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The Role of Distributed Trust in the Design and Diffusion of Central Bank Digital Currencies (CBDCs): An Institutional Trust Perspective

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The Role of Distributed Trust in the Design and Diffusion of Central bank Digital Currencies: An Institutional Trust Perspective

by

Prince Egyir-Biney

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree

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ACCEPTANCE

This dissertation was prepared under the direction of the *PRINCE EGYIR-BINEY* Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Business Administration in the J. Mack Robinson College of Business of Georgia State University.

Richard Phillips, Dean

DISSERTATION COMMITTEE

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DEDICATION

This work is dedicated to my loving wife, **Dr. Priscilla Egyir-Biney,** and children, **Reindorf**, **Prince**, **Piers,** and **Paige**, for their sacrifices, patience, and support all throughout the three years of my academic journey at Georgia State University.

I also dedicate this work to my dear mother, **Madam Cecilia Biney**, my siblings, and the entire family, as well as my community of Gomoa Akwamu in Ghana, who continually inspired me to be the best version of myself and serve as a role model for the younger generation. I hope this journey will inspire many to pursue their dreams no matter the obstacles.

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LIST OF ABBREVIATIONS

ACGC	Atlantic Council Geoeconomics Center
B2C	Business-to-Customer
BIS	The Bank for International Settlements.
BOG	Bank of Ghana
BOJ	Bank of Jamaica
CBDCs	Central Bank Digital Currencies
CBN	Central Bank of Nigeria
DLT	Distributed Ledger Technology
FinTech	Financial Technology
IMF	The International Money Fund
KYC	Know Your Customer
P2P	Person-to-Person
PBC	People's Bank of China
POS	Point-of-Sale
WVS	World Value Survey

ABSTRACT

The Role of Distributed Trust in the Design and Diffusion of Central Bank Digital Currencies: An Institutional Trust Perspective

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Advancement in technology is rapidly expanding the development and adoption of private digital currencies such as Bitcoin. To stay ahead of the financial technology revolution, central banks around the world are introducing Central Bank Digital Currencies (CBDCs), which are expected to bring many benefits to countries. However, given that trust in government and public institutions, such as central banks, has been particularly low in recent years, the introduction of CBDCs may not be accepted by the general public. Research on the role of trust in technology acceptance has often focused on trust-building mechanisms in the formal institutional environment, with less attention given to the informal institution's role in building trust. The study draws on the complementarities between trust in formal and informal institutions as a valuable input in the trust-building mechanism for CBDCs acceptance. Using the conceptual framework of diffusion of innovations and the concept of distributed trust, this dissertation explores how CBDCs could be designed to take advantage of the trust-building mechanism in formal and informal institutions for successful diffusion. A Distributed Trust Matrix for CBDCs is developed to provide central banks with design choices within the context of trust-building mechanism expected in their CBDC projects. The study provides theoretical and practical

insights into the design and diffusion of CBDCs. At the same time, it contributes to the academic literature on the influence of trust on the diffusion of innovations.

INDEX WORDS: Central Bank Digital Currencies, CBDCs, Trust, Distributed trust, Distributed ledger, DLT, Blockchain, Institutional trust, Formal institutions, Informal institutions, Diffusion of innovations, Social network, Monetary policy, Central banks, Payment systems, Financial inclusion, Digital finance

I INTRODUCTION

The quotation below is an extract from an opinion editorial about Sweden's central bank digital currency, the e-krona, which was published in the Bitcoin Magazine of BTC Incorporated, by one Peter Bistoletti, who described himself as a Bitcoiner who has lived in Sweden since 1971.

> *"...with the e-krona, the Swedish government will be able to see, in real-time, every money that anyone makes. It will also be possible to decrease access to the e-krona, for example, via a social credit score or if one is not compliant with climate change propositions".*
>
> *".....with the e-krona, the government can freeze someone's financial resources and the Swedish state can directly tax customers' account".*
>
> *".... the programmable capabilities of e-krona could mean that people are prohibited from buying certain goods. There will be numerous ways to program the e-krona, which opens the way to a dystopian, Orwellian surveillance and control state".*
>
> *(Bistoletti, 2023, May, 11)*

The above statement, although may reflect governments' actions in extreme circumstances, encapsulates a real concern for many potential users of central bank digital currencies (CBDCs) around the world, driven by suspicion and the lack of trust in governments and the central banks that issued them.

Financial services in the last decade have experienced a major revolution driven by technological innovations. These financial technology innovations have even expanded further

after the COVID-19 pandemic, which has changed how people interact with one another and technology. These changes have come in the form of new technologies enabling remote work, advancement in artificial intelligence systems and automation, and, most importantly, digitization of financial services with the proliferation of several FinTech start-ups around the globe. The greatest impact of these innovations is happening in developing countries in the area of financial inclusion, where people who were otherwise cut from the formal financial system are now accessing banking and financial services through new technology-driven channels. There has been enormous growth in fast and convenient digital payment systems around the world, such as PayPal and Zelle in the U.S., Alipay and TenPay in China, Swish in Sweden, M-Pesa, and Mobile Money in Africa, and all these services are largely driven by the private sector (Mu & Mu, 2022).

On the flip side of the financial technology revolution is the emergence of private digital currencies or cryptocurrencies such as Bitcoin. With the rapid expansion and innovations in the payment systems and the development of new forms of money, such as Bitcoins by the private sector, central banks are determined not to allow the evolution of money and payments by-pass them and be controlled by the private sector (Mu & Mu, 2022). As of May 13, 2023, the total market capitalization of the two largest cryptocurrencies, Bitcoin and Ethereum, amounted to 1.8 trillion US dollars. The growth in cryptocurrencies is not just taking place in developed economies, but many in developing countries are trading and holding crypto assets. In April 2022, the cryptocurrency exchange Kucoin estimated that 33.4 million Nigerians use peer-to-peer networks to trade or possess cryptocurrency assets. (Sanusi, 2023, May, 23). In response, many central banks across the globe are exploring and developing CBDCs as a means of preserving their public policy objectives, such as increasing financial inclusion, controlling

monetary policy, improving domestic payment efficiency, and guaranteeing the general stability of their economies (Duho et al., 2022; Kim & Kwon, 2022; Mancini-Griffoli, 2018).

I.1 Central Bank Digital Currencies (CBDCs)

Central Bank Digital Currencies (CBDCs) can be described as sovereign-backed digital currencies with the same characteristics as cash, as a digital store of value, a medium of exchange, and a unit of account. (Ahiabenu, 2022). The Bank for International Settlement (BIS) defines a CBDC as "a digital form of central bank money that is different from balances in traditional reserve or settlement accounts" (Bank for International Settlements (BIS), 2022). The US Federal Reserve System defines a CBDC as "a digital liability of a central bank, with no associated credit or liquidity risk" (US Federal Reserve, 2022). Based on all the definitions above, CBDC can be described as having the following four key characteristics: (i) a digital form of cash (digital fiat money), (ii) legal tender, (iii) part of the Money Supply (M0), and (iv) a claim on the central bank. Instead of printing money, the central bank issues electronic tokens or accounts backed by the full faith and credit of the government or sovereign of a country.

In a survey of central banks published by the Bank for International Settlement in 2021 (Boar & Wehrli, 2021), it was found that advanced economies and developing countries have different motivations for CBDC development. Whereas central banks in advanced economies are motivated by the need to improve domestic payment efficiency and safety with CBDC, especially to counteract the growth and influence of private digital currencies/cryptocurrencies such as Bitcoin, central banks in emerging and developing economies are focusing on advancing financial inclusion with their CBDCs.

According to data from the Atlantic Council Geoeconomics Center (ACGC), as of the end of May 2024, the number of countries conducting research, developing, experimenting, piloting, and fully implementing CBDCs increased from 91 in March 2022 to 130, representing over 90% of the world's GDP. Since the start of the year 2020, eleven CBDC projects have been launched worldwide. These include China (Digital renminbi/E-CNY) in April 2020, the Bahamas (SandDollar) in October 2020, the Eastern Caribbean (DCash) in March 2021, Nigeria (eNaira) in May 2021, Jamaica (Jam-Dex) in July 2022 and Brazil (Drex). Over 21 countries are piloting their CBDC projects, whereas about 79 countries are either developing or conducting research on CBDC projects as of January 2024. Figure 1 shows the status of CBDC implementation across the globe.

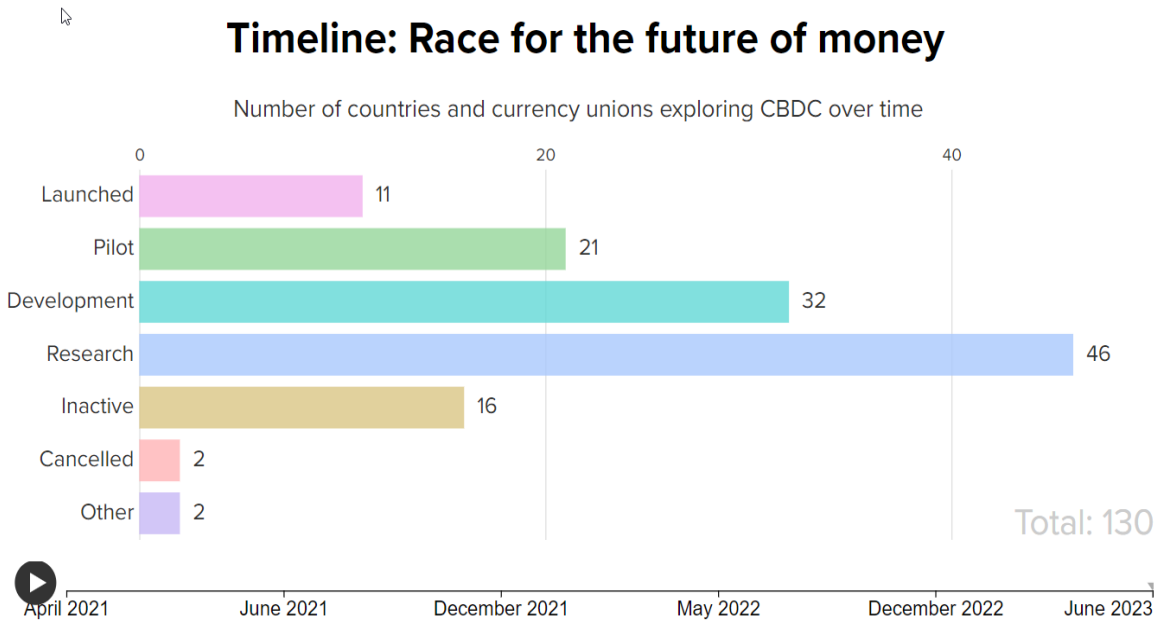


Figure 1: Global CBDC Implementation Status
Sources: Atlantic Council Research, https://www.atlanticcouncil.org/cbdctracker/

In the context of international trade and competition, certain countries are racing to outpace others in the development and issuance of CBDCs to preserve their competitive advantage in international trade and global financial influence (Tong & Jiayou, 2021). The

political urgency for central banks can be illustrated by the US Presidential Executive order issued in March 2022, which declared that the development of a CBDC is needed *to "... protect the United States and the global financial stability and mitigate systemic risk*" (United States Presidential Executive order, 2022). This is obviously in response to the fast pace of CBDC development in China and other countries. The competition and the race to obtain first mover advantage for global influence with central bank digital currencies is driving this urgency.

I.2 The Trust Problem of Central Bank Digital Currencies

Central banks play a critical role in the stability and effective functioning of the financial and monetary system of a country by ensuring public trust in money and supporting public welfare. A currency issued by the central bank, whether in the form of physical cash or digital currency, offers a common unit of account, store of value, the ultimate safe medium of exchange for goods and services, and settlement of financial transactions (Mu & Mu, 2022). This is an important advantage that issuers of private digital currencies such as Bitcoin do not have. However central banks suffer the collateral damage of public trust in government and its related institution, as a public institution working closely with the government. Several studies, such as Aghion et al. (2010) and Kuziemko et al. (2015) have shown that trust in government across the world has been at its lowest levels in recent decades. This was especially worse during the Covid-19 pandemic (Cena & Roccato, 2023; Hossain & Biswas, 2023; SteelFisher et al., 2023) when many individuals ignored warnings from governments and public health officials and took matters into their own hands in dealing with the pandemic.

Extant literature has also established that trust in government and public institutions varies across countries and has various implications for public policy, such as health services (Cena & Roccato, 2023; SteelFisher et al., 2023), income distribution (Fukuyama, 1996;

Kuziemko et al., 2015), government regulations (Aghion et al., 2010) and most importantly technology adoption (Gefen et al., 2003b; Kim et al., 2008; Pavlou, 2003). The World Bank Global Financial Inclusion Index 2017 concluded that about 7% of people aged 15+ globally do not have a bank account because of a lack of trust in financial institutions (Hess et al., 2020). Trust, or lack thereof, is a major impediment to improving financial inclusion and provision of financial access to the numerous unbanked populations across the world. There are fears and concerns that the launch of CBDCs in many countries may not be widely accepted by the general public due to the problem of trust in central banks and financial intermediary institutions involved in the delivery of CBDCs.

The trust problem is even much more exacerbated by the fact that transactions involving CBDCs are often done online, without physical interaction, lack of colocation, and social and emotional cues, which increases the risk of uncertainty, vulnerability, and unfair judgment (Jarvenpaa & Leidner, 1999; Srivastava & Chandra, 2018). The examples of the low rate of CBDC uptake in countries that have recently launched, such as Nigeria, Jamaica, and the Bahamas, indicate that without addressing the issue of trust, many of these CBDC projects may fail (The CBDC Tracker, 2024). For CBDCs to be generally accepted by the public, central banks must design their projects taking into account variations and differences in trust across countries and develop CBDCs with specific features that address such trust-related concerns and fears. Trust in institutions is critically important for the acceptance of CBDCs because trust is the main intrinsic value of a currency, as its validity and acceptance depend on the level of trust in the government and the central bank that issued the currency (Abdullah & Mohd Nor, 2018).

Trust has been found to play a critical role in the acceptance of new innovations across various types of products and services, including social commerce (Zhao et al., 2023), online

services (Aggarwal et al., 2021), e-government services (Ahmad & Khalid, 2017) and most importantly electronic payments services (Kissi et al., 2017; Moodley & Govender, 2016). However, what constitutes trust has not always been clear in the extant literature (Rousseau et al., 1998). Various authors have described the confusion around the definition of trust in terms such as 'conceptual confusion' and 'even conceptual morass' (McKnight et al., 2002). Most often, academics have defined trust from the perspectives of their specific academic domain. Economists view trust as either calculative or institutional (Williamson, 1993), Psychologists define trust according to the internal cognitive effects and characteristics of trustors and trustees (Tyler, 1990), whereas, from the Sociologist's perspective, trust is defined within the context of social relationships among people (Granovetter, 1985; Rousseau et al., 1998).

Most researchers agree that trust is a multidimensional construct, but even with that, there is still no full agreement as to what specific dimensions constitute trust. For example, when it comes to research on web trust, diverse and inconsistent definitions have resulted in difficulties in comparing results across studies (McKnight et al., 1998). Bailey, Gurak, and Konstan (2003) in their study on "trust in cyberspace," defined trust as the "perception of the degree to which an exchange partner will fulfill their transactional obligations in situations characterized by risk or uncertainty". In a broader sense, Gambetta (1988) defined trust as the subjective likelihood that a person or a group of persons will carry out a certain action in a situation when it influences their own interest, whether they have such capacity to monitor before or after such action is performed. A narrower definition is simply "confidence in another's goodwill" (Ring and Van de Ven 1992). Trust is defined as "a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another" (Rousseau et al., 1998).

Given the various definitions attributed to the concept of trust, and to avoid further ambiguity surrounding the concept, it is important that the definition is situated within the specific context of acceptance of new innovative technologies and social networks and from the viewpoint of business-to-customer relationships (B2C), which is quite relevant for central bank-to-user relationship. Therefore, this dissertation defines trust as a user's belief that the provider of an innovative technology has worthy attributes such as competency, honesty, and benevolence to protect their interest within a level of acceptable risk. (Gefen et al., 2003a, 2003b; Mayer et al., 1995; Pavlou, 2003). Just as there is no common consensus on the definition of trust, various researchers have proposed different concepts as dimensions of trust. Trust has been viewed in different dimensions, from institutional arrangement dimensions (Choudhury & Karahanna, 2008), based on the sociocultural context, consisting of social trust, general trust, and political trust (Newton & Zmerli, 2011). The dimensions of trust have also been studied from the perspective of the type, nature, and content of the social network influencing interaction with people and institutions (Tsai & Ghoshal, 1998).

A review of several empirical studies by Choudhury and Karahanna (2008) on the diffusion of electronic channels identified trust as one of the most important factors that influence users' perception of the relative advantage of new technological innovations. However, the work done by Choudhury and Karahanna (2008), like many other studies on the influence of trust on the acceptance of new innovative technologies, focuses on trust-building mechanisms in formal institutional systems, including structural assurance, situational normality, rules and regulations guiding the use of the technology, privacy, and security systems built around the product. The role of informal institutional factors, such as the influence of interpersonal connections with family, friends, and other social network variables, has been studied from the

perspective of social influence in general (Söilen & Benhayoun, 2021; Valente, 1996). However, the influence of the trust-building mechanism within informal institutions driven by social influence has received very little attention in the academic literature. This study posits that the trust-building mechanism for acceptance of new innovative technologies does not only flow through the formal institutional systems such as structural assurance, rules, and regulations guiding the use of the technology, privacy, and security systems and that the informal institutional environment also contributes to the trust building mechanism through social influence.

Adler (2001) identified three mechanisms through which trust is generated. He stressed that trust can be built through direct interpersonal interaction, representation through a network of other trusted parties, or through institutional factors, i.e., the way institutions shape the other actor's values and behaviors. All these three trust mechanisms complement each other. Social network connections and interpersonal interaction serve as important inputs in the formation of trust. It is therefore, critical to consider the influence of formal and informal social network connections of users of innovative technology as ingredients in the trust-building mechanisms. Given that a lot of confusion surrounds the definition of trust, and what constitutes trust dimensions, this dissertation seeks to contribute to the understanding of trust dimensions by highlighting the importance of trust in formal and informal institutions with specific reference to the type of social network connections linked to users.

Referencing Adler’s (2001) classification of trust, this study explores further the institutional mechanism of trust by looking into how trust in formal and informal institutions influences the design of new technological innovations, such as CBDCs, for successful diffusion. It seeks to explore how the trust-building mechanism in formal and informal institutions is

developed through the interaction of their respective formal and informal social networks. Informal institutions contribute to the building of trust in technology, especially in countries where trust in formal institutions, such as central banks, is particularly low, as people do not generally trust the government and related public institutions. Some of the causes of low trust in formal institutions have been attributed to factors such as institutional imperfections, weaknesses in the financial systems, suspicions about providers of new technologies, privacy issues, and government overreach (Acquaah, 2012).

Within the context of this dissertation, trust in formal institutions is derived from having confidence and faith in organizational arrangements, rules, procedures, and regulations and a sense of fairness and impartiality that the interest of the users of new technological innovation will be protected, despite facing fears of uncertainty and risk (Bachmann & Inkpen, 2011; Choudhury & Karahanna, 2008; McKnight et al., 1998). Trust in informal institutions is derived from the informal social patterns of connections often based on familiarity and sharing of mutual interest that allow one to be vulnerable to the conduct of another in the hope that the latter will carry out a specific task that is crucial to the former, regardless of whether the latter has the capacity and willingness to monitor and control the performance of the task (Brockman et al., 2020; Mayer et al., 1995). It must also be noted that the terms “trust” and “confidence” are used interchangeably throughout this dissertation to refer to the same concept.

Social networks play a critical role in trust-building mechanisms. Trust in formal institutions is linked to the formal social network, whereas trust in informal institutions is linked to the informal social network. Formal social networks represent patterns of relationships and the connections between individuals, groups, and institutions bounded by organized systems and structures, rules, regulations, and rigid chains of command. They often involve obtaining and

exchanging resources based on contractual obligations (Srivastava, 2015; Tucker, 2008). On the other hand, informal social networks are characterized by patterns of social connections often based on familiarity and the sharing of mutual interests. It is often in the form of friendship or family ties and not bounded by a sense of organized rules and structures (Srivastava, 2015; Tucker, 2008).

The theory of diffusion of innovations conceptualizes the complex behavior and social process by which new innovations are adopted. As information about the existence of new innovations flows through the social network, potential adopters are influenced based on their behavioral characteristics to accept such new innovations (Agarwal & Prasad, 1997; Moore & Benbasat, 1991). Several empirical studies have established strong connections between the theory of diffusion of innovations and social networks, as the rate of diffusion is impacted by the type of social networks, the level of embeddedness, and the strength of ties among users of the new technological innovations (Beaman et al., 2021; Brancheau & Wetherbe, 1990; Dover et al., 2012; Granovetter, 1983).

The studies highlighted above further reiterate the importance of social networks in the trust-building mechanisms toward acceptance of new technologies (Valente, 1996). Work done by researchers such as Aghion et al. (2010), on compliance with government regulations, revealed that government regulations are negatively correlated with trust in formal institutions and that under circumstances where trust is low, "*civicness made in families*," a form of informal institutional mechanism, helps to increase overall trust in government, as in the case of compliance with government regulations. At the country level of analysis, there is ample evidence to show that various levels of trust in formal and informal institutions across regions

have different implications on decision-making in areas such as investment decisions, technology adoption, etc. (Wei & Zhang, 2020).

Relying on the concept of distributed trust (Pal et al., 2021), this study posits the design configuration of CBDCs based on the type of architecture, infrastructure, and access technology combined in the system provides different choices of trust-building mechanisms for central banks which is important for successful diffusion. Distributed trust explains the mechanism through which trust is spread over several nodes in a network without overly relying on one central point of administrative authority (Chiu & Koeppl, 2019; Xi et al., 2015). The trust-building mechanisms improve as the number of independent nodes increases. When trust is distributed among many participants, failure on the part of one participant does not undermine the entire system. The concept of distributed trust is not new, as it has been the basis of many trust-building strategies for centuries. For example, distributed trust forms the underlying principles for the concept of separation of powers in our system of governance and segregation of duties in management theory. However, its recent application in blockchain technology extends the concept beyond human interaction into computers and technological systems (Liang et al., 2021). This study argues that central banks can take advantage of the distributed trust concept and design their CBDCs in a way that could overcome distrust among potential users.

I.3 Research Question

This study seeks to address the following research question.

1 How does the trust-building mechanism in formal and informal institutions influence the design configurations of central bank digital currencies (CBDCs) for successful diffusion?

I.4 Objectives of the Study

The study seeks to achieve the following objectives.

1 Develop a conceptual framework highlighting the interaction between trust in formal and informal institutions and how it impacts CBDC design choices.

2 Highlights the key differences across countries and regions and how different levels of trust in formal and informal institutions across these countries and regions could impact the design configuration choices available to central banks.

3 Develop a Distributed Trust Matrix for CBDCs that will serve as a helpful guide to central banks when making decisions on CBDC design options.

4 Contribute to the literature on trust in the diffusion of innovations by highlighting the importance of trust in formal and informal institutions and its linkages with the social network of users.

I.5 Significance of the Study

The dissertation seeks to contribute to the literature on the role of trust in the diffusion of innovations and acceptance of new innovative technologies by highlighting the importance of analyzing trust from an institutional perspective. The "conceptual confusion" surrounding trust is not only limited to its specific definition but also its constituent components, the dimensions of trust (McKnight et al., 2002; Rousseau et al., 1998). Adler (2001) argued that, trust has four dimensions consisting of sources, mechanisms, objects, and bases with their related components. He clarified that, in contrast to the trust-building mechanism, which entails direct interpersonal contact, reputation, and institutional context, sources as a trust dimension include familiarity through repeated engagement, a calculation based on interests and norms that produce predictability and trustworthiness. Objects as a trust dimension have components including

individuals, systems, and collectivises whereas bases a trust dimension has consistency, contractual trust, competence, benevolence, honesty, integrity, etc as its components.

It must be noted, however, that the typologies used here to explain the dimensions of trust have often been criticized as too complex, overlapping, and inconsistent (Harrison et al., 2023). To provide a simpler lens through which to view trust dimensions, this study builds on the institutional context provided by Alder (2001) and shares additional insights into the mechanism through which trust is formed as an interaction between formal and informal institutions and their connections with the social network characteristics of potential users of technology.

CBDCs are very recent innovations, and therefore, it is not surprising that there has been a limited number of empirical studies directly on CBDC diffusion, especially from the adoption and acceptance of new innovative technologies perspectives. Most central banks are still trying to figure out the right design specifications needed to achieve their expected results. Therefore, one of the critical areas of CBDC implementation that needs more attention is how the CBDC design specifications fit into the well-established theories of technology acceptance, such as the diffusion of innovations. By their distinct design configurations and hierarchy, CBDCs provide an opportunity to delineate key components of the design features of new technological innovations and how they influence the building of trust in the technology. The Distributed Trust Matrix for CBDCs is a framework that will serve as an important guide to central banks in the design configurations of their various CBDC projects. It provides central banks with design choices within the context of their specific country's circumstances by not necessarily implementing a particular type of CBDC just because other countries are implementing the same system.

The majority of publications on CBDCs have come from practitioner journals on banking, financial technology, and international development finance institutions such as the World Bank, the International Monetary Fund (IMF), the Bank for International Settlements (BIS), and other central banks around the world. These publications either covered monetary theory and policy implications of CBDCs or technology design specifications. However, there has been limited research from the perspective of user acceptance of this innovative technology in the academic literature (Söilen & Benhayoun, 2021). As a result of this gap in the literature, innovative characteristics and factors that influence the acceptance of CBDCs have not been fully studied. This dissertation seeks to contribute to the literature on trust as one of the most important factors that influence the acceptance of new innovative technologies, such as CBDCs. It also contributes to the literature on CBDCs by linking the trust-building mechanisms to the design configurations of the technology. Through the Distributed Trust Matrix for CBDCs, this study seeks to provide a guiding framework to central banks in their decisions on CBDC design configurations in order to take full advantage of the trust-building mechanisms between formal and informal institutions for successful diffusion.

II RESEARCH APPROACH

II.1 Research Design

Research on CBDCs has been fairly recent and limited to a few practitioner journals such as the Journal of Payments Strategy and Systems and mostly publications by central banks and international development institutions such as the International Monetary Fund (IMF), the World Bank, and the Bank for International Settlements (BIS). The limited publications on CBDCs in academic journals mostly center on monetary policy and macroeconomic implications on the economy (Chiu & Davoodalhosseini, 2023; Kim & Kwon, 2022; Tong & Jiayou, 2021). A significant gap exists in the area of research on the adoption of CBDCs from the well-developed field of technology acceptance, using theories such as diffusion of innovations, TAM, and UTAUT (Söilen & Benhayoun, 2021).

From the diffusion of innovation context, CBDCs are instruments of central banks, which require a country-level analysis. However, collecting primary data across countries may be time-consuming and logistically challenging. With such limitations in mind, this study utilized the pluralistic research methodology (Mingers, 2001; Müller et al., 2021) by combining 3 different research methodologies, including a systematic literature review, quantitative analysis of secondary data on trust across countries, and a case study of 3 CBDC projects. Using a pluralist methodology, the researcher benefits from triangulation by combining data sources, research methodologies, and conclusions (Tilooby, 2018; Van de Ven, 2007). The systematic literature review combined two streams of literature: a well-developed literature stream on the influence of trust on the diffusion of innovations and acceptance of new innovative technologies and an emerging literature on CBDCs, mainly from the technology design perspective. Whereas pluralist methodology is essential for bringing together the multidimensional perspective of a

phenomenon (Mingers & Brocklesby, 1997), it is also useful in studying a phenomenon using multiple methods to draw uniform conclusions (Mingers, 2001). Information systems research benefits from gaining rich and comprehensive insights from studies drawing on multiple theories (Müller et al., 2021) and research methodologies (Baskerville & Myers, 2002). This dissertation, as a design and evaluation research (Van de Ven, 2007), seeks to draw such rich insights from the combination of multiple research methods, consisting of well-developed literature on the influence of trust on the diffusion of innovations and acceptance of new innovative technologies and largely practitioner literature on CBDCs. Country-level quantitative data and case studies were used to provide empirical support for the propositions drawn from the systematic literature review.

II.2 Population of the Study

CBDCs are primarily instruments of central banks, and therefore, this study is positioned at the country level of analysis. The population of the study were countries, most of whom are in different stages of CBDC project implementation. Our secondary quantitative data covered about 102 countries across all continents and regions of the world. The secondary data was obtained from two sources, the World Value Survey 2014 -2022 and the Gallup-Meta global social connections survey 2023. This was followed by a case study of three (3) CBDC projects at various stages of development. The selected projects include China e-CNY, Jamaica -JAMREX, and Nigeria - eNaira.

II.3 Systematic Literature Review

Given the research gap in the literature, with respect to limited studies on CBDC adoption using the well-established theories of technology acceptance, such as diffusion of innovations, a systematic literature review was conducted on two main literature streams. The

first stream of literature is about the influence of trust on the diffusion of innovations and acceptance of new innovative technologies, mainly from a sample of empirical studies published in academic journals. The second body of literature comes from mainly practitioner journals on financial technology, banking, and other related fields, as well as publications by international development institutions such as the World Bank, IMF, Bank for International Settlement, and central banks across the world on CBDCs.

We followed the systematic literature review process adopted by Byba and Dingsoyr (2008) which involves developing a procedure, identifying inclusion and exclusion criteria, searching for suitable studies, evaluating them critically, and extracting data for analysis.

II.3.1 *Data Sources and Search Strategy*

A comprehensive search of the literature for peer-reviewed articles using the search text *"(institutional trust) and (social trust), and (diffusion of innovations) and (technology acceptance, or acceptance of technology, or technology innovation) "* was used for the first stream of literature on trust. The following electronic databases were used.

- ProQuest/ABS Inform,
- EBSCOhost/Academic Source Complete, Business Source Complete, and
- Web of Science

The search produced a total of 802 papers. Using the inclusion and exclusion criteria (Dybå & Dingsøyr, 2008), including the removal of duplicates and a refined search for **full text**, language in **English,** and publication date between 2010 and 2024, this was further reduced to 237 publications. Selecting the most relevant articles by reading the abstracts and/or a quick glance through the papers and also including other highly relevant articles from credible journals,

a total of 15 papers were reviewed as critically important to understand the role of trust and social influence on acceptance of new innovative technologies, also taking into account studies done across different countries, especially developing countries and also covering different types of technological innovation. Using the snowball search strategy (Wohlin et al., 2022), which involved using the reference list or the citations in the publication to identify further papers, we expanded our list of relevant papers to 54 articles, with 15 papers providing direct empirical evidence on the role of trust in acceptance of new innovative technologies, and the remaining papers providing theoretical insights, conceptual frameworks, and definitions which were all relevant for the comprehensive understanding of the role of trust in technology acceptance.

For CBDCs, the systematic literature search for articles using the search terms *"(central bank digital currenc* or CBDC*) was used* in the database in EBSCOhost/Business Source Complete. The search database was limited to only EBSCOhost/Business Source Complete since the subject of interest is business application and technology use. Unlike the concept of trust, which attracts multidisciplinary research interest across different fields of study (McKnight & Chervany, 2001; Rousseau et al., 1998), CBDCs are about finance, banking and payment systems technology and, therefore, have a limited span of research works across different disciplines. Therefore, to reduce the noise around the search, it was limited to only EBSCOhost/Business Source Complete. The initial search produced a total of 1,083 papers. Applying the inclusion and exclusion criteria (Dybå & Dingsøyr, 2008), removal of duplicates, and a refined search for **full text**, language in **English,** and publications dated between 2010 and 2024; this was further reduced to 154 papers. A total of 53 papers were considered to be highly relevant for the study. The majority of the papers were published by international development institutions such as the World Bank, the International Monetary Fund (IMF), the Bank for

International Settlement (BIS), and central banks across the world. Appendix 1 shows the systematic literature review process used for the study.

II.4 Quantitative Data Sources and Analysis

To understand the variations in trust across regions and countries of the world, this study required data on trust and social network ties at the country level of analysis. However, given the limitation of the lack of direct data on trust across countries and the enormous resources that may be required to collect primary data, this study used the closest possible secondary data as proxies from the World Value Survey Wave 6 and 7 (2014, 2022) and the Gallup-Meta Global State of Social Connections Survey (2023) to construct the trust variables.

The World Value Survey Association (WVS) is a global network of social scientists exploring changing values and their influence on social and political life (Aghion et al., 2010). It is led by an international team of researchers with a secretariat based in Stockholm, Sweden. The survey was first conducted in 1981, applying the most rigorous, high-quality research designs available in each country through the use of a common questionnaire and covers almost 90% of the world's population. The most recent survey covered almost 400,000 respondents through interviews (World Value Survey Association, 2014). The WVS is the biggest non-commercial cross-national time series study of human beliefs and values ever carried out. It is also the first scholarly research that examines the whole spectrum of variations of social variables in all of the world's main cultural zones, from extremely poor to highly affluent nations (Kim & Li, 2014).

For this study, country-level data on the three trust variables were analyzed for 102 countries. (N=102) using data from the latest WVS Wave 7 which was collected between 2017-2022. Where there are missing data, it was supplemented with data from WVS Wave 6, collected

between 2010 -2014. Results from respondents were originally reported in percentages for each category of answers on the questionnaire. Most responses were standardized across countries.

To standardize all the responses across the three variables and also allow for statistical analysis of the data, this study converted the percentages into ordinal variables starting from 0 to the highest value of 10 (Pal et al., 2021). For example, answers to questions on trust were converted at (a) Trust completely = 10, (b) Trust somewhat = 5, (c) Do not trust very much = 3, (d) Do not trust at all, and (e) Don't know/ No answer = 0. The average of the scores for each response was used to represent the scale for respective countries. To ensure completeness of the data structure, given the relevance of social network ties to the trust-building mechanism from a formal and informal institutions perspective, the study included data on social network ties from the Gallup-Meta Global State of Social Connections Survey (2023).

The Gallup-Meta Global State of Social Connections Survey (2023) is a collaboration between Gallup and the social network company Meta, owners of Facebook and other social networks. Gallup, Inc. is an American multinational analytics and advisory company based in Washington, D.C., USA, best known for conducting public opinion polls worldwide. Gallup provides analytics and management consulting to organizations globally (Gallup, 2023). The Meta-Gallup State of Social Connections research indicated significant differences in people's feelings of connectivity and loneliness among people in 142 countries. The survey included questions and responses on the strength of social network ties across these countries.

The 102 countries surveyed were further categorized into eight (8) groups according to the regions of the world. Studies have shown similarities in culture and social systems for countries within these regions of the world (Aghion et al., 2010) . For this study, the following

world regional groupings were used: 1) Europe, 2) North America, 3) Asia, 4) Middle East and North Africa (MENA), 5) Africa, 6) South America, 7) The Caribbean, and 8) Oceania.

II.5 Case Study Methodology of three (3) CBDC Projects

To provide empirical support to validate the role of distributed trust in the design choices for central banks, the dissertation developed three case studies of CBDC projects. These cases were selected based on the advanced stage of their CBDC project implementation. China currently has the most advanced and extensive pilot implementation of CBDC in the world, whereas both Jamaica and Nigeria have fully launched their projects into live environments. The cases were developed using data on CBDC projects in each of the case study countries from sources including project implementation reports, press releases, speeches by top officials of central banks, news articles, and journal publications. Content analysis was conducted using NVivo. Open coding strategy (Myers, 2020) was used to identify emerging themes in the various design configuration decisions made by the central banks. The result of the case analysis is presented in the discussion section.

III CENTRAL BANK DIGITAL CURRENCY DESIGN

The concept of making digital money available to the general public is not new, as revealed by the analysis of the literature on CBDC. To improve payments and lessen the dependency on deposit insurance, Nobel laureate James Tobin (1987) suggested the concept of "*deposited currency*," or *"a medium with the convenience of deposits and the safety of currency,*" as a way to bypass the heavy reliance on payment system deposit insurance (Ahiabenu, 2022; Tobin, 1987). Many central banks experimented with the idea of cryptocurrency technology and how that could be used to provide government-issued digital currencies in an apparent response to the launch of Bitcoin in 2008. By 2015, central banks in Canada, the Netherlands, and Singapore had commenced research and internal experiments on the use of Distributed Ledger Technology (DLT), which generally yielded inconclusive outcomes regarding the scalability of the system (Raphael Auer et al., 2021).

III.1 Evolution of Central Bank Digital Currencies (CBDCs)

Money is one of the greatest inventions of humankind, alongside fire and language since the beginning of civilization (Yamaoka, 2023). Throughout history, many different artifacts have been used to represent money. Examples of such items have been shells, gold, silver, copper, and some foods like wheat and corn. Before the invention of money, trade and economic transactions were conducted under the “Barter system”, where goods and economic benefits were exchanged for each other in economic transactions. Eventually, precious metals like gold and silver became the main representation of money for centuries. Between 1816 and 1971, paper currency in exchange for gold was introduced as the main medium of exchange for most trade and economic transactions around the world.

Major challenges began to show with the use of the gold-backed currency, especially in terms of a decline in purchasing power. Renowned economists at the time, despite their open disagreements about economic theory, quantity theorists Fisher and Friedman, mercantilist/purchasing power theorist Keynes and Hayek suddenly united around the demise of gold to propose a more effectively managed global monetary architecture based on the management of *"purchasing power to stabilize prices"* (Abdullah & Mohd Nor, 2018). The managed currency system, otherwise known as the 'Fiat Currency', which is the present-day paper currency without gold backing, was introduced in 1971 alongside the coming into being of the Breton Woods financial institutions and integration of the global financial architecture.

Under the fiat currency arrangement, governments across the world, through their central bank, issued paper and coin currencies that are not backed by gold or any other precious commodity but by the full faith and sovereign authority of the country of issue. **Institutional trust became the main intrinsic value of the paper currency as its validity and acceptance depended on the level of trust in the government and the central bank that issued it**. Today, different forms of money have evolved out of the fiat currency. Adrain and Macini-Griffoli (2021) developed the 'money tree' which groups all existing forms of money based on four key attributes, including 1) whether the money represents a **claim** or an object, 2) whether it is **redeemed** at a fixed or variable value, 3) who the **backstop guarantee** rest with, either the government or private entities and, 4) whether the **settlement technology** is built on a centralized or decentralized system.

Based on these characteristics above Adrain and Macini-Griffoli (2021), classified money into five forms. First, is **Central bank money**, which is the foundation of the unit of account feature of money and with the government as the backstop. Central bank money could be

presented in the form of cash, consisting of notes and coins in circulation, or CBDC with either a centralized or decentralized technology. The second form of money is **Bank money** (bank deposit) has a fixed value redemption with the government as the backstop, for example, debit card, current account, etc. The third form of money is **Electronic money** (E-Money). E-Money has fixed value redemption just like bank money, but their backstop is with private entities and may have either a centralized infrastructure, for example, Alipay, WeChat Pay, M-Pesa or built on a decentralized system, for example, Paxos, USD Coin, TrueUSD, etc. The fourth form of money, **Investment money** (I-Money), has variable-value redemptions and is built on a decentralized system. Gold coins could be considered an example of I-Money. Lastly, **Cryptocurrencies**, such as Bitcoin, Ethereum, etc, which are built on a decentralized technology and with their value determined by market forces are grouped in the last category of forms of money. The focus of this study will be on CBDCs, which are part of Central bank money, as discussed previously.

A number of central banks began research on digital currency for commercial reasons starting in 2016. A few of them concentrated on using DLT for wholesale interbank and international payments. Some central banks worked together to provide wholesale CBDCs for international payments. However, with respect to retail CBDCs, which is the main focus of this study, Sweden's Riksbank was the first to carry out work on a CBDC that was intended for use by the general public, the ‘e-krona’. (Rapheel Auer et al., 2021; Riksbank, 2017). The "e-krona" project has evolved over time since then, including re-aligning with the current scope and needs. Eleven (11) CBDC initiatives have been introduced globally since the year 2020 began. These include the Digital Renminbi/e-CNY in April 2020 for China, SandDollar in the Bahamas, DCash in the Eastern Caribbean, eNaira in Nigeria; Jam-Dex in Jamaica, and Drex in Brazil.

Today, the number of nations involved in some form of CBDC project has risen to 130 as of the end of January 2024, according to statistics from the Atlantic Council Geoeconomics Center (ACGC). These countries constitute over 90% of the global GDP. As of January 2024, more than 21 nations have launched or are piloting their CBDC projects, while over 79 countries were either developing or researching CBDC programs.

III.2 Benefits of Central Bank Digital Currencies (CBDCs)

Many countries are embarking on introducing CBDCs for the enormous potential benefits expected from the projects. Analysis of the literature on CBDCs has identified six key benefits expected from the introduction of CBDCs. These include helping to promote greater **financial inclusion**, enhancing **payment efficiency**, **expanding the tax base** of the country, serving as an instrument for flexible **monetary policy**, helping **limit illicit transactions**, and serving as a **payment backstop** to boast confidence and safeguard the interest of the general public in the use of digital currencies in general (Allen et al., 2020).

III.2.1 *Financial Inclusion*

Because central banks have public policy objectives rather than profit-making objectives, this enables them to provide welfare and inclusive services. Advancing financial inclusion was one common objective of introducing CBDCs by almost all central banks in developing countries (Boar & Wehrli, 2021). For example, in The Bahamas, the Central Bank of the Bahamas is introducing its CBDC (Sand Dollar) to help provide access to finance since parts of the population are excluded from financial services because they live in regions where it is not profitable for commercial banks to operate. Approximately 20 percent of the adult population in the country is estimated to have no bank account. Geography exacerbates the problem since The Bahamas consists of many islands, which are costly to serve (Soderberg et al., 2022). In the case

of the Nigerian CBDC, the eNaira, the Central Bank of Nigeria (CBN) attributed the fact that it is much cheaper and more convenient to open an eNaira wallet than to open a traditional bank account in Nigeria as an important indication of how effective CBDCs promote financial inclusion (Ree, 2023).

The World Bank's (2019) report on financial inclusion named access to finance as one of the four pillars of inclusive economic development and empowerment. Financial inclusion is defined as the level at which the general population of a given country is able to access financial services (Allen et al., 2016). The rate of financial inclusion is measured as a percentage of the adult population in a country who has access to at least a formal bank account or other forms of electronic money such as CBDCs or mobile money (Yang & Zhang, 2022). Several studies on financial inclusion, such as Brown et al. (2016), Célerier and Matray (2019), and Nguyen (2019) have established that proximity to financial services is a key driver of financial inclusion.

There has been ample empirical evidence linking access to finance to the economic development of a country (Burgess & Pande, 2005). These arguments have often motivated governments and development finance institutions across the world to pay particular attention to the provision of financial access to citizens especially those who are poor and vulnerable, including those living in remote areas of the country and women. This further establishes the strong link between advancement in financial technology and access to financial services. Compared to cash or cryptocurrencies such as Bitcoin, a CBDC provides a better means to distribute and use funds in geographically remote locations and also helps accurately capture income and spending information, which is important for micro-loan financing (Lee et al., 2021; Mu & Mu, 2022). CBDCs have been promoted by almost all central banks around the world as one of the most effective means of improving financial inclusion (Lannquist & Tan, 2023).

III.2.2 *Payment Efficiency*

CBDC has the potential to reduce the bottlenecks in the existing payment systems by lowering the cost of transactions, increasing speed, and ensuring finality of service. Due to network effects, payment systems may be subject to concentration, monopolies, or fragmentation. Those who provide payment services have the incentive to structure their platforms in a closed-loop manner to create high barriers to entry, allowing the few service providers to unduly benefit (Bank for International Settlements (BIS), 2022). CBDCs could provide a common means to transfer between fragmented closed-loop systems, ensuring greater efficiency and convenience. Furthermore, CBDCs shift the primary touch point of financial transactions from persons to digital wallets, thereby creating an attribute of combining the benefits of cryptocurrencies such as Bitcoins and mobile payment systems such as mobile money, Venmo, or CashApp (Scollan & Darling, 2023).

III.2.3 *Expanding the Tax Nets*

The introduction of CBDC has the potential to increase tax revenues for countries through the expansion of the tax net as transactions could be easily traceable and reduce tax evasion and manipulation of tax returns. Research on CBDCs has shown that it has great potential to help governments expand their tax nets, as most transactions could be easily traceable and verified against tax returns submitted by taxpayers. (Cunha et al., 2021). Kwon, Lee, and Park (2020) developed an economic model using data from the Central Bank of Korea. According to their research, combining record-keeping technology with CBDC can lessen tax evasion in cash transactions, enhance welfare, and ensure efficient allocation of economic resources in the country.

III.2.4 *Effective Monetary Policy Instrument*

The benefit of CBDC as an effective tool for monetary policy has claimed much attention from several researchers in economics and monetary policy, including Barrdear and Kumhof (2016), Bordo and Levin (2017), Davoodalhossenii (2022), Kim and Kwon (2022). CBDCs enable monetary policies to hit the *"core of the intertemporal decisions of households and firms"*, by reaching households and firms directly rather than through the indirect and imperfect channel of the banking system (Rapheel Auer et al., 2021). By its digital nature, CBDCs become programable such that they could be re-aligned to meet different circumstances of monetary policy considerations and thus expand the monetary policy tool kits available to the central bank. The central bank is able to observe directly when households are using CBDCs and at what level and thus could make effective monetary policy interventions to improve the distribution of money in circulation. (Davoodalhosseini, 2022).

Furthermore, interest rates could be a much more effective tool for conducting monetary policy (Bordo, 2017; Wierts & Boven, 2020; Yamaoka, 2023). In theory, a central bank might cut CBDC account balances at a predetermined pace in order to create a negative nominal interest rate. The disappearance of cash would allow that interest rate to be set to (any) negative levels, effectively removing the "zero lower bound". The zero lower bound on nominal interest rates has frequently been invoked by central banks to support positive and distorted inflation targets, which are beneficial during recessions, despite the fact that the zero lower bound on central bank reserves has been breached in numerous jurisdictions. Doing away with the zero lower bound will help eliminate liquidity traps and achieve optimal inflation targets across all phases of the business cycle in an economy. (Allen et al., 2020; Rapheel Auer et al., 2021). The

estimated gain from such an effective monetary policy mechanism is at around 3% of GDP (Barrdear & Kumhof, 2016).

III.2.5 *Limit Illicit Transactions*

It is been argued that CBDCs will make it harder for the illegal economy and money laundering (Adams et al., 2021; Cunha et al., 2021). The United Nations estimates that globally, the amount of money laundered on an annual basis is between 2-5% of global GDP or in the amount of $800 billion to $2 trillion in current US Dollars in real terms (United Nations Office on Drugs and Crime, 2024). Terrorist financing involves the strategies and tactics that terrorist groups employ to finance their activities that jeopardize domestic and global security. Terrorist financing and money laundering sources could be in the form of illegal activities such as drug trafficking, arms smuggling, and kidnapping for ransom, as well as legal means of generating income such as income from corporations and charitable organizations.

Some empirical research, for example, Foley, Karlsen, and Putnins (2019) have established that despite the advanced and innovative financial features of private digital currencies such as Bitcoin, the absence of a central authority to police the platforms and protect them from criminals and other illicit uses make Bitcoin and other cryptocurrencies attractive instruments for money laundering and terrorist financing. As a result, people with legitimate interest in using cryptocurrencies shy away from the platforms for fear of being defrauded. Central banks in most countries do not still recognize Bitcoins and other cryptocurrencies as legitimate forms of money. A survey by the consultancy firm Baker McKenzie in Africa in 2018 showed that the majority of the central banks on the continent forbid the use of Bitcoins and constantly warn clients and financial services consumers in dealing with such instruments (Baker McKenzie, 2018). In response, central banks around the world are offering CBDCs as a solution

that fully taps into the enormous benefits of digital currencies whilst retaining a central authority to police the system from criminals, scammers, and illicit users from the platform.

III.2.6 *Payment Backstop*

The CBDC payments infrastructure will help boost confidence in the entire payment systems in the country by serving as a backstop to commercial and private sector payment services by preventing the breakdown of payment systems in times of crises and increased counterparty risk (Allen et al., 2020).

Analysis of publicly released reports, news articles, and other publications from six (6) central banks across the world, which are managing some of the most advanced CBDC projects, including Brazil, China, Ghana, Jamaica, Nigeria, and Sweden, provided further validation to the importance of the benefits of CBDCs identified above from the extant literature. For example, it showed that financial inclusion was the most important benefit discussed by all central banks, followed by the need for an efficient payment system, digitization of the economy, privacy, and security protections, as being some of the top benefits expected from these CBDC projects. Central banks projected CBDCs as instruments that would help drive financial inclusion and create an efficient payment system, faster and cheaper than existing payment alternatives available to users. According to these central banks, CBDCs would help counter the emergence of cryptocurrencies such as Bitcoin and provide a safer alternative. It will also be an important system to facilitate efficient cross-border payments and international trade in general. African countries like Ghana and Nigeria hoped that CBDCs would help promote intra-African trade and provide easy access to remittance and fund transfers, which is one of the key sources of inflows of their economies. The emergence of CBDCs requires new laws and regulations in the area of anti-money laundering and countering terrorist financing, as well as privacy and digital security.

In general terms, these countries see CBDCs as part of the general evolution toward the digitalization of their economies. Another important consideration was the need to strike a fair balance between privacy and transparency. Central banks do not want to create a system that will facilitate its use for illicit transactions. Figure 2 below shows the distribution of coded items representing the benefits of CBDCs from the perspective of central banks involved in CBDC projects.

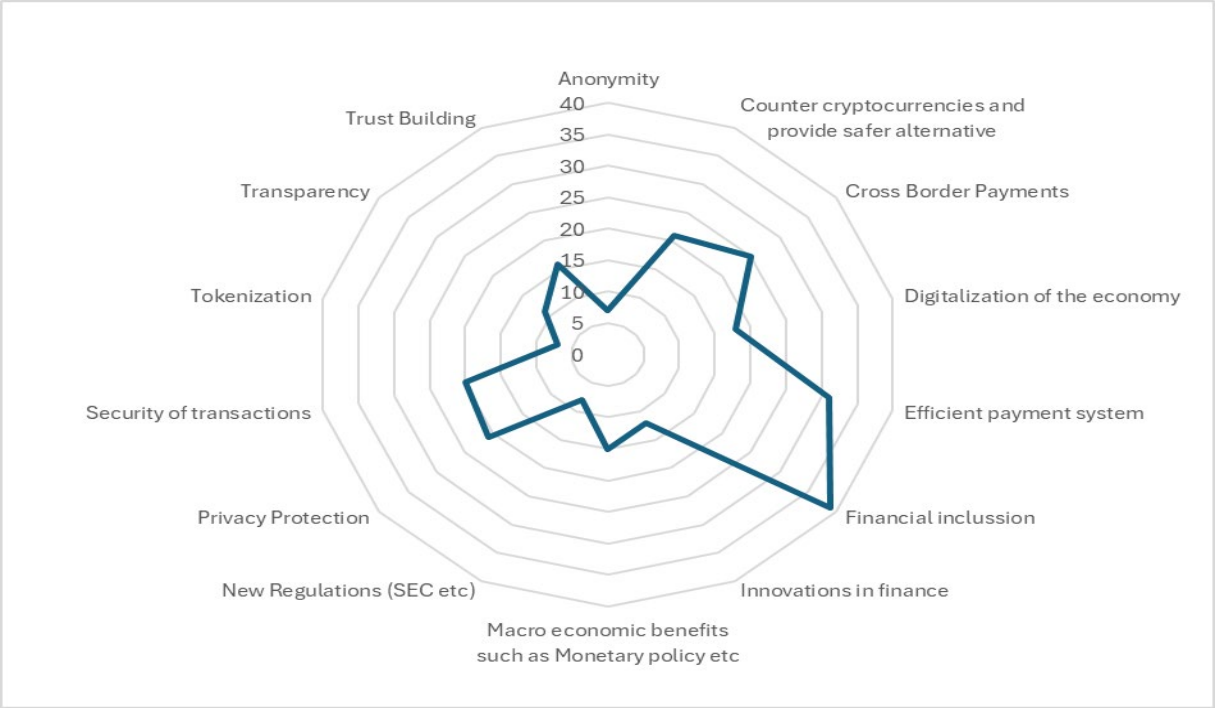


Figure 2: Expected Benefits from CBDC Projects

III.3 CBDC Design as a Form of Money/Financial Instrument

Being a new technological innovation that is still undergoing a lot of research, experimentation, and pilot studies, the design features of CBDC have become one of the key foci of academic and practitioner publications in recent years as resources continue to go into finding the optimum type of CBDC design that help central bank reap the enormous benefits expected from the projects as discussed in the previous section. Based on the IMF survey on CBDCs in six

relevant jurisdictions, Soderberg et al. (2022) concluded that there is no universal design or recipe to implement CBDC just as there is no universal case of CBDC. Each project is designed according to the specific needs and circumstances of the central bank and the country involved. The Bank for International Settlement (BIS) (2022) has proposed a comprehensive CBDC design checklist, which covers the following three core elements: **1) Instrument features, 2) System features**, and **3) Institutional features**. Detailed guidelines adapted from BIS (2010) are shown in Table 1 below for each of the three core features to be considered in CBDC design decisions.

Table 1: Core Features of a CBDC

Instrument features		
	Convertible	To **maintain the singleness of the currency** a CBDC should exchange at par with cash and private money.
	Convenient	CBDC payments should be as **easy as using cash**, tapping with a card, or scanning a mobile phone to encourage adoption and accessibility.
	Accepted and widely available	A CBDC should be usable in many of the same types of transactions as cash, including point of sale and person-to-person. This will include some **ability to make offline transactions** (possibly for limited periods and up to predetermined thresholds).
	Low Cost	CBDC payments should be **at very low or no cost to end users**, who should also face minimal requirements for technological investment.
System features		
	Secure	Both the infrastructure and participants of a CBDC system should be extremely **resistant to cyber-attacks** and other threats. This should also include ensuring effective protection from counterfeiting.
	Instant	Instant or near-**instant final settlement** should be available to end users of the system.
	Resilient	A CBDC system should be **extremely resilient to operational failure and disruptions**, natural disasters, electrical outages, and other issues. There should be some ability for end users to make offline payments if network connections are unavailable.
	Available	End users of the system should be able to make payments **24/7/365**.
	Throughput	The system should be able to process a **very high number of transactions**.
	Scalable	To **accommodate the potential for large future volumes**, a CBDC system should be able to expand.
	Interoperable	The system needs to offer sufficient interaction mechanisms with private-sector digital payment systems and arrangements to **allow easy flow of funds between systems**.
	Flexible and adaptable	A CBDC system should be **flexible and adaptable to changing conditions** and policy imperatives.

Institutional features		
	Robust legal framework	A central bank should have **clear authority** underpinning its issuance of a CBDC.
	Standards	A CBDC system (infrastructure and participating entities) will need to **conform to the appropriate regulatory standards** (e.g. entities offering transfer, storage, or custody of CBDC should be held to equivalent regulatory and prudential standards as firms offering similar services for cash or existing digital money).
Adapted from the Bank for International Settlement (BIS) (2022)		

Instrument features of CBDC must be the singleness of the currency, exchangeable at par with cash and private money. It must also be convenient, as easy as using cash, and must be widely available and accepted, allowing it to be used in many of the same types of cash-like transactions, such as Point-of-Sale (POS) and Person-to-Person (P2P). It should also have the ability to facilitate offline transactions within a certain acceptable framework.

According to the BIS (2020), the **system features of CBDCs** must consider the security against cyber-attacks, data privacy, counterfeiting, and other threats to the stability and reliability of the system. The system should be capable of offering instant or nearly instant final settlement to end users 24/7 throughout the year. Other important system features of CBDC include scalability, interoperability, resilience, flexibility, and adaptability. **Institutional features of CBDCs** must include a robust legal and regulatory framework and operating standards, with the central bank exercising clear authority over the administration of the system.

CBDC design features could also be analyzed from the perspective of its position among the various forms of money discussed in the previous sections (Adrian & Mancini-Griffoli, 2021). Bech and Garratt (2017) developed the “Money Flower”, which illustrates the taxonomy of all forms of money, including CBDCs, using four key properties: 1) Issuer (central bank or other); 2) Form (electronic or physical); 3) Accessibility (universal or limited); and 4) Transfer

mechanism (centralized or decentralized). The money flower explains how the design features of CBDC intersect with existing forms of money, including cash and other types of electronic money, such as Bitcoins. CBDCs incorporate various relevant and important features of other forms of money into a bundle of highly effective and cost-efficient instruments. This is the reason CBDC is considered the currency of the future. An adapted version of the Money Flower is shown in Figure 3, highlighting the position of the retail CBDC, which is the main focus of this study.

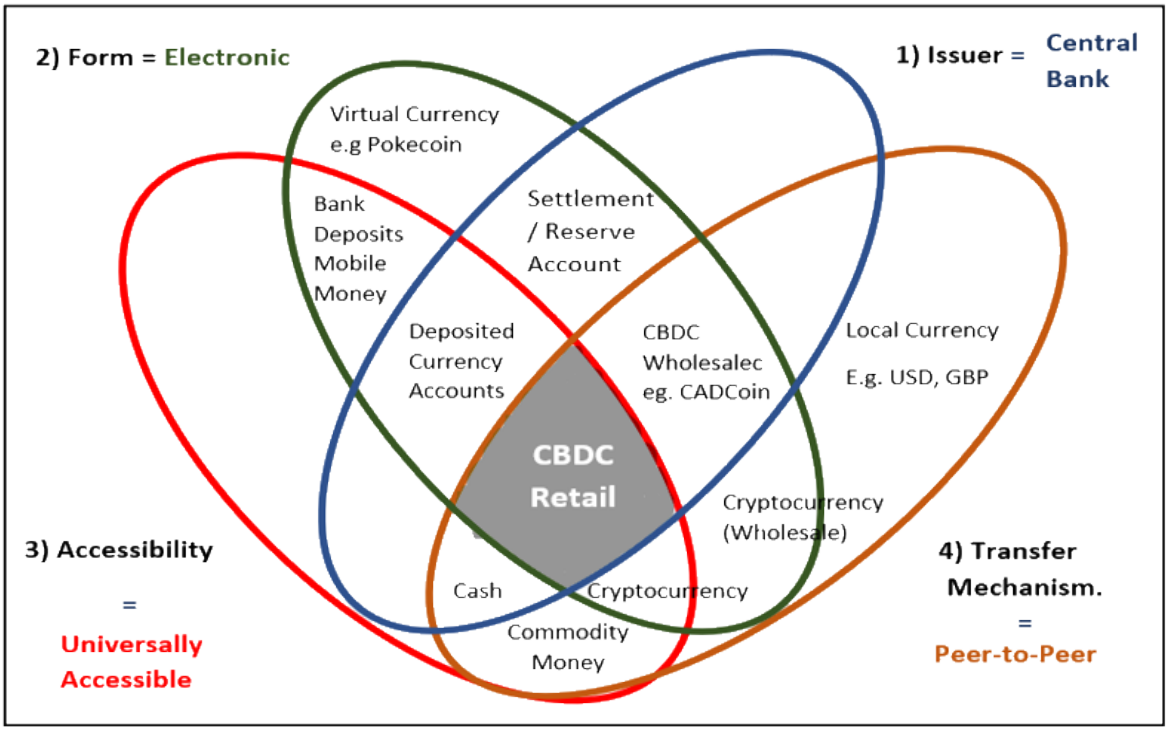


Figure 3: Adapted Representation of the Money Flower with Retail CBDC
Sources: Taxonomy of Money (Bech & Garratt, 2017)

Examples of the various forms of money shown in the money flower may include e-Krona for a typical retail CBDC and CADCoin for a wholesale CBDC. Mobile Money services such as M-Pesa and Venno represent the typical Bank deposit /electronic money category, whereas PokeCoin will be a good example of Virtual money.

Applying the taxonomy, token-based central bank digital currencies are most "cash-like" in terms of accessibility. The issuer of CBDCs is the central bank, and the form is electronic. However, it could have either universal access or limited and the transfer mechanism could be decentralized or centralized. CBDCs with limited access to the general public are referred to as Wholesale CBDCs. This study will focus on retail CBDCs, which are directly accessible to the general public on either a centralized or decentralized infrastructure. (Scollan & Darling, 2023)

The majority of the central banks are interested in retail CBDCs as they effectively combine the attractive features of cash and electronic money accounts, such as mobile money (Auer & Böhme, 2020). Users in developing countries are already familiar with mobile money services, which are delivered to them through their mobile phones. It is expected that there will be a smooth transition from mobile money to CBDCs.

III.4 CBDC Design: Technological Configuration

As a new form of money, CBDC is also an innovative technology whose function depends on a complex interlink between several highly advanced technological systems and programs. It has been described in a more technical term by Yao (2018) as *"a credit-based currency in terms of value, a crypto-currency from a technical perspective, an algorithm-based currency in terms of implementation, and a smart currency in application scenarios"* (Yao, 2018) and that *"it is not just a digital version of cash but has the potential to make money smarter.*"

Several countries working on CBDC projects are experimenting with different technological designs depending on their specific goals and objectives (Kiff et al., 2020). Synthesizing the various design specifications across several CBDC projects around the world,

Auer and Bohme (2020) developed the “CBDC Pyramid”, which grouped the key technical configurations into four (4) design choices matched with the consumer needs in a hierarchical order, an adaption of Maslow’s hierarchy of needs concept to CBDC design. A hierarchy is formed by lower layers representing design choices that lead to higher-level decisions. These four design choices are **1) Architecture, 2) Infrastructure, 3) Access technology,** and **4) Wholesale/Retail interlinkages** (Cross-border). Each of the four (4) configurations is discussed in the next section.

III.4.1 *Architecture Design*

At the base level of the “CBDC Pyramid”, consumers need a CBDC that is cash-like, has a capacity for a peer-to-peer transaction, and is convenient for real-time payments. CBDC design regarding the legal structure and architecture of the system, which includes decisions on whether it represents a direct claim or indirect claim on the central bank, as well as the respective operational role of the central bank as against the role of private intermediary banks, will align with the needs of consumers regarding their desire to have a cash-like, peer-to-peer and real-time CBDC (Auer & Böhme, 2020). There are four key architectural design options for CBDCs depending on the role of the central bank in terms of the structure of its legal claims and its record-keeping role.

Direct CBDC represents a direct claim on the central bank where it remains the only institution handling the payment services directly with customers, updating their records for every transaction done on the platform (Kiff et al., 2020). Know Your Customer (KYC) and customer due diligence could be outsourced to third parties. It is seen as a simple system to operate as it comes with few dependencies on entities outside of the central bank. However, there may be some inefficiencies regarding the payment systems' reliability, speed, and efficiency in

dealing with customers all across the country (Mancini-Griffoli, 2018). It is well agreed that the private sector other than the central bank is much more equipped to deal with customers directly in delivering payment services.

Under the **Indirect CBDC** architecture, which is also known as the "**two-tier CBDC**", legal claim on the digital currency rests with the intermediary commercial banks and private institutions, allowing the central bank to handle only wholesale payments and record keeping between itself and the intermediaries (Auer & Böhme, 2020). This architecture mirrors the current banking system operated around the world, where central banks deal with commercial banks on a wholesale basis whilst the latter handles all claims by customers. The downside of this system is that the central bank cannot honor claims from consumers without information from the intermediaries (Auer & Böhme, 2020).

A **Hybrid CBDC** combines elements of both the direct and indirect CBDC, where a direct claim on the central bank is combined with a "private sector messaging layover (Malik et al., 2022). Under this system, the legal structure that supports claims, makes it separate from the private entities' balance sheets allowing for more flexibility to switch the payment services responsibility to the central bank when a private entity fails (Auer & Böhme, 2020). The central bank retains copies of all retail CBDC holdings by private entities.

The **Intermediated CBDC**, which is a variant of the Hybrid CBDC, is where the central bank only maintains a wholesale ledger instead of a central ledger of all retail transactions under the Hybrid CBDC (Auer et al., 2020). Under this design, the CBDC remains a claim on the central bank while private intermediaries perform the payment services function. It may enable users to keep cryptographic evidence of their balances instead of the central bank to store them.

Should something go wrong technically, these proofs might be utilized to recover balances. Not having the central bank save retail account balances might potentially avoid privacy and regulatory difficulties. Giving people access to cryptographic proofs has the drawback of potentially making money more vulnerable to loss and theft.

Central banks developing CBDCs must consider these types of architectural designs or some combinations in their CBDC project configurations. It must be noted, however, that under all four architectural designs, the central bank retains the power to issue and redeem CBDCs.

III.4.2 *Infrastructure Design*

The second level of the CBDC design covers the type of infrastructure on which to deliver consumer needs for resilient and robust operations, following immediately after the decision on architecture since the infrastructure requirements for each of the architectures discussed above are different. Auer and Bohme (2020) proposed two key infrastructure options, the **Conventional centralized** infrastructure, and a **Decentralized/ Distributed Ledger Technology (DLT)** based infrastructure.

For a **Conventional Centralized** infrastructure, central banks can rely on existing infrastructure to deliver their CBDC projects. Central banks could deliver Indirect CBDC on their existing infrastructure with minimal changes as it reflects largely the current banking and financial systems in place. The conventional centrally controlled database will have its data updated by storing them over multiple physical nodes controlled by an authority at the central bank's top of the hierarchy (Auer & Böhme, 2020). The vulnerability of a conventional infrastructure concerns single-point failure, especially when it happens at the top of the hierarchy that controls the system.

With a **Decentralized/ Distributed Ledger Technology (DLT)** based infrastructure, the ledger is jointly managed by different entities in a decentralized manner without a top node. Digital currencies are built on distributed ledger technology and blockchain. Distributed ledger technology and blockchain are often used synonymously. They are both about the same concept of a ledger, a file that keeps track of transactions (Cela, 2021). Blockchain is a particular version of the technology with extra technical details, whereas distributed ledger is its broad form. The name "blockchain" refers to the method by which transaction blocks are linked into an immutable chain by calling the hash of the preceding block in chained cryptography (Lee & Lee, 2017). This allows database entries to be updated sequentially. A distributed ledger is a peer-to-peer network replicating database by multiple parties to safely and securely edit and share the database even if they do not know or trust one another (Guo & Liang, 2016). In general, a blockchain is a network software protocol that eliminates the need for a middleman like a bank and permits the safe movement of funds, assets, and information via the internet (Saleh & Jiang, 2021). There are four main characteristics of a distributed ledger: i) a shared transaction database that is ii) updated by consensus among network participants; iii) entries are timestamped with a distinct cryptographic signature and kept in an iv) tamper-proof auditable history of all transactions (Swan, 2015). The immutability, transparency, accessibility, and reach of the blockchain enable global trust. What makes blockchain technology unique is that verifiability is enforced without the need for human intervention at the center. Blockchains have so far been identified for possible use cases in contracts, identity verification, property registries, and real-time money transfers and payments like CBDCs and Bitcoin.

Auer, Cornelli, and Frost (2020) observed that the **DLT infrastructure is designed to replace trust in intermediaries with trust in the technology itself.** They further pointed out

that all central banks experimenting with DLT use permissioned versions, where operators can make decisions about who is admitted to the network. So far, most central banks working on CBDCs have been cautious about implementing a fully permissionless DLT infrastructure as used for Bitcoin and other cryptocurrencies (Ali & Narula, 2020). This is not surprising as central banks seek to introduce alternative digital currencies; they wish to have more control to secure the integrity of the financial system. A typical drawback, as explained by Buterin (2021), is that decentralized DLT platforms are less scalable because they require more computational power to provide a robust consensus mechanism. However, the scale constraint for DLT infrastructures is not a practical barrier because central banks might leverage financial intermediaries to deliver transactional consensus verifications if required (Raphael Auer et al., 2021).

III.4.3 *Access Technology*

After deciding on the architecture and infrastructure designs of the CBDC, the third level of the CBDC pyramid kicks in with respect to design decisions on who and how to provide access to potential users of the platform. Consumer needs at this level border on how accessible the platform is and the level of privacy and other guarantees that enable lawful exchanges on the platform. Two options are presented to central banks: whether to adopt the conventional account model, the **Account-Based CBDC,** or to take full advantage of the DLT/blockchain technology to deliver a **Token-based CBDC**.

Account-based CBDC is similar to the conventional account model and ties ownership to the identity of the customer. Claims are stored in a database that includes the value and a reference to the owner's identity, similar to a bank account. One significant advantage of an account-based system is that CBDC payments might be essentially quick and free. Of course, at

the initial construction of each CBDC account, the account holder's identity must be confirmed using methods similar to those used to get a driver's license or open an account with a commercial bank. From that point forward, however, financial transactions may be done promptly and securely (e.g., using two-step verification with a cellphone and digital pin), and the central bank would be able to monitor any unusual behavior and adopt further anti-fraud procedures as needed (Bordo, 2017). However, an Account-based CBDC has some limitations. It is extremely dependent on "strong" identities for all account holders - techniques that connect each user to a single identity across the payment system (Auer & Böhme, 2020). In certain countries, these plans might be difficult to implement, limiting universal accessibility especially if the central bank's goal is for financial inclusion. The same reasons account for the present-day impediments to expanding financial access through the traditional banking system.

With the **Token-based CBDC,** the central bank will only recognize claims if the CBDC user can demonstrate knowledge of an encrypted value, also known as digital tokens. This would allow the CBDC to interact with communication protocols, laying the groundwork for micropayments in the Internet of Things (Auer & Böhme, 2020). The central bank could issue CBDC tokens that circulate electronically among private persons and enterprises and are only rarely redeposited at the central bank. Using DLT technology to verify the chain of ownership of each token and validate payment transactions, there will be no direct participation from the central bank or any other clearinghouse (Bordo, 2017). In line with the CBDC Flower, it is established that Token-based CBDC access technology provides the highest level of identity protection, also referred to as 'anonymity', which is currently available with the use of cash. A Token-based CBDC provides the maximum level of individual anonymity, allowing access to money based on a unique identifier rather than an individual's identity. This level of anonymity

provided by Token-based CBDCs is linked to increasing the level of trust consumers have in the use of CBDCs.

However, there could be obvious challenges. For example, the possible danger of losing money if users do not keep their private keys hidden. Designing an effective AML/CFT framework for such a system would also be difficult. Law enforcement would face issues identifying claim owners or tracking money transactions, much as they would with cash or bearer securities. Retail CBDCs would thus require additional precautions if they took this path. An offline CBDC solution based on a token-based bearer method may provide security problems, such as counterfeiting. Furthermore, adopting a bearer instrument strategy to support anonymous transactions poses a bigger danger of a user losing their CBDC if their digital wallet becomes unavailable (Ahiabenu, 2022). Furthermore, the more anonymity a CBDC provides, the higher the danger of it being used by criminals, as seen with the use of Bitcoins.

III.4.4 *Wholesale/Retail interlinkages*

At the top of the CBDC pyramid, when the architectural and infrastructural designs have been made and retail customers are fully accustomed to the system, the next level of decisions borders on whether the CBDC is to be used domestically or for cross-border payments. This brings into place a host of new opportunities, including holding multiple currencies in one wallet and the possibility of executing foreign exchange transactions between one CBDC of a country with another. According to Auer and Bohme (2020), this will potentially improve market efficiency in foreign exchange transactions and reduce costs.

Given that this study is on retail CBDCs, our analysis of the design features will focus on the first three levels of the CBDC, consisting of architecture, infrastructure, and access features,

and exclude features at the top level of the pyramid with respect to wholesale and cross border interlinkages.

III.5 CBDCs Design features, Trust, and diffusion characteristics

Technological design standards for retail CBDCs entail "combining parts of the juggle" covering decisions on the type of architectural design configurations, whether it is direct, hybrid, intermediated, or indirect, and how it is being operationalized on either a centralized infrastructure using the existing conventional platforms or a decentralized infrastructure based on distributed ledger technology. Zhao, Xu, and Xu (2023) highlighted the importance of making a clear distinction between platform features and user features in social commerce and other financial technology innovations, as each component has different implications on the role of trust in the acceptance of new innovative technologies. Decisions on architecture and infrastructure, which are the first two levels of the CBDC pyramid, are considered **Platform features** (Zhao et al., 2023). In contrast, access technology features of an account-based or token-based is considered **User features** (Zhao et al., 2023). The access technology design features become the main touch point between the users and the platform as features with respect to architecture and infrastructure are established behind the scenes and out of the view of users. This mechanism of drawing a clear distinction between platform features and user features has critical implications for the role trust plays in the diffusion of CBDCs. Among many of the recent technological innovations in finance, CBDCs provide a unique opportunity with their clearly defined distinct features in the design configurations. Using the CBDC pyramid (Auer & Böhme, 2020), we are able to establish a link between CBDC design features and trust in formal and informal institutions. Lee, Yan, and Wang (2021) affirmed that the type of digital currency design is linked to the nature of trust components associated with the usage of that digital

currency. Table 2 below summarises the connections between the CBDC design, the dimension of trust, and the trust entities, as discussed in the previous sections.

Table 2: CBDC Design Relationship with Trust Dimensions

CBDC Pyramid (Auer & Böhme, 2020)	**Consumer Needs** (Auer & Böhme, 2020)	**CBDC Design** (Auer & Böhme, 2020)	**Trust Entity**	**Trust Dimension**
Level 1 Architecture Level 2 Infrastructure Level 3 Access Technology	Cash-like peer-to-peer, real-time convenience Resilient and robust systems Accessibility Privacy	Direct, Hybrid Intermediated Indirect, Conventional centralized, Decentralized DLT Account-based. Token-Based	Central bank Government Private intermediaries, Commercial banks, Fintech companies, etc Social influence from family, friends, and colleagues	**Trust in central banks (formal)** **Trust in Private intermediaries (formal)** **Trust in informal institutions**

Trust plays a significant role in the acceptance of new innovative technologies and diffusion. The mechanism through which trust influences diffusion has not been fully understood, especially with respect to CBDCs and its impact on trust in institutions, given the prominent role government and its related institutions, such as central banks, play in the delivery of CBDCs. Moreover, in some countries where trust in formal institutions such as the government and public institutions is low, decisions on how central banks can rely on informal institutional networks and social influence to complement the trust-building mechanism for successful diffusion is extremely important. Several technology acceptance frameworks have been consistent about the impact of social influence, which is derived from informal institutional

networks, where people accept certain types of technology just because they see their trusted close family and friends using them (Hagen & Choe, 1998; Tsai et al., 2010).

Within the context of CBDC diffusion, the design characteristics and its linkages with trust dimensions have been discussed. The next chapter fully discusses the conceptual framework of this study, explaining the origins and dimensions of trust relying on findings from a systematic review of the literature.

IV CONCEPTUAL FRAMEWORK

For central bank digital currencies to be successful, they must be widely accepted by the population. In some countries, one of the major impediments to the acceptance and diffusion of central bank digital currencies is likely the low trust in governments and related institutions such as the central banks. The low trust in formal institutions has been linked to several issues in developing countries, among them, institutional imperfections, weaknesses in the financial systems, suspicions about new technologies, privacy concerns, and government overreach (Acquaah, 2012). The low acceptance rates of CBDCs in recently launched nations like Nigeria, Jamaica, and the Bahamas show that many of these initiatives risk failing if the trust issue is not addressed. Understanding how the design of CBDCs could influence the building of trust for successful diffusion within the specific socio-cultural context of the country, such as the level of trust in formal and informal institutions, is critically important.

Several technology acceptance theoretical frameworks, such as the diffusion of innovations (DOI), the unified theory of acceptance and use of technology (UTAUT), and the theory of reasoned Action (TRA), and others that focus on cognition and behavioral characteristics have established the important role trust and social influence plays in the acceptance of new technological innovations (Choudhury & Karahanna, 2008; Gefen et al., 2003a, 2003b; Venkatesh et al., 2003). A study by Choudhury and Karahanna (2008) on the acceptance of electronic channels using the theory of diffusion of innovations confirmed that trust plays a significant role in user's perception of the relative advantage of electronic channels. As this study focuses on acceptance of new innovative technologies at the country level and from the perspective of the central bank offering the service, the theory of diffusion of innovations has

been adopted to build a conceptual framework explaining the influence of trust on the diffusion of CBDCs.

IV.1 Diffusion of Innovations

The theory of diffusion of innovations conceptualizes the complex behavior and social process by which new innovations are adopted. As information about the existence of new innovations flows through a social system, potential adopters are influenced based on their acceptance behavior (Agarwal & Prasad, 1997; Moore & Benbasat, 1991). Rogers (1995), through a synthesis of several previous empirical research efforts, identified five characteristics that influence acceptance behavior: relative advantage, complexity, compatibility, trialability, and observability. His work also showed that the portion of the population adopting innovation is normally distributed over time. He argued that the population of adopters possess varying degrees of willingness to adopt new innovations and could, therefore, be grouped into five stages: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards, based on the time between when the innovation is introduced and the time it is adopted.

The five characteristics of diffusion are linked to the design and specification of the new technology. Relative advantage is defined as the degree to which using a current technological innovation is considered to be better than its precursor. Complexity is defined as the degree to which an innovation is perceived as being difficult to use, whereas compatibility is the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters (Moore & Benbasat, 1991). Trialability is the degree to which an innovation may be experimented with before adoption (Karahanna et al., 1999), whereas observability represents the degree to which the results of an innovation are observable to others. These five characteristics are the basis on which potential users of the new technologies will

assess in order to decide whether to adopt the innovation. In this study, we focus on two important diffusion of innovation characteristics: relative advantage, which is linked to trust in formal institutions (Choudhury & Karahanna, 2008), and observability, which is linked to social influence (Venkatesh et al., 2003).

One of the key underlying assumptions of this study is based on the established evidence that trust flows through the social network of users who are influenced differently depending on the type of network, whether formal or informal (Chua et al., 2008). Social network explains how new ideas and information flow through a network of connections or linkages among individuals, groups, and institutions and how they affect the behavior of its members. Several empirical studies have established strong connections between the diffusion of innovations and social networks, as the rate of diffusion is impacted by the type of social networks connected to users of the new technological innovations (Beaman et al., 2021; Brancheau & Wetherbe, 1990; Dover et al., 2012).

The significance of social networks in fostering trust and facilitating the acceptance of new technological innovations is further supported by these studies. For example, Aghion et al. (2010) demonstrated that trust in government has a negative correlation with government regulations and that in situations where trust in government is low, civic engagement in families and the influence of informal social ties contribute to a general rise in trust. Newton and Zmerli (2011) studied the relationships between general trust, specific trust, and political trust. Their findings implied that specific trust serves as the basis for both general and political trust and that institutional and external factors significantly impact an individual's degree of trust. The results from the two studies and other similar studies on trust-building mechanisms support the proposition that the trust-building mechanisms that influence acceptance of technologies do not

solely depend on trust in formal institutions delivering the technology but complement trust in informal institutions for the diffusion of innovative technologies to be successful.

IV.2 Trust

Trust is defined as a user's belief and **confidence** that the provider of an innovative technology possesses desirable characteristics such as competency, honesty, and benevolence to protect their interest in using the technology within an acceptable risk level. (Gefen et al., 2003a, 2003b; Mayer et al., 1995; Pavlou, 2003). For the purposes of this study, the terms **confidence** and **trust** are used interchangeably. Trust is a psychological condition characterized by the willingness to accept vulnerability based on positive anticipation about another's intentions or actions (Rousseau et al., 1998). There is a strong consensus in the extant literature that trust influences the acceptance of new innovations in a diverse range of product and service categories, such as social commerce (Zhao et al., 2023), online services (Aggarwal et al., 2021), e-government services (Ahmad & Khalid, 2017), and most importantly, electronic payments (Kissi et al., 2017; Moodley & Govender, 2016).

Given the critical role trust plays in the acceptance of new innovative technologies, there are concerns that the introduction of CBDCs around the world may not be widely embraced by the public due to the weak public trust in government and institutions such as central banks. The fact that transactions involving CBDCs are frequently completed online, without in-person contact, lack of colocation, or social cues, further exacerbates the trust issue by raising the possibility of uncertainty, vulnerability, and unfair judgment. (Jarvenpaa & Leidner, 1999; Srivastava & Chandra, 2018).

Many studies on trust have adopted the multidimensional view of trust to comprehensively account for all the factors that are relevant to trust development. Mayer, Davis, and Schoorman (1995) deconstructed the dimensions of trust into three elements: **competence**, **benevolence**, and **integrity**. They described competence as the ability and **proficiency** to carry out a task, whereas **benevolence** represents the drive to assist others instead of oneself. When a trustee exhibits benevolence, it means that their actions are motivated by something other than their own self-interest (Mayer et al., 1995). **Integrity** was defined as the commitment to honesty and truthfulness, signifying the trustee's sense of fairness and morality that ensures that the actions of the reliable party are dependable, honest, and consistent. This three-dimensional view of trust is crucial to interpersonal relationships because it upholds reliability and honesty in dealings with others (Choung et al., 2023). From the perspective of psychology, the concept of disposition to trust has gained a lot of research interest. Disposition to trust, or trusting intentions, which refers to a consumer's overall propensity to trust others, have been attributed to the cognitive and social characteristics of the individual (McKnight et al., 2002). Scholars have employed the psychological notions of integrity, competence, and kindness to examine trust in technology, even though these ideas are often used to evaluate trust between persons, as in recent decades, there has been the tendency to project human characteristics onto technologies as they continue to advance into complex systems, for example in robotics and artificial intelligence (Harrison et al., 2023).

Adler (2001) expanded the concept of trust dimensions into a much more complex framework called the *"Dimensions and components of trust"*, arguing that trust has four dimensions, namely**, sources, mechanisms**, **objects,** and **bases** with their related components. He explained that, **sources,** as a trust dimension, include familiarity through repeated interaction,

a calculation based on interests and norms that create predictability and trustworthiness, and also involves direct interpersonal contact and reputation. For **trust mechanism**, its dimensions are based on the institutional context of the trusting entity, whether it is formal institution or informal. **Objects** as a trust dimension have components including individuals, and systems, and collectives, whereas **Bases** a trust dimension has consistency, contractual trust, competence, benevolence, honesty, integrity, etc as its components.

It must be noted, however, that the typologies used here to explain the dimensions of trust may be too complex, overlapping, and inconsistent (Harrison et al., 2023). For example, reputation, which was considered a component of mechanism as a trust dimension, could also be considered under bases as a trust dimension, as they all form part of the behavioral characteristics of the trusting entity, just like competence, benevolence, and openness.

The most common way to categorize trust dimensions was developed by McKnight, Cummings, and Chervany (1998). McKnight, Choudhury, and Kacmar (2002) expanded on the previous work using the theory of reasoned action (TRA). They classified trust into three forms: (1) **trusting belief**, which is the trustor's judgment that the trustee possesses qualities that are advantageous to the trustor; (2) **trusting intention**, which is described as the trustor's readiness to rely on a trustee in a given situation; and 3) **disposition to trust**, the degree to which an individual exhibits a propensity to be willing to depend on others under a wide range of circumstances and involving different kinds of unfamiliar people.

Trusting beliefs are cognitive beliefs that arise from the trustor's attributional processes. The prominence of understanding trust as trusting beliefs demonstrates a cognitive focus in research on the acceptance of new innovative technologies (2006). Gefen, Karahanna, and Straub

(2003b) go a step further to state that, "*trust as a feeling...has been previously studied in the context of interpersonal relationships, such as friendship and love. It is arguably irrelevant to a business transaction*". However, other authors have argued to the contrary that even though scholars have employed measures of trust as a construct underlying relationship between persons, it is common to often humanize technology and ascribe it to human characteristics (Harrison et al., 2023).

Trusting intention, on the other hand, is the trustor's readiness to rely on a trustee in a given situation. Intention is impacted by two factors: (1) attitude toward this behavior, which is a function of beliefs about the implications of this behavior, and (2) subjective norms surrounding this behavior, which are a result of normative ideas about this behavior (Komiak & Benbasat, 2006). Trusting intentions indicate the trustor's desire to rely on the trustee. Thus, trust indicates a readiness to rely on others while also leaving oneself vulnerable to them (McKnight et al. 2002). Unlike behavioral intentions, which are explicit and include definite risks, the desire to rely on others is characterized more broadly by one's openness to engage in trusting activities.

According to traditional thinking, trust in technology acceptance can be divided into two categories: trust in the technology itself and trust in the organization delivering the technology, which is referred to as institutional trust (McKnight, Choudhury, & Kacmar, 2002; Pavlou, 2003; Belanger and Carter, 2008; Schaupp et al., 2010). McKnight, Choudhury, and Kacmar (2002) argued that institution-based trust and a disposition to trust are 'antecedents' for trusting beliefs/intentions. Trust is often created procedurally, beginning with a disposition to trust, which leads to institution-based trust, and then trusting beliefs, trusting intentions, and finally trusting behavior (McKnight et al., 2002).

Choudhury and Karahanna (2008) found that trust is one of the most critical elements influencing users' perceptions of the relative advantage of new technological innovations. However, their research, like many other studies on the role of trust in the acceptance of new innovative technologies, focused on trust-building mechanisms in the formal institutional context, such as structural assurance, rules and regulations governing the use of technology, and privacy and security systems established around it. The involvement of informal institutional factors, including the influence of interpersonal ties such as family, friends, and social network variables, which are equally major contributors to the trust-building process, has received very little attention in the academic literature. Adler (2001) identified three mechanisms through which trust is generated, through direct interpersonal interaction, representation through a network of other trusted parties, or through institutional factors, i.e., the way institutions shape the other actor's values and behaviors. All these three trust mechanisms complement each other. Social network connections and interpersonal interaction, therefore, serve as an important input in the formation of trust. This dissertation focuses on understanding the mechanism through which trust in formal and informal institutions compliments and influences acceptance of new innovative technologies and the diffusion of innovations.

IV.3 Trust in formal institutions

Trust in formal institutions, within the context of this study, is derived from having **confidence** and faith in organizational arrangements, rules, procedures, regulations, a sense of fairness, and impartiality that the interest of users of new technologies will be protected despite facing fears of uncertainty and risk. It is the notion that the necessary structural conditions exist to improve the likelihood of a good outcome in dealings with an organization (Bachmann & Inkpen, 2011; Choudhury & Karahanna, 2008; McKnight et al., 1998).

Because users attribute a high perception of risk to the use of payment systems in general and CBDCs specifically, especially where there is low trust in government, it is imperative that central banks and intermediary institutions involved in CBDC projects take significant steps to assuage the fears of users by building trust into their institutional systems (Thusi & Maduku, 2020). The literature identifies two important sources of trust in formal institutions: **situational normality,** and **structural assurance.** Situational normality is the belief that the interactional environment of the new technological innovation is normal and advantageous for productive dealings with other interconnected members, while structural assurance implies the presence of protective structures, such as safeguards, rules, safety nets, commitments, and operational procedures, conducive to situational success (Harrison et al., 2023; Srivastava & Chandra, 2018).

Structural assurance as a source of trust in formal institutions represents the belief that existing systems, such as promises, commitments, rules, safety nets, and operational procedures, are put in place to help protect the interest of users of the technology. It also includes the faith users have that the technology is safe from hackers and unauthorized access to their personal data (Choudhury & Karahanna, 2008; Zucker, 1987). McKnight, Choudhury, and Kacmar (2002) included structural assurance as a crucial component in their model for online trust, arguing that it promotes users' beliefs about “uncertain technological situations”. Examples of structural assurance mechanisms often used by software producers include making the interface of the new software similar to the existing ones, training availability, money-back guarantee, return policy, and availability of customer support contact line or online assistance (Bahmanziari et al., 2003).

Situational normality is the perception that the online interactional environment is normal and conducive to successful dealings with other interacting members, whereas structural assurance refers to the presence of protective structures such as guarantees, rules, safety nets,

pledges, and operational processes that promote situational success (McKnight and Chervany 2001, Srivastava and Chandra, 2018). Using Lee and Turban's (2020) example, situational normality in CBDC will arise from users actively observing and learning details about other users on the platform. If the observed attitudes, intentions, and behavior of other users are appropriate, users will tend to believe that the interactional environment is appropriate when the situation appears safe and normal. As a result, if users develop perceptions of situational normality, they will believe that the system is reliable enough to conduct transactions.

Both situational normality and structural assurance signify the establishment of a formal relationship between the user and the institutions providing the service. Within the context of this study, it is argued that trust is facilitated within the formal social network connections between the institutions offering CBDCs and end users through structural assurance and situational normality. Research on trust and its influence on the diffusion of innovation and acceptance of new innovative technologies, in general, recognize the critical role social networks play in the behavioral characteristics of potential users (Chua et al., 2008).

IV.4 Trust in Informal Institutions and Social Influence

In the previous sections, it was discussed that the mechanism through which trust in informal institutions is developed revolves around a combination of sociocultural factors, including social influence and social networks. (Söilen & Benhayoun, 2021; Zhao et al., 2023). Trust in informal institutions is derived from the informal social patterns of connections often based on familiarity and sharing of mutual interest that allow one to be vulnerable to the conduct of another in the hope that the latter will carry out a specific task that is crucial to the former, regardless of whether the latter has the capacity and willingness to monitor and control the performance of the task (Brockman et al., 2020).

Social influence characterizes the situation whereby users of new technologies believe that the opinions or suggestions of others are important to their decision to accept the technology (Thusi & Maduku, 2020; Venkatesh et al., 2003). It is described as the change in behavior, thoughts, feelings, or attitudes that one person or a group purposefully or accidentally produces in another as a result of the way that the changing person perceives his connection with the influencing party and society in general (Dhahak & Huseynov, 2020). The concept of social influences reinforces the idea that one's social circle of users, including family, friends, and close acquaintances, has a significant influence on their acceptance behavior of new technological innovations such as CBDCs. There is a great amount of empirical support for the idea that social influence has a positive impact on acceptance of new innovative technologies (Bart et al., 2005; Venkatesh et al., 2003; Zhao et al., 2023).

Venkatesh et al. (2003) created the uniform theory of technology acceptance and use of technology (UTAUT) by combining attributes of several technology acceptance models, such as diffusion of innovations, technology acceptance model (TAM), and theory of reasoned action (TRA), and testing them on a range of innovations from human behavior to computer science and synthesizing them into four major factors that influence information technology acceptance and use. These factors include effort expectancy, which signifies the simplicity of using the system. Performance expectancy refers to an individual's belief that utilizing the system would assist him or her to improve performance, whereas, enabling conditions indicate individuals' ideas about the presence of procedures and infrastructure that facilitate the usage of the system.

Social influence is the fourth factor in the UTAUT framework. It has been shown from the previous sections that social network plays a significant role in technology adoption not only from the perspective of the flow of communication as proposed by Rogers (1995) and Agarwal

and Prasad (1998) but also through the mechanism of trust in institutions and social network ties (Choudhury & Karahanna, 2008). An investigation on the configuration of cognition- and affect-based trust in managers' professional networks by Chua, Ingram, and Morris (2008) showed that managers' levels of trust in network members vary depending on the structure of the connections within the network and that variations also exist in the associations between the various types of connectedness and the types of trust. In particular, managers place a higher value on affect-based trust in friends and other close acquaintances.

IV.5 Social Networks and Trust in Institutions

Several empirical studies, for example, Brancheau and Wetherbe (1990), Dover et al (2012), Goldenberg et al. (2009), Hill et al. (2006), Katona and Sarvary (2011) and Kratzer et al. (2009) have confirmed that the structure of a social network, including the nature and pattern of connections among its members, have a significant impact on the diffusion of innovations. Social network linkages can promote trust and perceived trustworthiness, which are the relational dimensions of social capital. Strong interaction linkages allow actors to know one another, share critical information, and see one another as trustworthy (Tsai & Ghoshal, 1998). As previously discussed, formal and informal social networks have been identified to directly support the trust-building mechanism for the acceptance of new innovative technologies. This is particularly important for developing countries where informal networking relationships facilitate economic exchanges and the adoption of new ideas because of the high levels of social and community ties, market imperfections, and the presence of institutional voids (Acquaah, 2012).

Formal social networks define the pattern of relationships and the connection between individuals and organizations bounded by organized systems and structures, rules, regulations, and rigid chains of command. They often involve obtaining and exchanging resources based on

contractual obligations (Srivastava, 2015; Tucker, 2008). In the context of CBDCs, a formal social network could be explained as a network of individuals and institutions with indirect ties who are influenced by structural equivalence characteristics and charged with formal responsibilities of delivering financial services such as CBDCs (Chung et al., 2021; Kratzer & Lettl, 2009; Yletyinen et al., 2021). They are characterized by having indirect ties with the members of the community, ahead of an important market trend, and are interested in commercially benefiting from the new innovations (Franke et al., 2006; Urban & Von Hippel, 1988). Formal networks are contractual relationships developed for a specific purpose. Members of a formal network must provide others access in order for them to join the network (Chetty & Agndal, 2008).

In contrast, informal social networks are characterized by patterns of social connections often based on familiarity and sharing of mutual interest. It is often in the form of friendship or family ties and not bounded by a sense of organized rules and structures (Srivastava, 2015; Tucker, 2008). Informal social networks are made up of relationships between friends, family, and acquaintances. Therefore, the parties involved have a personal link. As the ties among its members deepen via interaction, these networks emerge and expand (Chetty & Agndal, 2008).

In a study of the influence of different forms of trust and their relationship with the type of social network among managers, it was discovered that managers trust network members differently depending on the content of network ties, and differences exist in how each type of trust is related with different degrees of depth of social connections (Chua et al., 2008). Managers, in particular, exhibit stronger affect-based trust in network members who are friends, sources of career advice, or are deeply established in their networks through good ties. When a network member is a source of economic help, managers' affect-based trust in him or her falls.

Cognition-based trust is higher in those who offer task advice, financial support, or career direction (Chua et al., 2008). Social network, therefore plays a key role in influencing different forms of trust for acceptance of new innovative technologies.

Figure 3 below demonstrates the structure of the two types of networks and displays the nature of the network connections within each type (Zhang et al., 2018).

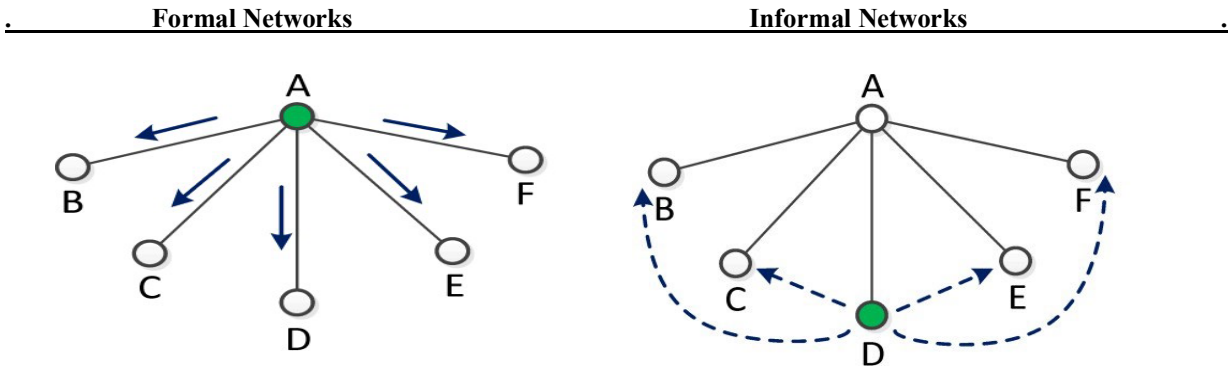


Figure 4: Formal Social Networks versus Informal Social Networks
Based on the conceptual framework of Zhang et al (2018)

In developing economies and collectivistic cultures, informal relationship plays a significant role in impacting the behavior of individuals especially when it comes to the adoption of new technologies (Acquaah, 2012). In a collectivistic culture, individuals may be swayed by others' beliefs to save face and adhere to the community (Zhang et al., 2020). For example, “Guanxi” is a Chinese notion of networking in which all social interactions and commercial transactions are governed by close-knit social networks. People who are in the same “guanxi” naturally have faith in one another, but outside of it, trust is never taken for granted. Thus, mistrust sets in by default, and trust should only be granted if one is positive that a new relationship will not jeopardize but rather uphold the interests of one's closest ties (De Cremer,

2015). It has also been established that in such countries, the influence of one's informal social network connection is significant (Tsai & Ghoshal, 1998), especially when trust in government and its related institutions is low.

Understanding the trust-building mechanisms in formal and informal institutions and how they are impacted by the social network connections of users is critical for decision-making on the appropriate CBDC design configuration, as these have different implications for each aspect of the technology (Valente, 1996). It must be noted, however, that users' formal and informal social networks do not operate in isolation. At any point in time, an individual user is exposed to both the influence of formal and informal social networks.

Figure 5 below depicts the combined social network for CBDC diffusion, showing the combination and interaction effect of formal and informal network connections to users.

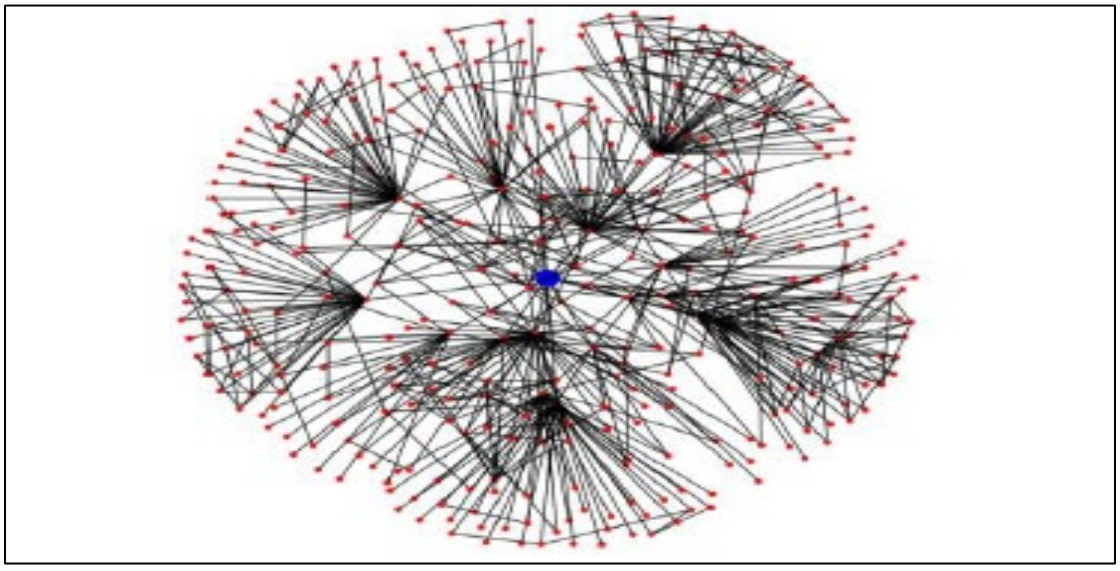


Figure 5: Combined Social Network of Formal and Informal Institutions
An illustration of the interaction effect between formal and informal social networks.
Sources: Modified depiction of Formal and Informal Social Networks of users of CBDCs, adapted from Zhang, Pavlou, and Krishnan (2018)

This creates a complex web of interactions that ultimately support the trust-building mechanism. The complex interaction of the two network types creates complementarities in the trust-building mechanism, where low trust in formal institutions may often be complemented by trust in informal institutions (Aghion et al., 2010).

IV.6 Complementarities between trust in formal and informal institutions

Within the context of political science study, there is support for the complimentary role various sources of trust play towards a given outcome. For example, Aghion et al. (2010) highlighted such a paradox, explaining the complex interconnections between personal trust and trust in institutions with respect to government regulations. They stated that people who are mistrustful of others in their communities prefer more government regulations and control of government officials, even though they are aware that these officials are corrupt and not trustworthy. Their model proposed that distrust among individuals promotes the desire for more government regulations despite knowing that government officials are themselves not trustworthy. For example, they stated that individuals in low-trust cultures justifiably distrust businesses because they see businesses as taking undue advantage of the people, and even though they clearly recognize that government regulation leads to even more corruption, they embrace it in order to ensure businesses are controlled. This example demonstrates the circumstances where there is low trust in institutions and yet users rely on the strength of the trust-building mechanisms within the formal institutions to reduce the risk of uncertainties in their dealings with private entities and individuals.

IV.7 Conceptual Development

Analysis of the data from the fifteen selected papers in the literature review on the role of trust in formal and informal institutions across different economic sectors and cultures, including

government e-services (Ahmad & Khalid, 2017), automated vehicle adoption (Zhang et al., 2020), adoption of online technologies (Zhao et al., 2023), payments systems (Söilen & Benhayoun, 2021), produced two groups of studies.

In the first group of studies, consisting of nine (9) papers, trust in formal institutions (through structural assurance, situational normality, etc.) and trust in informal institutions (through social influence) were found to have had a significant impact on users' intentions to accept the new innovative technologies. This was largely attributed to the unique characteristics of the users, who depended on their informal social network connections for support and advice towards acceptance of the new innovations as a compliment to their low trust in formal institutions (Moodley & Govender, 2016; Thusi & Maduku, 2020; Xia et al., 2023; Zhao et al., 2023).

At the individual level of acceptance of new innovative technologies, social influence compliments the role of trust, where users cannot fully appreciate the benefits, design features, and complexities surrounding the new technology and, therefore, do not fully trust it. Relying on their informal social network ties, including family, friends, and other close acquaintances, for advice and suggestions helped to develop a certain level of trust in the formal institutions sufficient to assuage their fears. relationships has often been a successful strategy to facilitate economic exchanges and influence the acceptance of new innovations (Acquaah, 2012).

Table 3 below shows a summary of the literature on the nine (9) studies done across different fields and in different countries where trust in formal institutions and social influence played a significant role in the acceptance of new innovations.

Table 3: Summary of Selected Literature on Trust where Social influence is significant

Study	Context	Trust	Social Influence	Other factors/ comments	Observation
1) Zhang et. al. (2020)	*Automated Vehicle Acceptance in China*	*Positive*	*Positive*	*characterized by a collectivistic culture*	*The influence of Trust and social influence is positive and largely significant in impacting acceptance of the relevant technologies studied. Several factors account for the positive impact of social influence. This includes relying on social influence to build up trust as well as the nature of the societies, being collectivists (Zhang et al., 2020).*
2) Ahmad and Khalid (2017)	*m-government (mobile) services in UAE*	*Positive.*	*Positive*	*high power distance and collectivism culture of UAE*	
3) Al-Edrus, Ahmad and Hanafiah (2023)	*Adoption of crowdfunding platform in Malaysia*	*Positive*	*Positive*	*hedonic motivation, price value, etc.*	
4)Akinwale and Kyari (2022)	*Financial Technology Services in Nigerian*	*Positive*	*Positive*	*influence of relatives, friends, etc*	
5) Dhahak and Huseynov (2020)	*Influence of Gamification on Online purchase of FMCG products*	*Positive*	*Positive*	*perceived enjoyment not significant*	
6)Kissi, Oluwatobiloba and Berko (2017)	*Debit card payment system among university students in Nigeria*	*Positive*	*Positive*	*Effort expectation and facilitating conditions insignificant*	
7)Al-Hujran, et. al. (2015)	*Citizen's adoption of e-governance in Jordan*	*Positive*	*Positive (national culture)*	*citizens must trust the government as well as the technologies.*	
8) Chong, Chan and Ooi (2012)	*Adoption of mobile commerce in Malaysia and China*	*Positive*	*Positive*	*trust and social influence were positive for both countries*	
9)Zimmermann, Somasundaram and Saha (2024)	*Adoption of new vaccine technology*	*Positive low*	*Positive high*	*social proof nudge reduces aversion to new technology.*	

Drawing on the same parallels at the country level of analysis, the low trust in formal institutions in some countries due to high incidence of corruption, political instability, government failures in the delivery of public services, weaknesses in the financial systems, and market imperfections often impede the adoption of new innovative technologies introduced by the government or its related institutions such as central banks. Improving the trust-building mechanisms and complementarities in informal social networking. In collectivist societies, people tend to respect the opinions of close friends, families, and communities (Zhang et al., 2020). These countries are often classified as low trust countries, for example, Mediterranean, Latin America, and Africa, whereas Nordic and Anglo-Saxon countries are considered high-trust countries (Aghion et al., 2010). In low-trust countries, it has been established that high power distance and collectivist culture have a great effect on social cooperation, as individuals would want to be seen as cooperating with the social norms and expectations in shaping attitudes and behaviors. (Ahmad & Khalid, 2017).

In the second group of studies, consisting of six (6) papers, it was found that where users have high trust in the formal institutions delivering the technology, the impact of informal institutions through social influence was largely insignificant, especially for users who demonstrated a high level of independent mindset, intellectual and technological awareness, for example, academicians (Moodley & Govender, 2016), technologically savvy millennials (Thusi & Maduku, 2020), etc. It revealed that users who are confident in formal network relationships with the provider of the technology trust the information about the innovation that is coming directly from the formal institution and do not have to rely on their informal social network for advice (Ahmad & Khalid, 2017; Chong et al., 2012; Zhang et al., 2020). Well-informed users, either by way of higher education, level of technology awareness, or from a society with a high

level of individualism as opposed to collectivism accepted the technology even when social influence was found to be largely insignificant.

Table 4 below summarizes the literature on the six (6) studies done across different fields and in different countries in which the role of social influence and informal institutions was not significant in influencing the acceptance of the new innovations.

Table 4: Summary of Selected Literature on Trust where Social influence is not Significant

Study	Context	Trust	Social Influence	Other factors/ comments	Observation
10) Zhao, Xu, and Xu (2023)	*Social commerce platform*	*Positive*	*Not Significant Mediates trust*	*Social systems influence more than individual decision-making styles*	*The impact of social influence on acceptance of the acceptance of the relevant technology was not significant, as users were already comfortable trusting directly the institution and the technology being introduced. These users were able to make independent adoption diffusion directly within the formal social network connection between them and the institutions offering the service.*
11) Xia al. (2023)	*Adoption/intention to use an automotive augmented reality head-up display (AR-HUD)*	*Positive*	*Not significant Indirectly mediates trust*	*social influence is more relevant to trust than cognitive or personal factors*	
12) Söilen and Benhayoun (2021)	*Adoption of CBDC by households in China's*	*Positive but less significant*	*Positive Less significant*	*CBDCs will not be successful unless trust issues are addressed*	
13) Moodley and Govender (2016)	*Internet banking among academics in South Africa*	*Positive and significant*	*Negative Less significant*	*academics are independent thinkers who research and draw their own conclusions*	
14) Ahmad, et al (2021)	*Fintech services among fresh graduates in Malaysia*	*Positive*	*Positive Less significant*	*seemed less interested in the recommendations of others*	
15) Thusi and Maduku (Thusi & Maduku)	*Mobile banking in South Africa among millennials*	*Positive*	*Positive Less significant*	*Millennials are generally regarded as independent thinkers possibly why the opinions of others are not significant*	

These users were able to make independent adoption decisions directly within the formal social network connections between them and the institutions offering the service. Structural assurance and situational normality were deemed sufficient to cultivate the level of trust necessary for acceptance of the new innovation.

It could be observed from the literature that the mechanism through which trust is developed from the institutional perspective depends on the complex interaction between formal and informal social network characteristics and the sociocultural environment within which the diffusion takes place. From the foregoing, this study develops a conceptual framework, showing the interrelationship between social network types, how they reflect in the formation of trust in formal and informal institutions, and their influence on CBDC design configuration.

IV.8 The Distributed Trust Matrix for CBDCs

The concept of distributed trust explains the mechanism through which trust is spread over several nodes in a network without overly relying on one central point of administrative authority (Chiu & Koeppl, 2019; Xi et al., 2015). The trust-building mechanisms improve as the number of independent nodes increases. When trust is distributed among many participants, failure on the part of one participant does not undermine the entire system. For example, distributed trust forms the underlying principles for the concept of separation of powers in our system of governance and segregation of duties in management theory. Allen et al. (2020) identified two key sources of distributed trust: **Trust dispersal** and **Threshold trust. Trust dispersal** occurs when one role in a distributed system is performed by multiple independent authorities, each serving just a small portion of the entire user population**.** In a CBDC design configuration where numerous institutions perform the role of financial intermediaries on behalf of their clients and only their clients, only a particular financial intermediary's clients are

theoretically required to trust that intermediary. The trust that the entire ecosystem collectively places in central banks and financial intermediaries is distributed among multiple institutions. This limits the impact of a lack of trust in one particular institution to that institution alone without affecting the entire system (Xi et al., 2015). An example cited by Allen et al. (2020) for trust dispersal occurs with the distribution of a country's political functions across several regional and local administrations, each having jurisdiction over the people who reside in that region and it is territorial boundaries.

The second source of distributed trust comes from **Threshold trust**, where a decentralized system helps to reduce the need for users to rely solely on a single authority. Instead, users individually or collectively divide their trust among numerous institutions, independently providing the same function so that no single authority or small coalition has unlimited power or authority over any user (Allen et al., 2020). An example of threshold trust is represented by the role of the board of directors of an organization or parliament of a country, where members are collectively trusted but cannot act alone. The concept of distributed trust is the foundation of the blockchain technology. The trust-building mechanism in blockchain technology allows it to be a tamper-proof consensus network without the need for a central point authority or middleman to facilitate economic exchange.

The concept of distributed trust is not new, as it has been the basis of many trust-building strategies for centuries. However, its recent application in blockchain technology extends the concept beyond human interaction into computers and technological systems (Liang et al., 2021). This study argues that central banks can take advantage of the distributed trust concept and design their CBDCs in a way that could overcome distrust among potential users.

The conceptual framework in Figure 6 below explains the role of distributed trust in influencing the design options for central bank digital currencies based on the relationship between trust in formal and informal institutions and their respective social networks.

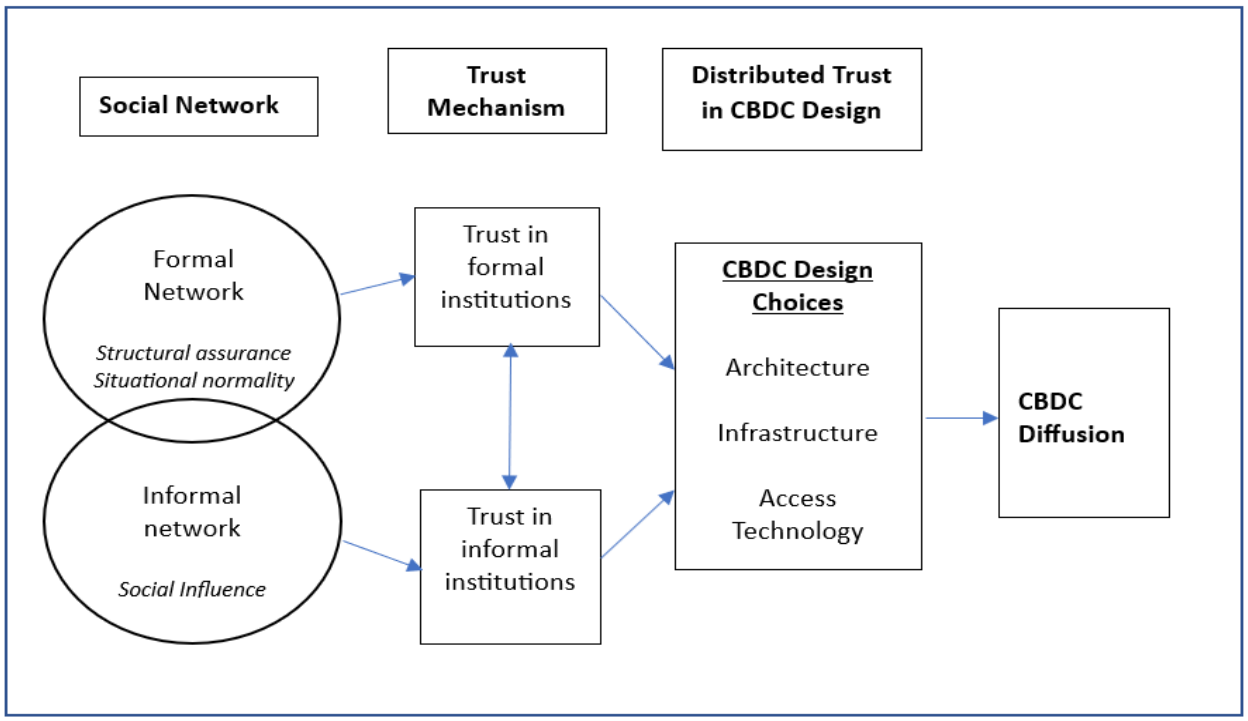


Figure 6: Conceptual Framework
Conceptual Framework of Distributed Trust in CBDC Design

Trust in formal institutions flows from the formal network of users through structural equivalence and situational normality, impacting design choices based on the configuration of the three CBDC design components: architecture, infrastructure, and access technology. On the other hand, trust in informal institutions is developed from the combination of informal social networks through social influence to impact the design features of CBDCs. The framework also shows the interaction effect between trust in formal and informal institutions, demonstrating the effects of the complementarities between them. This study develops the Distributed Trust Matrix for CBDCs to demonstrate how central banks could configure their CBDC design features for

successful diffusion within the specific context of the country-level socio-cultural factors, such as trust in formal and informal institutions.

Different components of the CBDC design configurations bring on board additional trust-building mechanisms as the number of participants (nodes) increases. Table 5 below shows the design configuration options and how they are represented in the Distributed Trust Matrix.

Table 5: The Distributed Trust Matrix and CBDC Design Choices

Distributed Trust Matrix Components	**CBDC Design Choices** (Auer & Böhme, 2020)	**Consumer Needs** (Auer & Böhme, 2020)	**CBDC Design Configurations** (Auer & Böhme, 2020)	**Application**
Vertical Axis	Architecture	Resilient and robust systems	i.Conventional centralized, ii.Decentralized DLT	Applicable to most types of Digital Currencies, including CBDCs, Bitcoin, Ethereum etc
Horizontal Axis	Access Technology	Accessibility Privacy	i.Account-based. ii.Token-Based	
Diagonal Axis	Infrastructure	Cash-like peer-to-peer, real-time convenience	i.Direct, ii.Hybrid iii.Intermediated iv.Indirect	Applicable to CBDCs

The Distributed trust matrix integrates the three CBDC design configurations, namely Architecture, Infrastructure, and Access technology, in a three-by-three matrix to demonstrate the trust-building mechanisms embedded in the combination of design choices available to central banks.

We break the matrix down into two frameworks. The first framework represents most types of digital currencies, including CBDCs, Bitcoins, etc., where developers are faced with design choices on Infrastructure and Access technology, i.e., whether it is a Conventional

centralized or Decentralized DLT infrastructure on the one hand and whether it is an Account-based or Token-based Access technology on the other hand. These initial design choices are presented in a two-by-two framework, as presented in Figure 7 below.

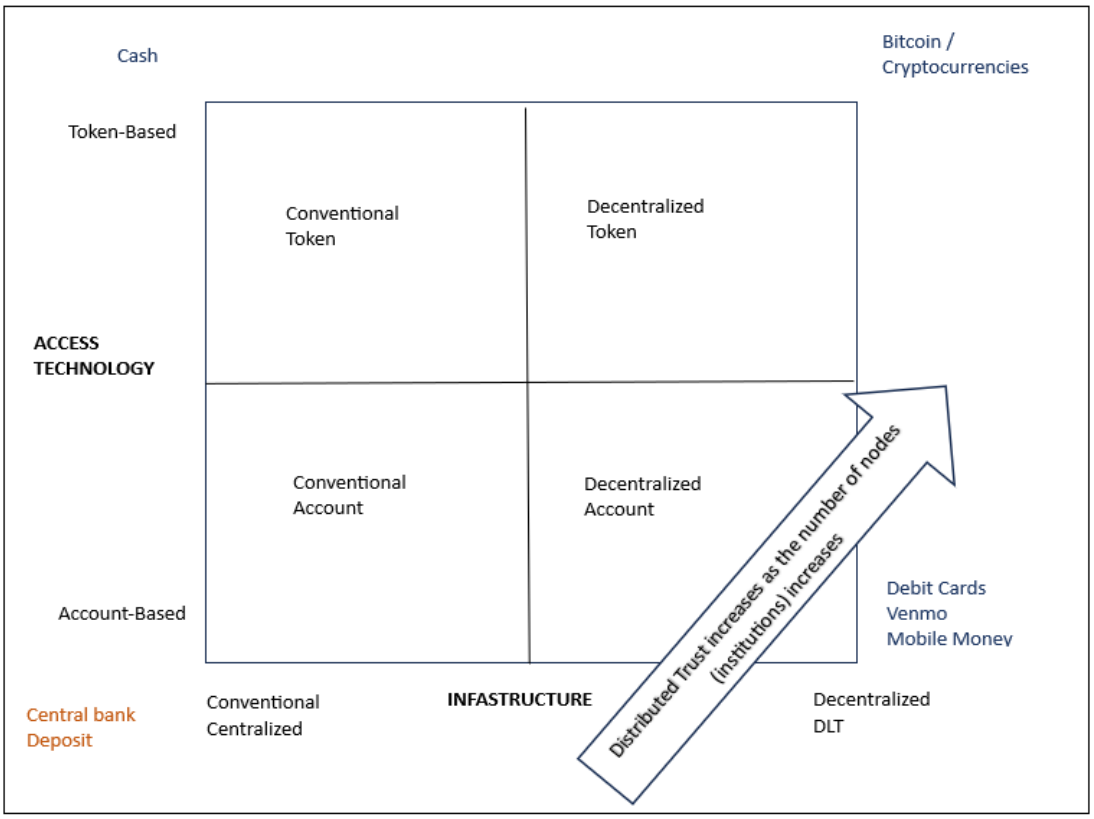


Figure 7: The Framework of the Distributed Trust Matrix for Infrastructure and Access Technology
Adapted from Adler (2001)

On the horizontal axis of the matrix, design choices on infrastructure are presented, consisting of a conventional centralized infrastructure option on the right and a decentralized DLT option on the left. Central banks have the option to roll out a conventional centralized infrastructure, similar to the current banking infrastructure across various countries. A decentralized DLT infrastructure benefits from the distributed trust concept as users spread their trust across several entities and not just one. The higher the number of entities, the better the

trust-building mechanism works. The DLT technology, by its design, is supposed to generate more confidence and trust as it is developed on the same principle of distributed trust.

On the other hand, the vertical axis of the matrix is represented by the Access technology, which has two design choices: either an Account-Based technology or a Token-Based technology. An account-based access technology provides less trust-building mechanism as compared to a token-based CBDC, which gives users a very high level of privacy and anonymity protection. A combination of the Infrastructure choices with Access technology provides four options for central banks and developers of digital currencies. Each combination of design choices of Infrastructure and Access technology provides different levels of distributed trust mechanisms (Auer & Böhme, 2020; Bordo, 2017). These design choices could be in the form of a **Conventional Account-based** digital currency, a **Conventional Token-based** digital currency, a **Decentralized Account-based** digital currency, or a **Decentralized Token-based** digital currency that has features close to that of a cryptocurrency, such as Bitcoin. Based on the Distributed Trust Matrix, the level of trust-building mechanism increases as design choices move from bottom-left to top-right.

The second framework of the Distributed Trust Matrix covers the Architecture design choices for central banks, as represented in the diagram shown in Figure 8 below.

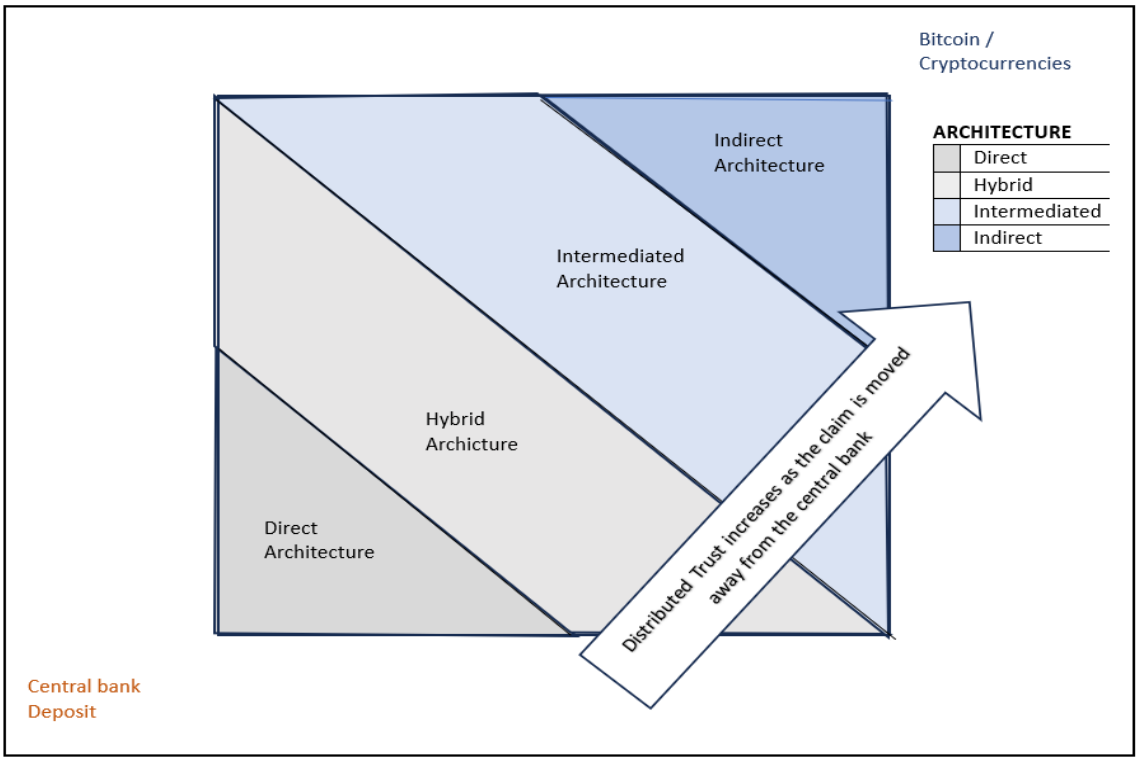


Figure 8: The Framework of the Distributed Trust Matrix for CBDC Architecture
Adapted from Adler (2001)

The Architecture design configurations, which is the level of legal claim on the CBDCs, provide central banks with options depending on their role in the legal and operating structure of the CBDC payment ecosystem vis-a-vis the financial intermediaries (Auer & Böhme, 2020). As previously stated, the design choices for Architecture include Direct, Hybrid, Intermediated, and Indirect, highlighting the various levels of legal claims on central banks. As one moves from the bottom-left to the top-right of the matrix, the number of trusting entities increases as trust is distributed among many more participants, leading to an improvement in the trust-building mechanisms (Allen et al., 2020).

Bringing together the two frameworks, as presented previously, produces eight (8) different configuration choices for central banks to choose from. Each combination of the three design choices of Architecture, Infrastructure, and Access technology provides different levels of trust-building mechanisms. Based on the distributed trust concept, the level of trust in the system increases as you move diagonally from the bottom-left to the top-right of the Matrix, as shown in Figure 9 below.

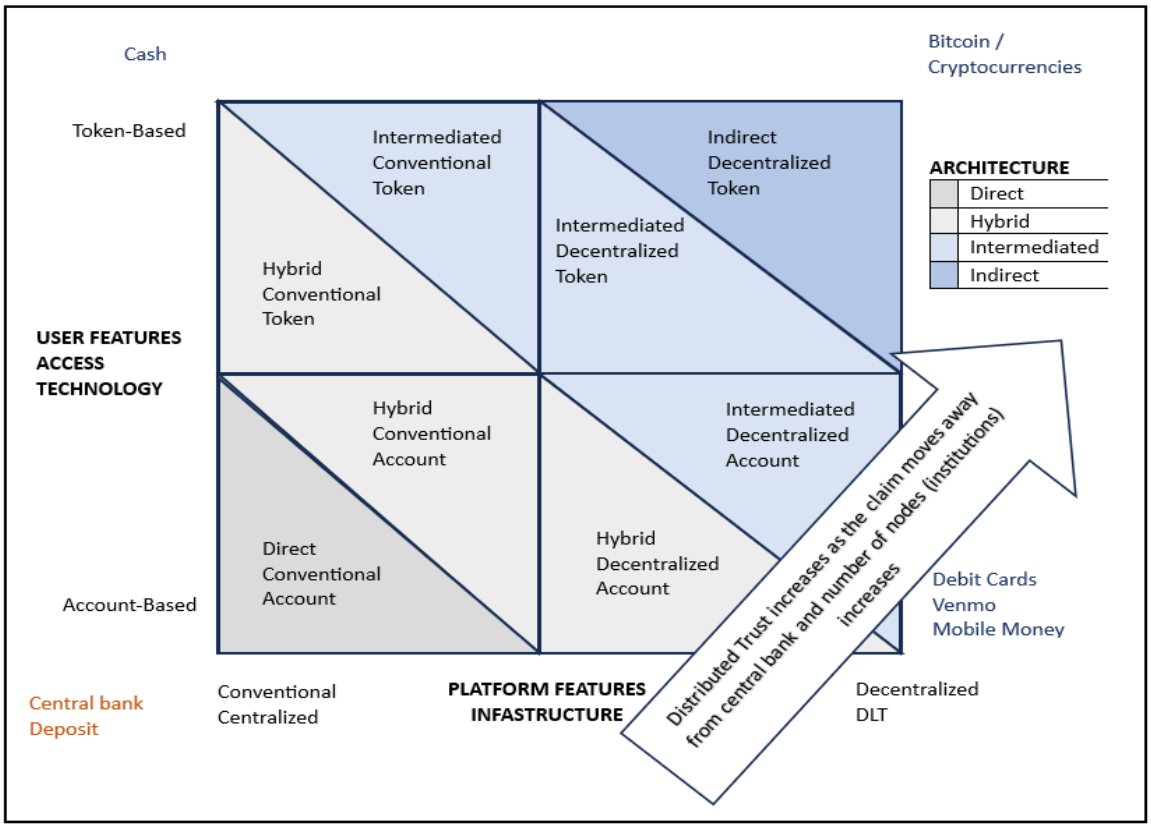


Figure 9: Distributed Trust Matrix for CBDCs – Design Options
Distributed Trust Matrix for CBDCs Showing Design Options
Adapted from Adler (2001)

The eight configuration options presented below are listed with their relative levels of trust-building mechanisms.

- Direct Conventional Account - Low
- Hybrid Conventional Account - Medium
- Hybrid Conventional Token - Medium
- Hybrid Decentralized Account - Medium
- Intermediated Conventional Token - High
- Intermediated Decentralized Token - High
- Intermediated Decentralized Account - High
- Indirect Decentralized Token - Highest

For example, an indirect CBDC with a decentralized infrastructure and Token-based access technology provides the highest level of distributed trust. This instrument will be closer in terms of features to cryptocurrencies such as Bitcoin. Based on the Distributed Trust Matrix, this dissertation posits that central banks have several choices in deciding the level of trust-building mechanism needed for the successful diffusion of their CBDCs.

IV.9 The trade-offs on the Distributed Trust Matrix for CBDCs

There are several trade-offs that underline how the matrix operates. These trade-offs could be in the form of economic, technical and time constraints. At the start point of the matrix, a central bank could implement a hypothetical CBDC with a Direct-Conventional-Account configuration. This will be the easiest system to implement technically, will be cheaper as it will rely on the central bank's own existing infrastructure, and may be quicker to roll out. As configuration options move up from bottom-left to top-right on the matrix, the technology

becomes complex, expensive, and time-consuming to implement as it involves many more third parties. The trade-off assumption of the matrix requires central banks to balance the design configuration requirements with resource limitations and availability.

The economic argument is highly critical in deciding what optimum resources are needed to be deployed in the development of the CBDC. Given the limited resources in developing countries, the best-fit technology must be considered without incurring excess and unnecessary costs. The Distributed Trust Matrix for CBDCs helps central banks to make optimum decisions within the context of their specific country's circumstances and not necessarily implementing a system because other countries are implementing the same.

V DISCUSSION

In this chapter, we present the insights drawn from the statistical data analysis and the cross-case study of the three CBDC projects involving China, Jamaica, and Nigeria to provide empirical support and validation of the role of distributed trust in the design and diffusion of central bank digital currencies as conceptualized in the Distributed Trust matrix.

V.1 Trust in formal and informal institutions by country and region

The details of each of the variables and how they were determined from the data are discussed in the following sections.

a) Trust in informal institutions

Trust in informal institutions was determined using the average scores by countries for five (5) different questionnaire responses. These were.

a) *Trust in family,*

b) *Trust in neighbors*,

c) *Trust in people you know personally,*

d) *Most people can be trusted'*

e) S*trength of social network ties, (how connected do you feel to people)"*

The average composite score ranged between 4.6 and 7.5 with a mean of 5.7, as shown in Table 6.

b) Trust in central banks (formal)

Despite their presumed autonomous status, central banks have not been completely independent from governmental influence in most countries. In developing countries, central banks are considered part of the civil service and work closely with the government to jointly manage the economy. Because the actions of the central bank

are often closely connected with the government, the concept of central bank independence has often come into question (Keefer & Stasavage, 2003). As a result, the general perception of trust in the central bank is often influenced by trust in the government. Using the World Value Survey 2014 & 2022, this study combined the average responses for the following questions as a proxy for trust in central banks.

a) *Confidence in government*

b) *Confidence in the civil service*

The average composite ranged between 1.9 and 7.5 with a mean of 4.0. as shown in Table 6.

c) Trust in private intermediaries (formal)

World Value Survey 2014 & 2022 reported results on trust in financial intermediaries (*"Confidence in banks"*) across the countries surveyed. For some countries, mostly European countries, including Albania, Austria, Bosnia, Bulgaria, Croatia, Denmark, Finland, France, Hungary, Iceland, Italy, Latvia, Lithuania, Montenegro, North Macedonia, Palestine, Portugal, and Switzerland, there were missing data and therefore, data result for survey question on *"Confidence in major companies"* was used as a proxy for trust in intermediaries (formal). The average composite score for the data set for trust in private intermediaries ranged between 2.1 and 10, with a mean of 4.1. as shown in Table 6.

The results of the statistical analysis of the data, including a test for correlation, show that trust in informal institutions has no statistically significant correlation with either trust in central banks ($r = 0.003$) or trust in private intermediaries ($r = 0.0034$). This further confirms that the two sets of variables are independent of each other and, therefore, are not measuring the same

concept, providing further validation to their application in the Distributed Trust Matrix for CBDCs.

Table 6: Result of Statistical Analysis of Data on Trust Across Countries
Descriptive Statistics: Mean, Standard Deviation, Range, Correlation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Trust: family										
(2) Trust: neighborhood	0.577**									
(3) Trust: People you know personally	0.799**	0.685**								
(4) Most people can be trusted	0.898**	0.469**	0.694**							
(5) Strenght of Social Network Ties	0.816**	0.178	0.435**	0.682**						
(6) Trust in Informal Institutions	0.532**	0.202*	0.341**	0.402**	0.256**					
(7) Trust: The Government	0.248*	0.329**	0.420**	0.14	0.147	-0.048				
(8) Trust: The Civil Services	0.181	0.280**	0.360**	0.049	0.11	-0.068	0.974**			
(9) Trust in Central Banks (formal)	0.320**	0.360**	0.462**	0.259**	0.185	-0.003	0.946**	0.850**		
(10) Trust in Private Intermediaries (formal)	-0.015	-0.001	0.105	-0.053	-0.034	-0.036	0.655**	0.662**	0.584**	
Mean	5.6	8.9	5.2	5.7	2.4	6.0	3.8	3.7	4.0	4.1
SD	0.7	0.7	0.8	1.0	1.7	0.7	1.2	1.4	1.0	1.4
Min	3.9	5.4	2.9	3.4	0.2	4.6	1.7	1.5	1.9	2.1
Max	7.9	9.9	7.0	8.8	7.4	7.5	8.0	8.6	7.5	10.0

Notes: level 1 N = 155642; level 2 N = 102; ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

Analysis of data on trust in formal and informal institutions across the 102 countries captured in the data confirms the propositions of this dissertation that trust varies across countries based on the socio-cultural environmental contexts of each country or region. For example, the level of trust in formal institutions is relatively lower in Europe and North America than in other parts of the world. This could be attributed to the deterioration of trust in the government, especially during the COVID-19 pandemic (Cena & Roccato, 2023; Hossain & Biswas, 2023; SteelFisher et al., 2023). Countries in South America and the Caribbean recorded the lowest level of trust in central banks, whereas countries in the Middle East and North Africa (MENA) recorded the lowest levels of trust in private intermediaries.

Figure 10 below shows the variations across countries in the three trust variables of the study,

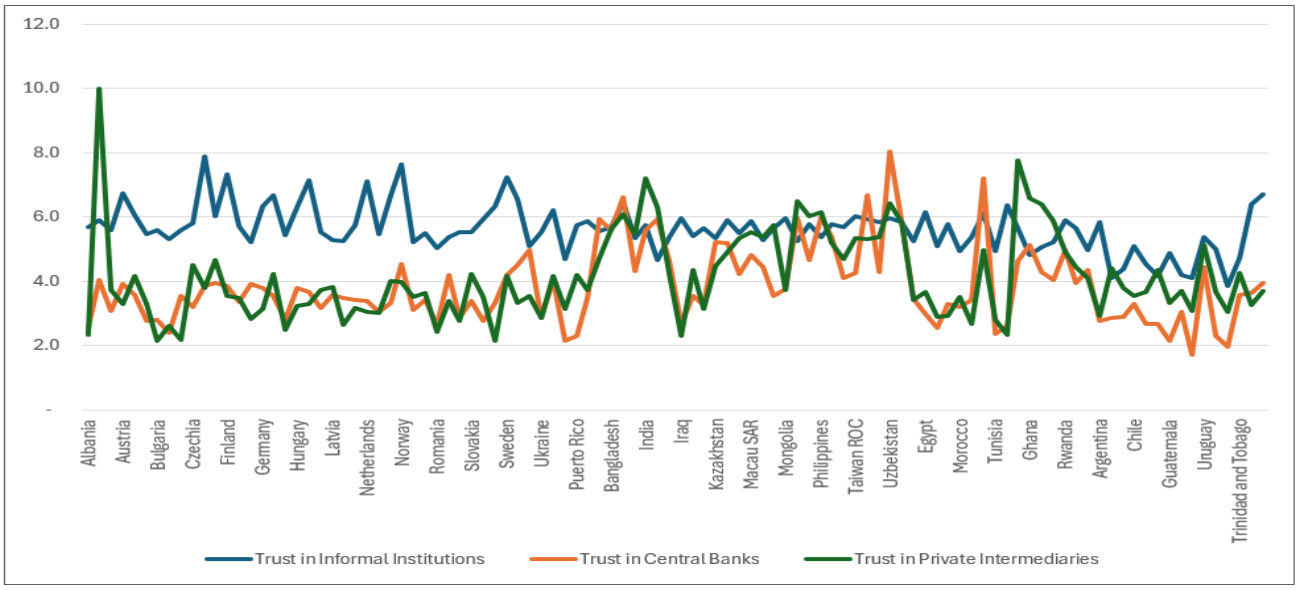


Figure 10: Level of Trust in formal and informal institutions by Country

This partially confirms the assertions by Acquaah (2012) that trust in governments in developing countries is low because of market imperfections and the presence of institutional voids. It is also attributed to general mistrust and growing suspicions about the government and its related institutions across the world, as was witnessed during the COVID-19 pandemic (Cena & Roccato, 2023; Hossain & Biswas, 2023; SteelFisher et al., 2023).

With the existence of such variations across countries with respect to the level of trust in formal and informal institutions, the sociocultural context of the country becomes a relevant factor in the CBDC design configurations. At the country level, there is sufficient evidence that varying levels of trust in formal and informal institutions across regions have distinct consequences for decision-making in areas such as investment decisions, and technology adoption etc (Wei & Zhang, 2020). These variations do not only exist at the country level of analysis but even in terms of differences across various regions of the world. The differences in

regional levels of trust in formal and informal institutions confirm the assertion that there cannot be one type of CBDC for all countries. and that because these countries vary in terms of key cultural and social attributes such as trust and social influence, a CBDC design specification that fits the socio-cultural attributes of the people will be more successful and diffuse widely among the population. The average score of trust in formal and informal institutions across regions of the world is presented in Figure 11 below.

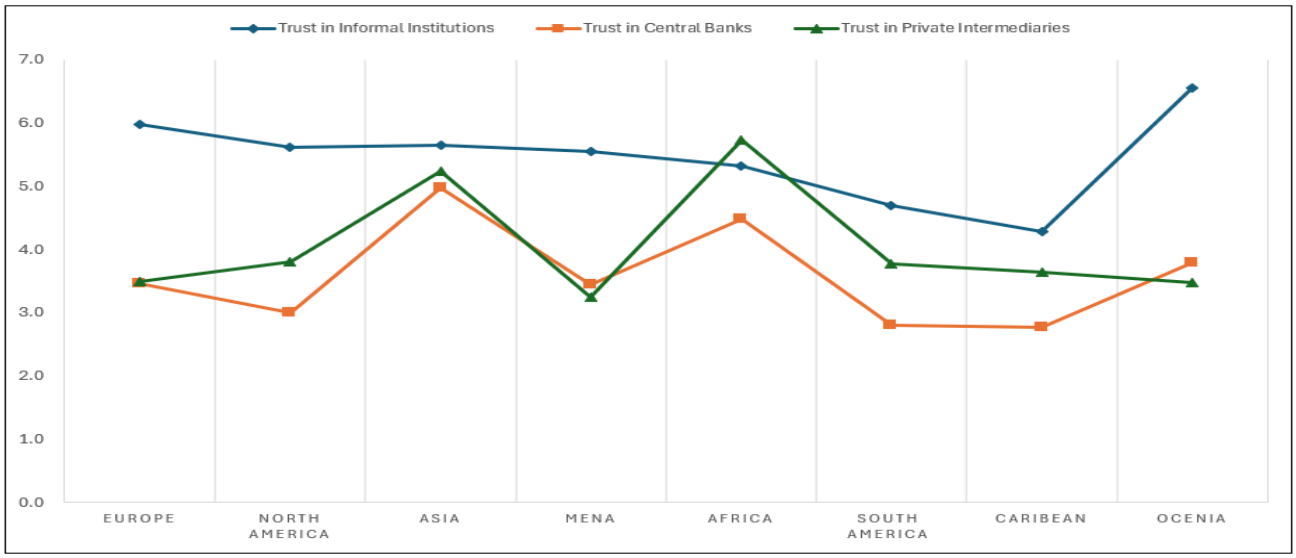


Figure 11: Level of Trust in Formal and informal institutions by region

As previously indicated, there are many other socio-cultural factors, other than trust that may impact the diffusion of new innovations. These may include factors such as gender, age, experience, performance expectation, and effort expectancy (Venkatesh et al., 2003). However, holding all these factors constant, this study argues that trust in formal and informal institutions plays a critical role in design choices available to central banks for the successful diffusion of CBDCs.

V.2 Cross–case Analysis of CBDC Projects in China, Jamaica, and Nigeria.

In this section, we present empirical support and validation of the concept of distributed trust and its role in the design and diffusion of central bank digital currencies through a cross-case study analysis of three CBDC projects in China, Jamaica, and Nigeria. The cross-case study is the third methodology used in this dissertation under the pluralist research methods (Mingers, 2001). The case study method provide an opportunity to share rich insights (Yin, 2018) on selected CBDC projects, highlighting the key implications of trust-building on the design choices and diffusion of CBDCs in those respective countries.

The three cases were selected purposively based on the advanced stage of their development. These projects represent some of the most advanced CDBC projects around the world. Using cross-case analysis, the research method helps to validate the Distributed Trust Matrix by demonstrating that the selected cases either indicate results that would be identical in a literal replication or results that would be different in a theoretical replication (Yin, 2018). They have certain similarities in terms of sociocultural contexts*(** but are also different in terms of implementation strategy and stage of development. There are about 130 countries currently involved in some aspect of CBDC project (The CBDC Tracker, 2024). Among the 130 countries, about 79 are either developing or conducting research on CBDCs, whilst 21 have been involved in a CBDC pilot. There are about 11 countries that have fully launched and gone live with their CBDC projects. Our cross-case analysis involved three countries: China, which is the most advanced pilot project in the world, and two other countries, Jamaica and Nigeria, which have fully launched and are running live CBDC projects. The cases were also selected taken into consideration geographical and regional representation for Asia, the Caribbean and Americas, and Africa, respectively.

Content analysis of published materials on these projects through open coding using NVivo provided a summary of cross-case characteristics of the three projects, as presented in Table 7 below.

Table 7: Cross-Case Analysis of CBDC Projects in China, Jamaica, and Nigeria

Project Characteristics	China	Jamaica	Nigeria
Project name /Start Date	• Name = e-CNY (initially DCEP) • Pilot in 4 cities in April 2020 • 10 cities during Beijing Winter Olympics	• Name = JAM-DEX • Launched July 2022	•Name = eNaira •Launched in October 2021
Objectives	• Financial inclusion • Payment systems efficiency • Global influence/international trade	• Financial inclusion • Reducing cost of handling physical cash by almost $7M	• Financial inclusion - 64% to 95% • Raising the informal sector's accountability
CBDC Design Choice	• Architecture = Intermediated • Infrastructure = Conventional and Decentralized (both) • Access technology = Account-based	• Architecture = Intermediated • Infrastructure = Conventional • Access technology = Token-based	• Architecture = Intermediated • Infrastructure = Decentralized • Access technology = Token-Based
other Design Considerations	• "one coin, two databases, and three certification centers."	• January 2024 started to update 10,000 point-of-sale systems to enable JAM-DEX QR codes	• The Hyperledger Fabric blockchain protocol • Integrated with 33 banks
Trust Quantitative Data	• Trust in central banks = 6.6/10 • Trust in intermediaries = 6.1/10 • Trust in informal institutions = 6.4/10	• Trust in central banks = 2.8/10 • Trust in intermediaries = 3.6/10 • Trust in informal institutions = 4.3/10	• Trust in central banks = 4.0/10 • Trust in intermediaries = 5.9/10 • Trust in informal institutions = 5.2/10
Current Status	• Pilot stage • 1.8T yuan ($249.33B) by June 2023 • 950m transactions June 2023 • 120m wallets representing 0.16% of Money Supply M0.	• in April 2023 - a reward program for wallet owners and a scheme for small and micro traders. • Proceeding with a phased roll-out	• expected to boost GDP by $20B • Live project • 919K wallets • 18M transactions as of October 2022

V.2.1 *The China e-CNY Project*

According to the Atlantic Council CBDC tracker, China's project is still in the pilot stage, and it is aimed at both retail and wholesale uses. China's central bank, the People's Bank of China (PBC) settled on an **Intermediated architecture** built on both **Conventional and Decentralized infrastructure** for pilot and testing purposes. China's CBDC was initially named Digital Currency Electronic Payments (DCEP), but later changed to the e-CNY in line with how other countries are naming their CBDC projects. The People's Bank of China (PBOC) established a task force in 2014 to investigate digital fiat money, with a focus on the issuance framework, key technology, issuance and circulation environments, and foreign trade compatibilities. The PBOC launched the Digital Money Institute in 2016, which created the first prototype of a digital fiat currency (Peoples' Bank of China (POBC), 2021). According to policymakers, the Chinese digital currency network consists of "one coin, two databases, and three centers". The PBOC guarantees an encrypted digital medium of exchange known as "one coin." The "two databases" relate to the People's Bank of China's ledger, which keeps records of all outstanding e-CNY, as well as all e-CNY ledgers managed by lower-tier institutions. The "3 centers" are located inside the People's Bank of China (Lee et al., 2021). They are composed of a certification center that maps the identities of all digital wallet users, a registration center that tracks ownership of digital wallets and their users' transactions, and a big data analysis center that analyses payment flows.

The project started with a pilot in four cities in April 2020, permitting commercial banks to carry out internal testing such as payments, account-balance checks, and cash-to-digital conversions. The pilot program was expanded to include twenty-eight large cities from 10 regions in August 2020 (Arendse Huld, 2022, September 22). As of June 2021, the PBOC

reported that more than 20.87 million personal and 3.51 million corporate digital yuan wallets have been established, with a total transaction value of around 5.39 billion dollars (Peoples' Bank of China (POBC), 2021). The Beijing Winter Olympics provided an ideal opportunity to demonstrate the currency's scalability by piloting it in ten regions across China in February 2022 (Subrahmanyam, 2023). Transactions using China's digital yuan reached 1.8 trillion yuan ($249.33 billion) at the end of June 2023, according to the country's central bank governor, Yi Gang, up from more than 100 billion yuan in August 2022 (Wee, 2023, July 19). Total e-CNY transactions totaled 950 million, with 120 million wallets opened, accounting for only 0.16% of China's M0 money supply, or cash in circulation. The e-CNY is an **Intermediated architecture** built on both **Conventional and Decentralized infrastructure** for pilot and testing purposes. However, the decision on the type of **access technology** is not yet finalized. Given that users in China are already familiar with the **Account-based** technology of two of the most popular payment systems in the country, Alipay and WeChat Pay, it is highly likely that the PBC will opt for an **Account-based** access technology.

China is also working to better incorporate e-CNY into its current payment mechanisms. In January 2023, China included e-CNY in its currency circulation estimates, with the digital currency accounting for 0.13% of the central bank's cash and reserves. China is exploring using CBDC's programmability to load interest rates onto the digital RMB using smart contracts. E-CNY is currently linked to the Hong Kong Monetary Authority's Faster Payments System, which was tested at the 19th Asian Games in China from September 23 to October 8, 2023. Hong Kong visitors entering mainland China were able to purchase and top up their digital RMB wallets over the FPS, as well as through Visa or MasterCard accounts. (The CBDC Tracker, 2024).

Managed anonymity is a unique concept of China's CBDC project (Ren et al., 2023). CNY places a high importance on privacy protection and follows the principle of "anonymity for low value and traceability for high value" transactions (Bank for International Settlements (BIS), 2022). It aims to meet the public's demand for anonymous small-value payment services by leveraging the current electronic payment system's risk characteristics and information processing logic. Meanwhile, it is vital to guarantee that transactions comply with AML/CFT requirements to prevent the use of e-CNY for illegal and criminal activities such as tele-fraud, online gambling, money laundering, and tax evasion (Chen, 2021). In an article published on China Briefing titled "China Launches Digital Yuan App – All you need to know", September 22, 2022, the author Arendse Huld confirmed the belief that trust in governments is linked to trust in central banks, as he alluded to the fact that *"the Chinese government already enjoys a relatively high degree of confidence, and it is possible that consumers may one day prefer to place their trust with the central bank rather than tech giants*" as he discussed the relevance of trust to the acceptance of China's CBDC (Arendse Huld, 2022, September, 22). From the foregoing, we are able to establish strong inferences that trust plays a significant role in China's CBDC project.

V.2.2 *The Jamaica JAM-DEX*

The JAM-DEX platform technology has an **Intermediated architecture** on a **Conventional infrastructure** with **Token-based access** technology. The Bank of Jamaica (BOJ) declared on December 31, 2021, that the JAM-DEX, its retail CBDC, has successfully concluded its testing (Wyss & Gardner, 2022) and was ready to go live. In July 2022, JAM-DEX was made available via the Lynk mobile app (The CBDC Tracker, 2024). Prior to going live, the Jamaican central bank had been collaborating on a sandbox experiment with the Irish

technology company e-currency Mint (The CBDC Tracker, 2024). After the sandbox experiment was successfully completed, the CBDC was renamed the Jamaican Digital Exchange, or JAM-DEX, in February 2022 (Wyss & Gardner, 2022).

The Jamaican central bank introduced two initiatives in April 2023 to encourage the use of JAM-DEX: a reward program for wallet owners and a scheme for small and micro traders. The governor of the central bank pledged in January 2024 to update 10,000 point-of-sale systems to enable payments with JAM-DEX using QR codes (Lannquist & Tan, 2023; Ministry of Finance Jamaica, 2023). The central bank intends to proceed with a phased rollout of the JAM-DEX to allow customers to conduct transactions on their digital wallets. During the deployment, the onboarding of both new and current users will continue, enabling two more wallet providers to give CBDCs to their clientele (The CBDC Tracker, 2024). The Central Bank of Jamaica, like most developing countries, is pursuing CBDCs to drive financial inclusion and create efficiency in the financial sector. It is expected that the CBDC could help reduce the expenses of managing and storing cash. The estimated yearly savings from JAM-DEX will offset Jamaica's existing cash replacement storage and handling expenses of almost $7 million US dollars.

However, participation in the Jamaica JAM-DEX has not been encouraging since its introduction. To boost the uptake of the Jamaican CBDC, the central bank is now offering incentives, such as discounts and free digital tokens to users to encourage adoption. However, the cost implications are not yet fully known. In an article published in the Financial Times on July 20, 2023, with the title “Jamaica, we have a CBDC, the Executive Director of Capri, Mr. Damien King, provided insights on how the lack of trust could impact negatively the adoption of Jamaica’s CBDC, emphasizing that over one in ten unbanked Jamaicans are in that position at least partially because they do not trust the government and financial institutions. He explained

that "*there are historical factors like the legacy of colonialism and slavery, which gave the majority of the population very good reason to distrust the government and the authorities*" (Financial Times, 2023). Building trust in the JAM-DEX, therefore, remains one of the major obstacles affecting the widespread adoption of CBDC in Jamaica.

V.2.3 *The Nigeria eNaira*

Nigeria launched its CBDC with an **Intermediated architecture**, running on a **Decentralized infrastructure DLT** using **Token-based access technology**. The eNaira, Africa's first digital currency, was launched in Nigeria in October 2021. At the time of the launch, about 500 million eNaira, the equivalent of $1.21 million US dollars, had already been created. Enhancing financial inclusion, raising the informal sector's accountability, and easing remittances are the objectives of the eNaira (Ozili, 2022). The eNaira infrastructure has been integrated with 33 commercial banks (The CBDC Tracker, 2024). The Central Bank of Nigeria published a 300-page book in October 2023 to demonstrate its continued faith in the eNaira by explaining its beneficial features, increasing its acceptance and efficacy while refuting accusations of financial instability risks and correcting misinformation about its influence on the banking sector (The CBDC Tracker, 2024).

In August 2022, the Central Bank of Nigeria initiated the second phase of eNaira's development, with the expectation that this phase would bring the total number of users to 8 million (The CBDC Tracker, 2024). A larger transaction limit for the eNaira is permitted based on the level of identity presented. Payments up to 50,000 Naira ($121) each day, or up to 200,000 ($484) for the bottom tier of a bank-approved account, can be made by individuals with a phone number and a recognized national identification. The number of transactions had increased to slightly about 18 million USD as of October 2022. It is anticipated that the eNaira

will assist Nigeria in achieving its goal of raising financial inclusion from 64% to 95%. Over the following ten years, a well-managed eNaira is expected to boost GDP by $29 billion dollars (The CBDC Tracker, 2024).

The eNaira's implementation accomplishes a lot of things well, but it fell short of utilizing many of the true advantages of blockchain technology, which is presumably why it is still not widely used. The Hyperledger Fabric blockchain protocol—an open-source initiative initiated by the Linux Foundation—is the platform upon which the eNaira was built. The eNaira project has implemented this as a private blockchain network. Instead of the popular public cryptocurrency initiatives, eNaira nodes are maintained solely by the Central Bank of Nigeria (CBN) and its trusted partners. Wallet apps are then connected to these nodes to communicate with the blockchain network, while the nodes themselves are utilized to maintain the blockchain protocol by verifying new blocks and performing transactions (Rawat, 2023, April, 28).

The most important implementation challenges faced by countries that have gone live with their projects have been the low market acceptance and general scepticism about CBDCs. In Nigeria, for example many users did not even understand why the central bank is implementing CBDCs. In an interview with Jennifer Echenim, a Lagos-based front-end engineer working with Web3 technologies, she concluded that the *"Adoption of digital currency is definitely on the rise, given the fact that businesses and individuals are constantly looking for ways to preserve value. However, the naira keeps devaluing; as such, the adoption of the eNaira looked like a failure even before it started*" …. "*It appears to me as a follow-up on restrictions placed on other digital currencies……. Proper research wasn't done before its launch*," she said. "*For a currency to be valued, there needs to be a demand for it; that's basically what drives digital*

currencies today (demand). No one is looking for Naira. It isn't even acceptable or usable outside Nigeria. Building a digital currency on that, is definitely a fail." (Sanusi, 2023, May, 23).

V.2.4 *Reflections on the CBDC Case Studies*

Figure 12 below shows the Distributed Trust Matrix with the representation of the design configurations of the three CBDC case studies.

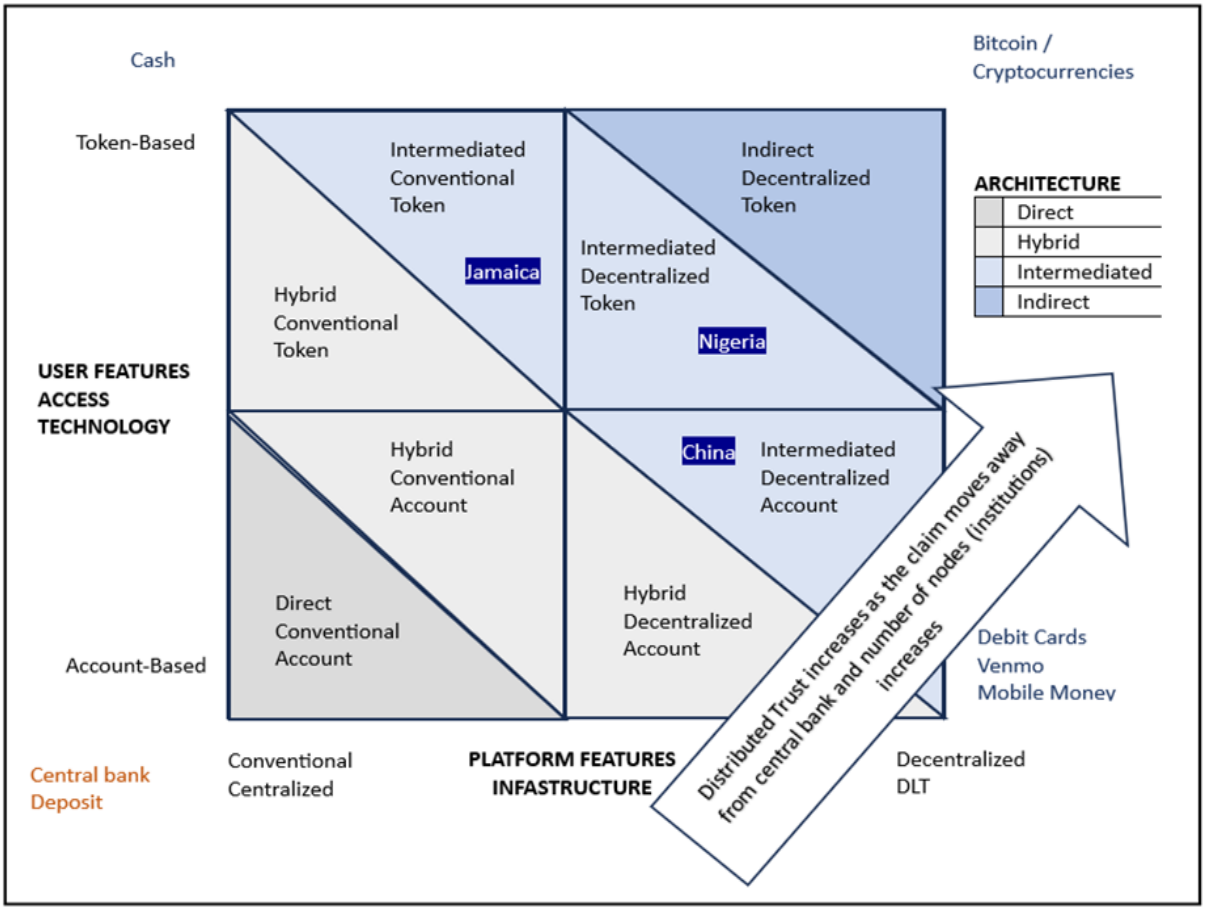


Figure 12: Distributed Trust Matrix for the Three Case Studies – China, Jamaica, and Nigeria

Adapted from Adler (2001)

Based on the design configurations represented on the Distributed Trust Matrix, China is piloting an **Intermediated architecture** built on both **Conventional and Decentralized infrastructure** for pilot and testing purposes. The JAM-DEX platform technology has an

Intermediated architecture on a **Conventional infrastructure** with **Token-based access** technology, whereas Nigeria has an **Intermediated architecture**, running on a **Decentralized infrastructure DLT** using **Token-based access technology.**

The empirical review of the three CBDC projects shows that all the CBDC projects launched thus far have faced low market acceptance. Perhaps the use cases and benefits of the projects have not been fully communicated to the public in the midst of a lack of trust in the government and central banks. At best, central banks have attempted to sell the idea of trust through privacy protections embedded in their CBDC designs. For example, in a joint opinion issued by the European Data Protection Board EDPB and the European Data Protection Supervisor (EDPS) on a proposed regulation for the digital Euro, the two bodies made significant recommendations on enhancing the privacy protections of the proposed digital euros. The Deputy Chair of the European Data Protection Board (EDPB), Irene Loizidou Nicolaidou, emphasized that: "*a high standard of privacy and data protection is instrumental in gaining citizens' trust in this new digital currency. With this Joint Opinion, we aim to ensure that data protection is embedded early on in the design phase of the digital euro when used both online and offline and that the data protection responsibilities of each of the actors taking part in the issuance of the digital euro are clearly specified in the Regulation*" (European Data Protection Board, 2023, October, 18). However, data on CBDC updates across these countries shows that privacy protections alone have not been enough to generate the needed interest for successful diffusion.

VI CONCLUSION

CBDCs present an exciting opportunity for central banks around the world to enhance their effective role in the financial systems of countries through innovative technologies. The benefits expected from CBDCs may not be fully realized if the problem of trust in central banks and private intermediaries is not addressed. In this dissertation, the study has developed a conceptual framework and prescriptive tools based on the concept of distributed trust, with design choices that could assist central banks in making decisions on their CBDC projects important for successful diffusion.

Given the nascent nature of the subject, it is not surprising that there has been a limited number of empirical studies directly on CBDC diffusion. Most central banks are still trying to figure out the right design specifications needed to achieve their expected results. Therefore, one of the critical areas of CBDC implementation that needs more attention is how the CBDC design configurations could ensure the building of trust in the system. The Distributed Trust Matrix for CBDCs helps central banks to make design choices within the context of their specific country's circumstances and not necessarily implementing a system because other countries are implementing the same.

VI.1 Limitations of the Study

The Distributed Trust Matrix for CBDCs demonstrates the trust-building mechanism embedded in various design configuration choices available to central banks. However, in practice, there are many other factors, apart from trust, that are likely to influence the CBDC design decisions. These factors may include the level of education of the population, the availability of resources, the right technological ecosystem, and the national infrastructure to support the technology. The study argues that other factors could be considered as important in

determining the right CBDC design configuration for countries. The Distributed Trust Matrix for CBDCs also assumed that only one type of configuration could be adopted at any point in time. However, as demonstrated by the current pilot programs highlighted in the selected cases, some countries are implementing several options at the same time. For example, China is piloting both centralized and decentralized infrastructure at the same time.

Given that CBDCs are very recent innovations, there is limited data on the acceptance of this technology across the world. At best, there are existing models to measure usage intentions at the individual level of analysis. However, we do not have significantly reliable data on the acceptance of this technology across the globe. Reliable data on the variables relating to the antecedents of the model, such as trust and social influence, are not yet available, at least at the country level of analysis. As a result, these models developed based on the distributed trust concept have not been empirically tested.

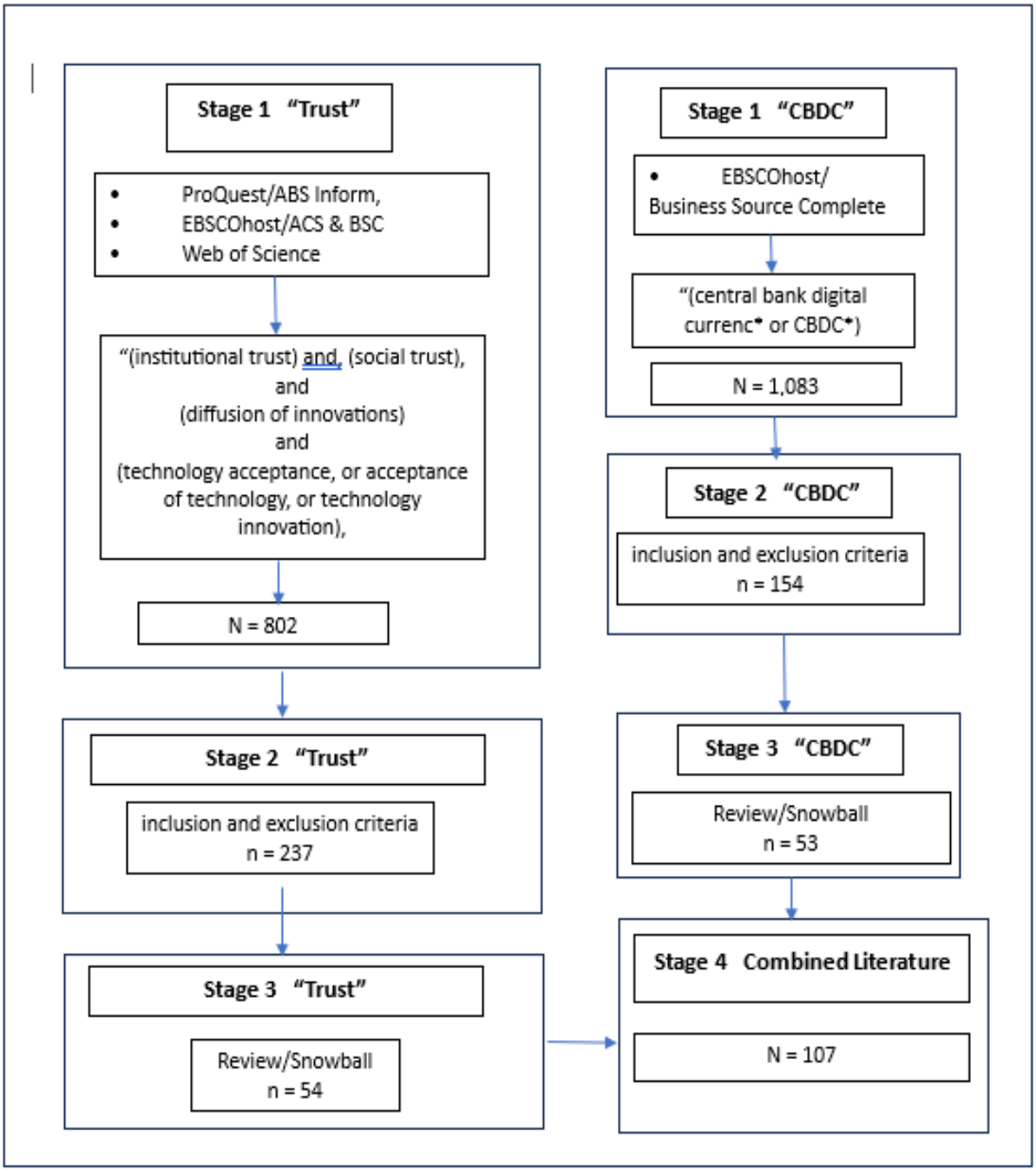
Our measurement of trust in formal and informal institutions was based on proxy data from generalized questionnaires that may not directly be relevant for CBDCs in particular (Pal et al., 2021). Given the nascent nature of the technology, several uncertainties exist with respect to public perceptions of trust and social influence as related to CBDC acceptance. Moreover, the data used for the analysis, which span between 2010 – 2014 for Wave 6 and 2017 -2022 for Wave 7, may be out of date, especially given the rapid development of CBDCs, blockchain technologies, and fintech innovations in recent years. Future research could be conducted to specifically obtain direct data on trust in formal and informal institutions across these countries and how they could impact the diffusion of CBDCs.

VI.2 Future Research

CBDCs implementation projects are still ongoing, and most have not fully taken off. Therefore, there is limited empirical data, such as its usage statistics, adoption rate, etc., which could be used to test the propositions developed in this dissertation. Future research may consider empirical testing with available data on the impact of trust in formal and informal institutions on CBDC diffusion. The Distributed Trust Model could be adapted to study other forms of digital currencies.

APPENDICES

Appendix A: Systematic Literature Review Process



Appendix B: Summary of Selected Literature on Trust and Social influence on Acceptance of new innovative technologies

Study	Context	Institutional	Social Influence	Other factors	Observation
1) Zhang et. al. (2020)	Automated vehicle acceptance in China	Positive	Positive	sensation seekers and those with a higher openness to experience were more likely to trust AVs	good social opinions would have significant downstream effects on AV acceptance
2) Ahmad and Khalid (2017)	Adoption of mobile government services in UAE	Positive.	Positive	high power-distance and collectivism culture of UAE	high power-distance and collectivism culture of UAE
3) Al-Edrus, Ahmad and Hanafiah (2023)	Adoption of crowdfunding platform in Malaysia	Positive	Positive	effort expectancy, facilitating condition, hedonic motivation, and price value were.	
4) Akinwale and Kyari (2022)	Financial technology services in Nigerian	Positive	Positive	impact of social influence in terms of relatives, friends and the community where the potential users found themselves	
5) Dhahak and Huseynov (2020)	Influence of Gamification on Online Consumers of FMCG Consumer	Positive	Positive	Trust and perceived ease of use have been found to positively influence perceived usefulness yet	

6) Kissi, Oluwatobiloba and Berko (2017)	Debit card payment system among university students in Nigeria	Positive	Positive	the insignificant results obtained for effort expectation and facilitating condition	
7) Al-Hujran, et. al. (2015)	Citizens adoption of e-governance in Jordan	Positive	Positive (national culture)	that trust is among the most significant factors affecting. e-government adoption, since citizens must	
8) Chong, Chan and Ooi (2012)	Adoption of mobile commerce in Malaysia and China	Positive	Positive	Both trust and social influence was positive for both countries	
9) Zimmermann, Somasundaram and Saha (2024)	Adoption of new vaccine technology	Positive low	Positive high	social proof nudge (communicating increasing population adoption) effectively reduces aversion to new technology.	Consumers, especially those with lower trust in government, and higher risk aversion are surprisingly. averse to new technologies. A social proof nudge reduces this aversion technologies.
10) Zhao, Xu and Xu (2023)	Social commerce platform	Positive	Not Significant Mediates trust	Social systems influence user adoption decisions more than individual decision-making styles and	Social influence mediates trust. Trust was essential in all stages of social commerce adoption

11) Xia al. (2023)	Adoption/intention to use an automotive augmented reality head-up display (AR-HUD)	Positive	Not significant Indirectly mediates trust	social influence is more relevant to the development of trust than cognitive or personal factors in technology	For individuals of high innovation characteristics, their trust is less affected by social influence.
12) Söilen and Benhayoun (2021)	Adoption of CBDC by households in China's	Positive but less significant	Positive Less significant	Policymakers cannot capitalize on their efforts to propose a flexible and understandable currency unless	trust and social influence
13) Moodley and Govender (2016)	Internet banking among academics in South Africa	Positive and significant	Negative Less significant	academics are independent, critical thinkers and seasoned researchers who choose to ask questions and draw their	Among academics, or people of high education, social influence impact on adoption is not significant.
14) Ahmad, et al (2021)	Fintech services among fresh graduates in Malaysia	Positive	Positive Less significant		individuals seemed to be less interested in the recommendations and attitudes of their reference groups (i.e., family,
15) Thusi and Maduku (Thusi & Maduku)	Mobile banking in South Africa among millennials	Positive	Positive Less significant	Millennials are generally regarded as independent thinkers possibly why opinion of others is not significant	

Appendix 3 Open coding summary from Central bank public communication materials

Name	Files	References
Benefits		
Anonymity	6	7
Counter cryptocurrencies and provide safer alternative	16	21
Cross Border Payments	16	25
Digitalization of the economy	15	18
Efficient payment system	23	31
Financial inclussion	25	39
Innovations in finance	7	12
Macro economic benefits such as Monetary policy etc	10	15
New Regulations (SEC etc)	6	8
Privacy Protection	13	21
Security of transactions	15	20
Tokenization	7	7
Transparency	10	11
Trust Building	7	16
Challenges		
Complex technolgy problem	7	10
Compliance with existing Laws and Regulations	5	6
Cyber security	5	6
Existing Viable Alternatives	1	1
Financial disintermediation	5	8
KYC, AML & Illicit use	6	8
Lack of Trust	5	6
Low market acceptance	16	23
Offline payments	7	8
Privacy Risk	8	14
Regulatory challenges	3	4
Communication and other considerations		
Adoption incentives	7	11
Design Technoloy and blockchain	16	22
Integration with existing payment systems	18	26
Involuntary adoption	4	5
Practical Use Cases	24	36
Role of Intermediaries (Banks, Fintechs)	24	35

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VITA

Dr. Prince Egyir Biney is driven by a passion for global financial equality through digital finance and the expansion of financial inclusive technology. Prince has over 20 years of experience in the financial services industry, having served as General Manager and Principal Deputy to the Chief Executive Officer of International Bank Liberia Limited, Liberia's premier bank, where he led the bank's growth and expansion into digital banking services, with the introduction cutting edge innovative technologies such as agency banking, mobile banking, and advance payment systems.

Prior to joining International Bank (Liberia) Limited, Prince served as the Financial Controller of Banque Sahelo-Saharienne Pour L'Investissment et le Commerce, Ghana (BSIC Group), a regional bank with operations in 16 African countries. At BSIC, he played a leading role in several projects, including the upgrade and integration of the group's banking infrastructure and information technology systems and the conversion of the group's financial reporting systems to IFRS and UEMOA accounting standards. He was also in charge of the financial control function at Guaranty Trust Bank Ghana.

Dr. Egyir-Biney's main areas of expertise include digital finance and financial technology, accounting and finance, treasury management, risk management, and bank capital management.

Education

QUALIFICATION	INSTITUTION	DATE
Doctor of Business Administration (DBA)	Georgia State University, J. Mack Robinson College of Business, Atlanta, Georgia, USA	May 2024
Master of Business Administration (MBA) Finance	The University of Ghana, Legon, Accra, Ghana	June 2014
Bachelor of Science Business Administration Major: Accounting	University of Ghana, Legon Accra, Ghana	May 2001
Association of Chartered Certified Accounts (ACCA), UK	ACCA Global, Glasgow, United Kingdom	Feb. 2008
ACI **Treasury Operations Certificate**	ACI Financial Markets Association, https://acifma.com/	Mar. 2014

Awards

Awarded best Doctorial Consortium,
Egyir-Biney, P., Hakimian, M., Haskell, A. (2022). *Race for the Future of Money: How does alignment of consumer privacy preferences impact Central Bank Digital Currency diffusion*? Engaged Management Scholarship Conference.

Future Research Interest

Dr. Egyir-Biney's future research interests will include central bank digital currencies, financial inclusion, digital payments, and banking and financial intermediation in general.