to other global major currencies like the US dollar. The study reviews that in the short term, if issued and rolled out on a large scale, the e-CNY is unlikely to unsettle the US dollar's dominance and could also act as a complement to its current cross-border infrastructure. The RMB is already used for settlement in China's international trade and has been applied to smaller-value trade settlements in wholesale markets will likely continue to be settled in dollars. In addition, there

is still a need for DC/EP to prove its robustness and so far, the in-country user adoption has been low and there are no obvious benefits to using the instrument over other payment methods following the pilot trials. The paper further suggests increased efforts to facilitate interoperability with the already dominant mobile financial services hosted by Alipay and WeChat. The Zambia jurisdiction can leverage on the increasing financial inclusion (FinScope, 2020) to learn and adopt from the digital currency electronic payment (DC/EP) approach which in leveraging on mobile technologies.

2.4.2. Central Bank of the Bahamas

The Central Bank of Bahamas launched the world's first central bank digital currency (CBDC) which went live in October 2019. A publication by Bloomberg (Bloomberg, 2021), reviews how the tiny Bahamas island beat most global giants in the race to issue E-Currencies. The paper also outlines how John Rolle, central bank governor since 2016, describes what his country has learned so far from its pioneering role in central bank digital currencies. Also known as the sand dollar, the currency's motivations were to digital payments infrastructure to quickly recover from natural extreme weather disruptions such as tornados and typhoons that the islands are susceptible. Another paper by the central bank of Bahamas (Central Bank, 2019) cites other motivations for the sand dollar such as the promotion of financial inclusion, modernizing the payment system, and making private wallet systems interoperable.

The publication further outlines that the Sand Dollar is the digital version of legal tender just like cash which is issued by the Central Bank of the Bahamas. Like cash, you keep Sand Dollar in a wallet, a digital wallet. The main goal of the Sand dollar is to be accessible and not to exclude users based on technology. Therefore, the currency is available on a smart card, not just on smartphones, to help with the elderly. At the other end of the age scale, children often run errands and have pocket money, so they need to have access to digital cash. The write up states that the Sand Dollar is much safer than cash and if a holder's digital wallet is lost or stolen, the cash is gone forever. On the other hand, however, if the holder's mobile phone is lost or stolen the Sand Dollars are safe because they are not stored on the device. The Sand Dollar also provides an excellent record of income and spending, which can be used as supporting data for micro-loan applications. Further, the Sand Dollar can be accessed flexibly with either a mobile phone application on both iOS and Android mobile operating systems or using a physical payment card to access your digital wallet and the Sand Dollar presents zero transaction fees for individuals. The authorities in Zambia borrow from the Central Bank of

the Bahamas model and leverage on the increasing mobile infrastructure according to the (FinScope, 2020) to learn and adopt some properties from the Sand Dollar implementation.

2.4.3. Continental CBDC Initiatives

The Bank for International Settlements (BIS) in its research (BIS, 2020) reviewed that 86% of all central banks in the world are working on some type of research, proof of concept of piloting CBDC. In Africa, most central banks are at the research stage and the advanced jurisdictions towards the proof of concepts include the South African Reserve Bank (SARB), Central Bank of Eswatini, National Bank of Rwanda (NBR), Bank of Ghana (BOG), Central Bank of Nigeria (CBN), Central Bank of Tunisia (BCT) and Central Bank of Egypt (CBE) in North Africa (BIS, 2020). Zambia could learn from experiences with the CBDC research outcomes from these African countries and come up with compelling motivations to consider issuing CBDC in its jurisdiction.

2.4.4. South African Reserve Bank (SARB)

The Republic of South Africa remains one of Africa's strongest economies. In its press release of May 2021, the South African Reserve Bank (SARB, 2021) reviewed that it had commenced a feasibility study for a general-purpose retail central bank digital currency. The main purpose is to investigate the feasibility, desirability and appropriateness of a central bank digital currency (CBDC) as electronic legal tender, for general-purpose retail use, complementary to cash. They defined a retail CBDC can be a digital form of cash aimed at providing the best attributes of both cash and electronic payments. Furthermore, the SARB stated that the objective of the feasibility study was to consider how the issuance of a general purpose CBDC would feed into the SARB's policy position and mandate. The study further focused on the issuance of a domestic CBDC that could be used by consumers in South Africa for general retail purposes.

Consequently, the report states that the feasibility study included practical experimentation across different emerging technology platforms, taking into account a variety of factors, including policy, regulatory, security and risk management implications (SARB, 2021). The SARB in the past had also run a proof of concept on tests that looked at using the distributed ledger technology (DLT) to speed up payment systems in the country on high-value transactions settlement on the blockchain in a project called Project Khokha (SARB, 2019). The SARB also maintained that it should be noted that while the CBDC feasibility study was different from Project Khokha, which focused on the settlement of high-value transactions

between commercial banks and other stakeholders at the wholesale level, it was expected that the two studies would result in better policy alignment and coordination. The Zambian jurisdiction currently using the Zambia interbank payment and settlement system (ZIPSS) for high value payments (BOZ, 2018) and could consider using the distributed ledger technology (DLT) to speed up payment systems in the country.

2.4.5. Central Bank of Eswatini

The central Bank of Eswatini in its diagnostic study findings signaled a green light for the next phase of the CBDC diagnostic for the country. The main objective of the first phase of the CBDC diagnostic study was to evaluate whether there were clear use cases that existed for the introduction of a retail and or wholesale CBDC specifically within the context of the Eswatini jurisdiction. According to the diagnostic study (CBE, 2020), the findings from the first phase of the investigation indicate that three potential use cases motivate further consideration by the CBE Board of Directors for the possible pilot testing and introduction of CBDC within Eswatini. More specifically, the study (CBE, 2020), outlines that since the strength of each use case is neither equal nor unconditional, the first phase of the findings suggests the need for further exploration under the second phase of the CDBDC diagnostics to determine whether Eswatini satisfies the key prerequisites needed to make CBDC gains a reality.

The diagnostic study publication on the Eswatini CBDC presents three use cases for the context of the country with varying degrees of strength. The strongest use case is for CBDC to provide an efficient and functional payment system for the country through the current National Payments Systems (NPS) in Eswatini which still remains a resilient and secure payment systems platform. The retail clearing house is notably underutilized and currently lacks the functionality to enable real-time payments and payment channel ubiquity. The financial stability study further reviews that wholesale and or retail CBDC can play a role in addressing these constraints in line with the current ambitions of the CBE to develop a fit-for-purpose national payment architecture, or switch (CBE, 2019). This could be achieved by specifically designing the newly proposed payment architecture to be overlaid with both retail and potentially wholesale CBDC. This solution offers the potential not only to increase consumer convenience through enabling channel or instrument interoperability and real-time payments but also to considerably decrease reconciliation costs for providers, thereby improving operational efficiency and allowing lower prices for end consumers. The paper views that this enhances retail payment system interoperability, speed and efficiency of payments, inclusiveness especially for presently excluded MMOs) and cost-effectiveness will provide more financial robustness and convenience for both providers and consumers, as well as

encourage greater use of digital financial services to increase the utilization of NPS infrastructure (CBE, 2019).

The Eswatini FinScope study of 2019 highlighted the deepening consumer demand and usage of digital financial services as an intermediate requirement for digital currencies since access to financial services in Eswatini is relatively high at 87% on aggregate (FinScope, 2019). Unfortunately, the use of digital payment methods continues to be surpassed by cash across most P2B, B2P and B2B use cases, according to the study. The publication also reviews those digital payments are playing a role in P2P remittances and the 18% of MSMEs who conduct B2B digitally. Mobile money has played a significant role in the former, with over 80% of remittances currently taking place through mobile money. Despite the gains, mobile money still faces constraints to achieving greater usage across P2P and P2B use cases. These constraints include high (cash-in, cash-out) CiCO costs for consumers and a lack of interoperability with other providers, thus inhibiting greater ease of transfer for consumers. Retail CBDC presents a unique opportunity to assist (mobile money operators) MMOs to overcome these constraints. (CBE, 2020) also maintains that by underpinning the design of all mobile money offerings and relying on the existing rails of mobile money, retail CBDC could potentially assist to reduce provider costs that are passed onto consumers/MSMEs and enable de facto interoperability between different mobile money services. Furthermore, given that mobile money already enjoys large penetration and trust from the population in Eswatini, the monetary and convenience gains that CBDC could provide should motivate deeper and enhanced use of mobile money for additional payment use cases.

(CBE, 2019) further argues that it is important to note, that for retail CBDC to increase the use cases of mobile money beyond P2P towards P2B, B2B and G2P payments, several contextual and market factors may need to be addressed as prerequisites to implementation and hence making this use cashless direct. These factors include expensive merchant and mobile money agent business models around cash-in cash-out (CiCO) fees at mobile money agents; the need to address value chain digitization; and the risk of excluding currently, marginalized population segments such as the rural people who depend on cash and may experience an increased digital divide.

The paper highlights the least compelling case for the CBDC as the economic policy strengthening monetary policies whose main objective is for price and financial systems stability. The fiscal policy was evaluated in terms of assessing whether there are opportunities or scope for CBDC to improve or strengthen current implementation and whether there is any possibility that CBDC could undermine policy objectives. The diagnostic study (CBE, 2020)

also reviews that retail CBDC offers the clearest opportunity in terms of fiscal resources. If coupled with a robust digital identity system, CBDC can optimize both government spending and tax collection. Not only will government ghost workers be made visible, but taxpayers can be more easily traced to increase tax revenue. A minimal use case exists for CBDC and monetary policy due to the limitations emerging from the MMA, which binds domestic monetary policy to the South African repo rate in terms of price stability. The actual effect of CBDC for peg maintenance, if it continues to satisfy the MMA, is likely to be neutral but ultimately depends on the approach chosen by the CBE in this regard. Similarly, while CBDC does not seem to offer a direct use case for or against financial stability, it is within the CBE mandate to determine how CBDC can be best designed and implemented to mitigate any potential risks to the financial system.

The diagnostic study (CBE, 2020) concludes that the next steps on the journey to an Eswatini issued CBDC suggest that the CBDC can add value to the economy and financial system in three important ways – namely, the payment system efficiency, consumer demand and fiscal consolidation. This indicates that exploring the possibility to pilot-test or eventually implementing a CBDC of some form in Eswatini is not only relevant but also beneficial for the country, and the CBE is tasked with promoting a sustainable, efficient, inclusive and modern financial system in line with long-run economic development. However, while these results are positive, further research is warranted to investigate whether the necessary prerequisites are currently in place to enable the identified CBDC use cases. These use cases could also be adopted in the Zambian study to address some similar requirements. The proposed subsequent investigation would therefore seek to address the following:

1. To identify whether key infrastructure and market prerequisites are in place to support the payment use case and the long-term gains on the fiscal policy side via existing identity systems.
2. To identify whether key preconditions are present to encourage merchant and consumer acceptance/adoption of CBDC.
3. To evaluate whether regulation and sufficient institutional capacity exist in Eswatini to bring CBDC into effect safely and securely, and to assess whether institutions are ready and capable of ensuring its success.

2.4.6. National Bank of Rwanda (BNR)

The Central Bank of Rwanda in its 2019 to 2020 annual report (BNR, 2020), suggests studying the possibilities of issuing its own Central Bank Digital Currency in response to global trends

in digital currency. The digital currency in this case represents any currency or money that is managed or exchanged on digital computer systems, especially over the internet and never converted into physical form at any point. Globally, the considerations of central bank digital currencies have increasingly become common following the popularity of decentralized cryptocurrencies such as Bitcoin and Ethereum, which are not managed by any governments and central banks, a Rwanda financial publication reported.

The communications from the Director of Payment Systems at the Central Bank of Rwanda told a briefing that their assessment and studies were focusing on economic, financial and technical aspects related to CBDC as well as the operationalization model, taking into account the local Rwanda context. Further, the study was also analyzed the implication of the CBDC on monetary policy and financial stability in the country. The study also observed that there were limited countries and case studies to bench market from as only one country globally had since officially launched a CBDC. The Bahamas was listed as the only country at the time of writing this paper to have so far launched a central bank digital currency, the sand dollar, with many others exploring the feasibility. The study from the Bank for International Settlements (BIS, 2020), also stated that other African Central Banks were looking into the subject, while Nigeria and Ghana were also reported to be exploring the feasibility of issuing a CBDC.

Furthermore, evidence from a study by (BNR, 2020), noted that there is not much literature in terms of global standards and reliable benchmarks on the CBDC subject at present but, nevertheless, the Central Bank of Rwanda is benchmarking with countries that are at more advanced stages, learning both on the positive and negative experiences. BNR is basing its research on the work that is already done by international institutions such as the International Monetary Fund, World Bank, and the World Economic Forum, respectively. The other stakeholders like the Rwanda Blockchain Association also noted that among the most important aspects to look into is the necessity of a CBDC, and whether or not it would bring value to the economy. They state that a CBDC should retain the best attributes of both cash and existing e-wallet solutions, and also that cash can be exchanged offline, without restrictions or fees, while digital payments such as mobile money allow for instant long-distance transfers. The other CBDC priority areas include inclusivity in the payment systems landscape and contrary to private interests, the central bank is mandated with the financial inclusion of all Rwandans and, therefore, the adoption of the solution would be expected to be applicable and relevant to the different user categories. The other important characteristic of the CBDC noted is the need for interoperability, as the proposed CBDC solution must interoperate and at least work with the AfCFTA by facilitating instant settlements and standards between central banks

and other already existing payment platforms so that people and machines pay each other instantly and the systems have to be inclusive for all.

Other global studies and projections (IMF, 2020), (Agur, Itai; Ari, Anil; Dell’Ariccia, Giovanni, 2021), (Griffoli, et al., 2018) have postulated that digital currencies hold multiple benefits such as faster payments and transfers, less expensive international transfers as opposed to high fees charged to move funds from one country to another. The other projections are that digital currencies could support in reaching out to the unbanked in the general public as they will have the financial history and are the main stakeholders who will be using the CBDC for their day-to-day transactions. Zambia could also leverage on some of these CBDC priority areas to hence the determinants of a Central Bank Digital Currency.

2.4.7. Bank of Ghana (BOG)

A publication by the Bank of Ghana on 11th August 2021 (BOG, 2021), observed that it had partnered with Giesecke+Devrient to pilot the first general purpose Central Bank Digital Currency (CBDC) in Ghana, a first on the African continent. The Bank of Ghana announced that G+D would provide the technology and develop the solution adapted to Ghana’s requirements, which would then be tested in a trial phase with banks, payment service providers, merchants, consumers and other relevant stakeholders. The Bank of Ghana has since signed an agreement with G+D to implement a pilot CBDC project as a precursor to the issuance of a digital form of the national currency, the Cedi.

The publication further stated that the project was part of the 'Digital Ghana Agenda', which involved the digitization of the country of 30 million people and its government services. The digital Cedi, or 'e-Cedi', was intended to complement and serve as a digital alternative to physical cash, thus driving the Ghanaian cash lite agenda through the promotion of diverse digital payments, while ensuring a secure and robust payment infrastructure in Ghana (BOG, 2021). The initiative also aims at facilitating payments without a bank account, contract, or smartphone, by so doing boosting the use of digital financial services (DFS) and financial inclusion amongst all demographic groups. Furthermore, the project was divided into three phases starting with the design, the implementation and finally conducting a pilot. The publication also reviewed that in the design phase, all the framework parameters for the CBDC pilot would be specified and defined. These framework parameters include the economic, regulatory and technical requirements of the West African country as well as the definition of the parameters for the test phase. In accordance with these individual requirements, G+D's CBDC solution would be adapted for the Ghanaian context in the second phase. In the pilot

phase, a user group of diverse demographic and socio-economic backgrounds would test the solution in the field using different channels and form factors such as mobile apps and smart cards. Throughout the pilot project, a study would be conducted on the acceptance of the e-Cedi from the end users' perspective.

The thesis further demonstrated that, for the CBDC to be effective, the IT security of the infrastructure, the impact of the project on monetary policy and payment system, and the legal implications should also need to be effectively evaluated (FATF, 2020), (Arakpogun, Elshahna, Nyuurb , & Olan, 2020). The insights from pilot user experiences would provide the Bank of Ghana and G+D with valuable lessons for a nationwide rollout of the e-Cedi. The Governor of Bank of Ghana at the time of this study, Dr. Ernest K. Y. Addision, also echoed the sentiments that “CBDC presents a great opportunity to build a robust, inclusive, competitive and sustainable financial sector, which is spearheaded by the Central Bank and from all indications, the concept of the CBDC has a significant role to play in the future of financial service delivery globally.” Furthermore, a study by the Bank for International Settlements shows that 86% of all central Banks around the world are exploring the introduction of digital money as legal tender (BIS, 2020). The Ghanaian government is one of the first African countries now entering a pilot phase, as the G+D's CBDC solution, combines the advantages of today's cash with the needs of users in an increasingly digitized world. The solution also guarantees outstanding security, high availability and resilience, as well as the ability to protect user data while complying with regulatory requirements. In addition, the solution enables secure, consecutive offline payments in case no network connection is available and this use case would also be very vital for the Zambia CBDC considerations.

2.4.8. Central Bank of Nigeria (CBN)

According to reports by (CryptoPlus, 2021), the Central Bank of Nigeria (CBN) has been doing some studies on the feasibility of CBDC and revealed the official wallet for its digital currency, e-Naira, the speed wallet in August of 2021. The Central Bank made it clear that the electronic Speed Wallet would not serve as a competition to existing banks but serve as a means to transact value, depending on when banks and other innovators can provide their own wallets for CBDC storage. The study further reviews that the Speed Wallet has three tiers of operations, with the first tier allowing users with no bank account to use the Speed Wallet. In order to meet the Know Your Customer (KYC) regulations, the users would have to submit a passport photograph, name, place and date of birth, gender, address and active phone number to the authorities.

The Central Bank of Nigeria (CBN) was set to launch the electronic Naira (eNaira) on October the 1st, 2021 which is the digital representation of the paper Naira currency issued by the Central Bank of Nigeria. Arguably, (CryptoPlus, 2021) also notes that the eNaira will be a complimentary legal tender in Nigeria, having the same exchange value as the Naira, and will aim to maintain a parity of value with the Naira. The eNaira is the digital form of the Naira, issued by the CBN in line with Section 19 of the CBN Act. It is a direct liability of the Central Bank, a legal tender and will form part of the currency in circulation and will be at par with the physical Naira at a 1:1 ratio. The eNaira shall complement traditional Naira as a less costly, more efficient, generally acceptable, safe and trusted means of payment. In addition, it will improve monetary policy effectiveness, enhance the government's capacity to deploy targeted social interventions and boost remittances through formal channels. The reports further note that the e-Naira will not earn any interest to holders and the digital currency will be built on a blockchain open ledger technology and this will protect against the duplicate or fake eNaira counterfeits making every eNaira unique.

According to the publication, on the regulatory guidelines of the eNaira (CBN, 2021), the guidelines were published to apply to all financial institutions and users of the eNaira in Nigeria. During the onboarding process, users shall have the option to disclose whether the eNaira wallet being created will be operated for themselves or as trustees. The guidelines further state that the Central Bank of Nigeria, under the CBN Act 2007 and the Banks and other Financial Institutions Act (BOFIA) 2020, is empowered to issue legal tender currency, ensure the financial system and promote the development of an electronic payments system. The Central Bank of Nigeria in furtherance of its mandate issued the following guidelines for the operation of the eNaira.

1. The eNaira shall be administered by the CBN through the Digital Currency Management System (DCMS) to mint and issue eNaira.
2. Financial institutions shall maintain a treasury eNaira wallet for holding and managing eNaira on the DCMS.
3. The Financial institutions (FI) suite will be the primary application used by the FIs to manage their digital currency holdings, requests, and redemption with the CBN.
4. The eNaira stock wallet belongs solely to the CBN and it shall warehouse all minted eNaira.
5. The two-factor authentication and other cybersecurity measures shall be adopted to ensure the security of the eNaira wallet.

6. The charges for eNaira transactions shall be in line with the Guide to Charges by Banks, other Financial and Non-bank Financial Institutions.

The CBN further clarifies that the Financial Institutions are required to comply with the Money Laundering Prohibition Act of 2011, the Terrorism Prevention Act of 2011 and all subsisting anti-money laundering laws and regulations as may be issued by the CBN from time to time. The CBN Journal of Applied Statistics (CBN, 2021), stated that the first tier of the digital wallet has a daily limit of N50,000, for send and receive. The minimum requirement for using the Wallet at this level is a telephone number which will be validated as a National Identity Number (NIN) and has an cumulative balance daily fixed at N300,000. For the second tier, users are allowed to own an account with an existing bank and can only send and receive N200,000 daily with an accumulative daily balance of N500,000 and the minimum requirement for this level is the Bank Verification Number (BVN). The third Tier allows daily transacting of up to N1,000,000 with the accumulative daily balance of N5,000,000 a BVN used as the minimum requirement. Furthermore, the merchant level allows the third tier user type to transact daily up to sending and receiving N1,000,000. However, merchants will have no limit to the amount of money they can move to their bank accounts with the minimum requirements being the KYC requirement stipulated by the CBN AML/CFT Regulations.

According to the paper (CBN, 2021) on the design principles and objectives of the eNaira payment system, the paper outlines its core pillars as a medium of exchange and as a payment system. Primarily, the eNaira is meant to meet three common principles espoused by the Bank for International Settlements which are: to do no harm, coexistence and allow for innovation and efficiency in a payment's platform. Based on these three general principles from the BIS and in consideration of the objectives of the eNaira, the CBN developed five Nigeria-specific principles to guide the design of the eNaira as outlined in Figure 2.3 below. The eNaira design principles could also be adopted and considered for the the Zambia CBDC to address the payment system's inclusivity, innovation, efficiency, payment systems resilience and to have a proudly Zambian CBDC infrastructure.

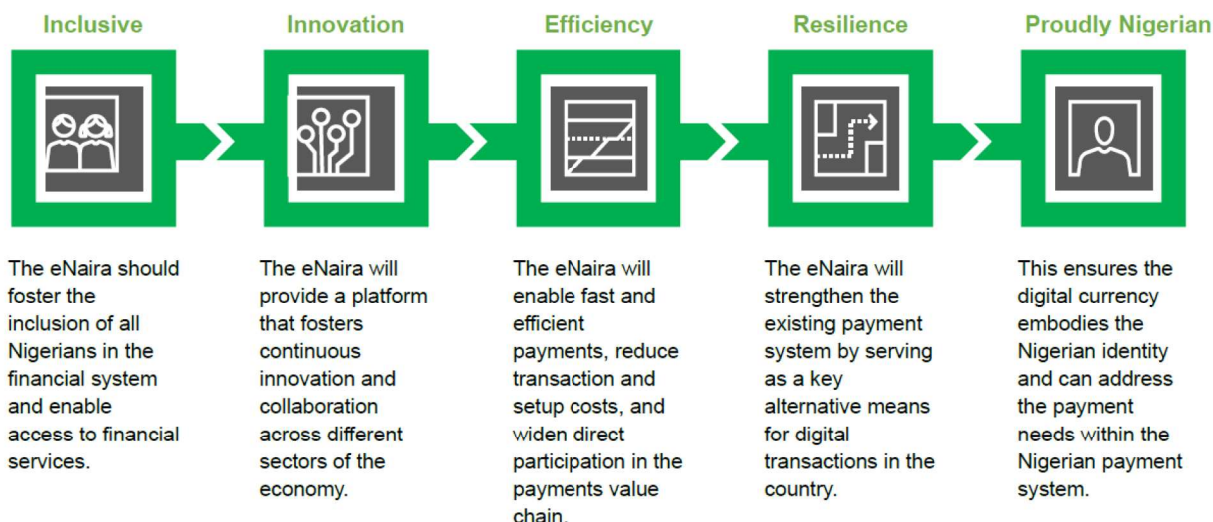


Figure 2.2: eNaira Design Principles (Source: (CBN, 2021))

2.5. Empirical Literature Review

This section focused on the review of the main motivations for the Central Bank Digital Currency (CBDC). The review addressed the specific research objectives including the how to determine if the introduction of a Central Bank Digital Currency can improve the efficiency of payments systems platforms in Zambia, examining if the introduction of a central bank digital currency can make a stronger national defense against AML/CFT in Zambia, to demonstrate whether Central Bank Digital Currencies can ensure nondiscriminatory access to domestic access to financial services in Zambia and to finally evaluate whether the introduction of a Central Bank Digital Currency can mitigate the cost of processing cash in Zambia.

2.6. CBDC as an Efficiency Payment System Platform

Research from the Bank for International Settlements (BIS, 2021), suggests that as central banks respond to the changing market needs and technology developments, they still need to maintain their primary mandate and ensure a safe and sound financial system, monetary and financial stability for their jurisdiction. The paper further questions whether the introduction of a CBDC can enable this mandate, to make sure that central banks fulfil their mandate to the best of their ability. The CBDC is the digital form of a country's fiat currency and the inherent properties such as traceability, transparency, reliability, convenience and security bring about efficiency in digital payment systems platforms. Other scholars argue that the adoption of private stablecoins poses financial stability risks and central banks around the world need to respond quickly and decisively to create a highly efficient payment infrastructure for the digital economy. However, this may come at the cost of privacy, especially when there is a lack of transparency around the design of CBDCs.

Studies from (ChainAlysis, 2021); (Schiller, 2021) have also demonstrated that the CBDC could also drive payment systems efficiency and effective competition as central banks open the national payment systems to non-bank financial players, enabling a platform that private companies can use to serve private customers. Additionally, there is an opportunity for embedded supervision which could lower the cost of compliance and supervision. There is also the question of how to build digital public infrastructure that will support inclusive and interoperable digital payment systems platforms. The authors further state that if central banks do not act quickly and decisively, the rise of private stablecoins and virtual currencies could result in negative implications for monetary policies and financial stability. Many central banks, including those in emerging markets and developing economies like Zambia, have an opportunity to collaborate with other regional payment systems platforms in order to ensure interoperability and develop an efficient payment system that meets the demands of a tokenized financial system. Furthermore, a retail CBDC could be established by a consortium of central banks to ensure efficient, interoperable and cross border payments infrastructure. This presents an excellent opportunity for central banks to join efforts in exploring CBDC, according to the Bank for International Settlements which is exploring cross-border CBDC through the Multiple CBDC (mCBDC) Bridge project (BIS, 2020).

2.7.CBDC Stronger National Defense against AML/CFT

Literature from the Zambian Financial Intelligence Center (FIC, 2019) in the 6th money laundering and terrorist financing trends report states that anti-money laundering cases have been on the rise with the center doubling its efforts of prevention and detection of Money Laundering, Terrorism and Proliferation Financing (ML/TPF) and other financial crimes in the country. The international AML/CFTP regime requires countries to demonstrate effectiveness by the level of ML convictions and forfeiture of assets from proceeds of crime. The FIC indicates that the institution received a total of seven hundred and ninety (790) reports comprising of seven hundred and forty eight (748) Suspicious Transaction Reports (STRs) and forty two (42) Spontaneous Disclosure Reports (SDRs) (FIC, 2019). This compares to seven hundred and ninety nine (799) reports received in 2018 comprising of seven hundred and twenty four (724) STRs and seventy five (75) SDRs. In addition, the Centre received a total of one hundred and forty nine thousand six hundred twenty five (149,625) Currency Transaction Reports (CTRs) in the year 2019 compared to seventy five thousand five hundred ninety two (75,592) CTRs received in 2018. This represents a 98% increase in the number of CTRs filed with the Centre. The increase was on account of more reporting entities becoming aware of their reporting obligations. The other type of report the Centre receives are the Cross Border

Currency Declaration Reports (CBDR). In 2019, a total of one thousand one hundred and twenty six (1126) CBDRs were received by the FIC compared to two thousand one hundred sixty nine (2169) reports in 2018.

The Global Financial Action Task Force (FATF, 2020), in its publication to the G20 Finance Ministers and Central Bank Governors on the Stablecoins and central bank digital currencies reviews that the immutability, traceability, transparency and security properties of digital currencies provide the ability for CBDC to provide a stronger defense to money laundering, terrorism and proliferation financing which has been increasing in Zambia. The government continues to lose revenue through laundered funds which negatively affect revenue mobilization necessary for the provision of public goods and services. As a result of the dissemination made by the Financial Intelligence Centre, the Zambia Revenue Authority assessed taxes amounting to ZMW 27.7 million in 2019, compared to ZMW 62 million in 2018 (FIC, 2019). According to another FATF discussion paper on the Central Bank Digital Currency and the risk-based approach to virtual assets and virtual asset service providers (FATF, 2019), CBDC provides an opportunity for Central Banks to utilize the virtual currency properties to mitigate the ML/TF risk. The paper further states that the ML/TF risks are higher and need to be mitigated due to the ease of transferring virtual assets across different countries as well as the absence of homogeneous controls and prevention measures at the global level. However, CBDC seeks to promote the use of secure cryptography and immutability technologies that could combat ML/CFT as long as these technologies are applied across different interoperable CBDC jurisdictions.

The IMF Fintech paper series on behind the scenes of Central Bank Digital Currency emerging trends, insights, and policy lessons (Soderberg , et al., 2022), contends that some features of cash, including anonymity and the lack of an audit trail, make it attractive for illicit transactions such as tax evasion, money laundering, and terrorist financing. The paper further reviews that the inherent properties of CBDC could potentially reduce this problem of AML/CFT. However, only the Bahamas and Nigeria have fully launched CBDC, with the former reporting a reduction of the illicit use of money as a top policy objective for its CBDC. The Bahamas was put on the Financial Action Task Force (FATF) grey list in 2018 due to strategic deficiencies in its AML/CFT framework, which resulted in increased monitoring. The Bahamian authorities subsequently implemented an action plan aimed at addressing the identified deficiencies, and as a result, the Bahamas was de-listed in December 2020 after the implementation of the CBDC.

2.8.CBDC Mitigation on the High Cost of Currency Processing

A number of notable publications by the European Central Bank, the World Bank and the Central Bank of West African States (ECB, 2019), (World Bank, 2020), (BCEAO, 2019) observes the increasing cost associated with processing cash in the Sub-Saharan African region. The studies further review that customers in the region, particularly in emerging markets, remain cash focused in the making of day-to-day purchases despite the rapid growth of electronic payments. The micropayments are a particular cash stronghold and this is a domain many banks would like to crack with the new emerging technologies such as mobile financial services, financial technologies and near field communication (NFC) enabled contactless payment. Central Banks in the SSA region are also exploring the options of minimizing the use of cash due to its high costs and lately to reduce the transmission of COVID-19 due to the person-to-person contact that the exchange of cash brings along (BIS, 2020). In some SADC countries including Zambia, customers require big amounts of cash, whether for paying for daily essentials and utilities such as fuel, food, beverages, groceries and even large purchases such as building materials in the real estate industry. These practices pose a logistical and costly challenge for the central banks and commercial banks in these jurisdictions. The South African Central Bank (SARB, 2021) also estimates that the cost of handling cash makes up of about 0.3% the total GDP in the country. Despite some considerable improvements in the recent past and sometimes accelerated by the need to prevent the person-to-person transmission of COVID-19, several mobile financial services have been adopted to reduce on the use of cash.

Other studies on the understanding the cost of handling cash in the developing nations of the Asia Pacific (Wincor, 2018), showed that banks in these emerging markets achieved the highest cost reductions in minimizing the use of cash by adopting financial technologies and digital financial services that use electronic means of exchanging value. For the more mature markets in this region, banks and central banks focus on the cost of holding excess cash mainly through improving their forecasting and planning capabilities and developing a leaner cash supply chain. The study further shows that the reduction of excess cash usage, will soon be the focus of attention of emerging market banks, as increasing pressure on the cost of cash handling due to tougher competition for profit margins and contracting margins is no longer just a characteristic of mature markets anymore but increasingly drives emerging market banks in the modern digital era. The whitepaper also examines the composition of the costs associated with cash handling, shows key pinpoints in the cash supply chain and provides retail bankers with ideas how to manage those cost more efficiently. The research brings out the main drivers for improving efficiency in cash handling to minimize cost and increase security by carefully

balancing cost savings and control in the development of an integrated cash supply chain. The human capital in terms of labor cost also comes up as the main cost factor in mature markets, as technology, outsourcing and process streamlining have significantly reduced costs such as machine downtime, excess cash, theft and insurance claims. The European Payments Council, in the publication on the improving of the efficiency of the handling of cash (EPC, 2019), also points out that emerging markets see the highest cost savings from minimizing the labor cost, particularly in outsourcing cash replenishment and maintenance, while the opportunity to cut cost through minimizing excess cash is not yet seized. EPC further reviews that adequate forecasting is the key to minimizing the excess use of cash but is also the most challenging task, as it is influenced by many other variables.

In Zambia, the cost of cash is not very clear, but the preliminary research conducted on the Central Bank's currency operations reviews several cost centers where cash are always on the rise. The cash processing cycle in Figure 2.3 shows the process and involved in the processing of cash starting with the central main site receiving the notes and coins from the printing, distribution to the remote branches and the holding sub chests. The figure also shows the management of soiled or bad notes which are processed through the high-end bank notes processing machines. The costs include the cost of printing currency, the cost of currency management, the cost of currency distribution, the cost of electronic currency management and security and the eventual cost of recycling the currency.

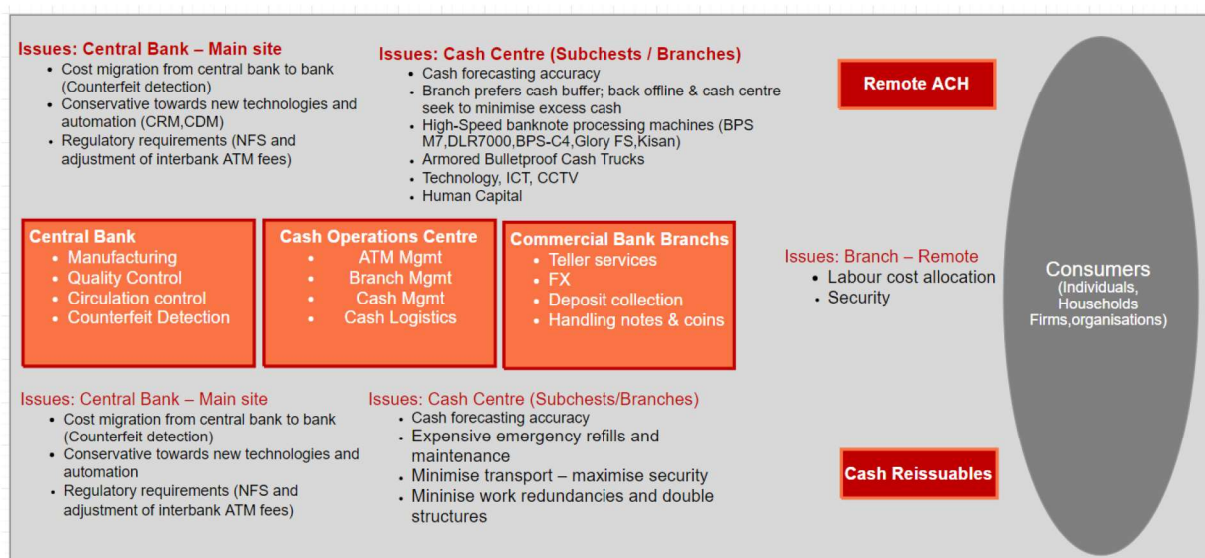


Figure 2.3: Cash Processing Cycle (Source: Authors Construct)

2.9. CBDC Non-discriminatory Access to Domestic Financial Services

Financial services are not readily available to everyone in developing economies like Zambia. Evidence from the thesis by the Consultative Group to Assist the Poor (CGAP) shows that

digital financial services make it easier for a developing society to pay for basic services, to buy water, have access to sanitation and hygiene infrastructure and use health care services. Financial services can also enable access to better food and nutrition, basic education, transport services, electricity and better housing and shelter (CGAP, 2019). The World Bank also reviews that there is a growing increase in mobile and digital financial inclusion involving the deployment of the cost-saving digital means to reach currently financially excluded and underserved populations. The lower cost mobile financial services have also bridged the gap and is helping facilitate payments among the population is an important objective for most central banks in most developing countries including Zambia. Access to payments is associated with, but not identical to, financial inclusion. Even countries with high levels of financial inclusion, such as Sweden, can still face access to payments challenges. Some central banks are concerned that private payment service providers might not find extending services to all parts of the population sufficiently profitable, and that declining use of cash will exacerbate the problem (World Bank, 2020).

The advent of virtual currencies has also seen an increase in illicit activities on digital platforms including the deep web where, due to their anonymity and decentralized nature, illicit activities such as human trafficking, illegal drugs and illegal firearms are traded peer to peer according to (FATF, 2019). The risks posed by these virtual currencies have sent a workup call to monetary authorities and most of them are now exploring the possibilities of further increasing digital financial inclusion by considering the implementation of Central Bank Digital Currencies CBDC which could help achieve or safeguard universal access to payments. These risks posed by virtual currencies and the threats to monetary sovereignty has led to almost 86% of all central banks exploring the possibilities of CBDC (BIS, 2021). At the time of writing this paper, the Bahamas and Nigeria are the only jurisdictions that had launched CBDC and some jurisdictions are still exploring if a CBDC could help achieve or safeguard universal access to payments. Access to payments may encounter multiple hurdles, including shortage of cash, firms' refusal to accept cash, and lack of or recurring disturbances of digital infrastructure. In the Bahamas, for example, the extreme weather patterns of tropical storms results into hurricane on the islands and the geography creates difficulties in both distributing cash and extending digital infrastructure. This was the main motivation for the Central Bank of Bahamas (CBOB) to launch a CBDC for all the major islands facilitating access to payment systems for everyone regardless of age, social status and location.

In Zambia, mobile financial services payment systems platforms have advanced the digital financial inclusion agenda and has provided access to many citizens in the remote area of the

country. According to reports by ZICTA, the number of mobile connections in Zambia as at January 2021 was equivalent to 89.7% of the total population (ZICTA, 2021). This has provided mobile financial services across the country both on USSD platforms and smart applications leaving no one behind. These platforms have come with some challenges such as mobile money fraud and authorities are working around the clock to mitigate such risks. These technologies and cyber security risks raise concerns for the monetary authorities in Zambia and for guaranteed monetary sovereignty and increased financial inclusion, the authorities might consider the options of introducing a CBDC. According to a press query response from the Central Bank of Zambia on 9th February 2022, the bank stated that it was currently researching on the determinants and the main motivations for considering Central Bank Digital Currencies (CBDC) in the Zambian Jurisdiction. The outcome of the research would inform the motivations and policy goals for the CBDC and all the follow-up steps (Bloomberg, 2022). The BOZ also emphasizes access to payments as a key policy goal despite near-universal financial inclusion. If cash availability falls beneath a certain level, some groups might experience difficulties in making payments. These groups include individuals in remote areas where private firms find it unprofitable to operate, with low income, and with different forms of impairments. A potential CBDC could hence be designed with universal access in mind. The literature review is summarized in the matrix as shown in table 2.1 below. The literature is categorized according to the main motivations outlined in chapter 1, section 1.4 of the study with the matrix being grouped to include the following motivations as the main determinants of central bank digital currencies (CBDC).

1. CBDC as an efficient Payments Systems Platform.
2. CBDC making a stronger national defense against AML/CFT.
3. CBDC ensuring non-discriminatory access to domestic financial services.
4. CBDC to mitigate the high Cost of Currency Processing.

Table 2.1:Literature Review Summary Matrix (Source: Authors Construct)

CBDC Efficiency as a Payments System Platform								
Author(s), Year	Title	Theoretical /Conceptual Frameworks/Specific Aims	Qualitative / Quantitative/Mix	Variables	Methodology/ Techniques of Analysis	Analysis, Results, Findings	Conclusions (+ / -)	
(Davoodalhosseini, 2018)	Central Bank Digital Currency and Monetary Policy, Journal of Economic Dynamics and Control.	The Paper outlines that a CBDC has certain potential benefits, including the possibility that it can bear interest and improve payment systems platforms.	Multi Methods	Central Bank Digital Currency (CBDC), Cash, Monetary policy, efficient payment Systems, narrow money and broad money.	In the main analysis, the author calculates the effective use of CBDC for welfare gains relative to the cash-only scheme.	More efficient payment systems may be achieved if implemented by using a CBDC than using cash, and the first best can be achieved.	Paper concludes by comparing the cost of using a CBDC relative to cash is around 0.25% of the transaction value, introducing a CBDC can lead to an increase of 0.12–0.21% consumption for the United States and 0.04–0.07% for Canada.	
(Agur, Ari, & Dell’Ariccia, 2021)	Designing Central Bank Digital Currencies, Journal of Monetary Economics.	The Paper outlines the optimal design of a central bank digital currency (CBDC) as analyzed in an environment where agents sort into cash, CBDC, and bank deposits according to their preferences over anonymity and security; and where network effects make the convenience of a payment instrument depend on the number of its users.	Multi Methods	CBDC, Fintech, Digital currency, Payment systems, Financial intermediation Network effects, internet penetration.		As emphasized by Lagarde (2018), there is a potential demand for a partially anonymous means of effective payment that can, for example, protect consumers from the use of personal transaction data for credit assessments, a possibility that is increasingly enabled by technological developments.	The paper provides the summary that the optimal CBDC design trades off bank intermediation against the social value of maintaining diverse effective payment instruments. CBDC may facilitate payments from anywhere making transactions instant, real-time and reduced settlement times.	
(Tymoigne, 2014)	Modern Money Theory and Interrelations between the Treasury and the Central Bank.	The paper shows that the previous theoretical conclusions of MMT can be illustrated by providing further evidence of the interconnectedness of the treasury and the central bank.	Multi Methods	Economic variables (impact on interest rates, exchange rates, balance sheets and national income).	The study applied econometric techniques and Methods to bypass the financial constraint, in the past the Treasury was responsible for a large quantity of the	Modern Money Theory (MMT) was used to explain resilient and agail Payment systems and why monetarily sovereign governments have a very flexible policy space that is	MMT has provided a theoretical framework to think about how monetarily sovereign governments operate and their impacts on the economy. It shows that it is relevant for theoretical purpose to aggregate the central bank and the treasury	

							money supply and it printed United States notes until the 1960s.	unconstrained by hard financial limits.	into a government sector that finances itself through monetary creation.
(Peters, Panayi, & Chapel'e, 2017)	Trends in Cryptocurrencies and Blockchain Technologies: A Monetary Theory and Regulation Perspective.	The paper shows that centralized virtual currencies, usually for the purpose of transacting in social and gaming economies, and crypto-currencies, which aim to eliminate the need for financial intermediaries by offering direct peer-to-peer online payments.	Quantitative	The study set the growth variable of k% at a rate equal to the growth of real GDP each year. Digital Infrastructure, Skills, nominal exchange rate.	Desktop Research and analysis.	Study shows how the blockchain technologies well organized and methodical payments systems platforms. Security on Blockchain, Electronic money and no need for Printing, Electronic Distribution of cash.	Paper concludes that these currencies are purely digital constructs, with no government or local authority backing, the paper discusses them in the context of monetary theory, in order to determine how they may have value. Paper also provided an overview of the state of regulatory readiness in terms of dealing with transactions in these currencies in various regions of the world.		
(Bassett, 2019)	What cryptocurrency and Modern Monetary Theory get wrong about money.	The paper focuses on the new theories about money to bring about the change they seek, but are neglecting ideas from classical economics that could assist prepare for economic disruptions ranging from the current COVID-19 pandemic to the coming AI revolution. Paper also outlines the elimination of costs associated with armoured Trucks and Security, Centralised ledger for Instant and Inclusive Payment Systems.	Qualitative	Mobile Subscriptions, Internet Penetration, Infrastructure, Digital Platforms	Desktop Research and analysis show that the theory starts with the axiom that money is a commodity, it fulfills certain specific use-values related to the function of money and is the embodiment of human labour. MMT, however, says that money is a legal creature created through government spending and killed off via taxes.	The paper concludes by bring out the systematic effects and Well structured payments plato=forms that borrow positive attributes from Cryptocurrencies.	Concludes that cryptocurrencies and MMT both have technical frameworks for economists to workout the details of their claims, back them up with statistics and economic data, and demonstrate that their ideas do or do not reflect reality. Any theory needs to undergo the same scientific process of careful study and experimentation before it should be accepted.		
(Fernández-Villaverd, Sanches, Schilling, & Uhlig, 2020)	Central Bank Digital Currency (CBDC) - Central Banking for all?	The introduction of a central bank digital currency (CBDC) allows the central bank to engage in large-scale intermediation by competing with private financial intermediaries for deposits.	Multi Methods	Digital Platforms, Mobile subscriptions, Internet penetration, Regulations, Coherent payments systems	The study uses a framework that focuses on the role of banks as maturity transformation providers. Uses the model to investigate how a CBDC, and the subsequent opening of central bank deposits to the public at large, affects financial intermediation and	The paper finds that while the lead in introducing these currencies came from private initiatives such as Bitcoin, Ehereum, and Libra, researchers and policymakers have explored the possibility that central banks can also issue their own digital currencies, aptly called a CBDC.	The paper has derived an equivalence result that shows that the set of allocations achieved with private financial intermediation will also be achieved with a CBDC, provided competition with commercial banks is allowed and if consumers do not panic. Removed the need for T+1 on Cheque settlement.		

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		banks. One possibility is central bank digital currency (CBDC) - a widely accessible digital form of fiat money that could be legal tender.			Mobile subscriptions, Internet penetration,		stability, and integrity. This note also surveys research and pilot studies on CBDC by central banks around the world.	the basic functions of money might not change, the form does evolve in response to user needs. Digitalization of activity is prompting central banks to seriously consider the introduction of CBDC.
(Mohammadreza Hosseini, 2018)	Central Bank Digital Currency and Monetary Policy.	Study discusses options of having both cash and CBDC available may result in lower welfare than in cases where only cash or only CBDC is available.	Multi Methods	Enabling Regulations, Platforms, Narrow money, Broad money	Desktop research and context analysis			Paper concludes that having both cash and CBDC available may result in lower welfare than in cases where only cash or only CBDC is available. The welfare gains of introducing CBDC are estimated as up to 0.64% for Canada.
(Bindseil, Central Bank Digital Currency (CBDC) - Financial System Implications and Control, 2019)	Central Bank Digital Currency - Financial System Implications and Control.	Paper compares the financial account implications of CBDC with the one of crypto assets, stable coins, and narrow bank digital money, noting the similarity and differences in terms of implications on the financial system.	Multi Methods	Variable spread between the remuneration of banknotes and CBDC, variable SUBST captures the possible disintermediation of the banking system, Infrastructure, Enabling Regulations, Narrow money, Broad money.	Desktop research and context analysis.			It is concluded that well-controlled CBDC seems feasible, without this implying that CBDC would not catalyze change in the financial system.
(Andolfatto, 2020)	Assessing the Impact of Central Bank Digital Currency on Private Banks.	This paper investigates how a central bank digital currency can be expected to impact a monopolistic banking sector.	Multi Methods	Infrastructure, Policies, Digital Skills, Digital Merchants, Mobile Subscription, Internet Penetration	Desktop research and context analysis	evidence suggests that a properly designed CBDC is not likely to threaten financial stability.		Introduction of a CBDC has no detrimental effect on bank lending activity and may, in some circumstances, even serve to promote it.

CBDC ensures non-discriminatory access to domestic financial services

Author(s), Year	Title	Theoretical /Conceptual Frameworks/Specific Aims	Qualitative / Quantitative/Mix	Variables	Methodology/ Techniques of Analysis	Analysis, Results, Findings	Conclusions (+ / -)
(Sheila, 2019)	Monetary Reform, Central Banks and Digital Currencies.	To ensure the provision of a safe money asset and a stable supply of credit within an inherently unstable financial system.	Qualitative	Policies, Regulations, Digital Merchants narrow money, exchange rate.	Desktop research and context analysis		It is concluded that the focus of attention should instead be on updating of regulation, not only to encompass digital currencies but also to address other innovations in

(Darrell, 2020)	Interoperable Payment Systems and the Role of Central Bank Digital Currencies	Paper reviews alternative approaches to interoperability, including central bank digital currencies (CBDCs), hybrid CBDCs, and two-ledger upgrades of bank- based payment systems.	Qualitative	Central bank issued CBDC tokens, Private-sector digital currencies, Internet penetration.	Desktop research and context analysis.	Concludes that central banks continue to show a preference for increasing the efficiency of bank-account-based payment systems over the deployment of CBDCs, but have also become more open to discussing the potential benefits of the introduction of a CBDC.	the financial sector that generate credit and liquidity, in order to meet the needs of the real economy
(Peters, Panayi, & Chapelle, 2017)	Trends in Cryptocurrencies and Blockchain Technologies: A Monetary Theory and Regulation Perspective.			regulatory readiness, mobile subscription, Blockchain Technologies, Monetary Theory		Cryptocurrency Application Areas including Value generation in: Asset-centric technologies; Application stacks; Asset registries.	Provides a Summary overview of the state of regulatory readiness in terms of dealing with transactions in these CBDC currencies in various regions of Africa and the world.
(Christian P. , 2020)	A Central Bank Digital Currency: Why? How? To What Effect?	Paper states that (CBDC) may be defined as an element of the monetary base that is traded at par against fiat currency and reserves and that only the central bank may issue or destroy.	Qualitative	Digital Infrastructure, Internet penetration Skills, Platforms	Desktop research and context analysis	Retail CBDC could also provide a way to promote the inclusion of vulnerable populations, such as disabled people, provided that access to the currency is sufficiently straightforward.	
(Lee P. , 2020)	Can Central Bank Digital Currencies Take Over The world?	Paper reviews how soon the People's Bank of China (PBoC) will launch its digital currency and how far and how fast it will push it.	Qualitative	Digital Identity (ID), mobile subscriptions, eKYC Enabling Regulations, Policies.	Desktop research and context analysis	Paper concludes that the People's Bank of China (PBoC) will in by 2022 launch its digital currency.	

CBDC mitigating the Cost of Currency Processing

Author(s), Year	Title	Theoretical /Conceptual Frameworks/Specific Aims	Qualitative / Quantitative/Mix	Variables	Methodology/ Techniques of Analysis	Analysis, Results, Findings	Conclusions (+ / -)
(Hughesa, Kietzmann, & Archer-Brown, 2019)	Beyond Bitcoin - What Blockchain and Distributed Ledger Technologies Mean For Firms.	Blockchain can be leveraged to drive innovation and increase efficiencies in new domains - including CBDC.	Multi Methods	Trust, Immutability, Transaction speed variability, internet penetration Infrastructure.	Desktop research and context analysis.		We conclude with a look at the limitations of blockchain and present several important factors for managers considering

								blockchain implementation within their organizations.
(Brunnermeiera & Niepelt, 2019)	CBDC On the Equivalence of Private and Public money.	To derive sufficient conditions for equivalence and apply them in the context of the “Chicago Plan”, cryptocurrencies, the Indian de-monetization experiment, and Central Bank Digital Currency (CBDC).	Multi Methods	Policies, Enabling Regulations, Infrastructure narrow money, broad money.	Analysis implies that the introduction of CBDC accompanied by a pass-through policy would not change macroeconomic outcomes independently of whether deposits are subject to bank runs or not.		The results imply that CBDC coupled with central bank pass-through funding need not imply a credit crunch nor undermine financial stability.	
(Ammous, 2019)	Can Cryptocurrencies Fulfil the Functions of Money	The paper analyses the monetary characteristics of five cryptocurrencies to evaluate whether they can perform the functions of money.	Qualitative	Stability, Credibility, narrow money, broad money supply growth, Policies, Laws, Digital Merchants.	Paper analyses and assesses the suitability of cryptocurrencies for these roles by understanding and analyzing their ‘monetary policy’ in contrast to that of more conventional currencies.		Other cryptocurrencies’ centralized control and use as tokens for specific applications make them unlikely to fulfil monetary functions.	
(Kosc, Sakowski , & Ślepaczuk, 2019)	Momentum and Contrarian Effects on the Cryptocurrency Market.	To investigate the momentum and contrarian effects on cryptocurrency markets.	Multi Methods	Parameters, Momentum strategy, contrarian strategy, Infrastructure Digital Skills.	The main idea behind the momentum strategy is to achieve excessive returns via investment in assets that have recently obtained the highest rates of return.	The paper reports the results of investigation of the presence and strength of momentum and contrarian effects in the set of over 1200 cryptocurrencies in the period between 2014-05-12 and 2017-10-28.	The results show a clear and significant dominance of the short-term contrarian effect over both momentum effect and the benchmark portfolios.	
(Lee J. Y., 2019)	A Decentralized Token Economy - How blockchain and cryptocurrency can revolutionize business.	Blockchain seeks to improve information security and transparency by sharing encrypted data among peer-to-peer (P2P) networks.	Qualitative	Tokenization, Internet penetration, Digital Identity, Digital Security, Digital Merchants.	Desktop research and context analysis.	The improvements in transaction transparency and reliability pursued by blockchain are of great importance in that they enable more objective and fairer consensus in terms of technology innovation and social perspectives.	Blockchain is expected to be a key technology that enables new protocols for the establishment of a token economy in the future, leading to a new economic paradigm.	

The literature reviews that CBDC should be viewed in the context of other types of fiat currency and the figure below is a representation of the taxonomy of money in the form of a Venn diagram referred to as the money flower (Bech & Garratt, 2017). The taxonomy version focuses on the combinations of four key properties which include the issuer that might be the Central Bank, some form of digital or physical assets, the accessibility which might be widely or restricted and the technology in form of the token- or account-based. Money is typically based on one of two basic technologies which are the tokens of stored value or accounts. Cash and many digital currencies are token-based, whereas balances in reserve accounts and most forms of commercial bank money are account-based. Figure 2.4 shows the money flower Venn diagram and how it can be applied.

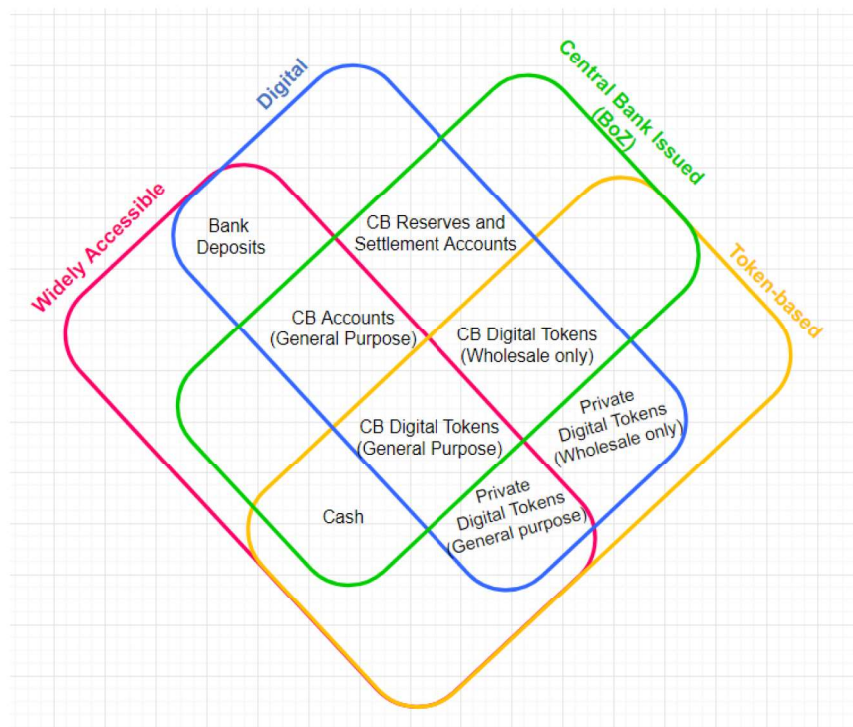


Figure 2.4: The Money Flower Venn-diagram (Source: Authors Construct).

From the diagram, here are many questions about who is supposed to issue the CBDC, how it is distributed and in what form the CBDC is held. The end-user for the CBDC can either hold an account or a token according to research by the R3 consortium. For a token-based CBDC, the digital currency is represented as a token with a specific denomination, mostly 1:1 with cash and the account based CBDC, each user of digital currency holds an account with the Central Bank or subsequently with commercial banks in a two-tier distribution model. An account-based model may ease AML and KYC compliance but can be a large overhead for Central Banks in a single tier model. The CBDC can also take the form of being token based

or an account based CBDC. In a token-based system, the token contains all information necessary for the recipient to verify the legitimacy of the transaction, and the recipient can verify the object transferred in terms of the token. The table below shows the token-based and account based-type of a CBDC. The simplest way of launching a CBDC would be to allow the public to hold deposit accounts with the Central Bank. The study by (BIS, 2020), observes that this implies that the Central Bank would be responsible for conducting know-your-customer (KYC) checks and ensuring AML/CFT compliance. This would include not only handling the initial KYC process but also authenticating customers for bank transactions, managing fraud, and dealing with false-positive and false-negative authentications. Given the limited physical presence of central banks in society and the fact that citizen authentication is currently not something Central Banks are likely prepared to do on a large scale, any account-based CBDC would require the central bank to outsource these checks. According to (Andolfatto, 2020), tokenization is the process of protecting sensitive data by replacing it with an algorithmically generated number called a token. Often times tokenization is used to prevent credit card fraud. The actual bank account number is held safe in a secure token vault. Table 2.2 below summarizes the main differences between token based and account based CBDC.

Table 2.2: Token Based vs Account Based CBDC (Source: Authors Construct)

Token-Based CBDC	Account-Based CBDC (Interest Bearing)
Verifying the validity of the object used to pay.	Verifying the identity of the payer (KYC).
Cash and many digital currencies are token-based,	Balances in reserve accounts and most forms of commercial bank money.
Held by Owners in Digital Wallets.	Citizens holding accounts at the Central Bank.
Risk of Disintermediation.	Risk of Disintermediation.
Token authenticates the sender.	Operator authenticates the sender.
Decentralized privacy, safety using DLT to avoid double spending.	Centralized with the ledger in one place.
Rely on tokenization.	Rely on trusted third-party operators.

According to a study by the World Bank global Findex of 2016, digital financial services lead to a great increase in financial inclusion (World Bank, 2016). Financial inclusion is defined as a global effort which seeks to ensure that all individuals, households and businesses, regardless of their income levels, have access and can effectively use the appropriate financial services they need to improve their lives. Virtual currencies including CBDC are a major type of digital finance which, if properly regulated and guided, would receive mass adoption, usage and also

add to financial inclusion. Financial inclusion is important in reducing poverty and achieving inclusive economic growth. The World Bank study further states that when people participate in financial systems, they are better able to plan for the future by saving and investing in good health to avoid diseases, plan for their children's future and plan for any other natural disasters.

Our final CBDC analysis involves an evaluation of the CBDC against the four main motivations including the efficiency of payments systems platforms, stronger national defense against AML/CFT, ensuring non-discriminatory access to domestic access to financial services and mitigating the high cost of processing cash in Zambia. We compare the baseline model without CBDC with an interest-bearing CBDC model under the impact of a quality of capital shock. While the previous analysis suggests that full allotment is necessary to prevent destabilizing effects, the Central Bank can also use another tool. (Bindseil, Ulrich, 2020) proposes that Central Banks can actively use the interest rate on CBDC to disincentivize its accumulation in a crisis and, thus, to counteract disintermediation. The literature also reviews different types of CBDC including the retail rCBDC, wholesale wCBDC and cross boarder mCBDC.

2.10. Retail Central Bank Digital Currency (rCBDC)

The CBDC is a novel form of money and is an addition to the category of money known as M0 which includes cash and reserves. It is not mined and is not minted by unknown parties and a CBDC is not pegged to any real-world assets such as gold or payment but as a means for payment itself. Research from (Barrdear & Kumhof, The Macroeconomics of Central Bank Digital Currencies, 2021), reviews that like other forms of money in the M0 category of money, CBDC is also legal tender and a claim on the Central Bank. Traditional economics represents central bank-issued money M0 just like cash and central bank depository accounts. The CBDC which is included in the M0 category and is meant to be used for day-to-day and peer-to-peer transactions between individuals and organizations is called the Retail Central Bank Digital Currency (rCBDC). The rCBDC is an instrument that is available to the general public for everyone to use and is used by individuals, consumers and businesses in any jurisdiction.

Literature according to (Schiller, 2021), contends that a CBDC can be built for either retail and or for wholesale payments and the retail CBDC mainly refers to a digital version of cash whilst the wholesale CBDC refers to a new infrastructure for interbank settlements. Most Central Banks that have been piloting or conducting proof of concepts have been focusing on lower-value transactions, especially on fast, low-cost payments. The study further reviews that the

retail CBDC is a broadly available for general purpose digital payment instrument, denominated in the jurisdiction's unit of account, that is a direct liability of the jurisdiction's monetary authority or Central Bank and is subject to the same rules and regulations as imposed on the jurisdiction's other units of account (Schiller, 2021). Furthermore, a retail CBDC is a widely accessible digital form of fiat money that is readily available to the public and is used as legal tender. Such CBDC would be a Central Bank liability and form part of the base money supply for any jurisdiction. The Bank for International Settlements (BIS, 2018), defines a retail CBDC as a digital payment instrument, denominated in the national unit of account and is a direct liability of the Central Bank and is a retail version of the Bank reserves. The retail CBDC is used for payments between individuals and businesses or other individuals that make use of digital banknotes for transactions.

Correspondingly, another study by (Fernández-Villaverde, Sanches, Schilling, & Uhlig, 2020) notes that CBDC should be complementary to other existing payment systems platforms in order for retail CBDC to increase the use cases of already widely used platforms such as mobile financial services such as mobile money beyond P2P towards P2B, B2B, G2P and P2G payments. Consequently, several contextual and market factors may need to be addressed as prerequisites to the implementation of rCBDC, thus making this use case less direct. The study further reviews that when introducing a retail CBDC, the issuing central bank must consider the possibility of large-scale adoption and use, and the data privacy and compliance challenges CBDC may present to the users. There must be a balance between user data privacy goals with anti-money laundering and countering the financing of terrorism (AML/CFT) requirements and the need to limit illicit activity within the CBDC ecosystem.

The study also points to the other forms of rCBDC, namely the indirect retail CBDC, the direct retail CBDC and the hybrid retail CBDC. The indirect retail CBDC is one of the common CBDC types with considerable similarities to existing retail payment processes. There is a need for an intermediary layer of financial institutions for setting up an indirect retail CBDC and such intermediaries take care of onboarding and communications with businesses and individuals, as well as sending payment messages to financial institutions. The other type is the direct retail CBDC solutions which focus on businesses and individuals holding ownership of CBDCs by leveraging Central Bank private accounts. Therefore, intermediaries are not necessary for the direct retail CBDC types. The Central Bank is responsible for the heavy lifting of onboarding and management of financial services. However, new developments in the direct retail CBDC model would encourage the involvement of intermediaries among users and

central banks. The other form is the hybrid retail CBDC which offers a blend of indirect and direct retail CBDC variants. They make use of an intermediary layer of financial institutions in hybrid retail CBDC. However, individuals and enterprises could enjoy a direct claim of a CBDC at the concerned Central Bank. One of the significant implications of this scenario is that intermediaries can maintain the separation of CBDC from the balance sheets resulting in the enterprises and individuals having more profitability for holding rCBDC.

Subsequently, research by (Auer, Raphael; Böhme, Rainer, 2021) discusses the concept of liability or legal claim to better understand the quantitative differences between CBDC, cash and commercial bank digital money. This is best illustrated using the balance sheet T-accounts. The T-accounts diagram below shows a retail CBDC, one of the major types of central bank digital currencies as outlined in the BIS, CBDC the quest for minimally invasive technology working paper.

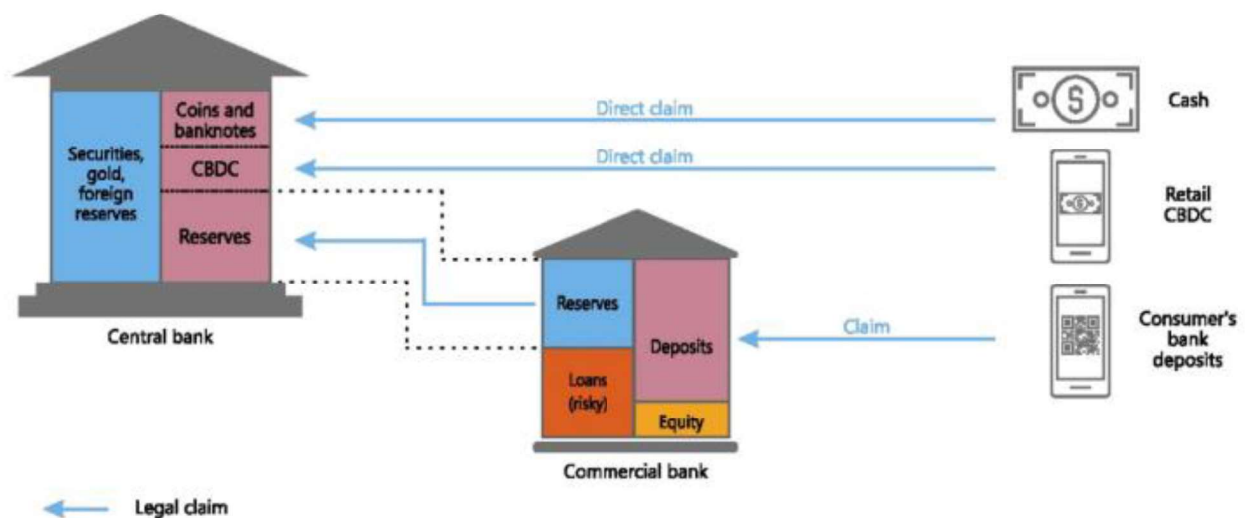


Figure 2.5: rCBDC T-Accounts (Source: (Auer, Raphael; Böhme, Rainer, 2021))

Figure 2.3 above uses T-accounts to illustrate a comparison of CBDC to cash and bank deposits. Cash is a direct and legal claim on the central bank, as indicated by the blue arrows. Like cash, a CBDC is a claim on the central bank. Deposit accounts, on the other hand, are claims on the commercial bank. Commercial banks back some of these claims by holding reserves at the Central Bank.

2.11. Wholesale Central Bank Digital Currency (wCBDC)

The wholesale CBDC is an instrument that is available to financial institutions and falls in the category of money known as M2. The wholesale CBDC (wCBDC) is limited to a set of

predefined groups, typically financial institutions (banks) and other members such as national payment systems providers that have accounts at the Central Bank or Financial Services Providers (FSP). Based on research published by (Fernández-Villaverd, Sanches, Schilling, & Uhlig, 2020), wholesale CBDC is used to facilitate interbank settlements which are payments between registered commercial banks and other entities that have accounts at the Central Bank. The daily volume of wholesale CBDC between these commercial entities is usually more than 100,000 high value transactions. The thesis further states that wholesale CBDC is limited to a set of predefined commercial user groups, which are typically registered financial institutions, and based on distributed ledger technology (DLT) which can run on either a centralized, decentralized ledger or no ledger at all.

On the other hand, wholesale CBDC types could offer improvements in risk management and efficiency of the settlement process by providing more efficient, consistent and reliable settlement times (Kumhof & Noone, 2021). Additionally, wholesale CBDC are also applicable for asset transferring and dealing with securitities and exchange. Central Banks can design and issue a CBDC for restricted access by registered financial institutions that hold reserves with the Central Banks. In contrast, a retail CBDC is widely available for use by the individual at a retail level and used for person-to-person transactions. This study also takes into consideration wholesale CBDCs which are a major area of focus, with several Central Banks around the world launching initiatives to modernize their payment systems. Examples of wholesale CBDC projects include South Africa's Project Khokhar, Singapore's Project Ubin, and Canada's Project Jasper (BIS, 2021).

2.12. Cross border Central Bank Digital Currency (mCBDC)

The third type of a CBDC is the cross border CBDC and as the name suggests, is used to transfer value across jurisdictions to facilitate trade. The current example of a joint effort in exploring CBDC is the work that is being done by the Bank for International Settlements (BIS) in exploring cross-border CBDC through the multiple CBDC (mCBDC) Bridge project (BIS, 2021). CBDCs can only be understood through experimentation, coordination and collaborative projects. These projects provide an opportunity for Central Banks to develop a global standard for Multi-CBDC arrangements that could bring up the issues of sharing personally identifiable information (PII) and digital identity across borders but will require a lot of international cooperation and collaboration between the governments that are involved. Further research by the BIS reviews that the multiple CBDC (mCBDC) Bridge is a wholesale Central Bank Digital Currency (CBDC) and a co-creation project that explores the potential of

distributed ledger technology (DLT) and examines the application of CBDC in enhancing financial infrastructure to support multi-currency cross-border payments. In addition, payments, foreign exchange transactions and other operations usually travel across the world within the networks of large global counterparty and intermediate banks, which serve as bridges between jurisdictions, a system generically known as correspondent banking. While serving a critical economic role, these networks and arrangements can be complex, sometimes fragmented, and involve operational inefficiencies. An example of the mCBDC is the current Inthanon-LionRock which is a project between the BIS innovation Hub at the Hong Kong Centre, the Hong Kong Monetary Authority, the Bank of Thailand, the Digital Currency Institute of the People's Bank of China and the Central Bank of the United Arab Emirates working together to build an mBridge prototype platform (BIS, 2022). Another such project is the project Dunbar which is exploring how a common platform for multiple central bank digital currencies could enable cheaper, faster and safer cross-border payments. Project Dunbar is comprised of Australia, Malaysia, Singapore, and the Republic of South Africa with project Khokha (BIS, 2022). Further, the BIA also reviews that Project Jura is a wCBDC platform exploring the direct transfer of euro and Swiss franc wholesale central bank digital currencies (wCBDCs) between French and Swiss commercial banks. Project Jura is hosted on a single DLT platform operated by a third party. Tokenized asset and foreign exchange trades are settled safely and efficiently using payment versus payment (PvP) and delivery versus payment (DvP) mechanisms. The experiment is conducted in a near-real setting, using real-value transactions and complying with current regulatory requirements.

2.13. The Central Bank Digital Currency Model

The literature reviewed that there are several models for CBDC including the single-tier, two-tier and the hybrid setups. The single-tier setup has no hierarchy of distribution of CBDC and it is more suitable for the direct model, where the central bank issues digital currencies to all its users, the financial institutions and citizens, after conducting the KYC and AML checks before onboarding. This study adopted the two-tier model proposed by the Bank for International Settlement in which the CBDC is issued from the Central Bank using the commercial banks as the second tier and may take the form of a retail, a wholesale and interoperable cross border multiple Central Bank Digital Currency (mCBDC). This model was ideal for this study because the study looks at the CBDC determinants that apply a two-tier CBDC model (BIS, 2021), which cements the benefits of tiered architectures for the distribution of retail CBDC through commercial banks, financial services providers and

payment service providers alike. The two-tier model is a simplified abstraction of reality which incorporates the Central Bank and all the financial institutions, banks, non-bank financial institutions (NBFIs), payment systems providers (PSPs) and all other financial services providers (FSPs). These in turn service the individuals, households and organizations that could have a CBDC account with FSPs. The model assumes that the CBDC can coexist with cash and serve as legal tender and be used as the medium of exchange, a unit of account and store of value for all agents in the Zambian financial landscape. The study adopted the framework of (Lagos & Wright, 2005) which has the same structure of a centralized market (CM) and a decentralized market (DM) and considered other theoretical investigations on the impact of CBDC in order to firm up on the two-tier model. The study also assumes that Zambia already has a competitive banking industry comprised of 18 commercial Banks (BOZ, 2021) and a growing number of NBFIs, payment systems providers (PSP) and financial technologies (Fintech) organizations that are providing various payment systems platforms in the country. The access to a CBDC does not imply that the Central Bank provides retail services to all holders of CBDC, and for simplicity, the study assumes that only banks and NBFIs can trade CBDC directly with the Central Bank, while households and firms use a new type of electronic money issuance from NBFIs, which can be assumed as a CBDC exchange that can be used to buy and sell CBDC in exchange for deposits. This is an alternative where individuals, households and firms can directly trade CBDC with the Central Bank but this is not the main responsibility of the Central Bank and the heavy lifting should be left to the commercial players for the Central Bank to concentrate on its main mandate (BIS, 2021). Figure 2.4 below shows the two-tier CBDC model and how the variables interact with each other. The main variables in this model include cash in circulation (CiC), internet penetration (IP), mobile subscription rates (MS), narrow money (M0, M1), broad money (M2, M3) and the nominal exchange rate (NER) for cross border transactions.

banks, CBDC does not necessarily disintermediate banks as the interest-bearing CBDC may incentivize individuals keeping the CBDC in commercial banks, unlike individual electronic wallets which should have limits on the amounts of CBDC they should hold to avoid the risk of disintermediation. In another model with a monopoly bank, (Andolfatto, 2020) reviews that a CBDC could lead to more financial inclusion, a higher deposit rate, and more bank deposits. (Chiu, Davoodalhosseini, Jiang, & Zhu, 2019), further show that a CBDC could limit banks' market power, increasing the deposit rate, bank deposits, and bank lending. Quantitatively, the lending and output can be increased up to 3.55% and 0.50%, respectively. In a model where independence of a Central Bank and scarcity of assets backing bank deposits are considered, (Williamson S. , 2019) derives conditions under which an interest-bearing CBDC can increase social welfare in a narrow banking arrangement. It is further argued by (Dong & Xiao, 2021), that some forms of CBDC can help implement a negative interest rate which can boost economic activity for a developing economy like Zambia by encouraging banks and other entities to lend or invest excess funds rather than pay penalties on funds in bank accounts. Literature from another paper by (Monnet & Keister, 2020) rightly argues that a CBDC can lead to less bank risk-taking and higher output and welfare and that CBDC can provide the Central Bank with more information about the state of the commercial banks, thereby increasing the effectiveness of the regulatory policy and improving financial stability.

2.14. Conceptual Literature Review

This study used the key concepts that were drawn from the two-tier model which looks at the CBDC determinants outlined in the literature review matrix and applied according to the (BIS, 2021) model. The conceptual framework cements the benefits of tiered architectures for the distribution of retail CBDC through commercial banks and payment service providers. The model takes into consideration all financial institutions, banks, non-bank financial institutions (NBFIs), individuals, households and organizations that could have a CBDC account. This conceptual framework was guided by the researcher's understanding of how the various motivations fit into the determinants of the CBDC as a payment systems platform and how the different independent and dependent variables are related. The conceptual framework depicted the diagrammatic model or representation of the relationship in form of a mind map and brought out the relationships between variables and how they are operationalized for the purpose of research. The conceptual framework also considered the linkages between the different components, the flow and the interactions among the variable. The initial mind map informed the conceptual flow starting with how the motivations of CBDC translate into the

policies management and governance the aim to address the issues to deal with consumer protection and end user management of the CBDC according to the research by (Hess, 2020). The conceptual framework takes into account all the variables that are used in the study. The money supply variable represents all the currency and other liquid instruments in a country's economy on the date measured. The money supply roughly includes both cash and deposits that can be used almost as easily as cash. A study published by the journal of economics and finance on the influencing of money supply on economic growth (Prasert , Chokethaworn, Chaiboonsri, & Khounkhalax, 2015) reviews that the various types of money in the money supply are generally classified as M0, M1, M2, and M3, according to the type and size of the account in which the instrument is kept. The study further states that not all of the classifications are widely used, and each country may use different classifications. In Zambia, the money supply reflects the different types of liquidity each type of money has in the economy. It is broken up into different categories of liquidity with M0 and M1 called narrow money and includes coins and notes that are in circulation and other money equivalents that can be converted easily to cash. M2 includes M1 and, in addition, short-term time deposits in banks and certain money market funds. M3 includes M2 in addition to long-term deposits.

The other variables in the framework include internet penetration (IP) in Zambia, the mobile subscriber (MS) base, the cash in circulation (CiC) and the exchange rate for cross boarder payments. This study also took into consideration the open protocols and technologies used to facilitate all the in-country and international payment platforms, the external payment transfers, the interoperability and gateways for cross border and international transactions and also the model of operation being centralized or decentralized. Furthermore, the framework considered the use of the underlying technologies such as the blockchain or tokenization. The security and assurance took into consideration the use of multifactor authentication for enhancing security and consumer protection and the CBDC Wallet and all the cybersecurity considerations. The security and assurance also reviewed the operations of the users' digital wallets on all the segments of CBDC ranging from retail, wholesale and the cross border Central Bank Digital Currencies. The CBDC connects to forex exchange in order to facilitate cross boarder payments with other jurisdictions in the region. The conceptual framework is summarized in Figure 2.5 below:

4. Pillar 4: Design of digital financial market infrastructure and systems that, in turn, support value-added financial services and products and deepen access, usage and stability.

This study makes the assumption and using the determinants for introducing a Central Bank Digital Currency with the prevailing conditions into the Zambian economy. As previously established, the author views digital currency as a technological innovation that allows the Central Bank to issue money that can bear either a positive or a negative nominal return and can potentially be used in a different set of situations including the distribution of government payments such as welfare allocations using helicopter money to eliminate the use of physical currency which attracts several costs such as security escorts required to distribute money. Arguably, (Ward, Orla; Rochemont, Sabrina, 2019) in the journal on understanding Central Bank Digital Currencies (CBDC) reveals that the macroeconomic effects of this type of currency will depend in large part on the type(s) of transactions in which it is used. This study focused on the following three cases: firstly where digital currency competes only with physical currency, secondly where it competes only with deposits, and thirdly where it competes with both the traditional means of payment.

2.16. Gaps in the Literature

The two-tier CBDC model on which this study is anchored references the framework of (Lagos & Wright, 2005) and this section of the study outlines the gaps in the literature. Research from other scholars (Barrdear & Kumhof, The Macroeconomics of Central Bank Digital Currencies, 2021), (Schiller, 2021) did not show any evidence of regulation, monitoring and oversight of these modern virtual currencies in developing economies. In Zambia, the monetary authorities have only issued cautionary statements on the dangers, volatility and non-recourse nature of cryptocurrencies which result in major consumer protection and cyber security risks. Further literature also shows gaps as cryptocurrencies are still operating within a regulatory vacuum as no globally harmonized approach or position has been reached as many regulators around the globe. Monetary authorities and policymakers in Zambia have not yet sufficiently addressed the phenomenon and have not yet settled on a collective approach towards regulation and oversight of cryptocurrencies. This study is among the first focusing on the CBDC factors in Zambia and aimed at contributing to the body of knowledge on the determinants and feasibility of Central Bank Digital Currencies in the jurisdiction. Furthermore, cryptocurrencies are mainly operating in unregulated environments and currently, there is no specific regulations in

the SADC region and Zambia in particular. Many financial and securities regulators including the Central Bank of Zambia (BOZ) and the Securities and Exchange Commission (SEC) are currently playing catch up and have only issued cautioning statements (BOZ, 2018); (SEC, 2018) to citizens on the risk of these cryptocurrencies instead of exploring exhaustive research and development to get the most out of these technologies. Globally, Central Banks have raised concerns about the growing use of cryptocurrencies and the spill over effects to the formal financial services industry and the eventual effects on guiding monetary policies and how to repair and mitigate the risks posed (SARB, 2014); (Borri & Shakhnov, 2019); (Kosc, Sakowski, & Ślepaczuk, 2019). Meanwhile, the technology keeps growing and the technology aware generation is actively using it and the various activities associated with this innovation can no longer remain outside of the regulatory perimeter.

The other gaps in the literature are the CBDC Trust, Security & Interoperability in emerging markets and developing economies (EMDEs) which did not show any evidence of regulation, supervision and monitoring of virtual assets (VA) and virtual assets service providers (VASP). However, the studies by (Christian P., 2020), (Griffoli, et al., 2018) suggests the need to further explore the CBDC options and further observes that there is no one size fits all design and such CBDC options will vary depending on the jurisdiction, the regulations, the digital infrastructure, digital platforms, digital identity and the state of the digital economy in that country. The other literature reviewed likens the Central Bank Digital Currencies (CBDC) with the modern money theory (MMT) (Tymoigne, 2014); (Bassett, 2019). The modern monetary theorists observe that there is need to exploit this property of money to stimulate more economic activity simply by increasing government spending without worrying about the resulting deficits. One of the main contributions of modern money theory has been to explain why monetarily sovereign governments have a very flexible policy space that is unconstrained by hard financial limits. Not only can governments issue their own currency to pay public debt denominated in their own currency, but they can also easily bypass any self-imposed constraint on budgetary operations. The underlying fundamentals for each jurisdiction are different and there is no one size fits all but different models will apply to different jurisdictions.

However, the modern money theory and interrelations with the labor theory of money do not adequately address the needs of a Central Bank Digital Currency (CBDC) and this gap can be bridged by considering the trust theory of money (TTM) according research by (Griffoli, et al., 2018) on casting the light on Central Bank Digital Currencies. Furthermore, evidence from a study on TTM shows that the theory supports CBDC to ensure non-discriminatory access to domestic financial services for all the citizens that trust these digital currency platforms as

efficient payment systems platforms and effective national defense against AML/CFT (Miedema, Minwalla, Warren, & Shah, 2020); (Ward & Rochemont, 2019). One of the earliest instances of the "trust theory of money" comes from a German economist, Georg Knapp who, at the turn of the 19th and 20th centuries suggests that trust is what gives money its value (Knapp, 1905); (Bassett, Matthew Eric, 2020). The TTM suggests that money is to be backed by an institution that is more deserving of trust and less susceptible to manipulation. This trust can be further enhanced by mathematics and cryptography to form a CBDC. This belief is similar to those held by advocates of Sound Money or "metalists" people who believe that money should only ever be backed by gold, silver, or other precious metals (Shostak, 2018). Yet it is also more ambitious and more inclusive, in that a well-designed CBDC system could allow more people to participate in the global economy than what the bank-dependent fiat current system allows.

The modern monetary theory challenges conventional beliefs about how the government interacts with the economy, the nature of money and how fiat currencies are used to collect taxes without full visibility of corresponding incomes (Shostak, 2018). The theory has some limitations with trust in the collection process which are complemented by the Trust Theory of Money (TTM). The TTM emphasizes that without this trust and cooperation, money must be inherently valueless (Bassett, Matthew Eric, 2020). This study integrates the two theories and are supplemented by the Cryptography and Security Theory (CST). According to the study by (Silvio, Peikert, Sudan, & Wilson, 2005), the cryptography in the CST theory brings in the lacking trust, efficiency, national defense mechanisms against AML/CFT, secure and accessibility for all properties of money that are not present in both the MMT and the TTM theories. The study further states that even though supplemented by the Cryptography and Security Theory (CST), there is no one size fits all in the CBDC design and will depend on the jurisdiction, regulations, digital infrastructure, digital platforms, digital identity and electronic know your customer (eKYC) infrastructure and the state of the digital economy in that jurisdiction.

2.17. Chapter Summary

The second chapter of this report is the literature review and starts with an introduction to the material that was reviewed. It further outlines the Central Bank Digital Currency (CBDC) global landscape and outlines the main model on which the study is anchored.

The chapter then tabulates the literature review summary matrix outlining the main scholarly work which were considered in the study. Further, the chapter brings forth the conceptual framework and the theoretical frameworks adopted by the study and concludes by looking at the options of considering a CBDC in the Zambian jurisdiction, as well as highlighting the research's main contributions to the knowledge gaps about the determinants of Central Bank Digital Currencies.

3.0 CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Introduction

In this chapter, the study provides a deep dive into the concepts and methods for the determinants of a CBDC, the materials and procedures that were used to conduct the research. The charter outlines the methodology as the main pulse of the study that was used to conduct this research and was followed by the methods that were applied during the collection and analysis of data.

In this research, we apply a two-tier CBDC model which depicts the central bank as one tier and the commercial bank as the second tier that interacts with organizations, families and individuals. This will bring out the determinants and the optimal motivations of a digital currency in the Zambian setting, including whether it should be widely accepted and circulated in Zambia and across the borders. The study uses an integrated qualitative and quantitative approach because the study will involve practical policy issues to be addressed and therefore a single approach may not be enough for the study. The chapter also looks at the theoretical stance in terms of the research philosophy, the approach to the research, methodological choice and the time horizons of the study.

3.2. Research Philosophy and Approach

The study adopted the research philosophy, approach and methods that intended to address and resolve the determinants of a CBDC as a payment systems platform in Zambia. The thesis also aimed to generate evidence and use it to address the practical issues of the study by adopting the pragmatism philosophy. The pragmatism philosophy facilitated the researcher's quest for solutions in the utilization of CBDC as a payment systems platform in P2P, P2B, P2G, B2B and G2P transactions and in the everyday life of a Zambian citizen. The philosophy further addressed challenges and resolved real world problems concerning the risks of virtual currencies to global economies and the CBDC determinants which take on most of the advantages of virtual currencies, mitigate their risks and add value to the payment systems platforms in Zambia. The study adopted a deductive research approach and tested the two-tier CBDC theory and how it can be applied to the Zambian jurisdiction. Further, the pragmatism philosophy facilitated the logic for solutions and addressed the overarching research questions adopted in the study including the 'how questions', which are the post-positivist approach rooted in pragmatism. Pragmatism also enhanced CBDC understanding and solved the

practical problem of determining what could work, what could not work and the effects of these determinants on the Central Bank Digital Currency.

3.3.Data Types and Data Sources

The research tested the two-tier CBDC model using the data in time series using data sets that were collected from databases obtained from the Bank of Zambia (BoZ), World Bank FinScope data and international monetary fund (IMF), international telecommunications union (ITU) and Zambia Information and Communications Technology Agency (ZICTA) in order to get the optimal determinants of a CBDC in Zambia. Table 3.1 below shows the variables, data types, descriptions and sources of the data used in the study.

Table 3.1: Variables, Data Types and Descriptions (Authors Construct)

Variable Name and Abbreviation	Variable Description	Source	Frequency of Data
Payment Initiation (PP_t)	Initiation process of a Payment	International Monetary Fund (IMF)	Monthly
Payment Clearance (CP_t)	Clearance process of a Payment	International Monetary Fund (IMF)	Monthly
Payment Settlement (SP_t)	Settlement process of a Payment	International Monetary Fund (IMF)	Monthly
$CBDC_{DET}$	Cumulative CBDC Determinants ($CBDC_DET$)	Principle Component Analysis (EViews)	Monthly
Financial Inclusion (P_F)	Financial inclusion rate	Alliance for Financial Inclusion (AFI), Monthly proxy data	Monthly
Payment Systems Efficiency (P_P)	Cumulative Payment Systems Efficiency (PSE) ($\sum_{eff} P$)	Principle Component Analysis (EViews)	Monthly
AML/CFT (P_A)	AML/CFT effects (Y^{CBDC})	Alliance for Financial Inclusion (AFI), Financial Intelligence Center (FIC)	Monthly
Internet Penetration (IP)	Penetration of Internet in Zambia	Zambia Information and Communications Technology Authority (ZICTA)	Monthly
Cash_CiC (P_C)	Cash in circulation in the Zambian economy	Bank of Zambia (BoZ)	Monthly
Mobile Subscriptions (MS)	Mobile services subscriptions in Zambia	ZICTA, International Telecommunications Union (ITU)	Monthly
Narrow Money (M0, M1)	Money supply, measured by central banks as narrow money	BoZ, IMF, World Bank	Monthly
Broad Money (M2, M3)	Money supply, measured by central banks as broad money	BoZ, IMF, World Bank	Monthly
Nominal Exchange Rate (NER)	Exchange Rate (NER)	BoZ, IMF for Cross border CBDC (mCBDC)	Monthly

3.4. Operationalization of Variables

The study defined CBDC as a digital representation of a sovereign currency issued by and as a liability of a jurisdiction's central bank or other monetary authority, in this study the monetary authority is the Bank of Zambia. However, the taxonomy of digital representations of money is still evolving, and at the time of writing this paper, there was no universally accepted CBDC definitions. Further, in this study, payment systems efficiency (P_p) is operationalized as a collection of processes that complete an end-to-end payment system cycle from payment initiation to settlement finality. It highlights a payment system process from the start of the transaction from payment initiation (P_{pt}), payment clearance (C_{pt}) to the final settlement (S_{pt}) and transfer of value from the payer to the payee.

Several scholars contend that payment systems efficiency will offer security and privacy provided by technologies such as blockchain and distributed ledger technologies that will reduce transaction costs, enhance transparency, immutability and improve traceability of payment systems platforms (BIS, 2017), (Kiff, et al., 2020). The literature also reviews that payment metrics help measure various aspects of the payment systems processes by measuring the performance of payment systems gateways and this can be applied to measuring the efficiency of CBDC. For a developing economy to attain an efficient payment system platform, there is need for specific business policies which need improvement by monitoring and measuring different aspects of payment systems. Further literature according to (Tanai, 2017) postulates that payment system efficiency will vary from one payment system platform to another depending on the number of authorization steps that are involved into the process. The efficiency of the Central Bank Digital Currency (CBDC) as a payment system platform will be affected by the following factors:

1. End-to-end payments system completion time and conversion rates
2. Conversion rates by the payment service providers (PSP) involved in the transaction chain
3. Conversion rates of any interoperable DFS or mobile transactions in the payments chain depend on the level of internet penetration (IP)
4. End-to-end cross boarder payments and how they are affected by the nominal exchange rates (NER)
5. Uncompleted transactions due to reported fraud cases
6. Downtime or infrastructure outage experience during any DFS or mobile financial services transaction depending on the mobile penetration (MP) in a jurisdiction

Conversely, it is further argued, according to (Andolfatto, 2020) that the stronger defence against AML\CFT of the Central Bank Digital Currency ((P_A)) as a payment system platform will be affected by the following factors including proceeds from illicit activities, arms and drug dealing and sometimes politically exposed persons (PEP) unsanctioned transactions, large or unusual transactions, outward remittance, avoiding reporting obligations and the sudden high value transactions. Further, the literature also reviews that the non-discriminatory access to domestic financial services of the CBDC as a payment system platform is affected by the factors such as mobile money penetration rates (IP), number of mobile subscribers (MS), cash in circulation (CiC), electronic cash in circulation ($^{CBDC}_{eCiC}$), narrow money (M0,M1) and broad money (M2,M3) and these variables are available as secondary data. Access is also affected by the barriers to DFS, unavailable access to financial services, restrictive and poor quality of products and services, the number of automated teller machines per number of adults in an area, the number of financial institutions branches per number of adults, the number of mobile booths agents in an area and the accumulative number of Bank accounts and active accounts in a jurisdiction.

The cost of processing fiat currency (Cash_CiC) also has an effect on CBDC as a payment system platform and is operationalized as the total cost of processing fiat currency. (McGough, 2017) reviews that cash is costly to an economy although it is free for users. The same approach may be adopted for CBDC where associated costs are absorbed by the central bank. The many costs associated with the processing of cash in circulation (CiC) include the cost of printing the notes and coins, cost of currency distribution, the purchase cost of armoured bulletproof cash delivery vehicles, cost of currency management using pieces of machinery such as the BPS M7 high-speed banknote processing machines, DLR7000 high-speed banknote processing machines, BPS C4-C5 desktop banknote processing machines and the cost of currency electronic management, surveillance and security systems.

Economic Environment, Agents and Participants

The study assumed that the agents that populate the Zambian economy include the financial institutions, banks, non-bank financial institutions (NBFIs), individuals, households and organizations that are involved in the use of fiat currency. With the growing use of digital currencies, these agents have options of making payments using cash, mobile financial services, electronic funds transfers (EFT) and using Central Bank Digital Currencies (CBDC).

This study focuses on the determinants of using CBDC as a payment systems platform which includes efficiency of payments, defense against AML/CFT, nondiscriminatory financial services and the high of processing currency.

The study used the circulation and distribution of the currency comprised of mainly the Central Bank which will host the main distributed ledger technology (DLT) main database on the first tier and the commercial banks cascade into the second tier. The two-tiered monetary system will be operationalized where the Central Bank supplies cash and deposits in form of M2, M3 broad money to commercial banks which further provide deposits in form of M0, M1 narrow money through credit creation based on the central bank money they hold in their central bank accounts. The model for CBDC would empower public-private partnerships and enable the digital currency to be designed and dispensed by central banks but distributed by commercial Banks and other approved payment services providers (PSP) that hold accounts with the central bank. The CBDC from the commercial banks and payment systems providers are issued through their customers into circulation to the public for day-to-day transactions. For the final settlement between the payer and the payee all the processes of settlement and clearing in the payment system chain must be fully completed. The settlement agent can either be the central bank for high value and other government payments and the electronic clearing house for other lower value and person-to-person transactions. According to the literature by (Wincor, 2018), the settlement process can be defined as the process of transferring of funds through a central agency, from payer to payee, through the participation of their respective banks, PSP or custodians of funds.

The two-tier model depicts the central bank as the main issuer and commercial banks distributing and acting as the main source of the CBDC into circulation. The payment process ecosystem involves the individual citizens, households and organizations that interact with payment system providers issued CBDC represented by the financial services providers (FSP). The payment systems providers also interact with the Banks and Non-Bank Financial Institutions (NBFI) and the central authority as the main issuer of the CBDC which is the Central Bank. The amount of CBDC in circulation from PSP, Banks and NBFI are directly matched with that issued by the central bank with the ratio of 1:1 with the fiat currency. This study also adopted the baseline model based on (Gertlera & Karadiab, 2016) and we adapt their model which is also referred to as the GK model to make the introduction of a CBDC in a jurisdiction possible. The model specifies that payment system efficiency depends on settlement finality which involves an end-to-end cycle from the initiation of the payment, clearance and settlement. it aims to create a framework that allows for changes in the level of

deposits based on the financial conditions and the individual, household or organization's spending patterns and preferences. Before the introduction of a CBDC in an economy (Gertler & Karadiab, 2016) outlines the implications of the implemented changes at the individual and household levels. We make the following assumptions, that CBDC will be interoperable with other already existing payment systems platforms and that individuals, households and organizations actively choose between different forms of payment methods ranging from card or mobile payments using mobile financial services using mobile wallets, accounting for different remuneration, liquidity, and risk. Secondly, banks do not merely intermediate funds from individuals, households and organizations to the production sector. Instead, they can additionally refinance themselves through the central bank using CBDC. The third assumption is when the central bank fully allocates demanded funds to the commercial banks as long as their participation constraint holds. The fourth option is refinancing through central bank money which is more expensive than refinancing through deposits (Bindseil, Ulrich, 2020). All these assumptions imply that an increase in central bank funds will also offset a decline in individuals, households and organizations' deposits in the case of full allotment. Therefore, changes in deposits have only a minimal impact on total intermediated funds, capital, and production and hence CBDC are impacted differently by their main motivations.

3.5. Theoretical Model Outline

In our two-tier model, economic agents are classified as individuals, households, organizations and government and these entities are assumed to choose to transact using fiat money in form of cash, or electronic CBDC issued by the central bank to meet their payment needs. We consider the study by the IMF (Kumhof & Noone, 2021) under the assumption of the main determinants of a CBDC includes the cumulative payment systems efficiency (PSE) the national defense against AML/CFT (A), domestic access to financial services in terms of financial inclusion (Fi) and the cost of processing cash. These variables cumulatively form the main determinants of the Central Bank Digital Currency (CBDC_DET) as proposed in equation 1 below showing how the main CBDC variables interact. We denote the main determinants CBDC (B) being Cash (C), Deposits (D), Financial Inclusion (F), AML/CFT (A) and Payment systems Efficiency (PSE) as the features for payments assets (P) as outlined by (Wenlong , Yang, & Peng, 2021). We further obtain analytical solutions, we employ the Constant Elasticity of Substitution (CES) utility function to aggregate all the determinants. The payments assets for (P) for all the main determinants are denoted by $(P_C, P_B, P_D, P_F, P_A, P_P)$, where P_C = Cash (C),

P_B = CBDC (B), P_D = Deposits (D), P_F = Financial Inclusion (F), P_A = AML/CFT (A) and P_P = Payment systems Efficiency (P).

Equation 1: CBDC Main Variables

From the Payments assets (P)

$P = P$ (Cash, CBDC, Deposits, Financial Inclusion, AML/CFT, Payment Systems Efficiency).....1

$P = P (P_C, P_B, P_D, P_F, P_A, P_P)$

Following equation (1) and in line with the study's theoretical model which is based on the two-tier model specification where the Central Bank interfaces with the commercial banks and the payment systems providers (PSP) to process the currency cycle in an economy (BIS, 2021). This study also reviews that the main variables of CBDC are dependent on internet penetration (IP), mobile subscriber base (MS) as the main platforms for electronic transactions, narrow money (M0, M1), broad Money (M2, M3) and the nominal exchange rate (NER) for CBDC cross border transactions. Further, a study on the evaluation of settlement delay to achieve payment systems efficiency (Tanai, 2017), concludes that settlement finality involves an end-to-end cycle from the initiation of the payment (P^{Pt}), clearance (C^{Pt}) and settlement (S^{Pt}), payment system platform downtime and all the other stages in the process forming the overall payment system efficiency (PSE). The study further reviews that the cumulative payment systems efficiency in equation 1 is made up of initiation of the payment (P^{Pt}), clearance (C^{Pt}) and the settlement (S^{Pt}) as depicted in equation 2 below.

Equation 2: Payment Systems Efficiency (PSE)

$PSE = (\text{Payment initialization} + \text{Payment Clearance} + \text{Payment Settlement})$2

$P_P = (\text{Payment initialization} + \text{Payment Clearance} + \text{Payment Settlement})$

Following a study by (Wenlong , Yang, & Peng, 2021), the above initiation, clearance and settlement payment systems variables (P^{Pt} , C^{Pt} , S^{Pt}) form the accumulative payment systems efficiency and (ε_t) is the error term as outlined as shown in equation 3. The error disturbance term series(ε_t) represents any unobserved factors and is used as a proxy for any other approval process in the payment system cycle that are not observed. We assume (ε_t) is normally distributed with the mean oscillating around 0 and the standard deviation around 1

making the error term to be stationary, with white noise and insignificant, therefore not adopted in the final optimized model in equation (9).

Equation 3: Payment Efficiency with Error Disturbance

$$P_p = Pp_t + Cp_t + Sp_t + \varepsilon_t \dots \dots \dots 3$$

The next step assumes that theory can also be used to explore the possible design options of CBDC determining if the CBDC can be direct, possibly without an intermediary, a variant of a direct CBDC, always intermediated, synthetic or a hybrid where intermediaries use their own separate distributed ledgers, which are kept in sync (Keister, Todd; Sanches, Daniel, 2019). This tiered distribution means that the Central Bank issues digital currency in form of narrow money and broad money to intermediaries such as commercial banks and any other authorized payment systems providers (PSPs) that hold accounts with the Central Bank. Those intermediaries then distribute the Central Bank Digital Currency to the consumers including the individuals, households, organizations, and businesses for day-to-day currency use in the economy as shown in Figure 3.1 below.

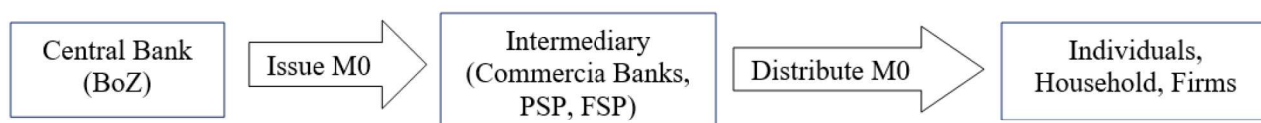


Figure 3.1: Distribution of Currency (Source: Authors Construct)

The study further adopted the research on the development of Digital Currencies (Tan & Xue, 2021) in which the mathematical equations were used to provide for the empirics that were used to solve for the most optimal model that was used to examine the determinants of the Central Bank Digital Currency as a payment systems platform.

Payment Systems Efficiency (P_p).

There have been many different policy approaches to payment systems efficiency in developing economies including the proposed adoption of instant, inclusive or fast payments that use near real-time straight through processing and settlement for finality. In this study, we consider some common analytical frameworks that affect payment systems efficiencies such as settlement delay-liquidity usage or too many approval processes in the payment systems chain. We do this to examine the use of a Central Bank Digital Currency as a payment instrument and the implications for payment systems efficiency, to compare pricing policies of payment services, and to focus on pricing methods, payment transactions, fees, costs and

revenue, and measures to enhance the efficiency of these payment systems. A study on the evaluation of settlement delay to achieve payment systems efficiency (Tanai, 2017), concludes that settlement finality involves an end-to-end cycle from the initiation of the payment (P_t), clearance (C_t) and settlement (S_t), payment system platform downtime and all the other stages in the process forming the overall payment system efficiency denoted by (P_P).

Further, we reference the discussion paper by the Bank of Finland on the Payment systems efficiency, policy approaches, and the role of the central bank (Tanai, 2017), which reviews the relationship between central banks and commercial banks and how they coordinate to facilitate payment systems efficiency up to the point of the final settlement and finality. The relationship between payment system providers, individuals and households rests on the theoretical underpinnings of the Keynesian model where the prices are somewhat rigid, fluctuations in any component of spending consumption, investment, or government expenditures cause output to change in payment systems (Davoodalhosseini, 2018). In this study, the accumulative payment systems efficiency is determined by the payment system providers, directly interact with the main issuers of CBDC from the Central Bank and the efficiency of the payment system platform which also depend on the amount of cash in circulation (CiC) the internet penetration rates (IP) and the coverage of the mobile subscriber (MS) base. This is introduced into circulation and the individuals, households and organizations use it to exchange value, purchase goods and services. The time taken for the transactions to reach finality is the period of time from transaction initiation, clearing and settlement over a period of time and the total efficiency (P_P) is the cumulative end to end payment process as outlined in equation (4).

This process includes the end-to-end straight through process including any authorizations and approvals. The optimal accumulative time taken from the Payment initiation, the Clearing process and the net settlement is the efficiency of the payment system platform as depicted in equation (4) below.

Equation 4: CBDC Payment Systems Efficiency

$$P_P = ((P_t) * (C_t) * (S_t)) \dots \dots \dots (4)$$

The P_t , denotes the payment initiation process time and the clearing process C_t and the final net settlement S_t , over time and measures the total payment efficiency of a CBDC (P_P) as shown in equation (4).

National Defense against AML/CFT

For a Central Bank Digital Currency to meet payment systems requirements and interoperate with other already existing payment systems platforms, it has to effectively address all the anti-money laundering and combating financial terrorism related to CBDC (AML/CFT) rules and regulations in any jurisdiction globally. Several other research (Barrdear, John; Kumhof, Michael, 2021), (Ramos , Garratt, & Arauz, 2021) shows an array of views towards AML-CFT. The studies also show that the increasing AML/CFT mitigation that is applied on platform directly results into reduction and lowering enforcement of the fines represented by (f) on payment system platforms assuming that AML/CFT can be below or above the value 0. This, therefore, implies that the more AML/CFT risk mitigants (β) applied on a platform results into lower enforcement of AML/CFT fines as depicted by equation 5.1 where we let (β) represent the AML/CFT risk mitigants and (f) represents the enforcement of fines . As (β) increases, there is a reduction in the AML/CFT fines and when (β) reduces, the AML/CFT fines increase to more than 0 as shown in equation (5.1) below.

Equation 5: AML/CFT Risk and Mitigation Relationship

$$\text{AML / CFT } (P_A) = \begin{cases} +\beta, & \text{if } f < 0 \\ -\beta, & \text{if } f \geq 0 \end{cases} \dots \dots \dots (5.1)$$

The study considers AML/CFT risk mitigants (β) on Narrow money (M_0, M_1), (FATF, 2014)
 $\text{AML/CFT Risks} = \beta (M_0 * M_1) \dots \dots \dots (5.2)$

The study also considers AML/CFT enforcement of the fines on Broad money (M_2, M_3), (FATF, 2014).

$$\text{AML/CFT enforcement} = f(M_2 * M_3) \dots \dots \dots (5.3)$$

$$P_A = ((\beta (M_0 * M_1) + (f(M_2 * M_3))) \dots \dots \dots (5.4)$$

Following (Ramos , Garratt, & Arauz, 2021), equation 5.2 shows the AML/CFT Risks when the mitigants are applied to narrow money (M_0, M_1) and equation 5.3 demonstrates how AML/CFT enforcement are applied to broad money (M_2, M_3). Equation (5.4) shows the cumulative mitigants for the national defense of AML/CFT provided by a CBDC platform on both narrow and broad money. The literature further reviews that a CBDC as a payment system platform must be designed with deliberate AML/CFT features in order to build trust in the payment system and also allow for anonymity through a tiered approach to CBDC thresholds. All lower value CBDC transactions remain anonymous and require basic identity such as only a phone number to transact. (Andolfatto, 2020), explains that effective AML/CFT needs strict

enforcement fines (f) and the need to mitigate high-risk on CBDC payment systems platforms. Further, (Andolfatto, 2020) suggests that the AML/CFT monitors of all the risks associated with any CBDC transactions in equation (5.2). For a retail CBDC allowing P2P transactions have tiered limits on transaction amounts not exceeding a set threshold to mitigate any AML/CFT risks. If these set limits are exceeded, the transaction will not be processed and a positive (+ve) AML/CFT flag will be raised. Higher thresholds are proposed to be set for B2B, B2G and G2B transactions on the CBDC platform. The AML/CFT tiered thresholds are set depending on the transacting parties and the transacting limits are set for the transaction type. Equation (5.4) shows the cumulative mitigants for the national defense of AML/CFT provided by a CBDC platform on both narrow and broad money.

This study adopted AML/CFT principles from (Morales-Resendiz, Raúl ; Ponce, Jorge; Picardo, Pablo; Chen, Bobby; Velasco, Andrés ; Guiborg, Gabriela; Sanz, León, 2021) research from the Latin American Journal of Central Banking, that presents alternatives to developing countries like Zambia that do not currently have Central Bank Digital Currencies and how to mitigate the AML/CFT concerns in the CBDC design. The research also applies to the current situation in the Zambian jurisdiction and depicts the unintended consequence of AML/CFT regulations in form of de-risking, which is defined as banks avoiding risk by exiting relationships with customers. This paper further seeks to provide an economic analysis of the drivers of de-risking and the broader consequences for the goal of financial integrity through stronger national defense of AML/CFT for any CBDC considerations and how the coins, notes and most liquid narrow money (M0), (M1) and broad money (M2), (M3) is supplied and circulated in an economy. To examine the drivers of de-risking, this paper adopted a simple theory analysis to illustrate the choice sets for the monetary authority and financial institutions and in turn, the bank's expected value for servicing a money transfer customer (McGough, 2017). This identifies two factors that drive down the commercial bank's expected value of doing business including the high cost of AML/CFT enforcement fines, (f) over time, and the high probability of an enforcement action being brought in a high AML/CFT risks. Further, (McGough, 2017) denotes AML/CFT risk mitigants as (β) in the ecosystem and the two-tier model provides protection and the benchmark allocation and distribution of physical cash to all the registered commercial banks from the central bank. The study reviews that the total cumulative effects of AML/CFT on CBDC is denoted by (P_A) which is the total cost of enforcement fines depending on the amount of mitigation as shown in equation 5.3. The study also reviews that central banks are usually not inclined to guarantee full anonymity

due to anti-money-laundering (AML/CFT) concerns and for simplicity in this study, we assume the non-anonymity for CBDC.

Domestic Access to Financial Services

There are many theories which outline the greater financial inclusion (*Fi*) which is crucial for a wider, inclusive and sustainable growth in any payment systems industry. This study adopted financial inclusion as one of the main motivations for a Central Bank Digital Currency and therefore, a measure of (*Fi*) is necessary to effectively monitor the progress of the policy initiatives undertaken to promote access to digital financial services. In this study, we adopted a multidimensional composite financial inclusion index (Fi-index) which was AFI proxy data from the Finscope data (FinScope, 2019). This has been constructed and is based on the indicators which quantify the extent of financial inclusion and is responsive to availability, ease of access to financial services, usage, unequal distribution and deficiency in services, financial literacy, and consumer protection according to (Andolfatto, 2020). The study focused on the annual Fi-index in terms of ‘access’, ‘usage’, and ‘quality’ of financial services. In this study, the selected indicators are normalized with respect to the case when a CBDC as a payment system platform does not support financial inclusion.

The study also adopted the financial inclusion theory (AFI, 2017) proposed by the alliance for financial inclusion which reviews that the public good of financial inclusion argues based on (i) delivery of formal financial services applies to an entire population (ii) ensuring that there is unrestricted access to finance for everyone in a jurisdiction and be treated as a public good for the benefit of all members of the population. Mobile financial services and increasing mobile subscription services (MS) have also contributed to the increase in financial inclusion. We further borrow from the (AFI, 2017) theory and further assume that all the indicators (Y_i) are normalized by (N_i), to make them unit free and to bring them on the same scale, by dividing them by the respective desired inclusion goals. Desired goals (t_i) of all indicators and weighting distributions (w_i) of indicators, the dimensions, and sub-indices. Financial inclusion for all dimensions can be enhanced by improving mobile subscription (MS) rates and is measured by averaging the normalized Euclidean distance of weighted normalized indicators ($w_1N_1, w_2N_2, \dots, w_kN_k$) from their worst points $(0, 0, \dots, 0)$ and inverse of the distance from their best points $(w_1, w_2, \dots, w_n)$ which is the distance between two points in n -dimensional space. The Fi sub-indices are calculated based on respective dimensions and Fi-index is calculated based on three sub-indices following the same methodology as used to calculate the dimensions as guided by Alliance for Financial Inclusion (AFI).

We let Y_i , where $i = 1, 2, \dots, k$, is i^{th} indicator, and w_i is associated weight to the i^{th} indicator and is the desired goal or target set for the i^{th} indicator. We now let N_i be the normalized value of i^{th} indicators corresponding to the increase in mobile subscription services (MS) as below.

Equation 6: Normalized Value for Mobile Subscription Services (MS)

$$N_i = \text{Normalized value (MS)} = \frac{Y_i - \text{State when no financial services are available}}{\text{Desired goal (ti)}} \dots \dots \dots (6)$$

$$N_i = \frac{Y_i - 0}{t_i} = \frac{Y_i}{t_i}$$

$$\text{Let } d_i = w_i * N_i; \quad {}^2_i d = d_i * d_i$$

We formulate the equations for D^2 and W^2 as below

$$\text{Let } D^2 = {}^2_1 d + {}^2_2 d + \dots + {}^2_k d = \sum_{i=1}^k t_i {}^2_i d$$

$$\text{Let } W^2 = {}^2_1 W + {}^2_2 W + \dots + {}^2_k W = \sum_{i=1}^k t_i {}^2_i W$$

$$\text{and } (W - D)^2 = \sum_{i=1}^k t_i (w_i - d_i)^2$$

we introduce additional parameters and let $MS_1 = \frac{\sqrt{D^2}}{\sqrt{W^2}}$ and $MS_2 = 1 - \frac{\sqrt{(W-D)^2}}{\sqrt{W^2}}$

Equation 7: CBDC Fi index of Dimension

$$\text{CBDC } fi \text{ index dimension } (P_F) = \frac{MS_1 + MS_2}{t} \dots \dots \dots (7)$$

Cost of Currency Processing

As guided by (Keister, Todd; Sanches, Daniel, 2019), when a digital currency is introduced into this environment, a key issue is the type of setting in which it can be used. Some costs are associated with the fiat currency cycle from the printing of the notes and minting the coins, distribution of the cash, security around the currency distribution in bulletproof armoured vehicles and specialized security cash in transit escort services. The accumulative cost of processing fiat currency in circulation (CiC) also includes the actual cost of printing the currency, currency management and the cost of cash processing machines such as the BPS M7, DLR7000 high-speed banknote processing machine, BPS, C5 and C4 desktop processing machines, glory FS-300 and FS-120 machines, Kisan smart K3 machines and Nota packs. The process also includes the costs associated to currency recycling that makes use of currency shredding machines such as online bracketing (OBS) machines that perform the mutilated and

soiled notes management and reissuing back for public circulation. The cumulative cost of cash processing is therefore associated with the simple model (Ramos , Garratt, & Arauz, 2021) that assumes that we let the total cash in circulation (CiC) include all the costs of processing fiat currency. However, with the introduction of a CBDC in a phased approach, the total cost of processing fiat currency is inversely reduced as shown in equation 8.2. The cumulative cost of processing fiat currency as stated above now translates to:

Cost = C₁, C₂ , C₃.....n, is nth indicator of all the costs associated with cash processing as shown below:

C₁ = Cost of Printing Currency

C₂ = Cost of Currency Management

C₃ = Cost of Currency Recycling_

C₄ = Cost of Currency Distribution

C₅ = Cost of Human capital for cash processing

C₆ = Cost of Currency Electronic Management and Security

C₇ = Cost of Currency Shredding machines

C₈ = Cost of Online Bracketing System Process (OBS)

C₉ = Cost of Soiled notes Management and reissuing

C₁₀ = Cost of Currency Processing

.

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.

C_n = Other cost of cash processing

Equation 8: Cost of Cash Processing as the CBDC is introduced

We further assume that the CBDC is introduced in a phased approach and operates together with fiat cash. The cost of processing cash remains but will reduce due to the reduction in cash in circulation volumes going through the processing cycle in equation 8.1 below.

$$\text{Cost_CiC} = C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + \dots + C_n \dots \dots \dots (8.1)$$

$$\text{CBDC} = K \left(\frac{1}{\text{Cash_CiC}} \right) \dots \dots \dots (8.2)$$

$$\text{CBDC} = \left(\frac{1}{\text{Cash_CiC}} \right) \dots \dots \dots (8.3)$$

The K in equation 8.2 is the constant of proportionality and determines how the increase in the supply of CBDC affects fiat currency (Cash_CiC). We assume (K) in equation 8.2 is normally

distributed with the mean oscillating around 0 and the standard deviation around 1, making the error term to be stationary, with white noise and insignificant in the optimized final model. The outlined cash processing operations and machines need to be purchased, contracted, serviced and maintained for efficient currency processing operations. This is a high cost to Central Banks and estimates from a study by (Ramos , Garratt, & Arauz, 2021) shows the cost being an average of 0.3% of a country's GDP. These costs add up and contribute to the high cost that are associated with processing cash. Research from the Reserve Bank of South Africa (SARB, 2021) also confirms the estimates that the cost of handling currency makes up about 0.3% of the total GDP in the country and these costs can be mitigated by issuing a Central Bank Digital Currency and eliminate the high costs of processing currency. Another study by the European Payments Council (EPC) on the social and private costs of retail payment instruments are approximately 0.4% of GDP indicating that due to the high usage of cash, the social cost of cash represents nearly half of the total social costs of all retail payment instruments in Europe (EPC, 2019). The study as guided by (Wenlong , Yang, & Peng, 2021), aggregates all the CBDC determinants combine in an equation including how the cash in circulation (CiC) inversely affects the cost of currency, internet penetration (IP) affects the efficiency of payment system efficiency on platforms (P_P), how the growth in the mobile subscriber (MS) base affects financial inclusion ($\frac{MS_1 + MS_2}{t}$). The equation also outlines how broad money (M0, M1) and narrow (M2, M3) affects the nominal exchange rate (NER) affect the national defines against AML/CFT. Finally, we solve for the most optimal determinants of Central Bank Digital Currency in the optimized aggregate equation using the Mathematica application which gives the equation (9) below.

Optimization of the Model

To obtain an analytical solution, we employed the Constant Elasticity of Substitution (CES) utility function to aggregate all the determinants. The payments assets (P) for all the main determinants are denoted by ($P_C, P_B, P_D, P_F, P_A, P_P$), where P_C = Cash (C), P_B = CBDC (B), P_D = Deposits (D), P_F = Financial Inclusion (F), P_A = AML/CFT (A) and P_P = Payment Systems Efficiency (P). The research further focused on the payment assets that provide liquidity for day to day transactions and used the classic cash in advance (CIA) and money in utility (MIU) models (Wenlong , Yang, & Peng, 2021), which review that the payment asset refers to physical fiat currency in form of cash as the main payment instrument. With the advancements in digital financial services (DFS) and development of payment systems, the primary payment instruments have advanced into electronic deposits, EFT, credit lines and

now the prospects of CBDC that are provided by commercial banks and other payment systems providers. The gradual decline in the use of cash and the emergence of other virtual platforms have prompted central banks to explore the possibility of the issuance of CBDC as a supplement to physical cash. As a consequence of this, we assume that individuals, families and organizations may choose among cash, deposits, mobile or CBDC to construct their payment portfolio for day to day use. Therefore, these economic agents construct a portfolio with the following payment assets namely: Cash, Deposits, or CBDC which have to be efficient, mitigate AML/CFT and allow for financial inclusion in order to satisfy the payments systems efficiency (PSE), payment needs (P) and to maximize the utility (U) as shown below:

$$\max_{\{Cash, CBDC, Deposit, PSE, AML/CFT, fi\}} U = U(Cash, CBDC, Deposit, AML/CFT, Fi, PSE) \dots \dots (i)$$

s.t (constraints)

Substituting the utility variables gives:

$$\max_{\{Cash, CBDC, Deposit, PSE, AML/CFT, fi\}} U = U(P_C, P_B, P_D, P_F, P_A, P_P)$$

s.t (constraints)

Subject to constraints the payments need (P):

$$Cash + CBDC + Deposit = P \dots \dots \dots (ii)$$

Based on the maximization equation (i) and (ii) above, we further look at the possible form of the utility function by specifying utility contributing factors and what affects these economic agents. Further research by (Andolfatto, 2020); (Auer, Raphael; Cornelli, Giulio; Frost, Jon, 2020) reviews that these economic agents prefer payment system platforms that exhibit efficiency (P_P), provide for a national defense against AML/CFT (P_A), non discriminatory access to digital financial services to allow for financial inclusion (P_F) and overall cost of processing currency (Cash_CiC). We employ the CES Cash Utility Function and specify the utility function as below.

$$U(Cash, CBDC, deposit, PSE, AML/CFT, fi) \dots \dots \dots (iv)$$

Substituting the utility variables gives:

$$U(P_C, P_B, P_D, P_F, P_A, P_P)$$

The next steps of the study is to categorize Cash, CBDC and Deposits and how the economic agents use them. To start with, both cash and CBDC are assumed to be issued by the central Bank of Zambia and serve as legal tender. Secondly, cash can deliver full anonymity and meet

the demand for privacy in transactions and for the electronic CBDC, central banks are usually not inclined to guarantee full anonymity due to enhancements such as traceability that mitigates the vices of anti-money-laundering and combating financial tourism AML/CFT concerns. For simplicity, we further assume that the CBDC is anonymous, and the deposits are interest-bearing payment assets that generate extra returns for individuals, families and organizations. Since the interest rates for the CBDC will always be lower than that of deposits, we assume no extra returns on CBDC for simplicity. Finally, both deposits and CBDC are in digital format, which reduces the carrying cost of cash or banknotes and makes transactions more convenient as summarized in table 3.2 below. According to literature by (Wenlong , Yang, & Peng, 2021); (Kumhof & Noone, 2021), payment systems efficiency (PSE) applies to CBDC, financial inclusion (Fi) can be made possible by cash, CBDC and deposits and AML/CFT may be enhanced by the implementation of a CBDC.

Table 3.2: Cash, CBDC and Deposits Utility Contributing Features

	Payment Systems Efficiency (P_P)	AML/CFT (P_A)	Financial Inclusion (P_F)	Central Bank Regulated
Cash (P_C)			√	√
CBDC (P_B)	√	√	√	√
Deposit (P_D)		√	√	

The utility-contributing features of cash (C), CBDC (B), deposits (D), Payment's efficiency (P), AML/CFT (A) and financial inclusion (F) are denoted by P_C , P_B , P_D , P_P , P_A , P_F as the payments assets with features of cash, CBDC, deposit, payments efficiency, AML/CFT and financial inclusion respectively. We obtain an analytical solution and employ the constant elasticity substitution (CES) utility function and specify the utility function as below.

$$U(P_C, P_B, P_D, P_P, P_A, P_F) = (\alpha_C P_C^{-\gamma} + \alpha_B P_B^{-\gamma} + \alpha_D P_D^{-\gamma} + \alpha_P P_P^{-\gamma} + \alpha_A P_A^{-\gamma} + \alpha_F P_F^{-\gamma})^{-\frac{1}{\gamma}}$$

$$\max_{\{Cash, CBDC, Deposit, PSE, AML/CFT, fi\}} U(P_C, P_B, P_D, P_P, P_A, P_F) = (\alpha_C P_C^{-\gamma} + \alpha_B P_B^{-\gamma} + \alpha_D P_D^{-\gamma} + \alpha_P P_P^{-\gamma} + \alpha_A P_A^{-\gamma} + \alpha_F P_F^{-\gamma})^{-\frac{1}{\gamma}}$$

$$s.t (constraints)$$

$$P_B = (\alpha_C P_C^{-\gamma} + \alpha_B P_B^{-\gamma} + \alpha_D P_D^{-\gamma} + \alpha_P P_P^{-\gamma} + \alpha_A P_A^{-\gamma} + \alpha_F P_F^{-\gamma})^{-\frac{1}{\gamma}}$$

Solving for the optimal

$$s.t \left\{ \begin{array}{l} P_C = Fi \\ P_B = PSE + \frac{AML}{CFT} + Fi \\ P_D = \frac{AML}{CFT} + Fi \\ P_P = CBDC \\ P_A = CBDC + Cash \\ P_F = P \\ P = Cash + Deposit + CBDC \end{array} \right.$$

Substituting with payments assets

$$s.t \left\{ \begin{array}{l} P_C = P_F \\ P_B = P_P + P_A + P_F \\ P_D = P_A + P_F \\ P_P = P_B \\ P_A = P_B + P_C \\ P_F = P \\ P = Cash + Deposit + CBDC \end{array} \right.$$

Financial inclusion ($P_F = P$) is the like portfolio (P) as the portfolio of assets and from the equation above, we can solve for the most optimal payment portfolio with and without the introduction of a CBDC in the Zambian jurisdiction as specified in the scenarios below.

1. Scenario 1: With an introduction of CBDC to the economy
2. Scenario 2: Without the introduction of CBDC to the economy

Scenario 1: Payment Portfolio with CBDC

$$CBDC^* = P \cdot \left(\frac{\alpha_P \alpha_A \alpha_F}{(\alpha_F + \alpha_D)(\alpha_P + \alpha_A)} \right)$$

$$Cash^* = P \cdot \left(\frac{1}{\left(\frac{1}{\alpha_F} + 1 \right)} \right)$$

$$Deposit^* = P \cdot \left(\frac{1}{\left(\frac{\alpha_A}{\alpha_F} + 1 \right)} \right)$$

With (P) being the need to satisfy payments, the equation above shows that the demand for a CBDC raises as individuals, households and organizations prefer to use CBDC because of its features such as of end to end traceability of transactions, payment systems efficiency (P_P), national defense against AML/CFT (P_A), non discriminatory access to digital financial services to allow for financial inclusion (P_F). The demand for cash also rises because of the preference

for anonymity features but cash does not have the digital properties that allows for end to end traceability. Additionally, the demand for deposits which is due to the preference for its interest bearing properties, end to end traceability and allows for instant settlement according to the research by (Wenlong , Yang, & Peng, 2021). These results are therefore in accordance with economic institutions that demand for a specific payment asset that increases with individual, household or organization preference for the payment features of ash, CBDC or deposit.

Scenario 2: Payment Portfolio without a CBDC

$$\text{CBDC}^0 = 0$$

$$\text{Cash}^0 = P \cdot (\alpha_F + 1)$$

$$\text{Deposit}^0 = P \cdot (\alpha_A + \alpha_F)$$

It follows therefore that, if the demand for a CBDC raises as individuals, households and organizations, the demand for cash reduces as economic agents prefer to use CBDC because of its features such as of end to end traceability of transactions, payment systems efficiency (P_P), national defense against AML/CFT (P_A), non discriminatory access to digital financial services to allow for financial inclusion (P_F), otherwise the demand for CBDC would be zero in a payments portfolio with CBDC. Since these different features are not substitute for each other, we assume zero substitution elasticity. In addition, we normalize the sum of the above parameters to 1 and assume them all to be positive including the payment systems efficiency, AML/CFT, financial inclusion and the cost of cash being equal to one (1) as shown below:

$$\{\alpha_C + \alpha_B + \alpha_D + \alpha_P + \alpha_A + \alpha_F = 1\}$$

with minimum function less than zero (0), minimizes the cash in circulation

$$\min\{\alpha_C, \alpha_B, \alpha_D, \alpha_P, \alpha_A, \alpha_F > 0\}$$

and the maximum function less than one (1), maximizes the CBDC in circulation

$$\max\{\alpha_C, \alpha_B, \alpha_D, \alpha_P, \alpha_A, \alpha_F > 1\}$$

3.6. Estimation Method and Data

3.6.1. Estimation Steps

This study used an estimation process that adopted a step by step method of estimation in order to reach the optimal solution and was guided by the following steps:

Step 1: We will start by re-specify the system regression model for the determinants for the CBDC and will use the systems of regression equations for estimation.

Step 2: The study will then extract estimated parameters and coefficients in order to calibrate the optimal solution with and without CBDC in the economy. We use the parameters of interest which are denoted by $(P_C, P_B, P_D, P_F, P_A, P_P)$, where P_C = Cash (C), P_B = CBDC (B), P_D = Deposits (D) are the payment systems assets and P_F = Financial Inclusion (F), P_A = AML/CFT (A) and P_P = Payment Systems Efficiency (P) are the intrinsic benefits which are augmented in the utility function.

Step 3: The third step will determine the impact of the CBDC by comparing the series with the introduction of a CBDC and without the introduction of the CBDC to the economy as specified in the two scenarios below:

Scenario 1: Payment Portfolio with CBDC

$$CBDC^* = P \cdot \left(\frac{\alpha_P \alpha_A \alpha_F}{(\alpha_F + \alpha_D)(\alpha_P + \alpha_A)} \right)$$

$$Cash^* = P \cdot \left(\frac{1}{\left(\frac{1}{\alpha_F} + 1 \right)} \right)$$

$$Deposit^* = P \cdot \left(\frac{1}{\left(\frac{\alpha_A}{\alpha_F} + 1 \right)} \right)$$

Scenario 2: Payment Portfolio without a CBDC

$$CBDC^0 = 0$$

$$Cash^0 = P \cdot (\alpha_F + 1)$$

$$Deposit^0 = P \cdot (\alpha_A + \alpha_F)$$

Step 4: Step four will analyze the comparison of the optimal conditions in order to determine the appropriateness of the CBDC in the economy using scenario 1: Payment Portfolio with CBDC and Scenario 2: Payment Portfolio without a CBDC.

Step 5: This step will determine the implications of introducing the CBDC determinants and analyzing the impact of all the determinants including the payments assets Cash, CBDC, Deposits and the intrinsic benefits that includes the Payment Systems Efficiency, Financial inclusion, and AML/CFT.

Step 6: The study will finally, determine the implications of NOT introducing the CBDC determinants and analyzing the impact of all the determinants including Cash, CBDC, Deposits, Payment Systems Efficiency, Financial inclusion, and AML/CFT.

3.6.2. Econometric Specifications and Tests

The methodology included the continued reviewing of published journal articles on determinants of CBDC and making use of time series high-frequency monthly data which was analyzed. The main determinants were tested and the impact on the dependent variable was determined by multiple regression to solve for the most optimal outcome for Equation (9). The methodological choice also adopted by the study included the multi methods using a single paradigm where both qualitative and quantitative data was used for comprehensive research and because the study called for practical policy issues to be addressed and therefore one approach may have been insufficient.

The study also used time series data of high-frequency time series data, monthly and quarterly secondary data spanning the period from January 2010 quarter one (2010Q1) through to December 2021 Quarter four (2021Q4) providing a total of 144 data points. This secondary data was collected from the Bank of Zambia (BoZ), Zambia Information and Communications Technology Agency (ZICTA), World Bank, ITU and IMF Databases. The data availability required identifying these accessible, reliable and time-consistent datasets from authentic sources and managing the data. To analyze the data, the study further employed the use of EViews econometric package because the time series data regression is a powerful way to control dependencies of unobserved, independent variables on a dependent variable, which can lead to biased estimators in traditional linear regression models. We further compared our results with how the other researchers used the empirical estimates and how they used the econometric packages to validate our findings of this study. The methodology employed the following data analysis techniques using the EViews econometric package.

The Unit Root Test: The study used the unit root test to analyze the time series data which is crucial for determining if the time series needed to be differenced and if so, the number of times such differences should be taken. The unit root testing uses the differencing technique that was used to stabilize the time series and eliminate any trend in the series. This technique eliminated any spurious or false results, and it was also used to determine if the trending data should be first differenced or regressed on deterministic functions of time to render the data stationary.

Co-Integration Analysis: The study also used co-integration to test cointegrating relationships between the non-stationary time series data to present more statistical evidence. The test aimed to uncover causal relations among the variables by determining if the stochastic trends in a group of variables were shared by the series. The cointegration explicitly allows for non stationarity, thus providing a sounder basis for empirical inference.

The Ordinary Least Squares (OLS): The study finally used the system OLS method which was used to find the simple linear regression of the data sets to estimate the relationships between the variables. The ordinary least squares regression (OLS) technique was used for estimating coefficients of linear regression equations which described the relationship between one or more of the independent quantitative variables in Table 3.1 and a dependent variable. Further, the study used ordinary least squares (OLS) as a type of linear least squares method for estimating the unknown parameters in our linear regression model. This method was preferred because it is an effective technique for estimating coefficients of linear regression equations which further described the relationship between the independent quantitative variables and a dependent variable using multiple linear regression.

3.6.3. Principle Component Analysis (PCA) Specification

In this study, we use the Principal Component Analysis (PCA) for the estimation of the latent variables. According to (Noelia & Tuesta, 2014), we use this estimation method to remove any sensitivity of econometric methods to outlier observations, and this can result in coefficients that do not accurately capture the underlying statistical relationship. To get the data values for the payment systems efficiency (*PSE*) in equation (03), we optimized the values for the payment initiation (P^p_t), payment clearance (C^p_t) and payment settlement (S^p_t) using the principal component analysis (PCA) function in EViews which is a method of analysis that involved finding the linear combination of a set of variables (P^p_t), (C^p_t) and (S^p_t) that has maximum variance and removing these effects and repeating this successively. The results are as depicted in table 4.2 in the results section.

The study also used the Panel Robust Least Squares (RLS) method among many other methods which is a variety of regression methods designed to be robust or less sensitive to outliers. There are three different RLS methods namely: M-estimation (Huber 1973), S-estimation (Rousseeuw and Yohai, 1984), and MM-estimation (Yohai, 1987). For this research, we employ the M-estimation method, which addresses the dependent variable outliers where the value of the dependent variable differs distinctly from the regression model norm of large residuals. Further, we use the E-views econometric computer software package to obtain the results for all the other variables. Before estimation of the model equation (9), we run panel unit root tests with the independence of the key variables and combines with the results from the principal component analysis (PCA).

3.7. Research Design and Strategy

The research design was mainly exploratory and explanatory and focused on looking at the causes and effects of relationships between the different variables of the study. The main variables in the study included the narrow money in circulation (M0 and M1), board money (M2, M3), cash in circulation (CiC), internet penetration (IP) and the mobile subscriber base (MS) and how these variables interact with the determinates of Central Bank Digital Currencies. The research also considered the exchange rating with other baskets of currencies for the option of a cross border CBDC to accommodate international trade using CBDC. The study design also involved the adoption of a mixed-method approach using both qualitative and quantitative data. This to facilitate comprehensive research because the study called for a practical approach for policy issues to be addressed and therefore a single approach may have been insufficient.

3.8. Research Ethics

This research did seek clearance to use the central bank data of Zambia datasets as shown in appendix 8.9 and was granted as indicated in the same appendix. Further, all the possible ethical issues that may arise during the study and all the participants and organizations were accorded secrecy and privacy according to the non-disclosure agreements. Consent was also explicitly sought from all participants stating confidentiality and prior permission was obtained from all the participants within the communities of practice (CoP) before they participated in the study. The participants had the right to understand what the research accomplished and the thesis shared the findings through some published work in the list of publications in section 7.0.

3.9.Pre-Testing, Data Validation and Reliability

The study validated the data by conducting some pre-testing on the time series data in order to ascertain the validity and reliability of the data. The data reliability tested how repeatable data sets were for any other future research and the validity made sure that the data is measured correctly from 2010Q1 to 2021Q4. The reliability of the time series was also tested by using the unit root test (URT) to analyze the time series data which is crucial for determining if the time series needed to be differenced at level and at first difference and determined the number of times such differences should be taken. The unit root testing uses the differencing technique that was used to stabilize the time series and eliminate any trend in the series. Additionally, the process required identifying accessible, reliable and time-consistent datasets from authentic sources like the Bank of Zambia, World Bank, ITU and IMF and managing the data. The study also considered pilot study to determine the validity and reliability of the data adopting (Yasar & Cogenli, 2014) approach of piloting.

3.10. Chapter Summary

The research methodology chapter introduced the research philosophy and approach to the study. The chapter explored the methodological choice and procedures used by the study and the design and strategy. Further, the chapter outlined the estimation methods and data including the estimation steps, the econometric specifications and tests used, including the Unit root tests, cointegration analysis and the ordinary least squares (OLS). The chapter also outlines the data types and data sources used in the study and closed by highlighting the data validation and reliability and time Horizon followed in the study.

4.0 CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION OF RESULTS

4.1. Introduction

In this chapter the study outlines the analysis and presentation of data, as well as the interpretation of the results which were obtained from the econometric packages after the examination and analysis of the collected secondary data. The study focused on the optimal design of a digital currency in a developing economy including whether the CBDC should be issued and considering the options to pay interest and how widely it should be circulated in Zambia and across the borders. The data was analyzed following the estimation steps as outlined under the estimation method and data in Section 3.6.1. estimation steps of the methodology. The subsequent sections of this chapter show how the data was presented, analyzed and interpreted.

4.2. Data Analysis

In analyzing the data, the study employs the method already outlined in the methodology and begins by specifying the system regression model for all the determinants for a CBDC and then proceeds to extract estimated parameters and coefficients in order to calibrate the most optimal solution with and without a CBDC in the economy. The analysis further determines the impact of a CBDC by comparing the time series with the introduction of a CBDC and without the introduction of a CBDC to the economy. Subsequently, the study analyzes the comparison of the optimal conditions in order to determine the appropriateness of a CBDC in the economy and finally determines the implications of introducing a CBDC determinants and of not introducing a CBDC by analyzing the impact of all the determinants including cash, CBDC, deposits, payment systems efficiency, financial inclusion, and AML/CFT as demonstrated by (Agur, Ari, & Dell’Ariccia, 2021).

In addition, the thesis estimates an econometric model which removes the sensitivity of methods to outlier observations with the optimized model attaining a steady state and therefore accurately capturing the underlying statistical relationship. During the data analysis, the thesis employed an estimation method which removed the sensitivity of econometric methods to outlier observations that can result in coefficients that do not accurately capture the underlying statistical relationships as suggested by (Barrdear, John; Kumhof, Michael, 2021). The data analysis adopted the Ordinary Least Squares (OLS) as the main type of Linear Least Squares method for estimating the unknown parameters in a linear regression model. The OLS is widely

used in econometrics, where the behavior of statistical units such as the time series data units are utilized. This thesis further employed E-views econometric software platform to analyze and obtain the results.

Before estimating the model, we ran Unit Root Tests with the independence for the key variables payment systems efficiency (P_P), national defense against AML/CFT (P_A), non discriminatory access to digital financial services to allow for financial inclusion (P_F), cost of processing currency (P_C) and the moderating variables such as internet penetration (IP), mobile service subscriptions (MS), narrow money, broad money and the nominal exchange rate as reported in table 4.2. The Unit Root Test (URT) was used to test whether the time series data was stationary and consisted of a unit root in time series analysis. The presence of a unit root in time series defines the null hypothesis, and the alternative hypothesis defines time series as being stationary. Subsequently, before applying regression and predicting the models in the study, we applied the Unit Root Test (URT) to the time series in order to check if the time series of the variable was stationary or not. Time series stationarity is when a stationary time series has properties that do not depend on the time at which the series was observed. Therefore, a time series with trends, or with stationarity, are not stationary and the trend and seasonality might affect the value of the time series at different times and a differencing technique was used to convert a nonstationary time series into a stationary one before applying regression.

In this analysis, the stationary data thus refers to the time series data that mean and variance do not vary across time. The data is considered non-stationary if there is a strong trend or seasonality observed from the data which was removed by using a differencing technique at level and at the first difference in order to remove trend, stabilize the series and make the time series more stable to avoid spurious results. Stationarity tests were important in this study because if the time series was non-stationary, the regression results might have become spurious or not being what it purports to be and false. The null hypothesis is generally defined as the presence of a unit root and the alternative hypothesis is either stationarity or trend stationarity.

To get the data values for the payment systems efficiency (PSE), we optimized the values for the payment initiation (P_{Pt}), payment clearance (C_{Pt}) and payment settlement (S_{Pt}) using the principal component analysis (PCA) function in E-views which is a method of analysis that involved finding the linear combination of a set of variables (P_{Pt}), (C_{Pt}) and (S_{Pt}) that has maximum variance and removing these effects and repeating this successively. The principal component analysis for the payment systems efficiency is outlined in Table 4.1 below.

Table 4.1: Payments Efficiency, Principal Component Analysis (Source: E-views Output)

Principal Components Analysis

Date: 08/07/22 Time: 09:48

Sample (adjusted): 2010M01 2021M09

Included observations: 141 after adjustments

Balanced sample (listwise missing value deletion)

Computed using: Ordinary correlations

Extracting 3 of 3 possible components

Eigenvalues: (Sum = 3, Average = 1)

Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	1.478202	0.473723	0.4927	1.478202	0.4927
2	1.004479	0.487159	0.3348	2.482680	0.8276
3	0.517320	---	0.1724	3.000000	1.0000

Eigenvectors (loadings):

Variable	PC 1	PC 2	PC 3
PAYMENT_CLEARANCE	0.043384	0.993526	0.104992
PAYMENT_INITIATION	0.708074	0.043561	-0.704794
PAYMENT_SETTLEMENT	0.704805	-0.104919	0.701600

Ordinary correlations:

	PAYMENT_CLEARANCE	PAYMENT_INITIATION	PAYMENT_SETTLEMENT
PAYMENT_CLEARANCE	1.000000		
PAYMENT_INITIATION	0.050601	1.000000	
PAYMENT_SETTLEMENT	-0.021400	0.477305	1.000000

4.2.1. Variable Empirical Results with Unit Root Tests

The study's empirical tests commenced by testing for the presence of unit root in all the variables using the Augmented Dickey-Fuller (ADF) statistical significance test for the unit root test. The table (4.2) below shows the stationarity unit root tests for the main variables used in the study. The tests were conducted both at level and at first difference to stabilize the time series and to avoid spurious results. The tests were conducted at level with intercept as captured in Table 4.1, and also captured at level with intercept and trend, at first difference with intercept and then finally at first difference with intercept and trend for all the variables. Furthermore, Table 4.2 below shows the summary results run for all the variables and Table 4.1 showing the specific unit root test for Cash_CiC (cash in circulation) variable with the t-statistic of *1.067642* and the probability of *0.054070* signifying that the variable captured at level with intercept and the variable is stationary.

Further, the other summary results for the main variables are taken from the unit root tests for the payment systems efficiency (P_p) at level being equal to *0.047642* and therefore being

statistically significant, the test for the AML/CFT effects (P_A), the unit root at level being equal to shows for 0.019432 , statistically significant and the financial inclusion index (P_F), being equal to 0.045119 and also being statistically significant. Nonetheless, the cost of processing currency is inversely proportional to the issuance of an electronic CBDC and at level being equal to 0.936644 is not significant. It follows, therefore, that all the main variables except one in this study are supporting the issuance of a Central Bank Digital Currency in Zambia.

Table 4.2: Cash in Circulation (CiC) at Level with intercept (Source: Authors Construct, EViews Output)

Null Hypothesis: CIC_CASH_IN_CIRCULATION has a unit root

Exogenous: Constant

Lag Length: 12 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
<u>Augmented Dickey-Fuller test statistic</u>		1.067642	0.054070
Test critical values:	1% level	-3.500669	
	5% level	-2.892200	
	10% level	-2.583192	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(CIC_CASH_IN_CIRCULATION)

Method: Least Squares

Date: 06/08/22 Time: 14:31

Sample (adjusted): 2014M02 2021M12

Included observations: 95 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CIC_CASH_IN_CIRCULATION(-1)	0.031291	0.029308	0.067642	0.0289
D(CIC_CASH_IN_CIRCULATION(-1))	-0.066054	0.103016	-0.641198	0.0322
D(CIC_CASH_IN_CIRCULATION(-2))	-0.020970	0.106288	-0.197293	0.8441
D(CIC_CASH_IN_CIRCULATION(-3))	-0.210841	0.108504	-1.943157	0.0555
D(CIC_CASH_IN_CIRCULATION(-4))	-0.280587	0.110866	-2.530871	0.0133
D(CIC_CASH_IN_CIRCULATION(-5))	-0.039348	0.114674	-0.343126	0.7324
D(CIC_CASH_IN_CIRCULATION(-6))	-0.153846	0.111841	-1.375578	0.1727
D(CIC_CASH_IN_CIRCULATION(-7))	-0.098647	0.115857	-0.851457	0.3970
D(CIC_CASH_IN_CIRCULATION(-8))	-0.043926	0.114215	-0.384592	0.7015
D(CIC_CASH_IN_CIRCULATION(-9))	0.062087	0.112112	0.553790	0.5812
D(CIC_CASH_IN_CIRCULATION(-10))	-0.071693	0.110008	-0.651705	0.5164
D(CIC_CASH_IN_CIRCULATION(-11))	-0.081049	0.111891	-0.724357	0.4709
D(CIC_CASH_IN_CIRCULATION(-12))	0.812725	0.114742	7.083036	0.0000
C	-98311.94	159948.6	-0.614647	0.5405
R-squared	0.920530	Mean dependent var		92502.80
Adjusted R-squared	0.903578	S.D. dependent var		477075.2
S.E. of regression	355867.9	Akaike info criterion		28.53782
Sum squared resid	1.03E+13	Schwarz criterion		28.91418
Log likelihood	-1341.546	Hannan-Quinn criter.		28.68989
F-statistic	6.764360	Durbin-Watson stat		1.977180
Prob(F-statistic)	0.025000			

The summary for all the other variables captured at level with intercept and trend, captured at first difference with intercept and then at first difference with intercept and trend with the order of integration as captured in Table 4.2.

Table 4.3: Summary Variable Unit Root Test Results (Source: Authors Construct)

Variables	At Level		At 1 st Difference		Order of Integration
	<i>Intercept</i>	<i>Intercept & Trend</i>	<i>Intercept</i>	<i>Intercept & Trend</i>	
P_p	0.047642	0.098897	0.058055***	0.443357	$I(1)$
P_A	0.019432	0.816333	-1.84865**	-5.81086	$I(1)$
P_F	0.045119	1.280316	4.015306**	5.983206	$I(1)$
IP	-0.721951	-3.357262	-12.04776**	-12.00285	$I(1)$
P_C	1.067642	-0.988097	-1.058055***	-1.843357	$I(1)$
$\left(\frac{1}{P_C}\right)$	0.936644	-1.012046	-0.94513	-0.542489	$I(1)$
MS	-0.194322	-1.816333	-12.84865**	-12.81086	$I(1)$
NER	-0.906402	-2.394409	-7.735134**	-7.697934	$I(1)$
$M0$	0.436841	-1.817428	-5.835529*	-5.821941	$I(1)$
$M1$	0.436841	-1.817428	-5.835529*	-5.821941	$I(1)$
$M2$	0.085119	-1.880316	-6.015306**	-5.983206	$I(1)$
$M3$	-0.394348	-2.091915	-5.352582***	-5.297098	$I(1)$

***, **, and * denote 1%, 5% and 10% levels of significance. In the Unit Root Test, $I(1)$ represents the order of integration.

We do not test for unit roots for P_p^t , S_p^t , C_p^t , as they accumulate into payment efficiency (P_p) variables because these are moderating variables which are strengthening the correlation between the independent and dependent variables. Now since the variables are integrated of the same order - that is, the variables are $I(1)$ - it is necessary to further test for co-integration to determine if there is a long-run equilibrium relationship among the variables.

4.2.2. Co-Integration Analysis

In the study we used the co-integration test to uncover the causal relationships between the main variables and thus provided a sound basis for empirical inferences. To carry out the co-integration analysis, the study adopted a measured lag length and the unrestricted approach. The results from the tests indicate that there is an existence of co-integration among the main variables. The evidence of co-integration implies that there is a long-run relationship between the main variables in the aggregate model in equation (9) of the system equation. Further evidence of co-integration implies that there is a long-run relationship between the variables in the system and therefore justifies the need to estimate a vector error correction as depicted in Table 4.3 below. The results also show the presence of at least three co-integrating equations

on both the trace and maximum value statistics at the 5 percent level of all equations. This confirms the presence of a long-run stable relationship among variables in the model. The results also show the presence of at least three of the CBDC determinant key variables including payment systems efficiency (P_P), national defense against AML/CFT (P_A), and nondiscriminatory access to digital financial services to allow for financial inclusion (P_F), all co-integrating at the 1 percent level of the model. This confirms the presence of a long-run stable relationship among the key CBDC variables in the main equation (9) in Chapter 3, Section 3.3 providing further evidence to allow for a CBDC in the jurisdiction.

Table 4.4: Co-Integration of Variables (Source: Authors Construct, EViews Output)

Date: 08/07/22 Time: 11:24
Sample (adjusted): 2010M06 2021M11
Included observations: 42 after adjustments
Trend assumption: No deterministic trend
Series: PAYMENTS EFFICIENCY AML/CFT FINANCIAL_INCLUSION CIC_CASH_IN_CIRCULATION
IP_INTERNET_PENETRATION M1_NARROW_MONEY M3_BROAD_MONEY MS_MOBILE_SUBSCRIPTION
NER_NOMINAL_EXCHANGE_RATE
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.997753	548.9343	111.7805	0.0128
At most 1 *	0.930162	292.8165	83.93712	0.0467
At most 2 *	0.763056	181.0300	60.06141	0.0300
At most 3 *	0.723749	120.5528	40.17493	0.0000
At most 4 *	0.600141	66.52217	24.27596	0.0000
At most 5 *	0.359309	28.02317	12.32090	0.0501
At most 6 *	0.199093	9.324455	4.129906	0.0027

Trace test indicates 7 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.997753	256.1178	42.77219	0.0120
At most 1 *	0.930162	111.7865	36.63019	0.0000
At most 2 *	0.763056	60.47718	30.43961	0.0256
At most 3 *	0.723749	54.03065	24.15921	0.0000
At most 4 *	0.600141	38.49900	17.79730	0.0000
At most 5 *	0.359309	18.69872	11.22480	0.0021
At most 6 *	0.199093	9.324455	4.129906	0.0027

Max-eigenvalue test indicates 7 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

The short-run dynamics estimation was also run and the coefficients of the error correction terms are summarised in the Table 4.4. The results show a *0.1121951* payment system efficiency at lag1, *0.043684* for national defense against AML/CFT (P_A) and *0.0194322* for non discriminatory access to digital financial services to allow for financial inclusion (P_F) which are all significant.

Table 4.5: Short Run Coefficients (Source: Authors Construct)

Variables in Optimized Model				
	<i>Lag 1</i>	<i>Lag 2</i>	<i>Lag 1</i>	<i>Lag 2</i>
P_C	-0.167642	-0.988097	-1.058055	-1.043357
P_P	0.011219	1.1357262	0.02776	0.00285
P_A	0.043684	(-1.317428)	-0.835529	(-0.821941)
P_F	0.019432	1.416333	0.024865	1.51086
IP	0.011394	1.1399262	0.01886	0.10285
MS	0.018321	1.316456	0.015765	1.42386
NER	(-1.906402)	-1.394409	-1.735134	(-7.697934)
$M0$	-0.336441	(-1.217778)	-0.838829	(-0.782941)
$M1$	0.043684	-1.2817428	0.03835529	-0.821941
$M2$	-0.085119	-1.180316	-0.015306	-0.983206
$M3$	-0.394348	-1.091915	-0.352582	-0.297098

4.2.3. Regression Analysis and Results

The study further used regression analysis to estimate equation (9) that was optimized in Chapter 3, Section 3.3 as a system in order to ascertain how the main variables acted as determinates for the Central Bank Digital Currency. We applied the Ordinary Least Squares method to the variables and the statistical results are obtained and presented in Table 4.4. Comparing our results with those from the study by (Keister, Todd; Sanches, Daniel, 2019) which uses cash-like CBDC and deposit-like CBDC and reached different conclusions for different types of CBDC. It is however clear that a Central Bank can decide to either use a cash-like or deposite-like CBDC depending on the underlying motivations to issue a CBDC. This study, further uses a CBDC determinant ($CBDC_{DET}$) as the dependent variable, the coefficient for internet penetration (IP) and accumulative payment systems efficiency (P_P) is interpreted to be equal to *0.01121951*. This implies that the average internet penetration rate of CBDC on the Zambian economy is positive and significant, the national defense against AML/CFT through narrow money (P_A) is equal to *0.0436841* meaning it is positive and also significant. Further, the mobile subscription (MS) and the effects on access to domestic digital

financial services through financial inclusion (P_F) is equal to 0.0194322, implying that it is positive and statistically significant. Finally, the nominal exchange rate (NER) is equal to (-1.906402), meaning that it is insignificant as depicted in Table 4.4.

From the analysis and results we have explored the main prevailing determinants for introducing a Central Bank Digital Currency (CBDC) in Zambia, taking into account all the main variables representing payment systems efficiency, national defense against AML/CFT, and financial inclusion. The results demonstrate that the variables are all highly significant, individually and collectively as the whole model. Conversely, the interpretation of the results from the cost of processing currency shows that the introduction of a digital CBDC will result into the same currency cycle and inversely proportional relationship with the fiat currency in circulation (Cash_CiC).

Therefore, these results significantly support and address the overarching research objective one (RO1) and have ascertained that the internet penetration is significant for CBDC introduction in Zambia. The results also meet research objective two (RO2) where the introduction of CBDC has the ability to improve the efficiency of payment systems platforms in the country. Furthermore, the stronger defense against AML/CFT is also highly significant and addresses research objective number three (RO3) of the CBDC ability to make a stronger national defense against AML/CFT in Zambia. Finally, the increasing rates of mobile subscription (MS) demonstrate that the introduction of a in Zambia CBDC can ensure nondiscriminatory access to domestic financial services in the country, resulting in financial inclusion and thus meeting research objective four (RO4) of this study as show by the evidence in Table 4.6 below.

Table 4.6: Variables in a Combined Equation (Source:(Authors Construct, EViews Output))

Dependent Variable: CBDC_DET
Method: Least Squares
Date: 08/07/22 Time: 15:14
Sample (adjusted): 2018M01 2021M11
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAYMENTS_EFFICIENCY	0.108325	0.141076	0.767851	0.0471
AML_CFT	-0.076628	0.129616	-0.591194	0.0377
FINANCIAL_INCLUSION	0.327045	0.156124	2.094780	0.0426
IP_INTERNET_PENETRATION	-0.099676	0.130838	-0.761825	0.0406
M1_NARROW_MONEY	0.256187	0.057064	4.489487	0.0001
M2_BROAD_MONEY	0.108325	0.141076	0.767851	2.4471
M3_BROAD_MONEY	-0.076628	0.129616	-0.591194	0.5577
MS_MOBILE_SUBSCRIPTION	0.327045	0.156124	2.094780	1.0426
CASH_CIC	1.48460.3	9.7516.66	1.522410	0.1358
C	-1239333.	1124123.	-1.102489	0.2768

R-squared	0.969857	Mean dependent var	9579842.
Adjusted R-squared	0.965336	S.D. dependent var	2624009.
S.E. of regression	488548.0	Akaike info criterion	29.17287
Sum squared resid	9.55E+12	Schwarz criterion	29.44842
Log likelihood	-678.5624	Hannan-Quinn criter.	29.27656
F-statistic	214.5016	Durbin-Watson stat	1.982636
Prob(F-statistic)	0.000000		

Figure 4.1 shows the combined line graphs for all the variables and how they relate to the introduction of a Central Bank Digital Currency (CBDC) in Zambia. From the model in Chapter 3, Section 3.3, equation 9 confirms that the actualization of a CBDC depends on the continued upward trend of the main variables during the period under review from 2010Q1 to 2021Q4 and these include internet penetration, mobile penetration, circulation of cash and both narrow and broad money. Further, the individual line graphs below for all the variables confirm the upward trends signifying an increase in the variable that can facilitate the implementation of a CBDC.

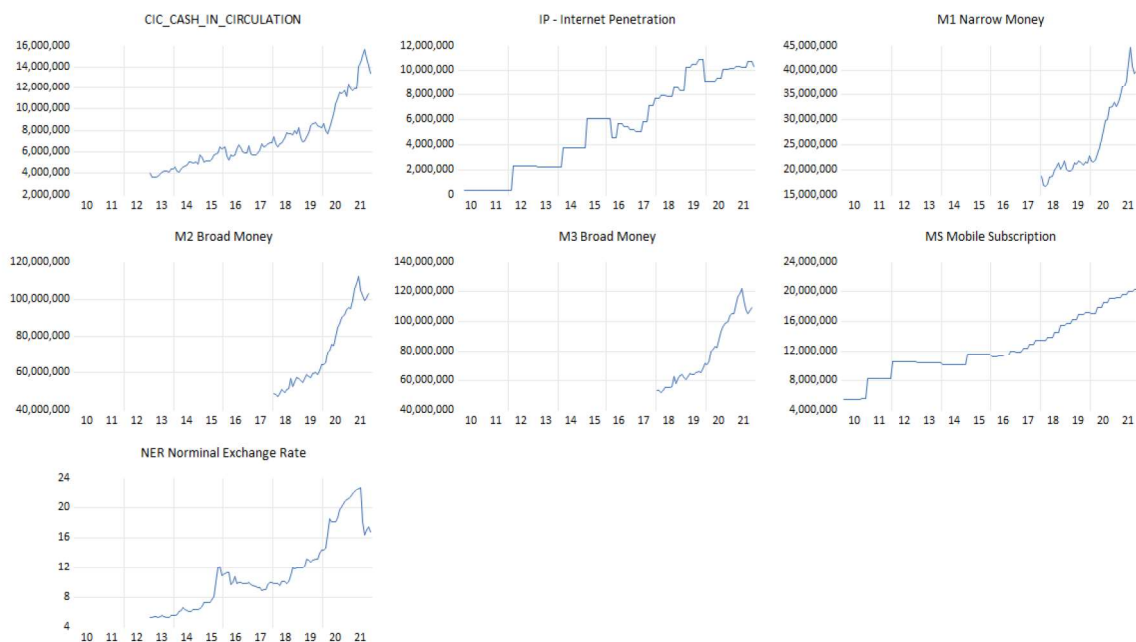


Figure 4.1: Individual Line Graphs for all Variables (Source: (Authors Construct, EViews Output))

Further evidence from Figure 4.1 also shows the combined line graphs for all the main variables CiC, IP, narrow money (M0, M1), broad money (M2, M3) mobile subscription and the nominal exchange rate increasing sharply in the mid of 2017 and continuing on an upward trend, suggesting the feasibility of a CBDC as the main variables increase as shown in the combined line graphs for all the variables in figure 4.2 below.

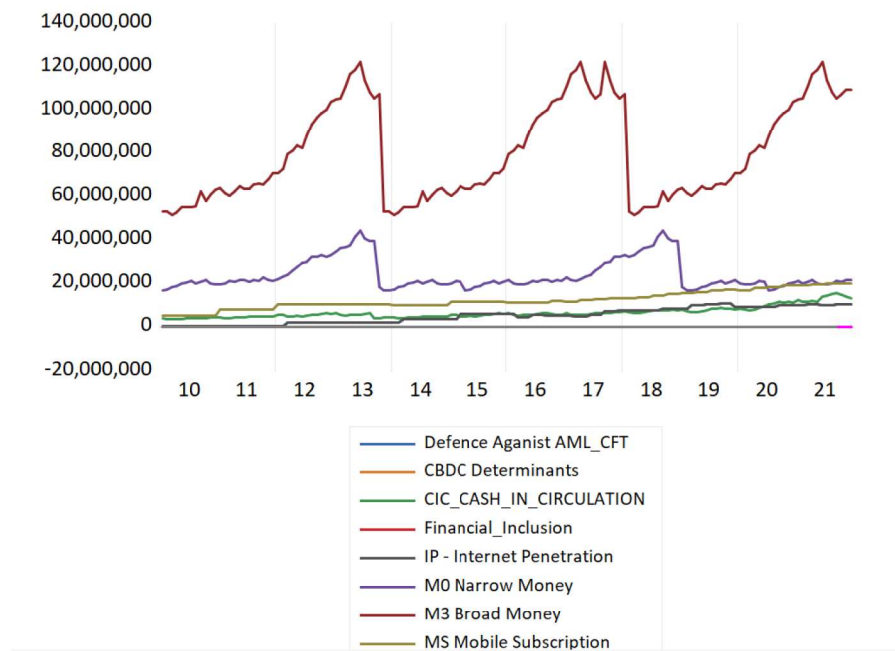


Figure 4.2: Combined Line Graphs for all Variables (Source:(Authors Construct, EViews Output))

4.3. Discussion of the Results

In discussing the results, we first state that the study tested all the key variables using unit root tests, cointegration and ordinary least squares. Using our optimal model and comparing it with the results from the study by (Wenlong , Yang, & Peng, 2021), where their model showed how economic agents choose among cash, deposits and CBDC to maximize the utility while satisfying their basic payment need, we infer that the economic agents choose among using cash and other digital financial services (DFS). The study results further compare with (Keister, Todd; Sanches, Daniel, 2019) model which uses cash-like CBDC and deposit-like CBDC and reached different conclusions for different types of CBDC. The model in this particular study shows great flexibility and can be generalized to more complicated scenarios that can include other motivations for the determinants of Central Bank Digital Currency such as retaining monetary sovereignty, enhancing monetary policy transmission and a CBDC to contribute to financial stability.

In addition, this study also conforms with another study on the CBDC cases of Sweden and Great-Britain (Virtanen & Junttila, 2021), which was investigated from the financial stability perspective to see how financial stability and payment systems efficiency of the monetary transmission process are affected by CBDC and concludes that a CBDC enhances payment systems efficiency.

The results of this study show that the payment systems efficiency (P_p) was interpreted to be equal to 0.01121951 , implying a positive and significant relationship supporting the use of a CBDC that will enhance payment systems efficiency. On the other hand, the results on the national defense against AML/CFT (P_A) was equal to 0.0436841 and this statistic was also positive and significant, confirming that a CBDC can enhance anti-money laundering and combating financial terrorism. Furthermore, the effects on access to domestic digital financial services through financial inclusion was equal to 0.0194322 , implying positive correlation and statistically significant results. Conversely, the cost of processing fiat currency was found to be reduced as a CBDC was being introduced, presenting an inverse relationship between CBDC and fiat currency.

Research objective 1: The first research objective of this study was to explore the prevailing determinants for introducing a Central Bank Digital Currency in the Zambian jurisdiction and the results showed that the main overarching research objective was met by the study.

Research objective 2: The second objective of this study was to determine if the introduction of a Central Bank Digital Currency could affect the efficiency of payments systems platforms in Zambia. The results showed the 0.01121951 significance level from the regression model and this confirms that a CBDC could enhance the payment systems efficiency in the Zambian economy, and this was consistent with the results from the research by (Wenlong , Yang, & Peng, 2021). The second scenario in which there was no introduction of a CBDC does not show any efficiency on the payment systems platforms.

Research objective 3: The results of the research also addressed objective three, which was to examine if the introduction of a Central Bank Digital Currency could make the national defense against AML/CFT in Zambia. The analyzed data show significant result of 0.0436841 which affirms objective 3 and is compared with the outcomes from the research by (Keister, Todd; Sanches, Daniel, 2019), whose model uses a cash-like CBDC and deposit-like CBDC.

Research objective 4: The fourth objective of the study was to demonstrate whether a Central Bank Digital Currencies can ensure a nondiscriminatory access to domestic financial services in Zambia. The results showed the significance levels of equal to 0.0194322 implying positive correlation and statistically significant results which establish that the introduction of a CBDC

could enhance financial inclusion through the nondiscriminatory access to domestic financial services.

Research objective 5: The final objective was to evaluate whether the introduction of a Central Bank Digital Currency could mitigate the cost of processing cash in the Zambian jurisdiction. In contrast, the result found that the costs of processing currency were insignificant and inversely proportional to the amount of CBDC that was introduced to the economy and depicted in the tests for scenario two with no CBDC introduced in the economy.

Consequently, therefore, these results have succeeded in addressing the main overarching research objective (RO1) of exploring the prevailing determinants for introducing a Central Bank Digital Currency in Zambia. The specific research objectives were also addressed in that (RO2) was to determine if the introduction of a Central Bank Digital Currency can improve the efficiency of payments systems platforms in Zambia and which was addressed by the *0.01121951* significance of the results of the payment systems efficiency variable. The third objective (RO3) was to examine if the introduction of a Central Bank Digital Currency would make a stronger national defense against AML/CFT in Zambia and this was shown to be significant from the AML/CFT result which was *0.0436841*. The fourth research objective (RO4) was to demonstrate whether Central Bank Digital Currencies could ensure nondiscriminatory access to domestic financial services in Zambia through financial inclusion and the result was equal to *0.0194322*, implying a positive collations and statistically significant results. On the contrary, the fifth research objective (RO5) was to evaluate whether the introduction of a Central Bank Digital Currency could mitigate the high cost of processing currency in Zambia and the result was found to be insignificant and inversely proportion to the amount of CBDC introduced in the economy.

Because of the three out of the four objectives being significant, the overall results suggests that the introduction of a Central Bank digital Currency could lead to efficiency in the payment systems space, make a stronger national defense against AML/CFT and could ensure nondiscriminatory access to domestic financial services in Zambia and increase financial inclusion, which confirms the other research on CBDC (Virtanen & Junttila, 2021).

4.4.Normality Tests

The study tested for normality to determine if the data sets were well-modeled by a normal distribution and to compute how likely it was for a random variable underlying the data set to

be normally distributed. Figure 4.3 shows the residuals normality test result, which demonstrates normality with the probability of *0.014* indicating further proof of the existence of white noise stochastic disturbance, hence providing more credibility to the model results that are used in the study.

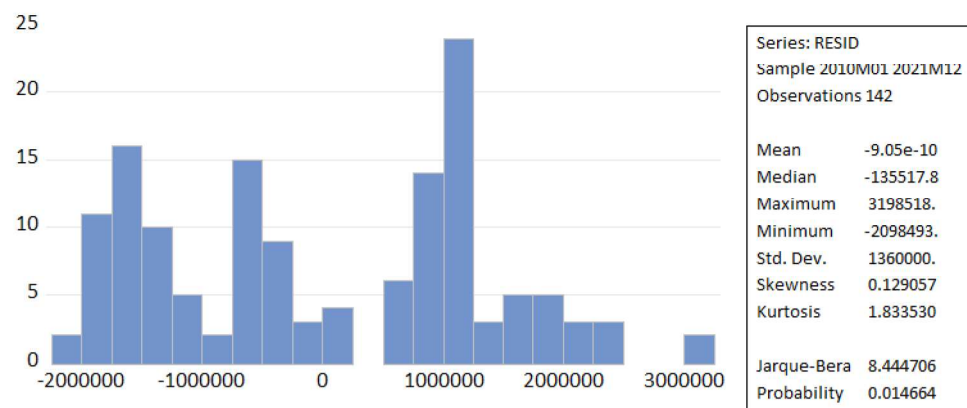


Figure 4.3:Residuals Normality Test (Source: Authors Construct, EViews output)

4.5.Reliability and Robustness Test

The study also tested for the reliability and robustness of all the data sets in order to determine the capacity of a method used and to make sure that the data remained unaffected by any small, deliberate variations in method used in the tests. In addition, the thesis examined how the core regression coefficient estimates behaved when the regression specification was modified by adding or removing any regressors. Figure 4.7 shows the positive unrotated loadings values at F1 for all the variables signifying that the results are reliable and robust.

Table 4.7:Reliability and Robustness of Results (Source: Authors Construct, EViews output)

Factor Method: Maximum Likelihood
Date: 08/07/22 Time: 15:15
Covariance Analysis: Ordinary Correlation
Sample (adjusted): 2018M01 2021M11
Included observations: 47 after adjustments
Balanced sample (listwise missing value deletion)
Number of factors: Minimum average partial
Prior communalities: Squared multiple correlation
Convergence achieved after 7 iterations

	Unrotated Loadings			Communality	Uniqueness
	F1	F2	F3		
CIC_CASH_IN_CIRCULATION	0.124202	-0.045963	0.346237	0.976142	0.023857
IP_INTERNET_PENETRATION	0.198730	0.473577	-0.004344	0.712518	0.287482
M1_NARROW_MONEY	0.147565	-0.098412	0.283586	0.987985	0.012015

PAYMENT_EFFICIENC	0.190490	-0.126887	0.048093	0.999484	0.000516
FINANCIAL_INCLUSIO	0.1991752	-0.128173	0.000000	1.000000	0.000000
MS_MOBILE_SUBSCRI					
PTION	0.174419	0.224740	0.000000	1.000000	0.000000
AML/CFT	0.148051	-0.055074	-0.265420	0.972281	0.027719

Factor	Variance	Cumulative	Difference	Proportion	Cumulative
F1	1.053186	1.053186	1.731043	0.910471	0.910471
F2	0.322143	6.375329	0.049062	0.048454	0.958925
F3	0.273081	6.648409	---	0.041075	1.000000
Total	6.648409	6.648409		1.000000	

	Model	Independence	Saturated
Discrepancy	0.178183	19.86594	0.000000
Chi-square statistic	4.196431	913.8334	---
Chi-square prob.	0.0421	0.0000	---
Bartlett chi-square	3.275818	850.9246	---
Bartlett probability	0.0636	0.0000	---
Parameters	25	7	28
Degrees-of-freedom	12	21	---

Warning: Heywood solution (uniqueness estimates are non-positive). Results should be interpreted with caution.

4.5.1. Chapter Summary

This chapter outlines the analysis of the data and presentation of the results in the study. The chapter starts with the introduction to the data analysis and the results to be presented and then proceeds to state the data analysis tools and methods that were used. The chapter further provides the empirical results obtained from the variable unit root tests and the subsequent co-integration analysis and the final regression analysis performed on the data. The chapter then tests for normality reliability of the test results and concludes with a chapter summary.

5.0 CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1.Introduction

In this chapter, the study provides a conclusion on the effects of the determinants of a Central Bank Digital Currency (CBDC) as a Payment Systems Platform in Zambia. The thesis adopted a two-tier model of a CBDC and the architecture where the benefits of tiered architectures for the distribution of retail CBDC to individuals, families and organizations and wholesale CBDC through commercial banks and payment service providers (PSP). The study further used high-frequency time series data for the main variables including the fiat cash in circulation (CiC) that was compared to the introduction of an electronic CBDC ($^{CBDC}_eCiC$), narrow money (M0, M1), broad money (M2, M3) forms of money, the exchange rate between cross border CBDC (NER), individual mobile subscribers (MS) and internet penetration (IP) rates in the country. This chapter provides the conclusion of the study.

5.2.Policy Implications and Recommendations

Given the evidence presented, the finding of this research call for strong intra and inter-agency collaboration which can be beneficial to the monetary authorities, the ministry responsible for finance, other financial services, the information and communications technology regulators or authority, Securities and Exchange Commission (SEC), Pensions and Insurance Authorities (PIA), the Competition and Consumer Protection Commission (CCPC), and all the other financial conduct authorities on the feasibility analysis and determinates of a CBDC in Zambia. The study also brings out the strong need for a CBDC to interoperate both vertically and horizontally with already existing payment systems platforms such as the mobile financial services (MFS), credit and debit card payments, electronic funds transfers (EFT), point of sale (PoS), automated teller machines (ATM), real-time gross settlement (RTGS) and connection to the national financial switch (NFS). The study also recommends allowing for competition on the infrastructure payment system providers and collaboration on products and value addition for the frictionless service to the end customer and the use of common protocols or standards in form of application programmable interfaces (API) in order to achieve frictionless payments in the country and across borders for enhanced trade.

The study also advocates for a CBDC that is open, secure, resilient, transparent and a competitive environment that promotes choice and diversity in payment options. It should seamlessly integrate with other regional, SADC, Sub-Saharan Africa, and integration with the African Continental Free Trade Area (AfCFTA) and the rest of the world. Further, the study

advocates for seamless access to other existing instant and inclusive payment systems (IIPS)/ faster payments, the SADC transactions cleared on an immediate basis (TCIB) and the recently launched Pan-African Payment and Settlement System (PAPSS) which is the cross-border, financial market infrastructure enabling payment transactions across Africa.

Following the risks identified in Chapter 1, Section 1.6, the research objectives in Section 1.9.1 and the cautionary statement from the Central Bank of Zambia in Appendix 8.3, this study wishes to put forward the some policy recommendations tabulated below. And in making these preliminary recommendations, the study refers to the Bank of Zambia regulatory frameworks, laws and regulations (BOZ, 2019), the core principles for effective banking supervision from the Bank for International Settlements (BIS, 2018) and the global financial action task force recommendations (FATF, 2022) to which the Bank of Zambia subscribes.

Table 5.1:Policy Recommendations (Source: Authors Construct)

Regulatory Policy	Rationale	Recommendation
Circular 04/2015 - Issuance of Principles for Financial Markets Infrastructures (PFMIs) for payment systems efficiency. (BOZ, 2015) Directive on the National Financial Switch Implementation [2015-02-13], (BOZ, 2015). Directive on Electronic Money Issuance [2018-04-27], (BOZ, 2018). FATF REC 15,16 (New Technologies and Wire Transfers), (FATF, 2022).	To determine if the introduction of a Central Bank Digital Currency can improve the efficiency of payments systems platforms in Zambia.	Monetary authorities in Zambia should engage in further regulatory policy research that should focus on ways to improve the efficiency of payment system platforms. This study also recommends CBDC interoperability with already existing low value and high value payment systems platforms including all mobile financial services and the National Financial Switch (NFS). The model in this study can also be used to determine how Central Bank Digital Currency can improve the efficiency of payment systems platforms in Zambia.
The Prohibition And Prevention Of Money Laundering Act, 2002, (BOZ, 2017). The Bank of Zambia Anti-Money Laundering	To examine if the introduction of a central bank digital currency can make a stronger national defense against AML/CFT in Zambia.	Monetary authorities in Zambia should engage in further regulatory policy research that should focus on enhancing stronger national defense against AML/CFT.

Regulatory Policy	Rationale	Recommendation
and Combating Financing of Terrorism or Proliferation Directives, (BOZ, 2017). FATF REC 1, Assessing risks and applying a risk-based approach), (FATF, 2022).		The model in this study can be used to determine how a Central Bank Digital Currency can make a stronger national defense against AML/CFT in Zambia.
Directive on Electronic Money Issuance [2018-04-27], (BOZ, 2018). Directive on the National Financial Switch Implementation [2015-02-13], (BOZ, 2015). FATF REC 15,16 (New Technologies and Wire transfers), (FATF, 2022).	To demonstrate whether Central Bank Digital Currencies can ensure nondiscriminatory access to domestic financial services in Zambia.	Monetary authorities in Zambia should engage in further regulatory policy research that should aim at ensuring nondiscriminatory access to domestic financial services and for increased financial inclusion in Zambia. The model in this study can be used to determine how a Central Bank Digital Currency can ensure nondiscriminatory access to domestic financial services and for increased financial inclusion in Zambia.
Bank of Zambia costs of processing fiat currency.	To re-evaluate whether the introduction of a Central Bank Digital Currency can mitigate the cost of processing cash in Zambia.	Monetary authorities in Zambia should engage into further regulatory policy research that should focus on enhancing the efforts to mitigate the high cost of processing currency. The model in this study found that the phased introduction of a Central Bank Digital Currency inversely affects the cost of processing Currency. The high cost of currency processing with depend on the amounts of coins and notes in circulation.
Bank of Zambia cautionary Statement on Cryptocurrencies appendix 8.3. Bank of Zambia Statement on Village	To re-evaluate the Bank of Zambia cautionary statement on the use of cryptocurrencies and Statement on Village Banking/Savings Groups.	To Bank of Zambia to consider BIS core principles for considering a CBDC (BIS, 2020), to “do no harm” to monetary and financial stability; (ii) coexist with cash and other types of money in a flexible and innovative

Regulatory Policy	Rationale	Recommendation
Banking or Savings Groups appendix 8.4.		payment ecosystem; and (iii) promote broader innovation and efficiency. To achieve trusted, durable, and adaptable digital payments; any CBDC ecosystem must be secure and resilient to cyber, fraud and other operational risks.
BoZ Regulatory Sandbox Guidelines for Conducting Regulatory Sandbox [2021-04-01], (BoZ, 2021).	The Bank of Zambia currently has a directive on the Guidelines for Conducting Regulatory Sandbox [2021-04-01] , (BoZ, 2021).	This study recommends that the Bank makes a deliberate to facilitate the running of a proof of concept or a pilot project in a safe and controlled environment in the Sandbox. This will fully test the feasibility of CBDC in the Zambian jurisdiction and comprehensively test all the determinants of Central Bank Digital Currency as a means of a payment systems platform.

5.3.Study Limitations

In this research, the limitations to the study were due to the matters and occurrences which arose in the study and were out of the researcher's control. These factors limit the extensivity of the study which might have also affected the end result and conclusions. This research also encountered delimitations in terms of what the thesis could not perform and included the elements outside the boundaries that were set for this study. Unlike limitations which flow from implicit characteristics of method and design, the delimitations resulted from specific choices which were made by the researcher. The other delimiting factors from the study might have emerged from the limited choice of the main determinants of CBDC that was restricted to four (4) and many other motivating factors could lead to the consideration and adoption of a CBDC as highlighted in Chapter 1, Section 1.5.

The study could have considered the effects of a CBDC on monetary policy, effects of these determinants on an interest bearing CBDC and also the effects of a CBDC financial stability. This implies that there are other determinants of a Central Bank Digital Currency that could have been used in the study and might use this model and be applied in future CBDC research.

5.3.1. Time Series Limitations

The limitations of the time series data included inherent seasonal, cyclical and random variations which were associated with time series and removing them is quite a complex process (Ihaka, 2015). Hence this study did not remove the cyclical and random variations from the time series data that was used. The time series analysis used in the study also suffered from a number of weaknesses, including problems with generalization from a single study (Lannquist, Warren, & Samans, 2020). Therefore, due to these characteristics of the time series, the researcher felt that the methodology might have been impacted and could have also influenced the interpretation of the findings from the research.

Furthermore, Central Bank Digital Currencies (CBDC) are a recent phenomenon and there is continued research, pilot studies, proof of concept (POC) and the researcher recommends considering these findings in future CBDC research and hence suggests future research in Section 5.4.

5.4.Future Research

This research and the subsequent proposed recommendations provide a solid foundation for future research on Central Bank Digital Currencies as this recent phenomenon is fully tested in developing economies like Zambia. The author recommends future studies that may focus on how retail rCBDC, wholesale wCBDC and cross boarder or multi mCBDC can interoperate with other payment systems platforms and CBDC in the region and around the globe. Other studies can focus on the effects of CBDC on both financial stability and monetary policy implications.

1. How CBDC may retain monetary sovereignty for any jurisdiction and to mitigate the risk of privately issued virtual currencies and global stablecoins
2. How CBDC may improve financial stability and monetary policy effectiveness to implement targeted policy or tap more granular payment data to enhance macroeconomic projections.
3. How CBDC may enhance monetary policy transmission by an interest bearing CBDC and improve monetary policy effectiveness, and supervisory policies.
4. How CBDC may affect the distribution of fiscal stimulus distribution to the unbanked including incorporating helicopter or hot money.

5.5. Chapter Summary

The last chapter of the study starts with the introduction to the conclusions of the study. The chapter also provides the policy implications and recommendations on the determinants and feasibility of a Central Bank Digital Currency (CBDC) as a payment systems platform in Zambia and ends with the study delimitations and limitations as the last section of the study.

5.6. Conclusion

The study provided a model whose research results and conclusions demonstrate that Zambia can issue a Central Bank Digital Currency into the economy. The issuance of the CBDC should be in a phased approach in order to balance with fiat currency in circulation. From the research results in Chapter 4, there is statistically significant evidence which addresses all the study objectives including the overall overarching objective one (RO1). The study further established that increased internet penetration supports payment systems efficiency (P_p) which is significant for CBDC introduction in Zambia. Additionally, the research results meet research objective two (RO2) where the introduction of CBDC has the ability to improve the efficiency of payment systems platforms in the country. Furthermore, stronger defense against AML/CFT (P_A) is also highly significant and addresses research objective number three (RO3) of the CBDC ability to make a stronger national defense against AML/CFT in Zambia.

From the results in Chapter 4, we can conclude that the CBDC should interoperate with other already existing payment system platforms such as mobile financial services that are facilitated by internet penetration and mobile subscriptions which are the main determinates of issuing CBDC in a developing jurisdiction like Zambia. These are mainly driven by the need for stronger national defense against AML/CFT, nondiscriminatory access to domestic financial services and that the CBDC does not mitigate the high cost of processing fiat cash. The research further showed that a decision to issue CBDC could depend on the determinants explored in this study and that the issuance of CBDC is a double-edged sword that may result into the benefit of replacing physical cash for a more efficient payment system platform that comes at the cost of disrupting the deposit base for commercial banks. The process to issue a CBDC could also stretch the technical capacity and resources of even the best equipped central banks, in an environment where technology and risks are evolving rapidly. At the same time, outsourcing vital central bank functions to external vendors calls for great care and vigilance, given the functions' systemic importance and significant financial, operational, and reputational risks to the central bank.

The model also helped us better understand the conclusions in prior studies (Wenlong , Yang, & Peng, 2021), where their model showed how economic agents choose among cash, deposits, and CBDC, to maximize the utility while satisfying their basic payment need. Further, the (Keister, Todd; Sanches, Daniel, 2019) model on cash-like CBDC and deposit-like CBDC arrived at different conclusions for different types of CBDC. The model in this study, on the other hand, shows great flexibility and can be generalized to more complicated scenarios that can include other motivations for the determinants of Central Bank Digital Currency such as retaining monetary sovereignty, enhancing monetary policy transmission and a CBDC to contribute to financial stability. Lastly, our model can be easily incorporated into general equilibrium models to analyze the interactions among different economic determinants required for the introduction of a Central Bank Digital Currency in the Zambian jurisdiction. This research also concludes by advising the monetary authority, the Central Bank of Zambia, to review some of the processes, roles, and responsibilities that would need to be defined for creating, issuing, distributing, freezing, deactivating, and circulation of an electronic CBDC in its economy and take into consideration the following:

1. The monetary authorities in Zambia should take the opportunity to reshape and modernize payment systems infrastructure by leveraging on agile and resilient infrastructure in partnership with the technology regulators and authorities.
2. The Central Bank should take advantage of the opportunities presented by CBDC to lower the cost of compliance and supervision of financial institutions through embedded supervision.
3. The Central Bank of Zambia needs to act quickly and decisively in order to mitigate the risks posed by the growing number of private cryptocurrencies and stablecoins.
4. There is a great need for all monetary authorities and financial market players in Zambia to adopt strong cyber security frameworks and adhere to global standards to ensure interoperability and the wide adoption of CBDC across jurisdictions.

This research has also demonstrated that, based on the main research objective (RO1) which was to explore the prevailing determinants for introducing a Central Bank Digital Currency in Zambia, the study further concludes as follows. According to the specific research objective number two (RO2), which was to determine if the introduction of a Central Bank Digital Currency can improve the efficiency of payments systems platforms in Zambia. The study concludes that the internet penetration (P_p) is significant and meets (RO2) of the introduction of CBDC ability to improve the efficiency of payments systems platforms in Zambia.

The specific research objective number three (RO3) was to examine if the introduction of a Central Bank Digital Currency can make a stronger national defense against AML/CFT in Zambia and the research concludes that the broad money is also significant and addresses (RO3) of the CBDC's ability to make a stronger national defense against AML/CFT in Zambia. Further, the specific research objective number four (RO4) set out to demonstrate whether Central Bank Digital Currencies can ensure nondiscriminatory access to domestic financial services in Zambia and the study concludes that the increasing rates of mobile subscription (MS) demonstrates that CBDC can ensure nondiscriminatory access to domestic financial services in Zambia and meets the research objective four (RO4) of this study. The final specific research objective number five (RO5) is meant to evaluate whether the introduction of a Central Bank Digital Currency can mitigate the cost of processing cash in Zambia and the research concludes that the issuance of a CBDC does not address nor mitigate the high cost of processing cash in Zambia.

From the analysis and results, we have investigated the main prevailing determinants for introducing a Central Bank Digital Currency (CBDC) in Zambia addressing research objective one (RO1) and have ascertained that the internet penetration is significant and meets the research objective number two (RO2) of the introduction of CBDC ability to improve the efficiency of payments systems platforms in Zambia. Furthermore, the broad money (P_A) is also significant and addresses the research objective number three (RO3) of the CBDC ability to make a stronger national defense against AML/CFT in Zambia. Finally, the increasing rates of mobile subscription (MS) demonstrate that CBDC can ensure nondiscriminatory access to domestic financial services in Zambia and meets the research objective number four (RO4) of this study.

6.0 LIST OF PUBLICATIONS

During the course of this research, the author has made presentations, conference appearances and publications on the subject of Central Bank Digital Currency as a Payment Systems Platform and below are the list of publications.

PUBLICATIONS, PAPERS AND CONFERENCES

1. K. Kaponda, O.K. Mungule, A.M. Mwange, Publication on the “ The Cost of Cash Processing as a Determinant of the Central Bank Digital Currency: A Critical Analysis of the Zambian Case“ International Institute for Science, Technology and Education (IISTE), August, 2022, Available on URL: <https://www.iiste.org/Journals/index.php/JEDS/article/view/59422/61346>; DOI: 10.7176/JESD/13-16-01
2. K. Kaponda, O.K. Mungule, A.M. Mwange, Publication on the “ An Exploration of the Development of Central Bank Digital Currencies in Selected Countries “ International Institute for Science, Technology and Education (IISTE), August, 2022, Available on URL: <https://iiste.org/Journals/index.php/EJBM/article/view/59351/61276>; DOI: 10.7176/EJBM/14-16-02
3. K. Kaponda, O.K. Mungule, A.M. Mwange, Publication on the “Central Bank Digital Currency: Critical Analysis of the Two-Tier Model Consideration for Zambia”, International Institute for Science, Technology and Education (IISTE), August, 2022, Available on URL: <https://iiste.org/Journals/index.php/EJBM/article/view/59352/61277>; DOI: 10.7176/EJBM/14-16-03
4. K. Kaponda, Presentation to the Global Central Bank Digital Conference, The Determinants of CBDC and the need for Interoperability in Emerging Market and Developing Economies (EMDEs): Case of Zambia. Frankfurt, Germany, July 2022. Available on URL: <https://www.cbdc-conference.com/agenda/speaker>
5. K. Kaponda*, O.K. Mungule, A.M. Mwange, Analysis of the main determinant of a Central Bank Digital Currency in Zambia (CBDC), Critical Literature Review, August 2022, Submitted to the International Institute for Science, Technology and Education (IISTE), <https://iiste.org/Journals/>
6. K. Kaponda, An Interrogation into the Regulatory Challenges of Virtual Currencies on the Zambian Economy (December 17, 2020), University of Zambia (UNZA), Available at SSRN: <https://ssrn.com/abstract=3509503> or <http://dx.doi.org/10.2139/ssrn.3509503>
7. K. Kaponda, 7Th Governance, Risk and Compliance (GRC Zambia) conference on the subject of Digital Currencies: “The Promise of Central Bank Digital Currencies (CBDC) Security & Interoperability in Emerging Markets and Developing Economies (EMDEs), Avani Victoria Falls Resort, Livingstone, Zambia, October 14 – 15, 2021, Available on URL: <https://grczambia.com/>; https://grczambia.com/speaker-details_kombe.html

8. K. Kaponda, Presentation to the Digital Finance Practitioners of Ghana, Promise of CBDC & need for Interoperability in Emerging Market and Developing Economies (EMDEs) in African. September 30, 2021, Available on URL: <https://bit.ly/3mG5AI8>

7.0 APPENDICES

This section of the research contains the information that the researcher did not include in the main body of the report. These items are a reference and add more information to the main report. All the necessary appendixes are added on the subsequent pages.

7.1.APPENDIX A: US Congress Letter to Facebook Libra

MAXINE WATERS, CA
CHAIRWOMAN

United States House of Representatives
Committee on Financial Services
2129 Rayburn House Office Building
Washington, D.C. 20515

PATRICK MCHENRY, NC
RANKING MEMBER

July 2, 2019

Mark Zuckerberg
Founder, Chairman and Chief Executive Officer
Facebook
1 Hacker Way
Menlo Park, CA 94025

Sheryl Sandberg
Chief Operating Officer
Facebook
1 Hacker Way
Menlo Park, CA 94025

David Marcus
Chief Executive Officer
Calibra
Facebook
1 Hacker Way
Menlo Park, CA 94025

Dear Mr. Zuckerberg, Ms. Sandberg, and Mr. Marcus:

We write to request that Facebook and its partners immediately agree to a moratorium on any movement forward on Libra—its proposed cryptocurrency and Calibra—its proposed digital wallet. It appears that these products may lend themselves to an entirely new global financial system that is based out of Switzerland and intended to rival U.S. monetary policy and the dollar. This raises serious privacy, trading, national security, and monetary policy concerns for not only Facebook's over 2 billion users, but also for investors, consumers, and the broader global economy.

On June 18, 2019, Facebook announced its plans to develop a new cryptocurrency, called Libra, and a digital wallet to store this cryptocurrency, known as Calibra. To assist it in this venture, Facebook has enlisted 27 other companies and organizations to form the Libra Association, which is based out of Switzerland.¹ These companies span the financial services and retail industry and include payment systems, like Mastercard, Paypal, and Visa, and technology giants, like Uber, Lyft, and Spotify. By the target launch date of early 2020, Facebook hopes to have recruited over 100 firms into the Libra Association.

While Facebook has published a "white paper" on these projects, the scant information provided about the intent, roles, potential use, and security of the Libra and Calibra exposes the massive scale of the risks and the lack of clear regulatory protections. If products and services like these are left improperly regulated and without sufficient oversight, they could pose systemic risks that endanger U.S. and global financial stability. These vulnerabilities could be exploited and obscured by bad actors, as other cryptocurrencies, exchanges, and

¹ The 27 other members of the Libra Association are Mastercard, PayPal, PayPal (Naspers' fintech arm), Stripe, Visa, Booking Holdings, eBay, Facebook/Calibra, Farfetch, Lyft, MercadoPago, Spotify AB, Uber Technologies, Inc., Ilad, Vodafone Group, Anchorage, Bison Trails, Coinbase, Inc., Xapo Holdings Limited, Andreessen Horowitz, Breakthrough Initiatives, Rabbit Capital, Thrive Capital, Union Square Ventures, Creative Destruction Lab, Kiva, Merry Corps, and Women's World Banking.

Mr. Zuckerberg, Ms. Sandberg, and Mr. Marcus:
July 3, 2019
Page 2 of 3

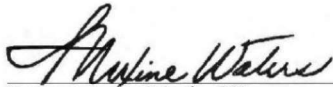
wallets have been in the past. Indeed, regulators around the globe have already expressed similar concerns, illustrating the need for robust oversight.²

Investors and consumers transacting in Libra may be exposed to serious privacy and national security concerns, cyber security risks, and trading risks. Those using Facebook's digital wallet – storing potentially trillions of dollars without depository insurance – also may become unique targets for hackers. For example, during the first three quarters of 2018, hackers stole nearly \$1 billion from cryptocurrency exchanges.³ The system could also provide an under-regulated platform for illicit activity and money laundering.

These risks are even more glaring in light of Facebook's troubled past, where it did not always keep its users' information safe. For example, Cambridge Analytica, a political consulting firm hired by the 2016 Trump campaign, had access to more than 50 million Facebook users' private data which it used to influence voting behavior.⁴ As a result, Facebook expects to pay fines up to \$5 billion to the Federal Trade Commission (FTC), and remains under a consent order from FTC for deceiving consumers and failing to keep consumer data private. In the first quarter of 2019 alone, Facebook has also removed more than 2.2 billion fake accounts, including those displaying terrorist propaganda and hate speech.⁵ It has also recently been sued by both civil rights groups⁶ as well as the U.S. Department of Housing and Urban Development for violating fair housing laws on its advertising platform and through its ad delivery algorithms.⁷

Because Facebook is already in the hands of over a quarter of the world's population, it is imperative that Facebook and its partners immediately cease implementation plans until regulators and Congress have an opportunity to examine these issues and take action. During this moratorium, we intend to hold public hearings on the risks and benefits of cryptocurrency-based activities and explore legislative solutions. Failure to cease implementation before we can do so, risks a new Swiss-based financial system that is too big to fail.

Sincerely,



Representative Maxine Waters
Chairwoman



Representative Carolyn Maloney
Chair
Subcommittee on Investor Protection,
Entrepreneurship and Capital Markets

² See, e.g. The Honorable Randal K. Quarles, Vice Chairman of Supervision for the Board of Governors of the Federal Reserve System and Chair of the Financial Stability Board, *Financial Stability Board Chair's letter to G-20 Leaders meeting in Osaka*, June 25, 2019, <https://www.fsb.org/2019/06/fsb-chair-letters-to-g20-leaders-meeting-in-osaka/>. ("A wider use of new types of crypto-assets for retail payment purposes would warrant close scrutiny by authorities to ensure that they are subject to high standards of regulation."); Bank of International Settlements Annual Economic Report, *Big tech in finance: opportunities and risks*, June 23, 2019, <https://www.bis.org/publ/afar2019e3.htm>. ("Big techs have the potential to become dominant through the advantages afforded by the data-network activities loop, raising competition and data privacy issues. Public policy needs to build on a more comprehensive approach that draws on financial regulation, competition policy and data privacy regulation... As the operations of big techs straddle regulatory perimeters and geographical borders, coordination among authorities – national and international – is crucial.")

³ CipherTrace Cryptocurrency Intelligence, *Cryptocurrency Anti-Money Laundering Report, 2018 Q3* https://ciphertrace.com/wp-content/uploads/2018/10/crypto_aml_report_2018q3.pdf

⁴ Kevin Grayville, *Facebook and Cambridge Analytica: What You Need to Know as Fallout Widens*, (March 19, 2018).

⁵ Facebook, *Community Standards Enforcement Report* (2019 Q1).

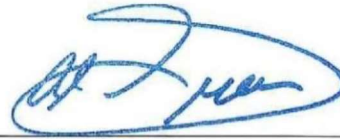
⁶ Complaint, Nat'l Fair Housing Alliance et al. v. Facebook, Inc., No. 18-cv-02689 (S.D.N.Y. Mar. 27, 2018), <https://nationalfairhousing.org/wp-content/uploads/2018/03/NFHA-v.-Facebook-Complaint-w-Exhibits-March-27-Final.pdf>.

⁷ Charge of Discrimination, U.S. Dep't of Housing & Urban Development v. Facebook, Inc., FHEO No. 01-18-0323-8 (March 28, 2019), https://www.hud.gov/sites/dfiles/Main/Documents/HUD_v_Facebook.pdf.

Mr. Zuckerberg, Ms. Sandberg, and Mr. Marcus:
July 3, 2019
Page 3 of 3



Representative Wm. Lacy Clay
Chair
Subcommittee on Housing, Community
Development and Insurance



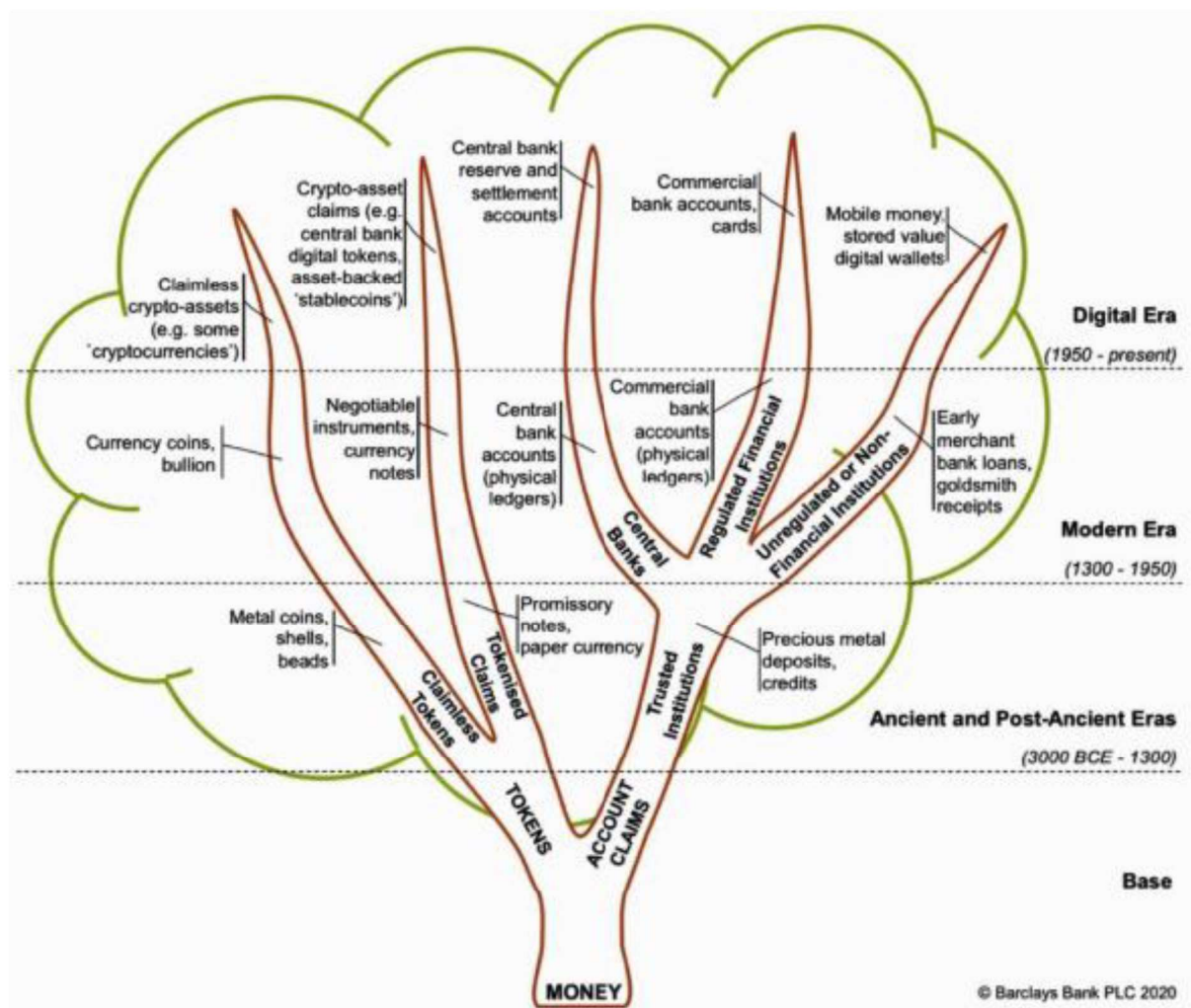
Representative Al Green
Chair
Subcommittee on Oversight and Investigations

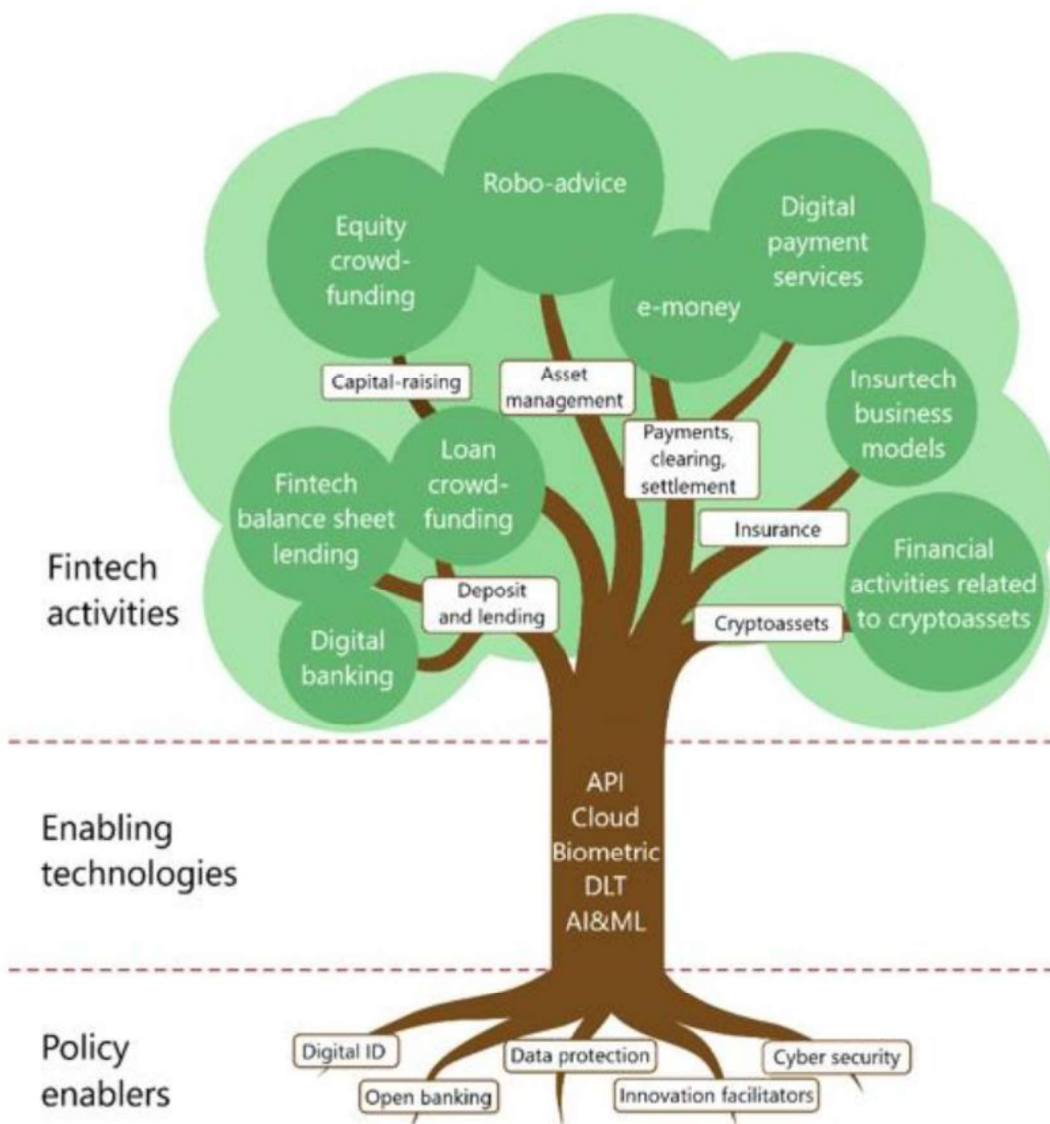


Representative Stephen Lynch
Chair
Task Force on Financial Technology

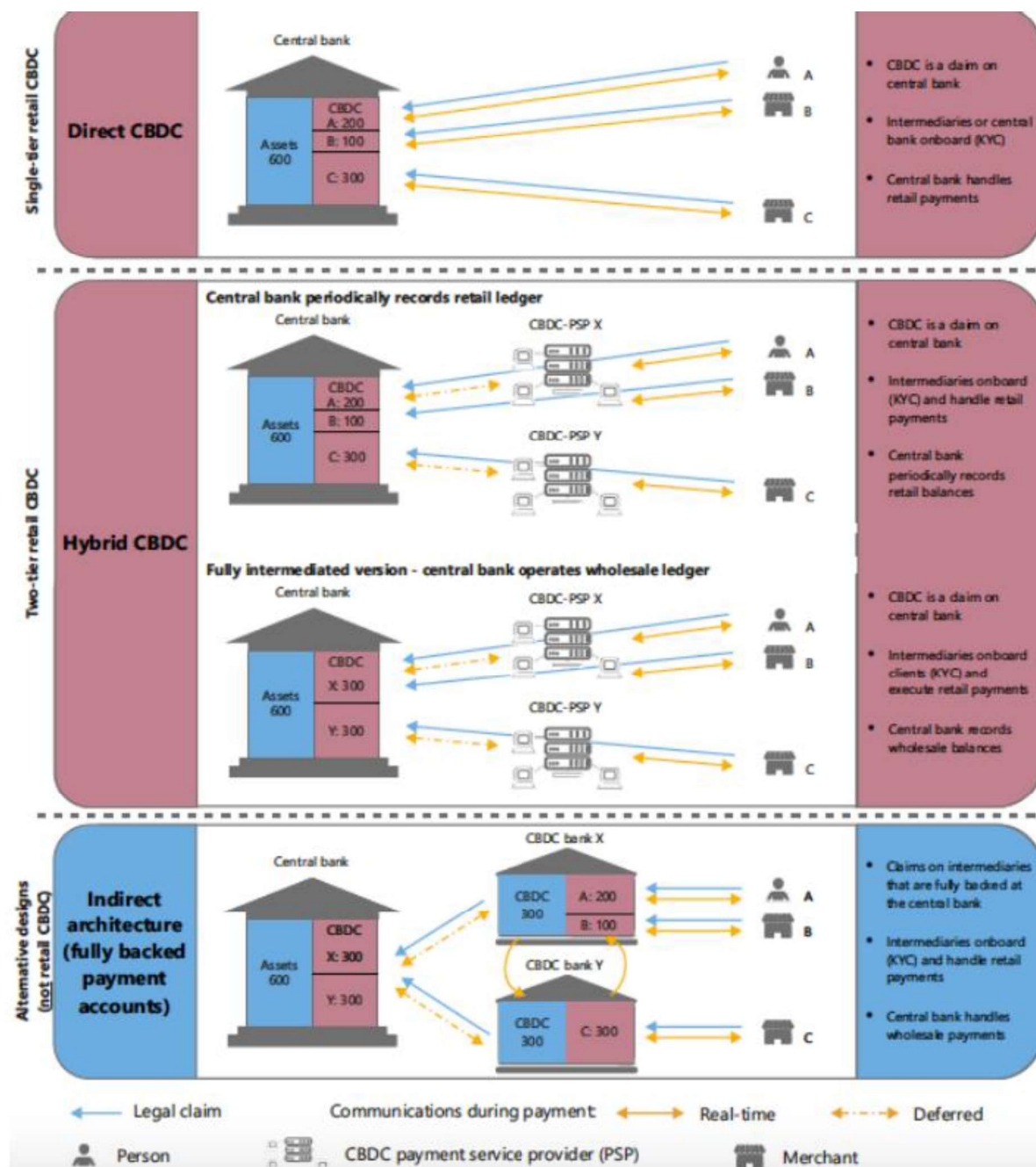
cc: The Honorable Patrick McHenry, Ranking Member

7.2.APPENDIX B: The Evolution of Money (Money Tree)





7.3.APPENDIX C: BIS Two-Tier Model



7.4.APPENDIX D: BoZ Cautionary Statement on Cryptocurrencies



PUBLIC NOTICE

PRESS RELEASE ON CRYPTOCURRENCIES

The Bank of Zambia (BoZ) has observed an increasing public interest in cryptocurrencies as evidenced by the growing number of enquiries that BoZ has been receiving on the subject.

While cryptocurrencies have some monetary characteristics, such as, being used as a means of payment on a person to person basis, cryptocurrencies are not legal tender in Zambia.

In order to safeguard the interests of members of the public and to maintain the integrity of the financial system in Zambia, the BoZ states as follows:

1. Section 30 of the Bank of Zambia Act vests the right to issue notes and coins exclusively in the BoZ. To date, BoZ has not issued any form of cryptocurrency. Cryptocurrencies are not legal tender in the Republic of Zambia;
2. BoZ does not oversee, supervise nor regulate the cryptocurrency landscape. Consequently, any and all activities related to the buying, trading or usage of cryptocurrencies are performed at owner's risk.
3. The general public should therefore fully understand and be aware of the risks associated with the use of cryptocurrencies.

4. Some of these risks include money laundering, financing activities of terrorism and general consumer protection risks such as fraud and hacking, to which in most cases, no legal recourse would be available to customers due to the unregulated nature of cryptocurrency-related transactions.

5. In line with BoZ's position that regulation should not constrain but enable innovation, BoZ will continue to actively monitor all developments.

Issued by: 

Head of Communications
Bank of Zambia
P.O Box 30080
Lusaka

7.5.APPENDIX E: BoZ Statement on Village Banking/Savings Groups



STATEMENT ON VILLAGE BANKING/SAVINGS GROUPS

Lusaka, Wednesday (16) September, 2020 – The Bank of Zambia (BoZ) reiterates its support to village banking/savings groups as they play an important role in providing community-based financial services although informally.

It must be noted that financial services are delivered through two main avenues, formal and informal.



Formal financial service providers include banks, non-bank financial institutions, and insurance and investment firms. These institutions are licensed, regulated, and supervised by regulators in the financial sector, namely, the Bank of Zambia, the Securities and Exchange Commission and the Pensions and Insurance Authority.

Informal financial service providers include individuals or groups of people that are not licensed nor regulated by the state or financial sector regulators. Examples include chilimbas and village banking/savings groups.



Village Banking/Savings Groups

Village banking/savings groups are small savings and lending schemes organised outside the formal financial sector. As the term "village" implies, membership is usually among people who are familiar with each other and share certain commonalities through their family, friends, and community. Membership is thus by self-selection and the number of members in the group is limited. Members formulate rules and procedures to guide the governance of the group. The group is self-managed and does not involve the placement of savings/deposits or arrangement of borrowings by an individual, agent or company outside the group membership.

Accumulated savings and interest earned on loans extended to members are the main source of benefits, which are shared-out at the end of the cycle.

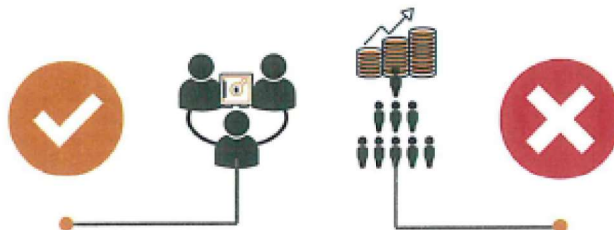
The Bank of Zambia Position on Village Banking/Savings Groups

The BoZ licenses, regulates, and supervises entities that are covered by the Banking and Financial Services Act, 2017 and these do not include village banking/savings groups. This notwithstanding, the BoZ recognises the relevant role village banking/savings groups play in communities, including transitioning their members into formal financial services and in driving the financial inclusion agenda.

Distinguishing Village Banking/Savings Groups from Money Circulation Schemes

Village banking/savings groups should be distinguished from money circulation schemes.

A money circulation scheme involves the pooling and distribution of funds by recruitment of subscribers. This is an illegal activity. One way to identify these schemes is that they tend to promise high returns or interest rates that are too good to be true. The core business model depends on the continuous recruitment of subscribers and not any meaningful underlying economic activity, which makes it unsustainable. It is thus a risky activity with no assurance that subscribers or investors will get back the money they have invested.

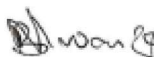


In a nutshell, it is an offence to:

- (a) Conduct, or participate in, a money circulation scheme; or
- (b) Issue a notice, circular, prospectus, proposal or other document inviting the public to subscribe to a money circulation scheme.

Members of the public are urged to be diligent and remain vigilant in their financial dealings, especially in the light of increased financial crimes as well as companies that lure people with the promise of high and unrealisable returns.

Issued by


Communications Division
Bank of Zambia
Box 30080
Lusaka
Email: info@boz.zm



September 16, 2020

7.6.APPENDIX F: SEC Notice on Cryptocurrencies and Assets



NOTICE ON CRYPTOCURRENCIES AND RELATED DIGITAL PRODUCTS/ASSETS

The Securities and Exchange Commission (“the Commission”) has noted the rise in popularity and prominence of cryptocurrency and related digital assets. These products/assets are numerous with their ever broadening form spanning from the famous Bitcoin, alternative coins, Initial Coin Offerings (“ICOs”) to other products/assets that are emanating from blockchain technology. Their market has grown rapidly with more and more people opting to use or invest in them.

The question running through most people’s minds is whether these products/assets are financial securities? The answer to this question largely depends on the characteristics and use of the particular product/asset under consideration. Some of the above mentioned products/assets, for example ICOs seem to possess features of financial securities. This is not to say that these products/assets are indeed financial securities but that they possess similar attributes. Whether any digital assets/products fit the description of a financial security in accordance with the Securities Act No. 41 of 2016 (“the Act”) will be assessed on a case by case basis focusing primarily on each asset/product’s characteristics, features and uses as indicated above.

Many have asked whether these products/assets are safe to invest in and if they fall under the Commission’s ambit. The fact of the matter is that currently these products/assets are not regulated by the Commission unless they meet the definition of a security as defined by the Act and this, as indicated above will be considered on a case by case basis.

It is for this reason that the Commission would like to urge any individuals or entities that are currently investing in or intend to invest in cryptocurrencies and related products/assets to exercise restraint and caution as they do so as the products/assets are largely unregulated and not subject to the jurisdiction of the Commission. It is also cardinal to recognize the fact that cryptocurrency product/asset markets span national borders and that significant trading occurs on systems and platforms outside Zambia. Invested funds therefore can quickly move across therein amplifying numerous risks including making it particularly difficult to pursue perpetrators in the event of fraud or any other undesirable occurrence.

The Commission would also like to advise investors, both current and potential, to observe extreme caution when dealing with self-proclaimed cryptocurrency educators, trainers and advisors (whose numbers are rapidly increasing) as the credibility and accurateness of their teachings and advice are unverified.

The Commission would further like to caution those that are operating any systems and platforms within Zambia that effect or facilitate transactions for the above mentioned products/assets to ensure that they are not in any way abrogating any part of the Act and that those that meet the description of securities in accordance with the Act are registered with the Commission.

In conclusion, we at the Commission believe that the emergent technology on which cryptocurrencies and other related digital assets/products are based may prove to be positively disruptive, transformative and efficiency enhancing. This could ultimately lead to an increased assortment of investible products/assets within financial markets and possibly enable the investment process to be made more efficient. However, as this process continues to develop, it is important that caution be observed by investors.

ISSUED: 13th February, 2018



Phillip K. Chitalu (Mr.)
CHIEF EXECUTIVE OFFICER
SECURITIES AND EXCHANGE COMMISSION

Tel: +260 211 227012/222369

Fax: +260 211 225443

Email: info@seczambia.org.zm

7.7.APPENDIX G: Central Bank of Nigeria Launch CBDC



www.cbn.gov.ng

Central Bank of Nigeria

Press Release

President Buhari To Unveil eNaira on Monday, 25 October 2021

President Muhammadu Buhari is scheduled to formally unveil the Nigerian Central Bank Digital Currency (CBDC), known as the **eNaira**, on Monday 25 October 2021, at the State House, Abuja.

The launch of the eNaira is a culmination of several years of research work by the Central Bank of Nigeria in advancing the boundaries of payments system in order to make financial transactions easier and seamless for every strata of the society. Following series of engagements with relevant stakeholders including the banking community, fintech operators, merchants and indeed, a cross section of Nigerians, the CBN designed the digital currency, which shall be activated on Monday, October 25, 2021.

The eNaira therefore marks a major step forward in the evolution of money and the CBN is committed to ensuring that the eNaira, like the physical Naira, is accessible by everyone.

Given that the eNaira is a journey, the unveiling marks the first step in that journey, which will continue with a series of further modifications, capabilities and enhancements to the platforms. The CBN will continue to work with relevant partners to ensure a seamless process that will benefit every user, particularly those in the rural areas and the unbanked population.

Since the eNaira is a new product, and amongst the first CBDCs in the world, we have put a structure to promptly address any issue that might arise from the pilot implementation of the eNaira.

Accordingly, following Monday's formal launch by the President, the Bank will further engage various stakeholders as we enter a new age consistent with global financial advancement.

The theme of the eNaira is: "Same Naira, more possibilities".

Visit the website to explore the benefits of our eNaira: www.enaira.gov.ng

A handwritten signature in blue ink, appearing to read 'Osita Nwanisobi'.

Osita Nwanisobi

Director, Corporate Communications

October 23, 2021

7.8.APPENDIX H: Central Bank of the Bahamas Launch CBDC



PRESS RELEASE

Project Sand Dollar: The Central Bank Identifies Preferred Technology Solutions Provider for Bahamas Digital Currency

The Central Bank of The Bahamas is pleased to announce the selection of NZIA Limited as the preferred technology solutions provider to design and implement the digital fiat currency system for The Bahamas. "Project Sand Dollar" is the official name for this payments system modernisation initiative. The Bank will commence negotiations with NZIA Limited to agree the final terms and scope of the engagement.

The selection of NZIA Limited reflects the company's expertise in resilient Internet of Things networks solutions. NZIA Limited brings together the collective know-how and expertise of IBM, a leader in enterprise blockchain, along with Zynesis Pte. Ltd., a Singapore-based software development company specializing in blockchain solutions.

The Central Bank expects that at the conclusion of this project all residents in The Bahamas will have equal, expanded access to modernised digital payments capabilities. A concurrent reduction in cash transactions is also expected. The evolved Bahamian payments infrastructure should reduce service delivery costs, increase transactional efficiency and improve the overall level of financial inclusion in communities throughout the archipelago.

Appropriate policy and legislative reforms will accommodate the functional aspects of a digital currency. The draft Central Bank of The Bahamas Bill, 2019, now before the Government, anticipates this framework, and will provide for the development of regulations to govern the instrument. The regulatory framework will include safeguards to satisfy Exchange Control Regulations; monitoring and controls against money laundering and terrorist financing, and specifications to ensure complementarity as opposed to material substitutability for existing banking services.

More details about Project Sand Dollar, including announcement of the Family Island communities chosen for the pilot phase, will be revealed in the coming weeks.

1 March 2019

7.9.APPENDIX I: Bank of Ghana Statement on Cryptocurrencies

BANK OF GHANA

NOTICE TO BANKS AND SPECIALIZED DEPOSIT-TAKING INSTITUTIONS (SDIs) AND THE GENERAL PUBLIC

NOTICE NO. BG/GOV/SEC/2018/02

DIGITAL AND VIRTUAL CURRENCIES OPERATIONS IN GHANA

The Bank of Ghana has taken notice of recent developments in the use, holding, and trading of virtual or digital currencies (also known as cryptocurrencies), such as Bitcoin in Ghana. The Bank of Ghana wishes to notify the general public that these activities in digital currency are currently not licensed under the Payments System Act 2003 (Act 662).

The Bank of Ghana is currently investing a lot of resources to further enhance the payments and settlements system, including digital forms of money and also to introduce cyber security guidelines to safeguard electronic and online financial transactions. A revised Payments System Act referred to as Payment Systems and Services Bill will be considered by Parliament within the next couple of months. This revision should bring the electronic payments space up to date to international standards and aligned with the evolving electronic payments landscape. While the Bank of Ghana acknowledges the enormous potential in the blockchain technology and how that can significantly transform the payments system landscape and promote financial inclusion, we are assessing with stakeholders and other international partners how the subsequent use of the blockchain technology into digital currencies would fit into the global financial and payments architecture.

The public is therefore strongly encouraged to do business with only institutions licensed by the Bank of Ghana to ensure that such transactions fall under our regulatory purview. For the avoidance of doubt, the public can always consult our website (www.bog.gov.gh) for a list of licensed banks and non-bank financial institutions in Ghana.

The Bank of Ghana assures the general public of its continuous efforts to safeguard the stability and soundness of the financial sector.

(SGD)
CAROLINE OTOO (MRS)
THE SECRETARY

7.10. APPENDIX J: Permission to Conduct Academic Research

AD-Currency

Kindly draft memo to DGA
confirming our ability to
help.

8/11/2021



November 01, 2021

ZCAS University,
School of Business,
Dedan Kimathi Campus, P.O. Box 32379
LUSAKA, ZAMBIA

The Deputy Governor - Administration
Bank of Zambia
Bank Square, Cairo Road
P.O. Box 30080
LUSAKA, ZAMBIA

Dear Madam,

RE: PERMISSION TO CONDUCT ACADEMIC RESEARCH IN YOUR
ORGANISATION – MR KOMBE KAPONDA.

We trust that this letter finds you well.

Mr. Kombe Kaponda (Student Number: ZU19316) is a Postgraduate Student pursuing a Doctorate in Business Administration (DBA) in the School of Business at ZCAS University. The student has completed the taught part of the programme and as part of the program, all candidates are required to conduct and publish the research in any renowned and peer-reviewed Journal article platform.

Mr. Kaponda proposed research area is around the *“Determinants of the Central Bank Digital Currencies (CBDC) as a payment systems platform: A Case of Zambia”*

In reference to the above, we seek your assistance to provide him with all the support that he needs to successfully accomplish his research work.

The focus group discussions and the responses that will be obtained will be treated confidentially and only for the purpose of the Academic research. We hope this request will meet your favourable considerations.

Yours Faithfully

Dr. Sidney Kawimbe
Dean - School of Business

Sidney.kawimbe@zcas.edu.zm

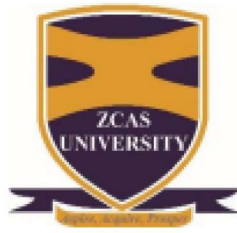
debut



Director Banking & Currency
Director Payment Systems
Are we able to assist
with this request?

02.11.2021





School of Business

29th October, 2021

Dear Respondent

Our student Mr Kombe Kaponda student No ZU19316 is carrying out a research titled **“Determinants of the CBDC as a payment systems platform: A Case of Zambia”** as part of the requirements for the Doctor of Business Administration degree. Participation in this study is purely voluntary. I would like to solicit your kind cooperation and take a couple of minutes of your precious time to fill up this questionnaire. All your responses will be treated with the strictest confidence, and will be solely used for purpose of research. Your involvement is highly appreciated as valuable contribution to the success of this study.

Any assistance availed to our student will be highly appreciated.

Should you have any queries, please feel free to contact the undersigned

Yours Sincerely,

Dr SIDNEY KAWIMBE

DEAN -SCHOOL OF BUSINESS

Email: Sidnev.kawimbe@zcas.edu.zm

Mobile: 0977 785194



4 May 2022

The Dean
School of Business
ZCAS University
Dedan Kimathi Road
P O Box 32379
LUSAKA

Dear Dr Kawimbe,

**PERMISSION TO CONDUCT ACADEMIC RESEARCH IN YOUR ORGANISATION -
MR KOMBE KAPONDA**

Reference is made to your letter dated 1 November 2022 requesting Mr Kombe Kaponda to conduct research at the Bank of Zambia "**Determinants of Central Bank Digital Currency as A Payment System Platform: A Case of Zambia.**"

We wish to acknowledge that the study by Mr Kaponda using Bank of Zambia public datasets, databases and any focus group discussions will be treated as confidential and for the purpose of academic research only.

The results from the research might be used for policy decisions if applicable.

We wish the student all the best in their studies.

Yours sincerely

Lazarous Kamanga
DIRECTOR - BANKING AND CURRENCY

7.11. APPENDIX K: Theoretical Model Equations

The payments assets for (P) for all the main determinants are denoted by ($P_C, P_B, P_D, P_F, P_A, P_P$), where P_C = Cash (C), P_B = CBDC (B), P_D = Deposits (D), P_F = Financial Inclusion (F), P_A = AML/CFT (A) and P_P = Payment systems Efficiency (P).

Equation 1: CBDC Main Variables

From the Payments assets (P)

$$P = P (\text{Cash, CBDC, Deposits, Financial Inclusion, AML/CFT, Payment Systems Efficiency}) \dots\dots\dots 1$$

$$P = P (P_C, P_B, P_D, P_F, P_A, P_P)$$

Equation 2: Payment Systems Efficiency (PSE)

$$PSE = (\text{Payment initialization} + \text{Payment Clearance} + \text{Payment Settlement}) \dots\dots\dots 2$$

$$P_P = (\text{Payment initialization} + \text{Payment Clearance} + \text{Payment Settlement})$$

Equation 3: Payment Efficiency with Error Disturbance

$$P_P = P_{Pt} + C_{Pt} + S_{Pt} + \varepsilon_t \dots\dots\dots 3$$

Equation 4: CBDC Payment Systems Efficiency

$$P_P = ((P_{Pt}) * (C_{Pt}) * (S_{Pt})) \dots\dots\dots (4)$$

Equation 9: AML/CFT Risk and Mitigation Relationship

$$AML / CFT (P_A) = \begin{cases} +\beta, & \text{if } f < 0 \\ -\beta, & \text{if } f \geq 0 \end{cases} \dots\dots\dots (5.1)$$

The study considers AML/CFT risk mitigants (β) on Narrow money (M0, M1), (FATF, 2014)

$$AML/CFT \text{ Risks} = \beta (M0 * M1) \dots\dots\dots (5.2)$$

The study also considers AML/CFT enforcement of the fines on Broad money (M2, M3), (FATF, 2014).

$$AML/CFT \text{ enforcement} = f(M2 * M3) \dots\dots\dots (5.3)$$

$$P_A = ((\beta (M0 * M1) + (f(M2 * M3))) \dots\dots\dots (5.4)$$

Equation 6: Normalized Value for Mobile Subscription Services (MS)

$$Ni = \text{Normalized value (MS)} = \frac{Yi - \text{State when no financial services are available}}{\text{Desired goal (ti)}} \dots\dots\dots(6)$$

$$Ni = \frac{Yi - 0}{ti} = \frac{Yi}{ti}$$

$$\text{Let } di = wi * Ni; \quad {}^2_i d = di * di$$

We formulate the equations for D^2 and W^2 as below

$$\text{Let } D^2 = {}^2_1 d + {}^2_2 d + \dots\dots + {}^2_k d = \sum_{i=1}^k t \quad {}^2_i d$$

$$\text{Let } W^2 = {}^2_1 W + {}^2_2 W + \dots\dots + {}^2_k W = \sum_{i=1}^k t \quad {}^2_i W$$

$$\text{and } (W - D)^2 = \sum_{i=1}^k t (wi - di)^2$$

we introduce additional parameters and let $MS_1 = \frac{\sqrt{D^2}}{\sqrt{W^2}}$ and $MS_2 = 1 - \frac{\sqrt{(W-D)t^2}}{\sqrt{W^2}}$

Equation 7: CBDC Fi index of Dimension

$$\text{CBDC } fi \text{ index dimension } (P_F) = \frac{MS_1 + MS_2}{t} \dots\dots\dots(7)$$

Cost = C1, C2, C3.....n, is nth indicator of all the costs associated with cash processing as shown below:

C₁ = Cost of Printing Currency

C₂ = Cost of Currency Management

C₃ = Cost of Currency Recycling_

C₄ = Cost of Currency Distribution

C₅ = Cost of Human capital for cash processing

C₆ = Cost of Currency Electronic Management and Security

C₇ = Cost of Currency Shredding machines

C₈ = Cost of Online Bracketing System Process (OBS)

C₉ = Cost of Soiled notes Management and reissuing

C₁₀ = Cost of Currency Processing

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.

C_n = Other cost of cash processing

Equation 9: Cost of Cash Processing as the CBDC is introduced

$$\text{Cost_CiC} = C_1 + C_2 + C_3 + C_4 + C_5 + C_6 \dots + C_n \dots (8.1)$$

$$\text{CBDC} = K \left(\frac{1}{\text{Cash_CiC}} \right) \dots (8.2)$$

$$\text{CBDC} = \left(\frac{1}{\text{Cash_CiC}} \right) \dots (8.3)$$

Therefore, these economic agents construct a portfolio with the following payment assets namely: Cash, Deposits, or CBDC which have to be efficient, mitigate AML/CFT and allow for financial inclusion in order to satisfy the payments systems efficiency (PSE), payment needs (P) and to maximize the utility (U) as shown below:

$$\max_{\substack{\{Cash, CBDC, Deposit, PSE, AML/CFT, fi\} \\ s.t (constraints)}} U = U(Cash, CBDC, Deposit, AML/CFT, Fi, PSE) \dots \dots (i)$$

Substituting the utility variables gives:

$$\max_{\substack{\{Cash, CBDC, Deposit, PSE, AML/CFT, fi\} \\ s.t (constraints)}} U = U(P_C, P_B, P_D, P_F, P_A, P_P)$$

Subject to constraints the payments need (P):

$$Cash + CBDC + Deposit = P \dots \dots \dots (ii)$$

$$U(Cash, CBDC, deposit, PSE, AML/CFT, fi) \dots \dots \dots (iv)$$

Substituting the utility variables gives:

$$U(P_C, P_B, P_D, P_F, P_A, P_P)$$

Table 7.1: Cash, CBDC and Deposits Utility Contributing Features

	Payment Systems Efficiency (P_P)	AML/CFT (P_A)	Financial Inclusion (P_F)	Central Bank Regulated
Cash (P_C)			√	√
CBDC (P_B)	√	√	√	√
Deposit (P_D)		√	√	

The utility-contributing features of cash (C), CBDC (B), deposits (D), Payment's efficiency (P), AML/CFT (A) and financial inclusion (F) are denoted by P_C , P_B , P_D , P_P , P_A , P_F as the

payments assets with features of cash, CBDC, deposit, payments efficiency, AML/CFT and financial inclusion respectively.

$$U(P_C, P_B, P_D, P_P, P_A, P_F) = (\alpha_C P_C^{-\gamma} + \alpha_B P_B^{-\gamma} + \alpha_D P_D^{-\gamma} + \alpha_P P_P^{-\gamma} + \alpha_A P_A^{-\gamma} + \alpha_F P_F^{-\gamma})^{-\frac{1}{\gamma}}$$

$$\begin{aligned} \max_{\{Cash, CBDC, Deposit, PSE, AML/CFT, fi\}} & U(P_C, P_B, P_D, P_P, P_A, P_F) = (\alpha_C P_C^{-\gamma} + \alpha_B P_B^{-\gamma} + \alpha_D P_D^{-\gamma} + \alpha_P P_P^{-\gamma} + \\ & \alpha_A P_A^{-\gamma} + \alpha_F P_F^{-\gamma})^{-\frac{1}{\gamma}} \\ s.t \text{ (constraints)} \end{aligned}$$

$$P_B = (\alpha_C P_C^{-\gamma} + \alpha_B P_B^{-\gamma} + \alpha_D P_D^{-\gamma} + \alpha_P P_P^{-\gamma} + \alpha_A P_A^{-\gamma} + \alpha_F P_F^{-\gamma})^{-\frac{1}{\gamma}}$$

Solving for the optimal

$$s.t \left\{ \begin{array}{l} P_C = Fi \\ P_B = PSE + \frac{AML}{CFT} + Fi \\ P_D = \frac{AML}{CFT} + Fi \\ P_P = CBDC \\ P_A = CBDC + Cash \\ P_F = P \\ P = Cash + Deposit + CBDC \end{array} \right.$$

Substituting with payments assets

$$s.t \left\{ \begin{array}{l} P_C = P_F \\ P_B = P_P + P_A + P_F \\ P_D = P_A + P_F \\ P_P = P_B \\ P_A = P_B + P_C \\ P_F = P \\ P = Cash + Deposit + CBDC \end{array} \right.$$

Financial inclusion ($P_F = P$) is the like portfolio (P) as the portfolio of assets and from the equation above, we can solve for the most optimal payment portfolio with and without the introduction of a CBDC in the Zambian jurisdiction as specified in the scenarios below.

1. Scenario 1: With an introduction of CBDC to the economy
2. Scenario 2: Without the introduction of CBDC to the economy

Scenario 1: Payment Portfolio with CBDC

$$CBDC^* = P \cdot \left(\frac{\alpha_P \alpha_A \alpha_F}{(\alpha_F + \alpha_D)(\alpha_P + \alpha_A)} \right)$$

$$\text{Cash}^* = P \cdot \left(\frac{1}{\left(\frac{1}{\alpha_F} + 1 \right)} \right)$$

$$\text{Deposit}^* = P \cdot \left(\frac{1}{\left(\frac{\alpha_A}{\alpha_F} + 1 \right)} \right)$$

Scenario 2: Payment Portfolio without a CBDC

$$\text{CBDC}^0 = 0$$

$$\text{Cash}^0 = P \cdot (\alpha_F + 1)$$

$$\text{Deposit}^0 = P \cdot (\alpha_A + \alpha_F)$$

$$\{\alpha_C + \alpha_B + \alpha_D + \alpha_P + \alpha_A + \alpha_F = 1\}$$

with minimum function less than zero (0), minimizes the cash in circulation

$$\min \left\{ \alpha_C, \alpha_B, \alpha_D, \alpha_P, \alpha_A, \alpha_F > 0 \right\}$$

and the maximum function less than one (1), maximizes the CBDC in circulation

$$\max \left\{ \alpha_C, \alpha_B, \alpha_D, \alpha_P, \alpha_A, \alpha_F > 1 \right\}$$

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