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Unlocking Digital Wallets: Factors that impact Mobile Money Adoption in Sub- Saharan Africa

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List of Abbreviations

AFI	Alliance for Financial Inclusion
AML	Anti-Money Laundering
ATM	Automatic Teller Machine
CBK	Central Bank of Kenya
CDD	Customer Due Diligence
DE4A	Digital Economy for Africa
DOI	Diffusion of Innovation
FATF	Financial Action Task Force
FDI	Financial Development Index
FIAP	Financial Inclusion Action Plan
GDP	Gross Domestic Product
GDFI	Global Partnership for Financial Inclusion
GSMA	Groupe Speciale Mobile Association
IMF	International Monetary Fund
ITU	International Telecommunications Union
KYC	Know Your Customer
ML/TF	Money Laundering/Terrorist Financing
MM	Mobile Money
MMPI	Mobile Money Prevalence Index
SMS	Short Message Service
UN-SDGs	United Nations -Sustainable Development Goals
USSD	Unstructured Supplementary Service Data

1.0 Introduction

1.1 Background of Mobile Money

For over a decade financial inclusion has occupied a dominant position in global developmental agendas. Researchers and policymakers have been interested in the contributions of financial inclusion at both a national and international level. Studies have found that financial inclusion promotes financial development, reduces poverty and income inequality, and facilitates economic growth (Hollanders, 2020; Barajas et al., 2020; Sha'ban et al., 2020). Mobile money has the potential to promote financial inclusion by facilitating payments and remittances and overcoming infrastructural challenges, such as poor roads and electricity, that could hinder establishment of banks and access to financial services in rural areas (Demirgüç-Kunt and Klapper, 2012; Jack and Suri, 2011). Mobile money was first launched in Kenya in 2007 to send and receive local remittances to rural areas where there were no bank branches (Mugambi et al., 2014). At its inception, mobile money used USSD¹ protocol and Short Message Service (SMS) to send notifications across mobile phones to confirm money was sent or received (Jack and Suri, 2011; Bwalya and Healy, 2010). The simplicity of the innovation and the technology it was built on facilitated the easy adoption of mobile money across sub-Saharan Africa. The success was achieved by establishing local agents, who were often small business owners providing cash-in² and cash-out³ services to customers needing to transact.

Mobile money is undoubtedly the most significant fintech innovation impacting the sub-Saharan African region. The region lags in other financial inclusion measures such as financial institution accounts, however, the availability of cheap mobile phones acted as a catalyst for the sub-region to become a leader in mobile money (Demirguc-Kunt et al., 2022). Sub-Saharan Africa represents the largest growth of mobile money accounts globally, highlighting the significance of the innovation. World Bank (2016, pp 5) stated that “more households own mobile phones than have access to electricity and clean water in sub-Saharan Africa”, emphasising the importance mobile phones have on the financial landscape of the

¹ USSD (Unstructured Supplementary Services Data) is a real-time session-oriented technology, used to provide mobile based network and banking services with/without Internet using USSD codes over GSM channel (Lakshmi K.K et al, 2017 pp 1)

² Cash-in is synonymous to making a deposit, money is given to an agent who then transfers electronic money into a mobile money account (Jack and Suri, 2011)

³ Cash-out is synonymous to making a withdrawal, electronic money is transferred to an agent who then gives the customer cash equivalent (Jack and Suri, 2011)

subregion. Mobile phones provide a platform for financial transactions and enable financial service providers to overcome infrastructural challenges such as poor road network and intermittent electricity that hinder branch and ATM expansion to rural areas within the region (Demirgüç-Kunt and Klapper, 2012).

Due to the widespread adoption of mobile phones, mobile money has become the widely used fintech innovation in sub-Saharan Africa and has been found to contribute 20 percent of GDP (CCAF, 2021). However, studies have shown that adoption across sub-Saharan Africa has not been uniform. Despite significant interventions from governments and other organisations, the adoption of mobile money in the region has remained low in some countries (Bwalya and Healy, 2010) and the success of mobile money has been uneven across different jurisdictions (Lashitew et al., 2019). In some jurisdictions, success of mobile money has resulted in increased GDP, job creation, and reduced poverty (Baganzi and Lau, 2017a). There are several factors that prior research suggests may impact upon mobile money adoption, including financial literacy, digital literacy, existing levels of financial inclusion, access to finance, demographic variables and regulation among other.

1.2 Motivation for study

To the author's knowledge, previous research that has focused on mobile money adoption in sub-Saharan Africa has been at country-level. Most studies have focussed on Kenya, given that the country has seen rapid growth in mobile money usage (Johnen et al., 2023; Gikunda et al., 2015; Jack et al., 2013). Sister countries in West Africa, such as Uganda (Tapiwanashe James et al., 2021; Kiconco et al., 2019; Baganzi and Lau, 2017a) and Tanzania (Di Castri and Gidvani, 2014; Rwechungura, 2024), have also been subject to academic scrutiny. However, cross-country comparisons across other jurisdictions within sub-Saharan Africa have been few; for example, Asongu (2018c) compared mobile money penetration in Kenya, Nigeria and South Africa, while Fanta and Kingstone (2021) investigated the impact of financial literacy on adoption of mobile money in Kenya and Tanzania. This research aims to fill a research gap by providing a cross-country investigation of factors impacting mobile money adoption across eighteen (18) sub-Saharan African countries with the aim of improving access to financial services in the sub-region.

This study proposes a framework for assessing the adoption of mobile money in sub-Saharan Africa by including mobile money attributes informed by the Diffusion of Innovation Theory (DOI) (Rogers, 2003; Rogers et al., 2014; Rogers, 1968). DOI can help understand

individual decision making when choosing to adopt an innovation and is therefore suited for mobile money. DOI has previously been applied to different fields such as health (Lambooj et al., 2010; Parston et al., 2015), agriculture (Avolio et al., 2014; Wu and Zhang, 2013), and e-learning (Al-Rahmi et al., 2019), but has received comparatively less attention in the context of mobile money. Integration of this theory represents a novel way to evaluate mobile money adoption in sub-Saharan Africa.

Studies that have focused on financial inclusion through mobile money usage have focused on individual countries such as Kenya and Uganda (Mugambi et al., 2014; Myeni et al., 2020; Ahmad et al., 2020). Most studies that attempt to measure financial inclusion use the number of financial institution or bank accounts as a proxy for financial inclusion (Allen et al., 2016; Mohammed et al., 2017; Demirgüç-Kunt and Klapper, 2012; Fungáčová and Weill, 2015; Asuming et al., 2019). Our study provides a novel measure of financial inclusion using mobile money by examining a common gap in literature on financial inclusion. By examining common mobile money functions namely, sending remittances, receiving remittances and bill payment as a way of measuring financial inclusion. We adopt the idea of mobile money ‘usage’ as a measure of financial inclusion as prior evidence suggests that usage of financial services is more reflective of how valuable a service is to a user and therefore a more effective measure of financial inclusion (Demir et al., 2022; Hollanders, 2020). In doing so, this study represents – to our knowledge – one of only a small number of studies that has assessed mobile money usage across several countries within a geographic region (Akinyemi et al., 2020; Reynolds et al., 2023).

Further, this study addresses a notable gap in regulatory cohesion as an explaining factor for mobile money adoption. Regulation plays an important role in governing mobile money and the adoption of financial services (Bahia et al., 2020). Studies have shown that where there are two or more regulations governing a financial product, regulatory ambiguity can arise (Easley and O’Hara, 2009). Regulatory ambiguity could result in a “non-enabling” environment and increase aversion by users wanting to open mobile money accounts (Jack and Suri, 2014; Easley and O’Hara, 2009). We therefore examine common themes in regulations to determine how cohesion based on these themes impacts mobile money adoption. To our knowledge this is the first study to examine themes across two sets of regulations and across countries in sub-Saharan Africa.

Therefore, this study investigates the determinants of mobile-money adoption in sub-Saharan Africa by exploring factors that impact mobile money adoption. These include

financial literacy (Ozili, 2021; Lusardi and Mitchell, 2011b); digital literacy (Nedungadi et al., 2018); financial access (Asongu, 2018c); and regulation (Ozili, 2021; Arner et al., 2020). Further we contribute to existing literature on investigating the use of mobile money to measure financial inclusion through the lens of financial literacy (Lusardi and Mitchell, 2011b; Lusardi, 2019); digital literacy (Kass-Hanna et al., 2021) as well as demographic variables such as education (Elena-Bucea et al., 2021); income (Amoah et al., 2020; Nyoka, 2019); gender (Reynolds et al., 2023); and age (Elena-Bucea et al., 2021; Akinyemi et al., 2020).

More broadly this study has significant policy implications. Firstly, we recommend that developmental policies aimed at improving financial inclusion through adoption of mobile money should incorporate strategies that improve digital and financial literacy. Secondly, to increase financial access in areas where it is limited due to infrastructural challenges, increasing mobile money agents can result in providing alternative financial services for those who are unbanked or underserved by the existing financial sector. Thirdly, our results suggest that economic development through urbanisation and employment may increase demand for financial services and therefore also increase the uptake of mobile money. Further, in areas where mobile money adoption is limited, policies that target women and the youth may improve the uptake of mobile money services. Lastly, policies that support uptake of mobile money will differ across different countries depending on the financial landscape. Policy makers should consider in-country characteristics when developing mobile money-related policies.

1.3 Thesis aims and findings

To support the overall objective of this research, investigating the factors that impact mobile money adoption in sub-Saharan Africa, this thesis is broken down into three main empirical chapters. This thesis research questions are broken down into three main empirical chapters, the first empirical chapter (Chapter 4), investigates the adoption of mobile money through establishing a linear regression model that assesses the impact of digital literacy, financial inclusion, and financial access on mobile money adoption, this addresses the first research question: *To what extent do mobile money attributes, digital literacy, financial access and financial inclusion impact mobile money adoption in sub-Saharan Africa?* Through an examination of mobile money usage, we explore how demographic variables of gender, education, income, and age combined with digital and financial literacy impact financial inclusion in the second empirical chapter (Chapter 5). To do this we propose a linear regression

model which measures financial inclusion using mobile money usage. Further we provide insights on factors that impact financial inclusion through mobile money by looking at different levels of mobile money prevalence at the country level, allowing comparison of countries with similar levels of mobile money usage. The second empirical chapter addresses the second research question; *can mobile money be used to measure financial inclusion in sub-Saharan Africa?*

By conducting a qualitative analysis of regulations governing mobile money we explore the impact of regulations on mobile money adoption. We do this by comparing two sets of regulations: *payment systems regulations* and *mobile money guidelines*, because these are the governing regulations for mobile money in most sub-Saharan African countries. We explore the common themes within the regulations to determine whether cohesion between two sets of regulations impacts mobile money adoption and reduces regulatory ambiguity in the third empirical chapter (Chapter 6). This analysis addresses the third and final research question: *What is the impact of regulation on mobile money adoption?* Further, the chapter also highlights the prominence of themes in regulation based on country priority areas and informs other countries with similar regulatory priorities on how to structure regulations.

Overall, our research findings strongly suggest that increasing digital and financial literacy increases mobile money adoption and therefore promotes financial inclusion. Further, the results suggest that cohesive regulations could result in increase in mobile money adoption. The rest of this section is laid out as follows Section 1.3.1 discusses the aims and findings of the first empirical chapter; Section 1.3.2 articulates the aims and findings of the second empirical chapter and Section 1.3.3 discuss the third empirical chapter aims and findings.

1.3.1 Aims and findings for the first empirical chapter

The first empirical chapter investigates mobile money adoption in sub-Saharan Africa by drawing on principles from Roger's Diffusion of Innovation (DOI) Theory (Rogers, 1968). To investigate the factors impacting mobile adoption we leverage on Roger's DOI theory which provides a lens through which we can assess mobile money adoption. DOI focuses on the innovation adoption stage where an individual makes a choice to adopt or reject an innovation (Rogers, 2003). Innovation attributes can explain the variance in adoption. To operate fintech based financial innovations consumers need both digital and financial skills (Kass-Hanna et al., 2021). Further, mobile money is designed for people who do not have access to financial services, therefore mobile money can potentially thrive where financial access is limited, and

existing levels of financial inclusion are low. In this context, we incorporate (i) digital literacy, (ii) access to finance and (iii) existing levels of financial inclusion into the DOI framework to develop a comprehensive model of mobile money adoption. Our study proposes a model in which mobile money adoption can be assessed on an individual country basis and across a group of countries, and which can be extended to other fintech innovations.

The study investigates the extent to which innovation attributes (represented by the value of transactions and agent availability), combined with digital literacy, financial inclusion, and financial access impact mobile money adoption across 18 sub-Saharan countries. Further, the chapter investigates mobile money adoption during three significant time periods, (i) the initial phase (2010-2014) which represents the period in which most countries introduced mobile money; (ii) the operational phase (2015-2018), which represents the period that the innovation had been accepted and settled; and (iii) the Covid-19 phase (2019-2021) which saw a lot of government intervention to promote mobile money usage. This was done to limit face-to-face contact and mitigate the spread of Covid-19. This study uses a combined dataset from World Bank Development Indicators, IMF Financial Indicators and International Telecommunications Union (ITU) ICT indicators compiled from 2010-2021. We advance previous research by examining fintech adoption in a regional context, thereby allowing cross-country comparison based on categorising countries according to IMF Financial Development Indicators (FDI).

The main contributions of the chapter are as follows. Firstly, the study proposes an extension of Rogers' DOI model by incorporating additional factors such as digital literacy, financial inclusion, and financial access with innovation attributes (observability and relative advantage) to assess fintech adoption in sub-Saharan Africa. The proposed model can be applied to other jurisdictions and used to evaluate other fintech innovations at a regional or country level. By incorporating relative advantage and observability into the model, we illustrate the importance of innovation attributes in mobile money adoption. Our findings suggest that observability explains up to 40% of the variance associated with mobile money adoption. This resonates with Rogers (2003), who suggests that innovation attributes explain 49-89% of the variance in the adoption process.

Secondly, we investigate the adoption of mobile money across three different time periods between 2010-2021. In doing so we can investigate how adoption of mobile money changes during the inception period (2010-2014); the operational period (2015-2018); and the

Covid-19 phase (2019-2021). Our analysis reveals that the factors influencing mobile money change through the different timeframes. During the inception of mobile money digital literacy was not significant. However, it became significant during the operational phase (2015-2018) and Covid-19 phase (2019-2021). This could be because knowledge gained from family and friends as they use mobile money and passed on through observation (Dearing and Cox, 2018). Further, during the operational years (2015-2018) mobile money underwent significant development in terms of service offering beyond sending and receiving remittances, including the introduction of bill payments, international funds transfers and access to microloans which required more digital skills (Scharwatt et al., 2014). During the Covid-19 pandemic, some governments provided cash support to vulnerable families through mobile money which resulted in previously excluded people needing the digital skills required to access mobile money (Demirguc-Kunt et al., 2022).

Thirdly, this chapter investigates mobile money adoption using the IMF Financial Development Index (FDI),⁴ as it has been suggested that a country's financial development can have a significant effect on economic growth and innovation (Hassan et al., 2011). We categorise the 18 countries according to FDI levels (low FDI, medium FDI and high FDI) to compare countries with similar financial landscape. This is because the financial development of a country could potentially influence the level of financial innovation and therefore the uptake of mobile money (Muganyi et al., 2022). Results for countries with low FDI indicate that low financial access, coupled with an increase in agent availability, have a positive impact on mobile money adoption. Our findings support previous suggestions that mobile money is a financial innovation that can provide financial services where banks are not available (Burns, 2018; Soutter et al., 2019). Further, Jack and Suri (2011) support that increasing mobile money agents would increase mobile money uptake. Individuals living in some poor areas in sub-Saharan Africa do not have access to financial services such as ATMs and banks and therefore mobile money provides a platform for available and affordable access to finance (Mothobi and Grzybowski, 2017). In contrast, financial access is not significant for high FDI countries and neither is agent availability, this is because in these countries there are relatively larger numbers of the population accessing banking and other financial services (IMF, 2022).

Fourthly, our study contributes to the literature investigating factors that impact mobile money adoption in sub-Saharan Africa which represents an unexplored area. Our study

⁴ The IMF Financial Development Index is a composite index that analyses how developed financial institutions and markets are in terms of their access, depth, and efficiency.

provides a cross-country view of mobile money across 18 Sub-Saharan African countries. A review of literature suggests that previous studies have focused on mobile money adoption at the country level (Baganzi and Lau, 2017a; Kiconco et al., 2019; Johnen et al., 2023; Rwechungura, 2024). Comparatively, studies have compared mobile money adoption across two or more countries (Asongu and Odhiambo, 2018; Fanta and Kingstone, 2021). To the author's knowledge, this study represents the first cross-country analysis of mobile money adoption across the sub-Saharan region. In doing so, the study contributes to the literature through a comprehensive overview of the impact of digital literacy, financial inclusion, and financial access on fintech adoption in sub-Saharan Africa.

Lastly, our analysis informs policies that aim at increasing financial inclusion, particularly by targeting the “unbanked” or “underbanked” at a regional and country level. The study contributes by informing policy at a regional and country-specific level in facilitating the adoption of mobile money based on a country's level of financial development. By highlighting possible barriers to mobile money adoption, through digital skills or innovation attributes, we provide insights which different jurisdictions draw on. This would enable policymakers to lower barriers to financial inclusion by addressing the factors that deter mobile money adoption through the development of relevant policies. In addition, the study allows policymakers to review the positive determinants of mobile money adoption amongst other Sub-Saharan African countries, characterised by strong mobile money adoption rates, and apply initiatives to improve those determinants domestically. Therefore, policies that aim to promote access to finance through initiatives such as financial inclusion, digital literacy, financial access, and fintech adoption can be supported through the findings of this chapter.

1.3.2 Aims and findings for the second empirical chapter

Financial inclusion has been paramount since the early 2000 and shows prominence in three of the United Nations Sustainable Development Goals (UN-SDGs); UN-SDG 1 (No Poverty) Hunger; UN-SDG 8 (Decent Work and Economic growth) and UN-SDG 10 (Reduced Inequalities) (AFI, 2022). Various non-profit organisations, such as Alliance for Financial Inclusion (AFI) and the Global Partnership for Financial Inclusion (GPFI) have been established across the globe to promote financial inclusion. Throughout academic research financial inclusion has been widely represented by ownership of a financial institution or bank account (Allen et al., 2016; Sha'ban et al., 2020). Other measures of financial inclusion that have been used in different studies include the number of ATMs, branches, and banks (Park and Mercado, 2018; Sha'ban et al., 2020; Gul, 2018).

In a survey conducted by World Bank in 2021 Sub-Saharan Africa reported 33% mobile account ownership with over 11 jurisdictions reporting more mobile money account ownership compared to financial institution accounts (Demirgüç-Kunt et al., 2022). With this background, this chapter investigates mobile money usage as a measure of financial inclusion in sub-Saharan Africa. Focusing on defining financial inclusion as the use of financial services (Park and Mercado, 2018), this chapter investigates how digital and financial literacy and demographic variables (gender, age, income and education) impact financial inclusion, measured by usage of mobile money. In exploring usage of mobile money, we investigate three main mobile money usage functions, *sending remittances*, *receiving remittances* and *bill payments*.

The main findings in the chapter are threefold. Firstly, the study reveals that financial and digital literacy have a significant impact on financial inclusion achieved through mobile money usage. Digital literacy represents the technical knowledge required to operate and navigate through mobile money product menus (Ndibalema, 2025). Financial literacy is associated with empowering individuals to make sound financial decisions which would result in financial inclusion (Bongomin et al., 2020a). Our findings resonate with prior findings that found that digital and financial literacy have the potential to impact adoption of mobile money (Triki and Faye, 2013; Kass-Hanna et al., 2021). To achieve financial inclusion through mobile money usage, government policies should include facilitating increase in digital and financial literacy.

Secondly, the chapter analyses the progression of mobile money usage for the years the data was collected, (i) 2014, (ii) 2017 and (iii) 2021. The purpose is to assess whether there is a change in the significance of the factors that impact mobile money across the years. One of the significant findings indicates that while digital literacy remains significant across the three years, it is particularly prominent for bill payments. This could be because bill payments have been the fastest-growing mobile money service. For example, GSMA (2022) reports that bill payments through mobile money grew by 36% from 2021 to 2022. Another significant finding is that financial literacy remains significant across the years but starts losing its significance in 2021 for sending mobile money and receiving mobile money, which could be a combined result of the simplicity of the services and the widespread use of sending and receiving mobile money (Suri, 2017; Travis et al., 2018). Further, other studies have suggested that due to low financial literacy levels skills to operate mobile money could be gained through observation or memorising the functions (Kiconco et al., 2019).

Lastly, the countries in this study were classified according to GSMA Mobile Money Prevalence Index⁵ (MMPI) which measures the extent of mobile money usage in a country. The main reason for this classification was to analyse financial inclusion based on similar levels of mobile money usage. Our analysis revealed that gender was not significant in Medium and High MMPI countries but was significant in Low MMPI countries. The results of this study resonate with Reynolds et al. (2023) who found that in countries where mobile money is established, gender was not significant, however, it was significant where mobile money was emerging. Results indicate that women's mobile money usage in Low MMPI countries is significant for financial inclusion. This is because men in most low-income countries have higher incomes and are therefore more likely to own mobile money accounts (Lotto, 2018). Government policies designed to promote women's access to financial services could have a significant impact on financial inclusion. Other demographic variables such as education and income are significant across all country classifications to achieve financial inclusion. Results indicate that as income and education increase, financial inclusion increases. This is because people with higher education have higher literacy levels and skills to understand financial products (Elena-Bucea et al., 2021). Similarly, as income increases individuals demand more financial services, thereby increasing mobile money usage (Amoah et al., 2020).

1.3.3 Aims and findings for the third empirical chapter

Regulations governing mobile money operations in a country are important in determining mobile money adoption. Kenya took a “test and learn” approach and allowed mobile money to operate from 2007 before introducing regulation in 2013 (Jack and Suri, 2014). Other countries such as Nigeria overregulated mobile money which failed to grow in the market as regulatory barriers created a “restrictive environment” (Asongu, 2018b; Lepoutre and Oguntoye, 2018). This chapter conducts a qualitative review of mobile money regulations for six sub-Saharan African Countries (Ghana, Kenya, Malawi, Namibia, Rwanda, Tanzania, and Uganda). The study examines each country's National Payment Systems Act as the parent regulation and the mobile money guidelines or regulations issued under the act. Six prominent themes were identified in the literature around the regulation of mobile money that highlight areas of importance when developing mobile money regulations: *customer due diligence* (Suri, 2017; Aron, 2017); *trust account to manage customer funds* (Suri, 2017; Di Castri, 2018); *interoperability of mobile money systems* (Burns, 2018; Suri, 2017); *management of mobile*

⁵ The GSMA MMPI comprises of a measure that takes number of mobile money accounts, registered active mobile money accounts on a 90-day basis and the number of agents per 100,000 adults.

money agents (Madise, 2019; Bahia et al., 2020); *setting transaction limits on accounts* (Suri, 2017; Madise, 2019); and *promoting consumer protection* (Aron, 2017; Martin, 2019). This analysis aims to review to what extent these themes are covered in mobile money regulations and whether this could be associated with mobile money adoption. The main findings of this chapter are threefold.

Firstly, our findings show that *consumer protection* is an important theme across all countries in both payment systems and mobile money regulations. This is because protecting consumers is important in developing countries where financial literacy levels are low as fraudsters could take advantage of the limited financial knowledge (Madise, 2019). *Consumer protection* can lead to consumer trust in mobile money making them feel confident in the product, thereby increasing usage and financial inclusion (Bongomin and Ntayi, 2020b). Another important theme that has shown prominence in the regulatory documents is *trust accounts*. *Trust accounts* mandate that the electronic money in circulation should always equal the amount held in trust, thereby safeguarding the integrity of the system (Di Castri, 2018; Madise, 2019). *Trust account* is particularly prominent in regulations for Ghana, Kenya, Uganda, Rwanda and Tanzania, countries where there is a high level of mobile money adoption (Demirgüç-Kunt et al., 2022).

Secondly, the results indicate a relationship between the structure of mobile money regulations and mobile money adoption. Higher levels of mobile money adoption are revealed in countries where all six themes have been addressed in the regulations and there is a moderate to high Jaccard coefficient between the documents. Our results show that Ghana, Kenya, Rwanda, and Uganda have regulations that address all six themes and relatively high Jaccard coefficient for the four countries. This suggest that for regulation to have a positive impact on mobile money adoption there should clear prominence of the themes in both regulatory documents and good cohesion of the documents. However, countries where both these conditions have not been met show low levels of mobile money adoption. For example, Malawi which has lower levels of mobile money adoption (34%), addresses all six themes in the payment systems and mobile money regulations but has a low Jaccard coefficient between the two documents. Similarly, Namibia has low mobile money adoption (32%), only addresses four of the themes in the payment systems and mobile money regulations. Therefore, to boost mobile money adoption, regulators should address all themes in regulations and ensure a relative cohesion between regulations.

Lastly, the chapter informs policies on how to review or amend existing payment systems and mobile money regulations to ensure ambiguities are minimised. Countries wanting to review or amend regulations should ensure that there is strong relative cohesion between regulations to avoid ambiguities in regulations. Further this study informs countries that aim to put legislation in place to govern mobile money and which areas to include based on in-country priorities. Our results indicate that different countries have different areas of regulatory focus. For example, in Tanzania 70 percent of coded themes relate to *trust account*, whereas in Namibia 51 percent of coded themes relate to *agent management*. Other jurisdictions in this study show prominence in different areas suggesting that policy makers should look at their socio-economic environment to determine which areas to emphasis on.

1.4 Thesis contributions

The first main contributions of this thesis comprise of frameworks to assess mobile money adoption and financial inclusion in sub-Saharan Africa; and a novel way to review of mobile money regulations in sub-Saharan Africa. We propose a model to assess fintech adoption in sub-Saharan Africa based on Roger's (1968) DOI model that incorporates innovation attributes (value of mobile money transactions and availability of mobile money agents) with digital literacy, financial inclusion, financial access. The model provides a lens through which we can assess how new financial innovations gain traction during the implementation stage. Rogers (2003) articulates that adoption of an innovation depends on the innovation attributes, the time it is introduced, the social context and how the innovation is communicated. Our novel model is significant because it provides understanding of the factors that impact mobile money adoption and is potentially applicable to other fintech innovations in different regions. The second model we propose is derived from Kass-Hanna et al. (2021) to measure financial inclusion through mobile money usage. This study investigates the impact of digital and financial literacy on financial inclusion measured by mobile money usage and examines the impact of demographic variables on financial inclusion. Lastly, we propose a method to analyse mobile money regulations by leveraging on O'Neill et al. (2018) *8-Step method for literature review in NVivo* and condensing it into four broad steps to review regulatory documents. This method can be used to review similarities between related regulations in different fields and can complement quantitative analysis to provide further insights into how regulations impact adoption of financial innovations. The method allows the comparison of themes in the regulatory documents and highlights similarities and differences between regulations, further highlighting areas where ambiguities may exist in regulation

which could impact mobile money adoption because of ambiguity aversion (Easley and O'Hara, 2009). Cohesion between regulations can provide a clearly understanding of regulatory requirements and reduce ambiguity (Jack and Suri, 2011).

A second major contribution of this study is the contribution to literature investigating mobile money adoption in sub-Saharan Africa. The study contributes to literature on mobile money adoption in sub-Saharan Africa which to our knowledge is limited. This study contributes to mobile money adoption across 18 sub-Saharan African countries. Further the study categorises countries according to IMF FDI to provide more in-depth insights into mobile money adoption based on a country's financial development. Previous studies have explored categorising countries according to GDP (Demir et al., 2022) or levels of income (Kass-Hanna et al., 2021). This categorisation provides a unique perspective to assess mobile money adoption in countries with similar financial landscape. The study also contributes to literature on measuring financial inclusion through mobile money usage and further analyses how demographic variables of gender, income, education, and age impact financial inclusion through mobile money usage. To the author's knowledge studies that have used mobile money to measure financial inclusion have been limited and at a country level (Myeni et al., 2020; Nyoka, 2019). Our study examines financial inclusion through mobile money usage across 18 sub-Saharan African countries and uses three different mobile money functions, sending and receiving remittances and bill payments through mobile money to represent financial inclusion. Further, this study categorises countries according to GSMA Mobile Money Prevalence Index (MMPI) to assess mobile money usage according to the prevalence of mobile money in the jurisdiction. The categorisation provides a unique perspective on financial inclusion based on the prominence of mobile money in a jurisdiction that has not been done before and fills a gap in literature as it provides a comparison across sub-Saharan African countries. Categorising countries in this way provides a way for countries with different levels of mobile money adoption to assess their own environment and therefore potentially adopt policies that would suit their level of mobile money usage. Our final contribution to literature examines two pairs of regulations that govern mobile money across six sub-Saharan African countries. We compare the overarching payment systems regulations to mobile money regulations issued under the payment systems. We introduce a novel method of comparing the structure of two regulations based on common themes in the regulations to assess the cohesion between regulatory documents. Our method could be applied to other fields governed by two sets of regulations to determine the similarity and prominence of themes within the regulations.

Our study highlights several insights for policymakers who aim to improve financial inclusion through mobile money adoption. Firstly, we propose that policymakers should seek to improve digital literacy to promote the uptake of mobile money and financial inclusion. Our recommendations resonate with Kass-Hanna et al. (2021), who suggested that emerging economies should promote digital and financial literacy to achieve financial inclusion. Secondly, we propose that in areas where banking services are not available due to poor infrastructure, policymakers should promote use of mobile money to provide alternative ways of accessing financial services for those “unbanked” or “under-banked”. The thesis policy recommendations support findings that suggest that mobile money can be instrumental in bringing the “unbanked” into the formal financial sector (Hollanders, 2020; Arner et al., 2020). Further, our study reveals that uptake of mobile money is different for countries with different levels of financial development, thereby suggesting that policymakers should look at in-country conditions and apply strategies from countries that have similar levels of financial development to their own. In addition, this thesis reveals that financial inclusion policies on mobile in countries where mobile money is emerging should target the youth (15-24) and women as they have limited access to financial services (Reynolds et al., 2023).

Our final contribution at the policy level supports countries that would want to review their regulations to remove ambiguities by encouraging cohesion between the payment systems regulations and mobile money guidelines. We recommend themes that should be addressed in both the payment systems and mobile money regulations to avoid regulation ambiguity and ensure better cohesion. Further, countries that do not have legislation governing mobile money could draw insights from this study on how to structure regulation to avoid ambiguities. This study further confirms the need to address the six identified themes (*trust account, interoperability, transaction limit, anti-money laundering, consumer protection and agent management*) in regulations to promote mobile money adoption and ensure a safe operating environment.

1.5 Structure of Thesis

The remaining structure of the thesis is as follows: Chapter 2 documents the literature review supporting this thesis. Chapter 3 outlines the research methodology employed in this study. Chapter 4 addresses the impact of mobile money adoption in sub-Saharan Africa by investigating the impact of digital literacy, financial access and financial inclusion on mobile money adoption. Chapter 5 assess the mobile money usage as a measure for financial inclusion

by investigating how digital and financial literacy and demographic variables impact financial inclusion. Chapter 6 provides a comparative review of regulations governing mobile money, specifically conducts a thematic review of payments systems and mobile money regulations. Chapter 7 offers overall discussions and conclusions of the thesis.

2.0 Literature Review

2.1 Introduction

This chapter critically reviews the literature on financial inclusion, financial literacy, digital literacy and diffusion of innovation in relation to mobile money adoption in sub-Saharan Africa, while situating discussion within a broader global context. The purpose of this review is to identify theoretical and empirical gaps and establish conceptual foundations that underpin this thesis.

The chapter is structured as follows, Section 2.2 examines the concept of financial inclusion and its relationship with financial technology (fintech), presenting both global perspectives and developments within sub-Saharan Africa. The section further reviews emergence of mobile money as a financial inclusion mechanism and discusses methodological challenges of using mobile money as a proxy for financial inclusion. Section 2.3 defines financial literacy, provides a summary of financial literacy initiatives around the world and provides a focus on financial literacy in sub-Saharan Africa.

Section 2.4 defines digital literacy and reviews the global perspective on digital literacy and the focus on sub-Saharan Africa. In addition, the section discusses why it is important in relation to mobile money. Section 2.5 discusses the banking sector development and how it impacts introduction of mobile money in sub-Saharan Africa.

The last section 2.6 defines the Diffusion of Innovation model (DOI) and the different elements that constitute DOI framework. The section highlights why it is suitable for mobile money adoption. Section 2.7 compared other frameworks to DOI, highlighting differences and similarities and Section 2.8 concludes the chapter.

2.2 Financial Inclusion

2.2.1 Defining Financial Inclusion

Despite widespread use in academic and policy discourse, financial inclusion does not have a universally accepted definition. Broadly, the concept refers to the provision of affordable financial services to individuals and businesses that are excluded from formal financial system, with broader objective of reducing poverty and promoting economic participation (Demirguc-Kunt et al., 2018; Senyo and Osabutey, 2020). Existing definitions emphasise different dimensions of financial inclusion. Ozili (2018, p 458) define financial inclusion as “the process of ensuring individuals, especially poor people, have access to basic

financial services in the formal financial system”. On the other hand, Jajah, Anarfo, and Aveh (2020, p 32) focus on availability and accessibility, defining financial inclusion as “all interventions to make formal financial services accessible and available at affordable costs to all segments of the population”. Further, Senyo and Osabutey (2020, p 2), emphasise product usefulness and affordability, defining financial inclusion as “access to useful and affordable financial services and products such as payments, deposits, insurance and loans by organisations and individuals”.

These definitions illustrate that financial inclusion is a multidimensional concept encompassing access, availability, affordability and usage of financial services. Consequently, different jurisdictions define financial inclusion according to their national priorities and institutional contexts. Table 2.1 below summarises definitions of financial inclusion extracted from national financial inclusion strategies across several countries, highlighting the policy emphasis placed on improving financial access, consumer protection and financial empowerment.

Table 2.1: Financial Inclusion definitions from some jurisdictions

Country	Definition
Lesotho	“Individuals and businesses accessing and using a wide range of suitable and affordable quality financial products and services that meet their needs – in order to contribute to inclusive socio-economic growth and well-being – the products and service being delivered in a responsible and sustainable way ” (MOF-LNFIES, 2024, p10)
Eswatini	“Financial inclusion means that individuals and businesses have access to, and effectively use financial products and services that meet their needs, are affordable, and are delivered in a responsible and sustainable way. ” (MOF-ENFIS, 2023, p 6)
Zimbabwe	The effective and informed use of a wide range of quality ² , affordable & accessible financial services by all Zimbabweans, on a sustainable basis, provided in a fair and transparent manner through formal/ regulated entities ” (RBZ-NFIS, 2022, p 36)
Tanzania	“Financial inclusion means access to and usage of a broad range of affordable and quality financial products and services on a sustainable basis by individuals and businesses to improve their financial well-being and standard of living ” (NCFITZ-NFIF, 2023, p 9)
Suriname	“Financial inclusion is a situation in which every citizen, regardless of income level, social status and geographical location, can access and use formal financial products and services ” (CBS-NFIES, 2024, p 7)

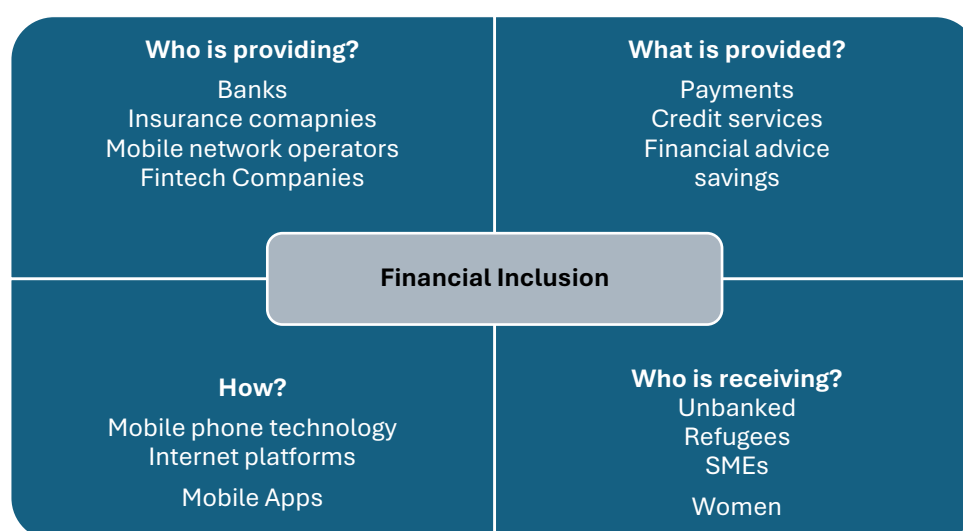
Note: Table 2.1 highlights definitions of financial inclusion extracted from National Financial Inclusion strategy documents, sourced from the Alliance for Financial Inclusion website

While early literature primarily focused on improving physical access to financial institutions, more recent studies emphasise the importance of actual service usage. Park and Mercado (2018, pp 185) conceptualise financial inclusion through three dimensions: ‘*accessibility*’, ‘*availability*’ and ‘*usage*’ of formal financial services. Empirical research has demonstrated that increasing the availability of banking infrastructure, such as bank branches

and ATMs may contribute to reducing inequality (Mookerjee and Kalipioni, 2010). However, other scholars argue that availability alone is insufficient to ensure meaningful financial inclusion. Hollanders (2020), for instance, contends that ‘usage’ provides a more accurate measure because it reflects the extent to which financial services deliver tangible benefits to users. Similarly, Demir et al. (2022) argue that the view of ‘usage’ as being more reflective of financial inclusion, because indicators such as the number of branches or financial institution accounts may overestimate financial inclusion if individuals do not actively engage with financial services.

Building on this perspective, Bongomin and Ntayi (2020a) conceptualise financial inclusion as an ecosystem consisting of four interacting components: service providers, financial products, consumers and delivery mechanisms. This framework emphasises that financial inclusion is not only determined by access to financial services but also by the extent to which vulnerable populations actively use these services. Figure 2.1 illustrates this ecosystem perspective by highlighting the interaction between financial service providers, the products offered, the consumers who use them and the delivery channels through which services are provided. The conceptualisation reinforces the importance of analysing financial inclusion not only in terms of access but also in terms of effective utilisation.

Figure 2.1: Elements of financial inclusion



Note: Figure 2.1 is constructed using arguments from (Bongomin and Ntayi, 2020a) and depicts the four elements of the financial inclusion ecosystem; service providers, service provided, consumers of the service and how the service is provided.

2.2.2 Importance of Financial Inclusion

Financial Inclusion has been at the centre of global developmental agenda since the early 2000s. In 2010, the G20 established the Global Partnership for Financial Inclusion (GPFI), a working group tasked with promoting financial inclusion policies and improving household access to finance worldwide through the Financial Inclusion Action Plan (FIAP) (Busch et al., 2017; Girard, 2021). Similarly, the Alliance for Financial Inclusion (AFI) was created to support financial inclusion policy development among central banks and financial regulators, particularly in developing and emerging economies. AFI currently comprises more than 90 member institutions that collaborate to promote financial inclusion policies globally (Gabor and Brooks, 2017). In 2011, AFI launched the Maya Declaration, a statement aimed to represent AFI's core values and set measurable commitments to financial inclusion policy, supporting sustainable development goals set by the United Nations (AFI, 2022). By September 2021, 73 AFI member countries had signed the declaration, cementing the commitment of AFI members toward promoting financial inclusion. The signing of the Maya Declaration allows AFI to follow up and document in-country progress of member countries on meeting financial inclusion targets set in the declaration (Queralt et al., 2017; AFI, 2022).

One of the most significant developments towards an all-inclusive world was the establishment of United Nations Sustainable Development Goals (UN-SDGs) for 2030 in 2015 (Biermann et al., 2017). The prominence of financial inclusion in six⁶ of the UN-SDGs emphasizes the importance of financial inclusion in the face of global development (Demir et al., 2022). The common message at the international level has been to bring the “unbanked” and “under-banked” into the formal financial sector with the aim to increase economic activity, improve livelihood and reduce poverty (Arner et al., 2020; Hollanders, 2020).

Empirical research indicates that financial inclusion can contribute to poverty reduction, economic growth, reducing inequality and promoting women empowerment among others (Sethi and Acharya, 2018; Mohammed et al., 2017). For example, a study conducted in China finds that, after government policy to develop inclusive finance in 2015, an increase in adoption of digital financial services was found to be correlated with economic growth (Ahmad et al., 2021). Using a sample of 35 sub-Saharan African countries, Mohammed, Mensah and

⁶Goal 1(No Poverty), Goal 2 (Zero Hunger), Goal 5(Gender Equality), Goal 8(Decent work and economic growth, Goal 9 (Industry, Innovation and Infrastructure), Goal 10 (Reduced inequalities)

Gyeke-Dako (2017) find that access to financial services decreases inequality, supports economic growth, and promotes women empowerment as financial services allow women to be financially independent and start businesses. However, the benefits are evident in the poor who are financially included, poverty levels reduced by 11.3 percent. In addition, the study also finds that the poor who saved were likely to reduce their poverty by 7.56 percent. The findings suggest that those who are financially included have a better quality of life than those financially excluded. Furthermore, Gul (2018) found that increased access to bank accounts, bank branches and ATM machines has a positive impact on economic growth. 10 percent increase in bank branches increases economic growth by 5 percent, similarly 10 percent increase in ATMs increases economic growth by 6 percent. The results are more prominent for low-income countries where the appetite for financial services is high. However, the authors observe that increasing access to life insurance does not have a big impact on economic growth due to its low contribution to GDP.

Financial inclusion initiatives have shown significant impact in low-income, high inequality jurisdiction where appetite for financial services is high. A good example is the financial inclusion initiative in Bangladesh by Grameen Bank, which successfully generated women employment through access to credit (Sethi and Acharya, 2018), prior to joining the bank the average worker was employed 6 days a month after joining, employment improved to 18 days a month, this was because access to the bank credit increased potential to buy more farm inputs which then resulted in the need for more labour on the land (Sarker, 2001). The bank monitors the agricultural activities of its borrowers and encourages the borrowers to invest in high yielding crops which increase their income and ability to pay back the loans. The study reveals that the relationship between financial inclusion and economic growth is bidirectional. Financial inclusion, through bank service expansion, improved economic growth which led to further increase in accessing bank services (Sarker, 2001; Sethi and Acharya, 2018).

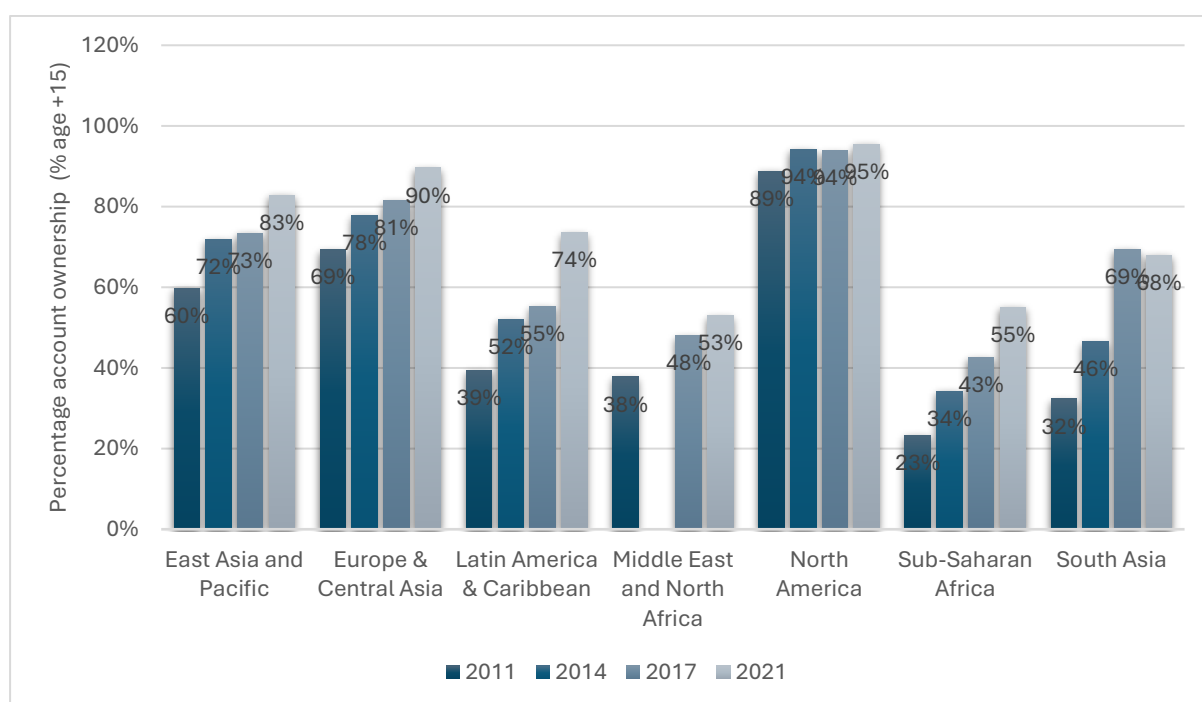
2.2.3 Financial Inclusion in sub-Saharan Africa

Financial indicators compiled by internal organisations such as IMF and World Bank reflect poorly on sub-Saharan Africa, indicating inefficient financial institutions, poor access to finance and inadequate reach to unbanked populations, often signalling room for growth and deepening of the financial sector (Adom et al., 2020). Different scholars have used different indicators for financial inclusion, such as the number of ATMs, number of branches, or number of banks (Park and Mercado, 2018; Sha'ban et al., 2020; Gul, 2018), however account

ownership⁷ is one of the widely used measures because the data on number of accounts is readily available for most jurisdictions (Demir et al., 2022; Chikalipah, 2017; Demircuc-Kunt et al., 2022).

Figure 2.2 below illustrates increase in account ownership levels across different regions from 2011-2022. From Figure 2.2 it is evident that Latin America and South Asia have seen significant increase in account ownership (from 39% to 74% and 32% to 68% respectively), while sub-Saharan Africa has lagged as accounts ownership increased from 23% to 55%. Chikalipah (2017) attributed the low uptake of financial services in sub-Saharan Africa to poor infrastructure, high transaction costs and bank charges among others. On the other hand, findings from the World Bank Global Findex Survey 2021 indicate that distance to financial institutions, lack of adequate documentation are significant reasons for individuals not having bank accounts (Demircuc-Kunt et al., 2022).

Figure 2.2: Change in account ownership by region 2011-2021.



Note: Figure 2.2 is constructed from World Bank Global Findex Database 2021 depicts account ownership by region from 2011-2021. Account ownership has been used as a proxy for financial inclusion

⁷ account ownership is “an individual or jointly owned account at a regulated institution, such as a bank, credit union, microfinance institution, post office, or mobile money service provider” (Demircuc-Kunt et al., 2022 p 15)

Tchamyou et al. (2019) point out that while in industrialised countries life is built around technology advancements with contactless payments, easy and efficient online purchases, and electronic tracking systems there is room for digital breakthrough in developing countries which have less than efficient system and economies largely based on cash transactions. For sub-Saharan Africa, a region where approximately 30 percent have a bank account, mobile phone technology has provided a new platform for access to digital financial services as a result of the high mobile phone subscriptions in the region (Demirguc-Kunt et al., 2018; Joseph et al., 2026; Adelaja et al., 2024). Therefore, there exists a gap digital financial services accessed through mobile phones can be used to measure financial inclusion in sub-Saharan Africa. Financial inclusion gains for sub-Saharan Africa include increased investment, women empowerment, increased economic growth and inequality reduction (Mohammed et al., 2017). The success of mobile money in Kenya is estimated to have brought 194,000 households out of poverty, representing two percent of Kenyan population (Suri and Jack, 2016). This thesis explores the use of mobile money to support financial inclusion.

2.2.4 Fintech and Financial Inclusion

Scholars agree that fintech has the potential to change the financial landscape; by bringing the poor out of poverty and boosting economic activity across the globe through offered financial (Aracil et al., 2025b; Adelaja et al., 2024). The Financial Stability Board (FSB)⁸ describes fintech as “technology enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and provision of financial services” (Navaretti *et al.*, 2018, p 12). Fintech has creates new ways of accessing financial services and products; access to credit, efficient payment systems and remittances and new ways of doing business. Fintech changes how people transact, how they behave financially, lowers existing financial barriers allowing greater participation, shapes existing regulations and redefines the role of ICTs in finance (Puschmann, 2017; Aracil et al., 2025b).

Several studies find that fintech benefits are more pronounced where financial services have reached previously unbanked groups such as, low-income earners who did not have prior access to financial services (Agarwal and Yeow Hwee, 2020; Appiah-Otoo and Song, 2021; Morgan and Trinh, 2020). However, the IMF highlights that fintech could also bring potential risks to vulnerable groups due to lack of understanding of costs and other implication (Sahay

⁸ The Financial Stability Board was established by the G20 to monitor and make recommendations about the global financial system

et al., 2020). In addition, digital credit could result in failure of repayment for people who have low income and low financial literacy levels. For example, Kaffenberger et al. (2018) report that digital loans through mobile money in Kenya and Tanzania resulted in 31 percent in Tanzania and 10 percent in Kenya defaulting. In addition, 20 percent of the loan borrowers in Kenya reduced food purchases to repay the loans. The lack of digital and financial awareness could result in harassment by debt collectors (Sahay et al., 2020). Therefore we investigate the role digital and financial literacy play in mobile money adoption, and importantly in financial inclusion.

Global Impact of Fintech adoption on financial inclusion

One of the countries where fintech has had significant impact in increasing access to finance has been China. Several studies find that the benefits of fintech have been more pronounced in low-income households and SMEs (Hua and Huang, 2021; Zhang et al., 2020; Appiah-Otoo and Song, 2021). Appiah-Otoo and Song (2021) report that peer-to-peer lending for rural farmers in China allowed them access to loans, and in so doing enabled them to develop information sharing system, rural e-commerce platforms where they could sell their produce. In so doing the income and household consumption improved. Zhang et al. (2020) use data from Ant Group⁹ and focused their study on the impact of fintech on rural households in China and find that access to fintech enabled households that did not have access to credit cards previously to build fintech-based credit history which allowed them to access loans. They found that fintech reduced income disparity not only between urban and rural households but also within the groups themselves, increasing financial inclusion increased household income by 14-20 percent. Li et al. (2020) collaborate this observation through their study, observing that households with lower income and lower assets benefit more from access to fintech, largely because higher income households already have access to financial services and therefore experience the ongoing benefits of being financial included in their daily lives. Further, the authors find that household expenditure on food, entertainment, medical care, education improved with access to fintech.

The fintech successes documented in China have been identified in other parts of the world. For example, in 2013 PayPal¹⁰ launched its PayPal Working Capital (PPWC) to provide short term credit to SMEs in the US with the aim of reaching entities that were not serviced by

⁹ Ant Farm is the world's largest mobile payment platform based in China with over 1.8 billion users

¹⁰ PayPal is an American multinational financial technology company operating an online payment system in multiple countries

traditional retail banks, and that faced barriers such as inadequate collateral, high interest rates and stringent loan requirements. 25 percent of PPWC loans were disbursed to SMEs in areas where retail banks had closed due to the 2008 financial crisis, while 61 percent of the loans were dispersed to businesses that had been in operation for less than five years. Businesses that received PPWC loans saw their PayPal sales increase by 22.4 percent (Ahmed et al. (2016).

The impact of Covid-19 resulted in significant policy changes and adoption of fintech in different capacities across different jurisdictions. The World Bank reports that more than a third of adults worldwide paid utility bills from a bank account for the first time, in addition 40 percent of adults from developing economies made digital payments in shops for the first time (Demirguc-Kunt et al., 2022). During the Covid-19 pandemic, Jordanian government mandated payments to be made in mobile wallets and people to move from cash-centric behaviour and migrate to digital payments to mitigate the risk of cash exchanging hands (Al Nawayseh, 2020). Over 100,000 new electronic wallets were issued with government and the central bank providing support for the users. Fu and Mishra (2020) conducted a global survey of fintech application downloads and estimate that on average downloads increased by 24 to 32 percent a day during the Covid-19 pandemic months of February 2020 to April 2020. However, the Covid-19 pandemic had an adverse effect of some of the fintech suppliers. For example, Sahay et al. (2020) report that in Asia funding for fintech activities dropped by 69 percent during the pandemic which resulted in a significant number of businesses closing. It is therefore essential to investigate the impact of Covid-19 on mobile money adoption in sub-Saharan Africa.

Impact of fintech adoption in sub-Saharan Africa

One of the greatest success stories of fintech bridging the financial gap is M-Pesa¹¹ (M-mobile, Pesa-money in Swahili), a mobile money product in Kenya which was launched in 2007. M-Pesa is a payment system that allows local remittances, salaries, payments to be made using mobile money (Mugambi et al., 2014). M-Pesa achieved its success through the establishment of agents in rural locations where there were no bank branches, providing easy access for cash-in and cash-out services (Johnen et al., 2023; Mugambi et al., 2014). The demand for M-Pesa agents in Kenya resulted in job creation and poverty reduction: Suri and Jack (2016) report that 194,000 households, representing two percent of the Kenyan population, are estimated to have been brought out of poverty because of starting businesses as M-Pesa agents. Another success for the product was enabling efficient and secure local

¹¹ M-Pesa is a leading mobile money transfer and payment service that was founded in Kenya in 2007 by Safaricom and Vodafone.

remittances while reducing costs and eliminating middlemen. Prior to M-Pesa, one of the ways in which money was sent to rural areas involved an informal arrangement between a local bus driver and the sender, where the sender would entrust the money to the driver and pay a small fee, the recipient would then meet the bus at the destination to collect the money sent (Mugambi et al., 2014; Burns, 2018). This practice even though common was risky and subject to theft (Gikunda et al., 2015; Kusimba, 2015).

The value of money transfers executed using M-Pesa grew from 30 percent of GDP in 2011 to 85 percent of GDP in 2016 (Lashitew et al., 2019). One by-product of the success of M-Pesa was shaping an enabling regulatory environment for mobile money to thrive and provide inclusive finance (Burns, 2018). However, despite M-Pesa's success, Hove and Dubus (2019) report that one of the areas M-Pesa had challenges was mobilising savings, only 6.8 percent of the participants in their study saved using M-Pesa. The authors suggest that the low savings on M-Pesa were due to lack of incentive to save on mobile money as there was no interest associated with saving. The authors also suggest that those wishing to save long term would rather use other means rather than trust money on a digital wallet long term.

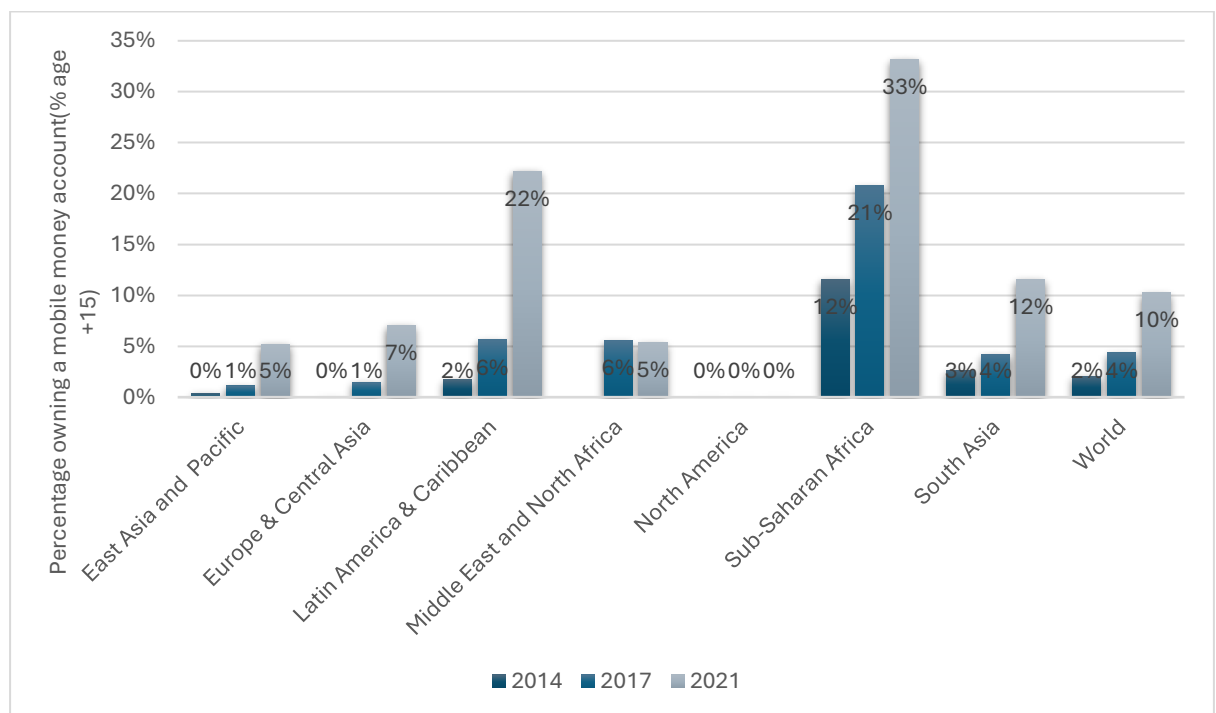
In sub-Saharan Africa mobile money continues to play a particularly important role in the agricultural sectors. A study conducted among rural small holder farmers in Ghana showed that those that adopted mobile money increased their farm output between 33 and 56 percent (Peprah et al., 2020). This was primarily because mobile money afforded them a platform for saving to invest in the next harvest and access to additional finance if needed. In contrast to the findings in Kenya, the farmers were willing to engage in short-term savings through mobile money.

The impact of the Covid-19 pandemic resulted in several policy changes promoting digital payments, online banking, and mobile banking in favour of cash transactions, with the intention of limiting face to face contact and mitigating the risk of spreading of the Covid-19 pandemic (Schizas, 2020). This impacted the role of ICT and how people transact, allowing fintech to thrive and in so doing promoting financial inclusion. Governments in some African countries such as Zambia, Malawi, Tanzania used mobile money to transfer cash to vulnerable households for relief against the pandemic (Akinyemi et al., 2020). Kenya took the initiative further by removing all mobile money person-to-person transfer transaction costs to discourage cash payments (Akinyemi et al., 2020; Schizas, 2020).

2.2.5 Mobile money adoption in sub-Saharan Africa

Sub-Saharan Africa has lagged in other fintech innovations, however due to availability of cheap mobile phones, it became the global leader in mobile money usage (Demirgüç-Kunt et al., 2022). Figure 2.3 below illustrates the growth in mobile money accounts from 2014 to 2021 across different regions. Mobile money accounts grew from 12 percent (2014) to 33 percent (2021) in sub-Saharan Africa, the largest growth compared to the average world growth from 2 percent (2014) to 10 percent (2021). The World Bank (2016, p5) state that “more households in sub-Saharan Africa own mobile phones than have access to electricity and clean water”. The availability of cheap mobile phones and ease of use made mobile phones a good foundation for mobile money adoption. Mobile phones enable service providers to overcome infrastructural challenges such as road network and electricity that hinder branch and ATM expansion to rural areas within the region (Demirgüç-Kunt and Klapper, 2012).

Figure 2.3: Change in mobile money account ownership across different regions from 2014-2021



Note: Figure 2.3 was constructed from World Bank Global Findex Database 2021 and shows increase in mobile money accounts worldwide from 2014-2021

Due to the widespread of mobile phones, mobile money established a clear foothold in sub-Saharan Africa and contributed over 20 percent of GDP (CCAF, 2021), however studies have shown that adoption across sub-Saharan Africa varies and it is worth investigating the

factors that impact the differences in adoption rates (Lashitew et al., 2019). While mobile money has been hugely successful in Kenya, resulting in increased GDP; reduction of poverty and job creation, other jurisdictions have not enjoyed similar success (Baganzi and Lau, 2017a). Similarly, in Rwanda, Tanzania and Uganda over two-thirds of the population depend on mobile money for their financial transactions (Dobler, 2021). Despite efforts to promote digital payments and mobile money users in Ghana preferred cash transactions, citing the language barrier between the natives' local language and the mobile money services offered in English as one of the main reason for shunning the service (Senyo and Osabutey, 2020).

Table 2.2 below shows the percentage of mobile money account growth from 2014-2021 across sub-Saharan Africa, compared to financial institution accounts. There were a higher proportion of financial institution accounts in 2014, however by the end of 2021 the proportion of mobile money surpassed financial institution accounts in all countries, except for Nigeria, Mauritius, and South Africa. For Mauritius and South Africa one of the reasons is because the two jurisdictions have efficient and more developed banking sectors with over 80 percent of the population maintaining a financial institution account (Burns, 2018). David-West et al. (2021) conducted a study in Nigeria and only 2.4 percent of phone users had adopted mobile money, one of the reasons was because vendors in the markets were partial to cash transactions. Other studies identify over regulation and failing to open the market for mobile money growth as one of the challenges that faced mobile money operators in Nigeria (Lepoutre and Oguntoye, 2018; Asongu, 2018a).

Table 2.2 below reveals that some of the countries that have shown significant growth in mobile money accounts from 2014 to 2021 are Ghana (an increase from 13 to 60%), Gabon (7 to 57%), Senegal (6 to 49%), and Cameroon (2 to 4%). Other countries that have a high portion of mobile money accounts and have experienced steady growth of mobile money accounts since its inception include Kenya, Tanzania, Uganda, and Zimbabwe. Kenya is the pioneer and world-leader of mobile money (Jack et al., 2013), whereas Tanzania and Uganda closely followed in Kenya's footsteps by focusing on creating an enabling and less stringent regulatory environment (Burns, 2018). The case for Zimbabwe is unique in that the country had emerged from a period of hyperinflation followed by dollarisation and utilisation of other foreign currencies in 2009, which resulted in scarcity of cash making mobile money more convenient and affordable for users (Mutsonziwa and Maposa, 2016). Results from the table show clear increase in mobile money usage across sub-Saharan Africa, increasing at different rates and providing a basis for investigation on what impacts the adoption.

Table 2.2: Growth in Financial Institution Accounts and Mobile Money Accounts for sub-Saharan Africa 2014-2021

Country	Financial Institution Account (% age 15+)			Mobile Money Account (% age 15+)		
	2014	2017	2021	2014	2017	2021
Benin	16%	32%	24% (↓8%)	2%	18%	37% (↑19%)
Burkina Faso	13%	23%	21% (↓2%)	3%	33%	25% (↓8%)
Cameroon	11%	27%	24% (↓3%)	2%	15%	42% (↑27%)
Congo. Rep	17%	23%	18% (↓5%)	2%	6%	37% (↑31%)
Cote d'Ivoire	15%	15%	21% (↓6%)	24%	34%	40% (↑14%)
Gabon	30%	34%	28% (↓6%)	7%	44%	57% (↑13%)
Ghana	35%	42%	39% (↓3%)	13%	39%	60% (↑21%)
Guinea	6%	15%	14% (↓1%)	1%	14%	22% (↑8%)
Kenya	55%	56%	51% (↓5%)	58%	73%	69% (↓4%)
Malawi	16%	23%	20% (↓3%)	4%	20%	34% (↑14%)
Mali	13%	18%	28% (↑10%)	12%	24%	29% (↑5%)
Mauritius	82%	89%	90% (↑19%)	1%	6%	16% (↑10%)
Namibia	58%	77%	66% (↓11%)	10%	43%	43% (0%)
Nigeria	44%	39%	45% (↑6%)	2%	6%	9% (↑3%)
Senegal	12%	20%	28% (↑8%)	6%	32%	45% (↑13%)
Sierra Leone	14%	12%	14% (↑2%)	4%	11%	19% (↑8%)
South Africa	69%	67%	84% (↑17%)	14%	19%	37% (↑18%)
Tanzania	19%	21%	23% (↑2%)	32%	39%	45% (↓6%)
Togo	18%	34%	25% (↓9%)	1%	21%	36% (↑15%)
Uganda	28%	33%	37% (↑4%)	35%	51%	54% (↑3%)
Zambia	31%	36%	24% (↓12%)	12%	28%	42% (↑14%)
Zimbabwe	17%	28%	29% (↑1%)	22%	49%	51% (↑2%)

Note: Table 2.2 was compiled from data from Global Findex database 2021 and compares increase in financial institution accounts and mobile money accounts between 2014 – 2021 across several sub-Saharan countries.

2.2.6 Challenges in determining financial inclusion using mobile money

One of the challenges with measuring financial inclusion through mobile money is the idea of ‘registered users’¹² against ‘active users’.¹³ By the end of September 2013 Tanzania had 30 million registered users of which 9 million were active users (Di Castri and Gidvani, 2014). Similarly, by the end of March 2017 there were 20 million registered users and 9 million active users in Ghana (Yeboah-Asiamah et al., 2018). Registration implies that people have subscribed to the service, while active users are those who interact with the service on a regular basis and use the application to better their lives. Di Castri and Gidvani (2014) argue that

¹² A registered user is one who has subscribed to the mobile money service

¹³ An active user is a user who uses the mobile money service for payments, remittances, cash-in and cash-out

registered users of a service do not reflect active users because registered users may be higher than active users. Batista and Vicente (2020) categorise users who had used mobile money service at least once a year as active users. In contrast a report from the World Bank measured active use of mobile money in the Philippines as twice a month or more (Pickens, 2009). However, there is no guidance or standard to determine what constitutes and active usage of mobile money services.

Another challenge associated with mobile money as a measure for financial inclusion is that where there is more than one mobile service provider a person may have two or more mobile money accounts. This is often done because cross network transfers are more expensive due to lack of interoperability and accountability between two different platforms and users may want to reduce costs and risk of using mobile money across platforms (Bongomin and Ntayi, 2020b). In addition, because some people have more than one mobile phone, having two mobile money accounts from two different service providers could be seen as an increase in mobile money accounts and portray increased financial inclusion when individual registering is already financially included. Further, new mobile money users may already have a bank account and therefore be financially included through the banking sector (Batista and Vicente, 2020).

In Tanzania, Di Castri and Gidvani (2014) find that some members of the family used one mobile money account and therefore did not need to have individual accounts. The observation was consistent with the World Bank survey (2017) where 11 percent of the population in sub-Saharan Africa did not have an account because a family member already had one (Demirgüç-Kunt et al., 2020). The challenge is that these users are financially included but not counted due to the use of one account having multiple users.

To overcome these challenges we use mobile money usage to measure financial inclusion, this is in agreement with studies that reflect that “usage” is more representative of financial inclusion (Hollanders, 2020; Demir et al., 2022). In doing so we explore the gap of using mobile money to measure financial inclusion.

2.2.7 Factors that influence the uptake of mobile money

Several factors influence the adoption of mobile money services. These include regulatory frameworks, financial literacy, digital literacy, perceived risks, and the level of financial sector development within a country (Akinyemi et al., 2020; Baganzi and Lau, 2017b; Bongomin and Ntayi, 2020b). Regulation plays a particularly important role in shaping mobile money adoption, studies suggest that mobile money adoption tends to be stronger in countries where regulatory frameworks are “enabling” (Soutter et al., 2019; Burns, 2018). The pioneers of mobile money, Kenya, took a “test-and-learn” approach during the early development of mobile money services (2007), allowing M-Pesa to operate before formal regulations were established in 2011.

One of the challenges with regulating mobile money during its inception in Kenya, was the question of whether the financial regulator or telecoms regulator was responsible for oversight of mobile money activities as the innovation (Vlcek, 2011). However, due to the grey area within the law the Central Bank of Kenya had no powers to stop the telecommunications company from providing mobile money decided to observe rather than amend the law to prevent telecoms from providing mobile money (Burns, 2018). In contrast other, jurisdictions such as Nigeria, took a position to only allow banks to lead provision of mobile money, this implied that telecommunications companies needed to partner with banks if they wanted to provide mobile money (Lepoutre and Oguntoye, 2018). However, success has been experienced in markets where mobile money was allowed to take its own shape as over-regulation can hinder adoption (Soutter et al., 2019).

The regulations governing consumer protection; Anti Money Laundering and Countering the Financing of Terrorism (AML/CFT)¹⁴, are very important when dealing with mobile money. Vlcek (2011) report that both Kenya and the Philippines put in place transaction limits on maximum amounts that can be transacted on mobile money and require physical identification verification before opening a mobile money account to curb the risk of money laundering and terrorist financing. This has worked well because the transfer limit set favour low-income users.

¹⁴ AML/CFT are measures put in place to stop terrorists from abusing the financial system

Further regulation changes that have been prompted by the advent of fintech include the areas of customer due diligence, consumer protection, and oversight of fintech providers (Arner et al., 2020; Imam et al., 2022; Ozili, 2021).

Financial Literacy

Financial literacy is important for financial well-being, planning and making sound financial decisions. Mobile money products are primarily designed for vulnerable members of society, they have low literacy levels and even lower financial literacy levels and do not have access to financial products. Studies suggest that women to have lower financial literacy levels than men, this is more pronounced in developing countries because women drop out of school and are expected to marry and have a man supporting them financially (Singh and Kumar, 2017; Bonga and Mlambo, 2016). Bongomin et al. (2020a) propose that low financial literacy could be the result of low availability of channels to financially educate consumers.

Studies have shown that improving financial literacy improves understanding and uptake of financial products (Domeher et al., 2014; Hussain and Sajjad, 2016; Sadok and Elouaourti, 2025). The World Bank conducted a financial inclusion survey in 2017 with the aim of assessing country-level initiatives (World Bank, 2017). The survey reported 16 out of 124 countries had incorporated financial education as a separate subject in schools, on the other hand 45 out of 124 countries had incorporated financial education as a sub-topic integrated within other subjects. Ozili (2021) stated that when policies and regulations have been put in place to promote financial inclusion and there is still a low uptake of fintech, and regulators should look to address the gaps in financial literacy. We therefore explore the role of financial literacy in mobile money uptake.

Digital literacy

Digital literacy is important for users to be comfortable in using digital financial services (Lee, 2021; Kass-Hanna et al., 2021). Digital literacy is prominent in most developing countries where it has been incorporated in education systems, retail services, entertainment, and different segments of the economy; however in contrast for developing countries digital resources are not incorporated in daily lives, with systems remaining manual and fraudsters taking advantage of limited digital knowledge of users (Reddy et al., 2022; World Bank, 2022). The world bank reports that despite having mobile broadband coverage, 43 percent of the world's population remained unconnected because of poor lack of knowledge, awareness, and digital skills (World Bank, 2022; Hounbonon et al., 2021)

In digital financial services such as mobile money, one of the reasons fraud is high is because fraudsters take advantage of lack of digital knowledge of users, users fail to differentiate a call from a fraudster and their service provider (Aracil et al., 2025a; El Amri et al., 2026). Users trust service providers, they give out sensitive information such as PINs, passwords, and any login credentials to fraudsters unknowingly. Digital literacy aids in the consumer protection and gives users the confidence to operate mobile money without giving out sensitive information (Kass-Hanna et al., 2021; Lee, 2021).

A second aspect of digital literacy is the ability to operate technological gadgets, if users cannot navigate through mobile money applications and menus, they would not be willing to adopt the innovation (Kalba, 2016). Sinha et al. (2018) proposed that the poor for whom mobile money products are made lack a reference to digital technology if interaction were improved uptake of mobile money would also improve. However, Senyo and Osabutey (2020) propose that mobile money is easy to use because the using the phone does not require specialised training. The ability to use and understand technology will have significant impact on mobile money adoption, we therefore investigate how digital literacy impacts mobile money adoption.

Financial Market Development

A study conducted in Nigeria, Kenya and South Africa suggested that adoption of mobile money in South Africa was low because the banking sector was efficient and developed (Soutter et al., 2019). The launch of mobile money failed to have the desired impact as people preferred banks compared to mobile money because the bank accounts that met their financial needs. Existing financial markets provide sufficient products, access to banking premises without having to walk long distances, have managed to attract more customers than those that keep their presence in urban areas (Mookerjee and Kalipioni, 2010).

Countries that allow mobile money to be provided by non-bank entities such as mobile network operators, for example, Kenya and Tanzania experienced more growth in mobile money growth than countries that restricted provision to banks only (Jason, 2016). This is largely on account of the products and barriers in requirements entry within the banking sector. The banking sector itself was not sufficiently developed to accommodate products designed for low-income earners.

2.2.8 Synthesis of Financial Inclusion Literature

The literature reviewed in this section highlights the growing importance of financial inclusion as a global development priority and emphasises the role of technological innovations

in expanding access to financial services (Adel, 2024; Aracil et al., 2025a; Demir et al., 2022). While traditional banking systems have historically been the primary channels for financial inclusion, structural limitations such as high transaction costs, limited physical infrastructure, and weak institutional capacity have constrained their reach in many developing regions, particularly sub-Saharan Africa (Soutter et al., 2019; Mookerjee and Kalipioni, 2010). In response to these limitations, fintech innovations, most notably mobile money have emerged as important mechanisms for expanding financial access by leveraging existing mobile phone infrastructure and agent networks (Joseph et al., 2026; Osabutey and Jackson, 2024).

Despite the significant expansion of mobile money services across the region, the literature also demonstrates that access alone does not guarantee meaningful financial inclusion (Senyo and Osabutey, 2020; Hollanders, 2020). Scholars increasingly emphasise the distinction between access and usage, noting that individuals must possess the necessary knowledge, skills, and confidence to utilise financial services effectively (Park and Mercado, 2018; Demir et al., 2022). Furthermore, variations in mobile money adoption across countries suggest that contextual factors such as regulatory frameworks, financial sector development, and individual capabilities influence the extent to which financial innovations translate into improved financial inclusion outcomes (Jason, 2016; Kass-Hanna et al., 2021; Soutter et al., 2019).

These observations indicate that supply-side innovations such as mobile money must be complemented by demand-side capabilities that enable individuals to understand and utilise financial technologies. Financial literacy and digital literacy are likely to play a critical role in shaping individuals' perceptions of financial services and their willingness to adopt mobile money platforms (Kass-Hanna et al., 2021; Adel, 2024). The following sections therefore examine the literature on financial literacy and digital literacy in greater detail, with a view to understanding how these capabilities influence the adoption of digital financial services in sub-Saharan Africa.

2.3 Financial Literacy

2.3.1 Defining financial literacy

Financial literacy broadly refers to the knowledge and capabilities required to make informed and effective financial decisions. It encompasses individuals' ability to understand financial concepts, evaluate risks associated with financial products, select appropriate financial services and manage personal finances in both the short and long term (Dewi et al., 2020a; Lusardi, 2019). Financial literacy therefore involves not only knowledge of financial concepts but also the ability to apply that knowledge in everyday financial decision making.

In developing countries financial literacy is often associated with empowering individuals, particularly low-income populations, to participate more actively in financial systems (Bongomin et al., 2020b; Andreou and Anyfantaki, 2021). Individuals who lack financial knowledge and skills may feel excluded from formal financial institutions and may perceive financial services as inaccessible or unsuitable for their needs (Gabor and Brooks, 2017). Muñoz-Céspedes et al. (2021) suggest that financial literacy programs provide a mechanism for enabling financially excluded populations to make informed financial choices and improve economic wellbeing. Developing countries are also characterised by lower levels of general literacy which translate into limited financial literacy skills and knowledge deficiencies in literacy rates and these are often translated and cascade down to financial (Saka-Helmhout et al., 2020). Although numerous definitions of financial literacy exist, two widely cited definitions are provided by the Organisation for Economic Co-operation and Development and Remund (2010) provide two of the most referenced definitions.

The OECD defines financial literacy as:

“Financial literacy is knowledge and understanding of financial concepts and risks, as well as the skills and attitudes to apply such knowledge and understanding in order to make effective decisions across a range of financial contexts, to improve the financial well-being of individuals and society, and to enable participation in economic life.”
(OECD, 2021, pp18)

Remund (2010, p.284) defines financial literacy as;

“Financial literacy is a measure of the degree to which one understands key financial concepts and possesses the ability and confidence to manage personal finances through

appropriate short-term decision-making and sound, long-range financial planning, while mindful of life events and changing economic conditions.” (Remund, 2010, p284)

Both definitions emphasise two key dimensions of financial literacy: ‘knowledge’ and ‘understanding’ of financial concepts. Muñoz-Céspedes, Ibar-Alonso and Ros (2021) argue that knowledge in itself is not sufficient and must be accompanied by understanding of the financial product(s). Financial knowledge refers the information individuals acquire regarding financial concepts and products and the ability to use that knowledge when making financial decisions (Dewi et al., 2020a; Fernandes et al., 2014). Evidence of financial knowledge is perceived through financial behaviours such as savings for future needs; retirement planning and building investments (Scott et al., 2018). Individuals who possess greater financial knowledge are generally better equipped to prioritise expenditures and manage financial resources effectively (Demirgüç-Kunt et al., 2022).

However, research has shown that financial knowledge does not always translate into improved financial behaviour. For example, Barboza et al. (2021) find individuals who demonstrated financial knowledge still engaged in overspending and accumulating credit card debt. Their findings show that those respondents who correctly answered financial literacy questions still had 5.09% probability of repaying less than their credit card balance, compared to 5.64% among those who answered incorrectly. These findings suggest that while financial literacy improves knowledge, it does not necessarily guarantee effective financial decision-making (Tokar Asaad, 2015).

2.3.2 Significance of Financial Literacy

Financial literacy has become increasingly important in the context of financial inclusion initiatives worldwide. During the 2013 G20 Summit, policymakers recognised that despite the expansion of digital financial services, a significant proportion of low-income populations remained excluded from formal financial systems (Ozili, 2021). One of the biggest challenges in sub-Saharan Africa and developing countries has been financial literacy. One of the major barriers identified was limited financial literacy. Low levels of financial literacy can hinder individuals’ ability to understand financial products, evaluate financial risks, and utilise available financial services effectively. The African Development Bank highlights that low levels of financial literacy and limited digital knowledge significantly constrain the adoption of digital financial services in developing countries (Triki and Faye, 2013). Consumers who lack confidence in using financial technologies often rely on family members or acquaintances

to assist with transactions, which may limit their independence and participation in financial systems (Malady, 2016).

Chikalipah (2017) suggested that approximately 40 percent of the adult population in Africa is illiterate, and many financially excluded individuals report that they do not perceive the need for a bank account due to limited knowledge of financial products. Similarly, Gabor and Brooks (2017) argue that many low-income households are unaware of financial products that may be suitable for their needs, which leads them to perceive themselves as excluded from the formal financial system.

Several studies have demonstrated that improving financial literacy can positively influence financial inclusion outcomes (Bhagwan, 2019; Bongomin et al., 2020a; Bongomin et al., 2017). Financial literacy influences key financial behaviours such as saving, borrowing, investment decisions, and financial planning (Abdeldayem, 2016; Adam et al., 2017; Bhushan, 2014). Individuals who possess higher levels of financial literacy are more likely to make informed financial choices and utilise financial services more effectively.

Financial literacy also contributes to improved financial wellbeing by enabling individuals to manage financial risks and prepare for unexpected financial shocks. Lusardi et al. (2014) suggest that financially literate individuals are better prepared for emergencies and are less likely to rely on high-cost borrowing options. In addition, financial literacy improves individuals' ability to manage credit responsibly, reducing the likelihood of excessive debt accumulation or default (Lusardi and Mitchell, 2011b).

Furthermore, financial literacy supports effective budgeting and long-term financial planning. Studies have shown that individuals who engage in financial planning accumulate significantly more wealth over time compared to those who do not (Lusardi and Mitchell, 2011a). Financial literacy therefore plays a critical role in improving financial stability and economic resilience among households.

2.3.3 Global perspective on financial literacy

One of the most comprehensive global assessments of financial literacy was conducted by (Klapper et al., 2015) using data from the Standard and Poor's Global Financial Literacy Survey. The survey evaluated four core financial concepts: interest rates, interest compounding, inflation, and risk diversification. The results revealed that global financial literacy levels remain relatively low. On average, only one in three adults worldwide was considered financially literate. Financial literacy levels were also found to vary significantly

across regions, with developed countries generally exhibiting higher levels of financial literacy than developing economies (Klapper et al., 2015; Lusardi and Mitchell, 2011b).

Gender disparities in financial literacy were also evident. The survey found that 35 percent of men were financially literate compared to 30 percent of women globally. However, some studies suggest that financial inclusion outcomes do not always follow the same pattern. For example, Mukong et al. (2020) report that in Namibia financial inclusion levels were higher among women than men, highlighting that financial literacy and financial inclusion do not always move in parallel.

Other studies have emphasised the importance of education in improving financial literacy and financial inclusion outcomes. Park and Mercado (2018) found that completion of primary education significantly increases the likelihood of financial inclusion. Similarly, Bhagwan (2019) reports that more than half of respondents in a survey of financially excluded individuals in India believed that financial literacy helped them make better financial decisions and improved their access to financial services. Despite growing global recognition of the importance of financial literacy, Lusardi (2019) emphasises that financial education programmes should particularly target vulnerable populations, including low-income households and financially excluded individuals.

2.3.4 Financial Literacy in sub-Saharan Africa

Financial literacy remains a challenge across sub-Saharan Africa Domeher et al. (2014) argued that, in Ghana, understanding of electronic financial innovations such as internet banking, mobile banking, and ATM products proved to be a challenge until banks offered education and guidance on how to use the products . Those who received support and information on e-banking services are 1.7 times more likely to adopt e-products. Fanta and Kingstone (2021) developed a financial literacy questionnaire for a study across Kenya and Tanzania, and produce results consistent with findings from the Global Financial Literacy survey (Klapper et al., 2015). Specifically, they found financial literacy to be higher in men than in women; in addition, financial literacy was low among young adults (15 to 25 years old), improved with age and decreased among older people (55 and older), thereby following an inverted-U shape, further as education levels increased the financial literacy levels increased (Xu and Zia, 2012; Finke et al., 2017).

Christian et al. (2022) conducted a study in rural Mozambique to investigate how financial advice from consultants impacted farmers decisions to investment in agricultural

equipment. The study comprised of a control group and a treatment group that were exposed to financial literacy training from consultants. Both groups received financial advice on savings and were required to devise a savings plan to purchase agricultural equipment, however the treatment group received regular follow up visits and financial advice from consultants, whereas the control group only received the initial training and no follow up training. They found 21 percent of farmers in the treatment group were reported to saving more due to the regular visits from consultants. In addition, those who received advice from consultants were able to adjust their plans according to emergencies and unplanned events. Sayinzoga et al. (2016) conducted a similar study in Rwanda to assess the impact of providing financial literacy training on rural agricultural cooperatives and savings groups to improve financial knowledge. The study found that those who received training exhibited a change in financial behaviour; savings increased by 44 percent; savings frequency was higher by 33 percent; borrowing increased by 24 percent and start-up of income generating activities increased by 16 percent.

Despite evidence of the benefits of financial literacy, the figures across sub-Saharan countries remain low. Table 2.3 below shows financial literacy rates for sub-Saharan countries range from 15 to 52 percent. In comparison, literacy levels across the sub-continent indicate that adult literacy ranges from 66.0 to 91.5 percent. Xu and Zia (2012, p 9) report low financial awareness across some African countries and state that “a large proportion of the population in Mozambique, Malawi and Nigeria lack awareness of basic financial products such as loans, savings, interest on savings and insurance.” Nanziri and Leibbrandt (2018) report that some people in Malawi and Tanzania do not have bank accounts because they had never heard about a bank account and did not know how to open one following a survey done in the countries. These observations are consistent with the World Bank Global Findex 2021 Survey results, which found that only 36 percent of residents in sub-Saharan Africa would be able to use a bank account without any help if they opened one (Demirguc-Kunt et al., 2022). This is common in many rural households across sub-Saharan Africa that do not have access to finance. Addressing the supply side of financial products is not enough, there is need to invest in educating the people on the functionalities and benefits; and how to use financial products (Bongomin et al., 2017).

Table 2.3: Financial literacy compared to literacy rates across sub-Saharan Africa

Country	Financially Literate Adults (%) ¹	Population Literacy (25 to 64 years) ²	Adult literacy (Over 15 years) ²	Youth literacy (15 to 24 years) ²
Angola	15	77.4	66.0	62.1
Botswana	52	97	86.8	85.1
Kenya	38	87	81.5	79.6
Malawi	35	72.1	62.1	59.1
Namibia	27	95.1	91.5	91.7
Rwanda	26	86.5	73.2	70.4
South Africa	42	95.3	87.0	87.7
Tanzania	40	85.7	77.8	77.4
Uganda	34	89.4	76.5	69.9
Zambia	40	92.1	86.7	85.0
Zimbabwe	41	90.4	88.7	88.8

Note: The table has been with data from Standard and Poor's financial literacy survey 2014 and World Bank Education Statistics 2014.

In sub-Saharan Africa financial literacy can contribute to financial wellbeing, financial sector development, poverty reduction, enhanced economic activity, sustainable businesses (Refera et al., 2016; Demirgüç-Kunt and Klapper, 2013; Mejía et al., 2022). Recent trends in finance and sophistication of products, including digital platforms have made financial literacy essential to progress and participation in the financial arena. Poor financial knowledge leads to poor financial choices and can result in loss of funds through frauds, holding non-profitable financial assets, over exposed to credit that the consumer cannot repay (Refera et al., 2016). Table 2.4 below shows some in-country financial education strategies across sub-Saharan

Africa. Initiatives across the region vary from incorporating financial inclusion in the school curricula, after school activities or using media to put the message across. Across all jurisdictions, initiatives are being taken to ensure that vulnerable and marginalised groups are equipped with financial skills.

Table 2.4: Financial Education strategies across some sub-Saharan African countries

Country	Document Name	Focus
Lesotho	Financial Education Strategy (2014)	Focused on providing financial education messages through television, radio, print media, mobile phones, newspapers, and face-to-face workshops. The target audience is mainly rural people, women, low-income earners, youth (Finmark-Trust, 2014).
Namibia	Financial Literacy Initiative (2018/19-2022/23)	The focus is youth and minority groups (farm workers, prisoners, pensioners) under personal finance and Micro, Small and Medium Enterprises (MSMEs) with cooperation from Non-Governmental Organisations and Universities (MOF-Namibia, 2018).
South Africa	National Consumer Financial Education Strategy (2013)	The strategy seeks to empower those vulnerable and marginalised and to introduce financial education in primary school curriculum. The main targets are empowering the youth to be financially literate, equipping adults to make sound investments and enabling the elderly to feel financially secure. The aim is baseline financial knowledge to increase to 70 by 2023 (Treasury-RSA, 2013).
Zambia	National Strategy on Financial Education for Zambia (2019-2024)	The aim is to have a financially secure Zambia by 2030, targeting improved financial knowledge for all Zambians. Some of the strategies include incorporating financial education into the school curriculum, financial education for the workplace, financial education for small-scale farmers, and financial education for MSMEs (MOF-Zambia, 2019) .
Tanzania	National Financial Education Framework (2016-2020)	The strategy focuses on providing training to youth and MSMEs through classroom training, village road shows and mobile phone messages. The framework also looks at providing financial education in schools through extra curricula activities such as clubs (TNCFI, 2017).
Rwanda	National Financial Education Strategy for Rwanda (2013)	The strategy priority segments are children, youth, and adults and addresses the gender gap. The elderly are not included due to lack of resources. The strategy includes staff of financial service providers who can later provide financial education to their clients. Targeting children and youth is hoped to have a multiplier effect as they can advise friends and relatives as trusted sources. The mode of delivery of programs is through after-school activities such as clubs, youth camps, sports activities, mobile phones, radio (MOF-Rwanda, 2013)

Note: Table 2.4 was compiled using published country financial literacy/education strategies from the above-mentioned countries sourced through internet search.

Bongomin et al. (2017) posit that in developing countries financial literacy poses a barrier to access and use of financial products and services. Poor households are not comfortable with using financial products and therefore will not demand them until they know they can use them (Nanziri and Leibbrandt, 2018). Financial education strategies enable

governments to improve financial literacy for the vulnerable in society, as is evidence in Table 2.4 above. Financial literacy will allow poor households to make better financial decisions, plan for retirement, increase economic activity and reduce reliance on family and friends for financial support.

2.3.5 Financial literacy and mobile money

Financial literacy plays an important role in shaping individuals' ability to adopt and utilise digital financial services. Mobile money platforms are frequently targeted at low-income and previously unbanked populations, many of whom have limited financial knowledge and experience with formal financial systems (Saka-Helmhout et al., 2020; Gabor and Brooks, 2017). Research suggests that improving financial literacy enhances individuals' understanding of financial products and increases the likelihood of adoption and sustained usage of financial services (Domeher et al., 2014; Hussain and Sajjad, 2016). Financial literacy therefore contributes to empowering individuals to make informed financial decisions and engage more confidently with financial technologies.

In the context of mobile money adoption, financial literacy may influence how individuals perceive the benefits, risks, and usability of digital financial services (Dewi et al., 2020b; Lusardi, 2019). Individuals with higher levels of financial literacy are more likely to understand transaction processes, evaluate costs and benefits, and utilise mobile money services for savings, payments, and transfers. Given the growing role of mobile money in expanding financial access across sub-Saharan Africa, understanding the relationship between financial literacy and mobile money adoption is therefore essential. This study contributes to this area by examining how financial literacy influences individuals' adoption decisions within the broader framework of diffusion of innovation.

2.4 Digital Literacy

2.4.1 Defining Digital Literacy

Digital literacy broadly refers to the ability to effectively access, understand, evaluate and utilise digital technologies in everyday activities. Barrett-Zahn (2021, p1) defines digital literacy as “the ability to find, evaluate, utilise, share and create content using technologies on the internet”. Similarly, UNESCO conceptualises digital literacy as a set of competencies to enable individuals to access, manage, and communicate information through digital

technologies in ways that support employment, education and economic participation as quoted below:

“the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs, and entrepreneurship. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy, and media literacy” (Nancy et.al, 2018, pp 6)

Although these definitions emphasise the technical ability to operate digital technologies, scholars increasingly argue that digital literacy extends beyond basic technological competence. (Ng, 2012) suggests that digital literacy also incorporates cognitive and socio-cultural dimensions, including the ability to interpret digital information critically and engage with digital environments responsibly. Similarly, (Lee, 2021) uses the concept of digital self-efficacy to emphasise the role of confidence and familiarity in shaping individuals' willingness to interact with digital technologies.

These perspectives highlight an important distinction between access to technology and the ability to utilise it effectively. While digital infrastructure may enable access to digital services, the absence of digital literacy can limit individuals' ability to engage meaningfully with digital platforms. This distinction is particularly relevant in developing economies, where technological access has expanded rapidly through mobile phones but digital skills remain unevenly distributed.

The concept of “digital natives” has frequently been used to describe individuals who have grown up interacting with digital technologies and therefore possess intuitive familiarity with digital environments (Ng, 2012). However, this assumption has been criticised for oversimplifying the relationship between age and digital competence. Even among younger populations, levels of digital literacy may vary significantly depending on education, access to digital infrastructure, and exposure to digital technologies. These challenges are particularly pronounced in developing regions such as sub-Saharan Africa. While mobile phone penetration has increased rapidly, access to reliable internet connectivity and digital infrastructure remains uneven (Nedungadi et al., 2018). In many countries across the region, electricity shortages, high internet costs, and limited broadband infrastructure constrain opportunities for digital engagement. As Hounbonon et al. (2021) note, a significant proportion of the global

population lacking access to electricity resides in sub-Saharan Africa, further limiting the potential for digital inclusion.

Consequently, digital literacy in developing contexts is often closely linked to mobile phone usage rather than broader internet-based competencies. Mobile devices provide an accessible entry point into digital environments, enabling communication, access to information, and participation in digital financial services (Asongu and Odhiambo, 2022b). However, the ability to use mobile technologies effectively still depends on individuals' digital skills and familiarity with digital interfaces.

2.4.2 Significance of Digital Literacy

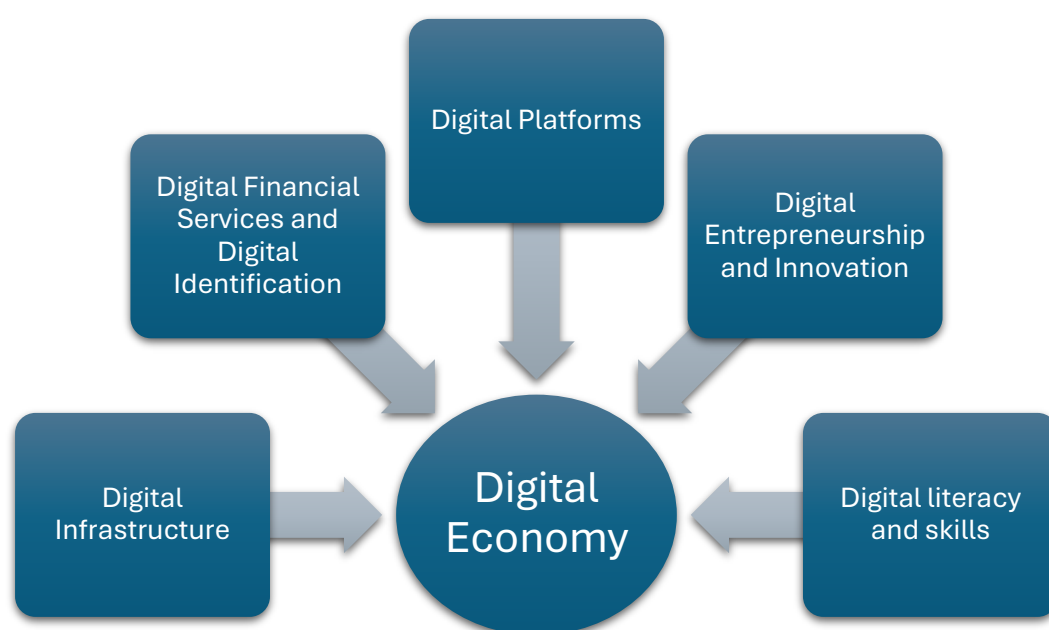
Digital literacy has become increasingly important as economies transition toward digital platforms and services. Recognising the importance of digital skills, UNESCO developed a global digital literacy framework aligned with the United Nations Sustainable Development Goals (SDGs), particularly SDG 4.4, which focuses on developing relevant skills for employment and economic participation (Nancy et al., 2018; World Bank Group, 2021). The framework identifies several key competencies required for effective digital participation, including the ability to manage digital devices, evaluate information, communicate using digital technologies, maintain cybersecurity awareness, and create digital content. These competencies highlight that digital literacy involves a combination of technical skills, cognitive abilities, and behavioural competencies.

The European Commission's DigiComp framework similarly conceptualises digital literacy as encompassing five key dimensions: information and data literacy, communication and collaboration, digital content creation, safety and security, and problem solving using digital technologies (Nancy et al., 2018). Together, these frameworks reflect a growing recognition that digital literacy is essential for enabling individuals to participate in increasingly digitised economic and social systems.

Recognising the significance of digital economy and digital literacy the World Bank established the Digital Development Global Practice (DDGP) in 2016 to work with Governments across the globe to promote, advise, and facilitate the growth of digital economies (World Bank, 2022). Figure 2.4 below represents the five pillars to achieving digital economies as proposed by the World Bank DDGP. Developing digital literacy and skills is key in implementing all the pillars and should be promoted across the framework. However, despite the growing emphasis on digital skills, global disparities in digital literacy remain substantial.

The World Bank reports that approximately three billion people worldwide remain unconnected to the internet, with the majority residing in developing countries (World Bank, 2022). Moreover, even where digital infrastructure exists, individuals may lack the skills required to utilise digital technologies effectively. Hounghonon et al. (2021) refer to this phenomenon as the “usage gap,” where individuals live within mobile broadband coverage areas but do not utilise internet services due to limited digital skills or awareness.

Figure 2.4: Five key elements for inclusive digital economies



Note: Figure 2.4 was constructed from World Bank, DDGP Digital Economy Strategy, 2016.

The Covid-19 pandemic further highlighted the importance of digital literacy in enabling access to essential services. Digital technologies allowed many businesses, educational institutions, and governments to continue operating during lockdown periods (Amankwah-Amoah et al., 2021). However, these benefits were not evenly distributed. In sub-Saharan Africa, nearly half of students targeted by online learning platforms lacked internet access at home during the pandemic (Langthaler and Bazafkan, 2020). These disparities illustrate how limitations in digital infrastructure and digital literacy can reinforce existing socio-economic inequalities.

2.4.3 Global Perspective on Digital Literacy

In response to the growing importance of digital skills, many countries have developed national digital literacy strategies aimed at preparing citizens for participation in digital economies. These initiatives vary widely in scope and implementation but generally focus on integrating digital skills into education systems, workforce training programmes, and public awareness campaigns. Table 2.5 below shows digital literacy framework development in selected countries around the globe.

Table 2.5: Digital literacy initiatives across different countries

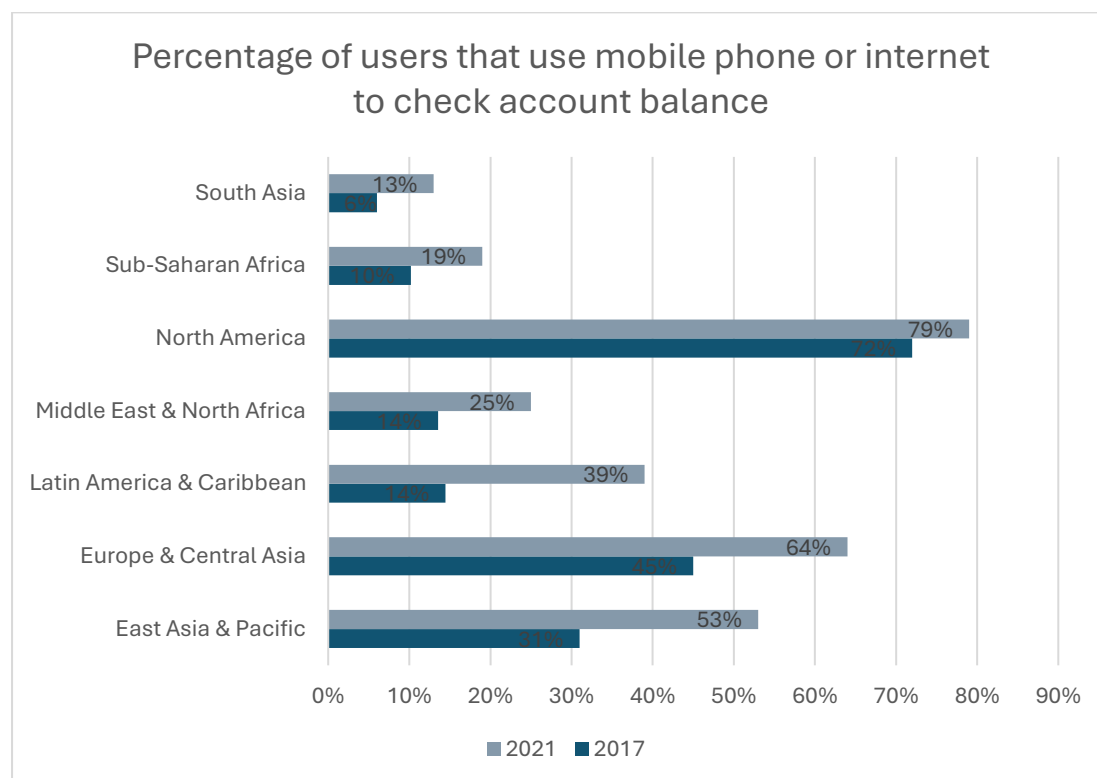
Country	Responsible body	Digital Literacy Summary
Kenya	The Ministry of Education through the Kenya Institute of Curriculum Development (KICD)	Mode: Incorporated digital literacy in Kenya school curricula. Objective: “To provide bespoke, differentiated, innovative learning experiences that ensure each and every child can take their place in the world with confidence and pride as 21st century Kenyans” Target group: K-12
British Columbia	British Columbia Ministry of Education	Mode: Developed a digital literacy program for K-12 students. The curricula were implemented in public and private schools in September 2016. Objective: “Preparing young Canadians to be digital citizens and to make good choices when using digital media” Target group: primary and secondary mainstream students.
Chile	Enlaces - Centro de Educación y Tecnología - Ministerio de Educación	Mode: Developed a National ICT Skills Assessment Framework. Approximately 10,000 high school students to take the test each year. The test was administered in 2011 and 2013, no other subsequent test results have been reported. Objective: “To test ICT skills and development of Chilean children.” Target Group: high school students
Costa Rica	Omar Dengo Foundation (ODF); Ministry of Public Education (MPE)	Mode: Establish performance standards in digital technology-enhanced learning from pre-K to grade-level 12. Performance standards developed between 2006-2008 Objective: “Costa Rican educational system expectations for student capability with digital technology as an exit profile at each education level. The performance standards should inform classroom teaching and learning practice” Target Group: primary and secondary students
India	India state governments and implementation agencies, and certifying agencies	Mode: Deliver a free 20-hour course, with five modules to be completed between 10 and 30 days, in the official languages of India. Objective: To realize the government’s Digital India vision, to train rural people to use digital devices for specific functions, to build up the nation and to reduce the digital divide amongst people groups. At least each household should have one member who was digitally literate. Target Group: Households can nominate one person between 14-60 years old to receive training.

Note: Table 2.5 summarises examples of digital literacy strategies reported by UNESCO (Nancy et al., 2018) in support of UN-SDG 4.4.1.

For example, several countries have incorporated digital literacy into school curricula to develop digital competencies from an early age (Ndibalema, 2025). Such initiatives reflect the view that formal education systems play a crucial role in building foundational digital skills. However, evidence suggests that educational interventions alone may not fully address digital literacy gaps, particularly among older populations or individuals outside formal education systems (Houngbonon et al., 2021).

Empirical evidence also indicates substantial variation in digital technology usage across regions. Data from the World Bank Global Findex Survey, depicted in Figure 2.5 below, show that individuals in more economically developed regions such as North America and Europe are significantly more likely to use digital technologies to access financial services compared to individuals in developing regions (Demirgüç-Kunt et al., 2022). In contrast, fewer than one-fifth of individuals in sub-Saharan Africa report using mobile phones or the internet to check account balances.

Figure 2.5: Percentage of users that use mobile phone or internet to check account balance



Note: Figure 2.5 was constructed using data from World Bank Global Findex Database 2021

While infrastructural constraints partly explain these disparities, scholars argue that digital literacy also plays an important role. (Birba and Diagne, 2012) suggest that high internet

costs and limited digital skills reduce incentives for individuals to engage with digital technologies. Similarly, Nedungadi et al. (2018) emphasise that inadequate infrastructure, unreliable electricity supply, and limited digital training opportunities collectively hinder digital technology adoption in developing regions. These findings suggest that digital literacy initiatives must be integrated with broader policies aimed at improving digital infrastructure and affordability. Without such complementary investments, digital literacy programmes alone may have limited impact on digital technology adoption.

2.4.4 Digital literacy in sub-Saharan Africa

The development of digital economies in sub-Saharan Africa is closely linked to the rapid expansion of mobile phone technology. Mobile devices have become the primary means through which individuals access digital services, including communication platforms, information resources, and financial technologies. GSMA (2022) reports that smartphone adoption in sub-Saharan Africa reached approximately 64 percent in 2021, reflecting the increasing role of mobile technology in the region's digital transformation.

However, the expansion of mobile connectivity has not been accompanied by equivalent improvements in digital literacy. While many individuals possess mobile phones, their ability to utilise digital technologies effectively remains limited. For example, although mobile broadband coverage has expanded significantly across the region, a large proportion of individuals who live within coverage areas do not use mobile internet services (GSMA, 2022). Scholars attribute this gap partly to high internet costs but also to limited digital awareness and skills (Birba and Diagne, 2012; Katz and Callorda, 2019).

The education sector is frequently identified as a key mechanism for improving digital literacy. Reddy et al. (2022) argue that integrating digital skills training into educational systems could help develop digital competencies across broader populations. However, educational infrastructure limitations continue to constrain such initiatives in many African countries. During the Covid-19 pandemic, many schools across sub-Saharan Africa were unable to transition to online learning due to limited internet access, unreliable electricity, and inadequate digital infrastructure (Adarkwah, 2021).

Despite these challenges, some countries have begun implementing national digital literacy strategies. Ghana, for example, has integrated digital literacy initiatives into its broader digital economy strategy, resulting in increased development of digital platforms and e-commerce services (World Bank Group, 2019). Similarly, Kenya has introduced digital skills

programmes across primary, secondary, and tertiary education systems to prepare its workforce for participation in digital economies (MoICT-Kenya, 2019). While these initiatives demonstrate progress, digital literacy development across the region remains uneven. Many countries continue to face structural barriers including limited technological infrastructure, insufficient digital training programmes, and inadequate policy coordination. As a result, digital literacy gaps persist across much of sub-Saharan Africa.

2.4.5 Digital literacy and mobile money adoption

Despite the growing importance of digital technologies in financial services, relatively few studies have explicitly examined the relationship between digital literacy and mobile money adoption. Existing research suggests that digital literacy influences individuals' ability to interact with digital financial platforms, particularly through their familiarity with mobile devices and digital interfaces. (Kass-Hanna et al., 2021) develop a digital literacy index incorporating mobile phone proficiency, mobile money proficiency, and access to mobile technology. Their findings suggest that digital literacy significantly influences individuals' ability to participate in digital financial ecosystems. Individuals with higher digital literacy levels are more likely to understand transaction processes, recognise potential fraud risks, and navigate mobile money platforms effectively. Similarly, (Kiconco et al., 2019) find that mobile phone usage skills significantly increase the likelihood of mobile money adoption in Uganda. Their study also highlights the role of social learning, suggesting that digital skills may be transmitted through social networks as individuals observe others using mobile technologies.

However, the literature also suggests that digital literacy does not operate in isolation. (Radovanović et al., 2020) demonstrate that technological design can influence digital accessibility. In their study of a sound-assisted mobile money application in Burkina Faso, users who interacted with an audio-guided interface were significantly more successful in completing transactions compared to users relying solely on visual instructions. These findings suggest that technological design may compensate partially for limited digital literacy.

Taken together, these studies highlight the complex relationship between digital literacy and mobile money adoption. While digital skills facilitate interaction with digital financial platforms, factors such as user interface design, social networks, and contextual constraints may also influence adoption decisions (Farmer, 2025; Ndibalema, 2025). Consequently, understanding how digital literacy interacts with these factors remains an important area of research in the context of mobile money adoption.

2.4.6 Synthesis: Financial and Digital literacy and Financial Inclusion

The literature on financial literacy and digital literacy highlights the growing importance of individual capabilities in enabling meaningful participation in modern financial systems (El Amri et al., 2026; Sadok and Elouaourti, 2025; Adel, 2024). While financial inclusion initiatives have traditionally focused on expanding access to financial services through infrastructure and institutional reforms, recent research emphasises that access alone does not guarantee effective utilisation of financial services (Osabutey and Jackson, 2024; Adel, 2024). Instead, individuals must possess the knowledge, skills, and confidence required to engage with financial products and digital platforms.

Financial literacy enables individuals to understand financial concepts, assess risks, and make informed financial decisions. However, existing studies present mixed evidence regarding the extent to which financial knowledge translates into improved financial behaviour, particularly in low-income contexts where financial constraints and institutional barriers remain significant (Fernandes et al., 2014; Lusardi, 2019). Similarly, digital literacy facilitates the ability to interact with digital technologies and platforms, but its impact on financial participation is often shaped by broader contextual factors such as infrastructure availability, affordability of digital services, and technological design (Houngbonon et al., 2021; Katz and Callorda, 2019).

Taken together, these studies suggest that financial literacy and digital literacy should not be viewed as isolated determinants of financial inclusion but rather as complementary capabilities that influence individuals' ability to adopt and utilise digital financial services. In the context of mobile money, these capabilities may shape how individuals perceive the usefulness, complexity, and risks associated with digital financial innovations. Despite the increasing importance of digital financial services across sub-Saharan Africa, relatively limited research has examined how financial literacy and digital literacy jointly influence mobile money adoption (Kass-Hanna et al., 2021; Triki and Faye, 2013). Existing studies often examine these factors independently or focus primarily on supply-side drivers of financial inclusion (Aracil et al., 2025b). Consequently, there remains a need to better understand how individual capabilities interact with technological innovations in shaping financial behaviour.

Addressing this gap, the present study this thesis examines how financial literacy and digital literacy influence mobile money adoption within the framework of the Diffusion of Innovation theory (Rogers, 1968). By integrating these literacy dimensions into the innovation

adoption process, the study aims to provide deeper insight into the demand-side factors influencing the diffusion of mobile money services in sub-Saharan Africa.

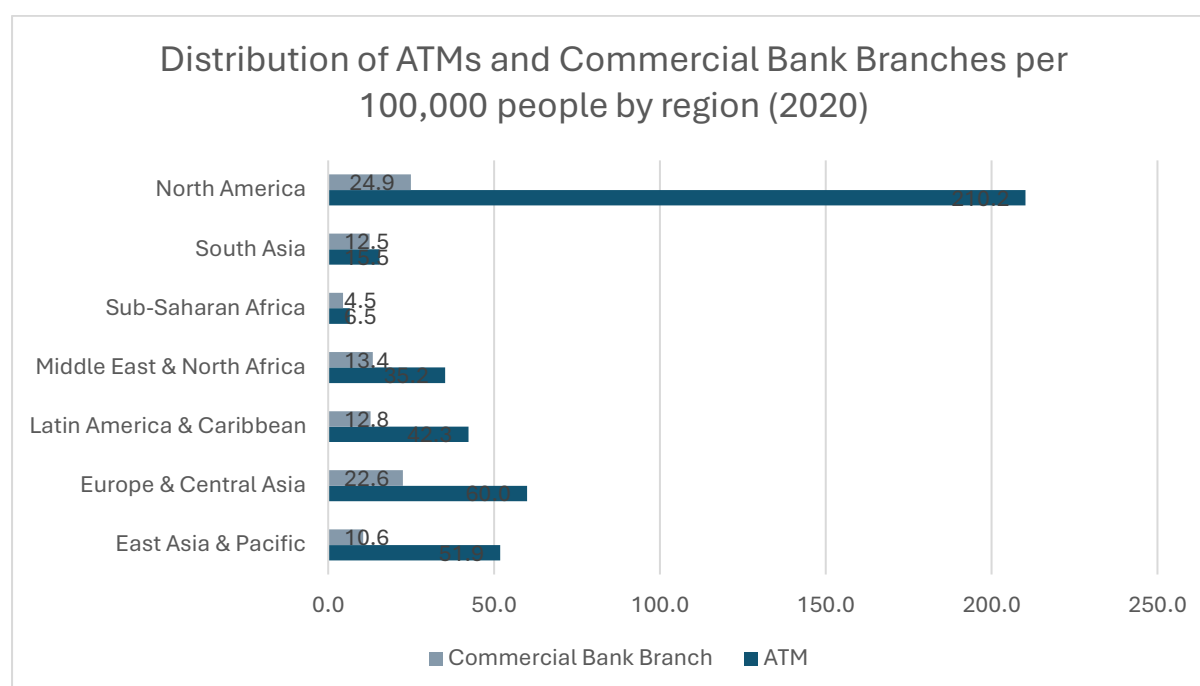
2.5 Access to financial services

Access to financial services remains a central component of financial inclusion and economic development. However, despite significant policy attention, access to formal financial services in sub-Saharan Africa continues to lag global averages. Financial indicators compiled by international organisations such as the International Monetary Fund (IMF) and the World Bank consistently highlight structural weaknesses in the region's financial sector, including limited outreach of financial institutions, high transaction costs, and inadequate financial infrastructure (Adom et al., 2020).

One commonly used measure of financial access is financial account ownership. According to the Global Findex database, approximately 40 percent of adults in sub-Saharan Africa hold an account with a formal financial institution compared to a global average of 74 percent (Demirgüç-Kunt et al., 2022). While these figures indicate progress relative to previous decades, they also illustrate the persistent gap between sub-Saharan Africa and other regions in terms of financial sector development. One commonly used measure of financial access is financial account ownership. According to the Global Findex database, approximately 40 percent of adults in sub-Saharan Africa hold an account with a formal financial institution compared to a global average of 74 percent (Demirgüç-Kunt et al., 2022). While these figures indicate progress relative to previous decades, they also illustrate the persistent gap between sub-Saharan Africa and other regions in terms of financial sector development.

Scholars have attributed limited financial access in the region to both supply-side and demand-side constraints. On the supply side, the physical distribution of financial infrastructure remains uneven. Figure 2.6 illustrates that sub-Saharan Africa reports the lowest number of bank branches and automated teller machines (ATMs) per 100,000 adults compared to other regions, reflecting limited institutional presence in rural and low-income areas.

Figure 2.6: Distribution of ATMs and Commercial Bank Branches per 100,000 adults by region (2020)



Note: Figure 2.6 was constructed IMF Financial Access Survey 2020, shows number of ATMs and bank branches per region

However, the literature increasingly suggests that the mere expansion of financial infrastructure does not automatically translate into improved financial inclusion. While traditional financial development models emphasised the expansion of banking infrastructure as a key mechanism for improving access to finance, more recent studies argue that institutional availability alone cannot fully explain patterns of financial service adoption. Instead, the interaction between institutional capacity, regulatory environments, and individual demand factors appears to play a more decisive role in shaping financial inclusion outcomes.

2.5.1 Challenges with banking sector in Sub-Saharan Africa

The structure and performance of banking sectors across sub-Saharan Africa have been widely examined as potential determinants of financial inclusion. Several studies argue that banking systems in the region are characterised by limited competition, inefficient financial intermediation, and a concentration of market power among a small number of dominant institutions (Kablan, 2010; Mlachila et al., 2013). These structural characteristics may reduce incentives for banks to expand services to low-income or geographically remote populations. Kablan (2010) suggests that banks in sub-Saharan Africa exhibit relatively low levels of financial intermediation efficiency, with approximately 76 percent of mobilised deposits converted into loans. While this figure indicates some degree of financial activity, it also

suggests the existence of excess liquidity within banking systems. Instead of expanding credit to underserved populations, banks often allocate substantial portions of their portfolios to government securities, which offer lower risk and higher institutional stability.

However, not all scholars attribute limited financial access solely to supply-side inefficiencies. Some studies highlight the importance of demand-side constraints. Aluko and Ajayi (2018) argue that weak institutional quality and ineffective legal systems may discourage financial institutions from expanding credit provision. Similarly, (Mlachila et al., 2013) emphasise that geographical barriers and limited distribution networks contribute significantly to restricted financial outreach. Empirical evidence also suggests that removing financial barriers alone may not be sufficient to increase financial service usage. Dupas et al. (2014), for example, conducted an experiment in Kenya where bank account opening requirements were waived and free accounts were offered to participants. Although approximately 60 percent of individuals opened accounts, only 18 percent actively used them within a year. Similar patterns were observed in South Africa, where millions of low-cost bank accounts were opened but remained largely inactive. These findings challenge the assumption that financial exclusion is solely the result of institutional barriers. Instead, they suggest that behavioural and contextual factors such as, trust in financial institutions, perceived usefulness of financial services, and income volatility, may significantly influence individuals' decisions to engage with formal banking systems.

Further supporting this view, Simatele and Maciko (2022) identify perceived risk, income instability, and lack of employment as important determinants of financial service adoption. In their study, respondents frequently cited distrust of financial institutions and high transaction costs as key reasons for remaining outside the formal banking system. These findings align with the broader literature on financial behaviour, which suggests that individuals' perceptions of financial institutions and services may be as important as the availability of those services.

Collectively, these studies highlight a fundamental limitation of traditional banking models in addressing financial exclusion in sub-Saharan Africa. While banks remain central actors within financial systems, their institutional structures and operational models may not be well suited to serving low-income populations or geographically dispersed communities.

2.5.2 Banking and Mobile Money

The limitations of traditional banking infrastructure have created opportunities for alternative financial service delivery models, particularly those enabled by digital technologies. Mobile money has emerged as one of the most prominent innovations addressing financial access gaps in sub-Saharan Africa.

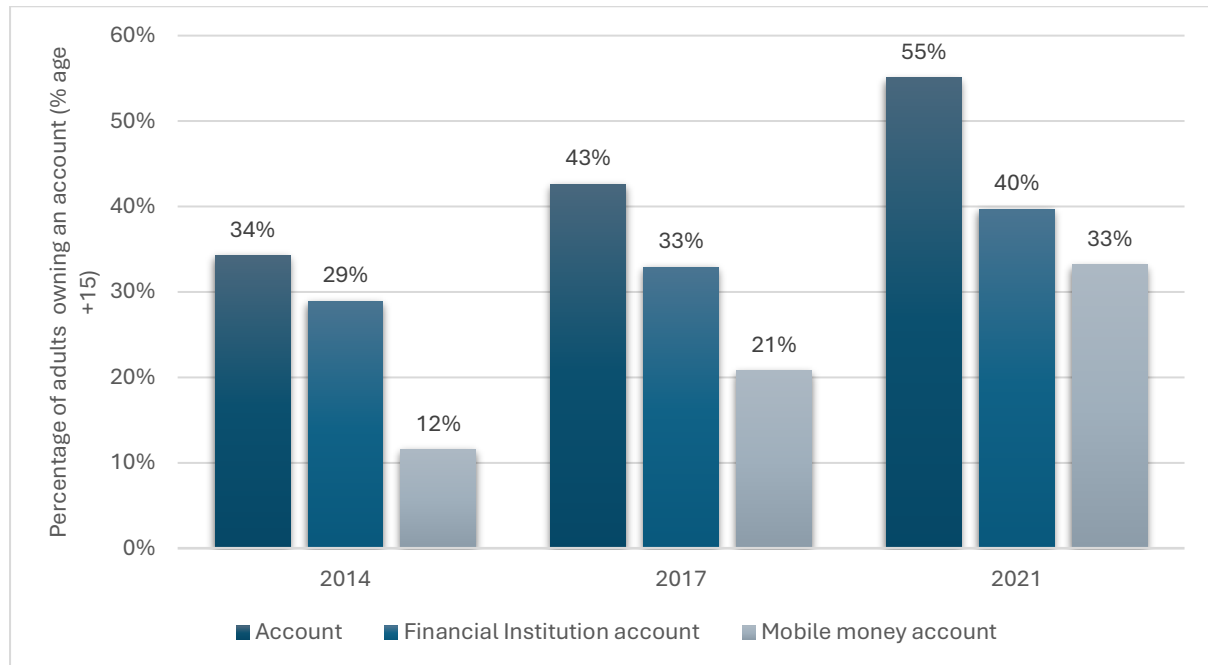
Unlike traditional banking systems, which rely heavily on physical branches and formal financial infrastructure, mobile money platforms leverage existing mobile telecommunications networks and agent systems. This model allows financial services to be delivered through widely accessible mobile devices, significantly reducing the infrastructural costs associated with traditional banking expansion (Mlachila et al., 2013; Houngbonon et al., 2021). The regulatory environment within which mobile money operates has also played a crucial role in shaping its diffusion. Burns (2018) argues that the success of mobile money in countries such as Kenya can be attributed partly to regulatory creating and “enabling. Rather than imposing strict regulatory controls at the early stages of development, regulators adopted a “test-and-learn” approach that allowed innovations such as M-Pesa to evolve while regulatory frameworks were gradually developed.

Comparative studies further highlight the importance of regulatory design in shaping mobile money adoption. Countries that permitted non-bank entities, particularly mobile network operators, to provide mobile money services experienced faster adoption rates than those that restricted mobile money provision to traditional banking institutions (Jason, 2016). This suggests that regulatory openness may foster innovation and competition within digital financial ecosystems. However, the relationship between banking sector development and mobile money adoption is not necessarily straightforward. (Pelletier et al., 2019) observe that stronger legal rights frameworks may reduce the likelihood of mobile money introduction, suggesting that highly regulated financial systems may inadvertently constrain financial innovation.

These findings indicate that mobile money does not simply substitute for traditional banking services but rather emerges in response to structural limitations within existing financial systems. In contexts where banking infrastructure is limited or inefficient, mobile money platforms may provide an alternative mechanism for delivering financial services to previously underserved populations. Evidence from the Global Findex database depicted in Figure 2.7 below illustrates this dynamic. Between 2014 and 2021, mobile money account

ownership in sub-Saharan Africa increased from 21 percent to 33 percent, outpacing the growth of traditional financial institution accounts during the same period (Demirgüç-Kunt et al., 2022).

Figure 2.7: Increase in account ownership between 2014-2021 in sub-Saharan Africa



Note: This figure has been constructed from Global Findex and shows increase in account ownership from 2014-2021 for sub-Saharan Africa

These trends highlight the growing importance of mobile money as a complementary financial service channel rather than a direct replacement for traditional banking institutions (Aracil et al., 2025b). In several countries within the region, mobile money accounts now exceed the number of traditional bank accounts, illustrating how digital financial innovations can reshape financial inclusion landscapes (Demirgüç-Kunt et al., 2022). Nevertheless, the diffusion of mobile money remains uneven across countries and populations. While supply-side factors such as regulatory frameworks and telecommunications infrastructure are clearly important, existing literature suggests that demand-side capabilities, including financial literacy and digital literacy, may also influence individuals' willingness and ability to adopt mobile financial technologies (Kass-Hanna et al., 2021; Soutter et al., 2019).

Understanding how these capabilities interact with technological innovations is therefore essential for explaining patterns of mobile money adoption. The following section introduces the Diffusion of Innovation (DOI) theory as the conceptual framework used to analyse these adoption processes.

2.6 Diffusion of Innovation Theory

2.6.1 Background

The diffusion of innovation theory (DOI) was originally proposed by Rogers (1968) and has been revised and improved over the years (Rogers, 1968; Rogers, 2003; Rogers et al., 2014). It remains one of the most widely used theories to study adoption of innovation and has been applied across various sectors such as health (Sanson-Fisher, 2004; Roughead, 2006), agriculture (Nordin et al., 2017); energy (Reyes-Mercado and Rajagopal, 2017), technology (Woodside et al., 2017; Roberts and Saint, 2015), banking (Mullan et al., 2017; Paltrinieri and Kutan, 2019) among others. DOI's applicability across different fields, different type of innovations, and focus on factors that affect an individual's intention to adopt the innovation renders it ideal for assessing uptake of new products and services (Rogers, 1968; Rogers, 2003).

Rogers (2003) identifies four elements that are critical in the uptake of innovations under DOI; the innovation itself, communication medium, time, and social setting. According to Rogers (2003) an innovation involves a new concept, idea, service, or product. The innovation itself does not necessarily have to be new, but it must be new to the individual adopting it. The key principle is how the innovation is adopted within the social society.

Communicating an innovation can take different forms for example through marketing strategies, word of mouth, incentives or offers for consumers to try out the innovation. Communication in DOI involves prior knowledge or usage of the innovation communicated to someone who does not have prior experience with the innovation (Rogers, 2003). Communicating through mass media can reach a lot more consumers compared to individual word-of-mouth, however individual communication allows a potential user to make decisions based on someone else's prior experience.

Time is an important factor in DOI as it denotes the time it takes for an innovation to be adopted and the rate at which adoption takes place (Scott and McGuire, 2017). Katz et al. (1963) discussed the time it takes to accept the innovation as the most important element in the time factor, this is because longer period may mean users do not understand the innovation, communication channels are not effective, or the social group has not embraced the innovation.

The social setting within which an individual lives or interacts has a big influence on how an innovation is adopted (Dearing and Cox, 2018). Users may feel left out if everyone

around them is using a certain innovation and therefore may adopt the innovation to be part of the group. If there are natural leaders within the group that are using a certain innovation, other members in the group may adopt the innovation. Nyblom et al. (2003) found that it was more likely for a farmer to adopt organic farming if his neighbour was employing organic farming, supporting the idea of social influence in adoption of innovation.

2.6.2 Attributes of the diffusion of innovation process

A central contribution of DOI theory lies in its identification of five innovation attributes that influence the rate of adoption: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). These attributes capture how individuals perceive innovations and evaluate their potential benefits and risks.

Relative advantage refers to the degree to which an innovation is perceived as superior to the existing solution it replaces. Innovations that offer clear advantages in efficiency, convenience, or cost savings are more likely to be adopted rapidly. For example, (Lin, 2011) finds that perceived convenience and efficiency significantly influenced mobile banking adoption in Taiwan. Similarly, studies on mobile financial services suggest that users often adopt digital financial platforms because they provide faster and more convenient alternatives to traditional financial transactions. Compatibility reflects the extent to which an innovation aligns with existing values, experiences, and behavioural patterns of potential users. Innovations that fit well within existing lifestyles or cultural practices are more likely to be adopted. Phonthanakitithaworn et al. (2016), for example, show that mobile payment applications are more likely to be adopted when they integrate seamlessly with consumers' existing purchasing habits.

Complexity refers to the degree to which an innovation is perceived as difficult to understand or use. Innovations that require significant effort to learn or operate tend to experience slower adoption rates. Lin (2011) highlights that users' perceptions of the ease of completing transactions and navigating mobile banking applications significantly influence adoption decisions. In digital financial services, perceived complexity is particularly relevant in contexts where users have limited technological experience. Trialability describes the extent to which potential adopters can experiment with an innovation before committing to its use. Opportunities for experimentation allow users to evaluate an innovation's benefits and reduce uncertainty surrounding its adoption Al-Jabri and Sohail (2012). Trialability can therefore play an important role in encouraging adoption, particularly for innovations that involve financial

risk. Observability refers to the visibility of the innovation's benefits to others within a social system. When individuals observe others benefiting from an innovation, the perceived credibility and usefulness of the innovation increase, thereby accelerating diffusion (Rogers, 2003).

Although these attributes are widely accepted within the literature, empirical studies demonstrate that their relative importance varies across contexts and technologies. Rogers (2003) suggests that innovation attributes may explain between 49 and 87 percent of the variance in adoption rates. However, subsequent research indicates that the significance of individual attributes often depends on contextual and institutional factors.

2.6.3 Diffusion of Innovation across different fields

Empirical applications of DOI across different sectors reveal that the importance of innovation attributes is highly context dependent. For example, (Chung, 2014) finds that compatibility and trialability were not significant predictors of mobile banking adoption in Kazakhstan, largely because the population already possessed high levels of technological familiarity. In contrast, (Dash and Bhusan, 2014) report that trialability and compatibility significantly influenced mobile banking adoption in India, where users preferred to test digital financial services before fully adopting them.

These contrasting findings suggest that innovation adoption is not determined solely by the attributes of the innovation itself but also by the technological maturity and behavioural norms of the population. In technologically advanced environments where digital technologies are already widely used, certain attributes such as trialability may become less important. Conversely, in contexts where users have limited experience with new technologies, opportunities for experimentation may significantly influence adoption decisions.

Similarly, the relevance of innovation attributes may vary depending on the nature of the innovation being studied. Bharadwaj (2021) for instance, finds that complexity, compatibility, and observability significantly influenced cryptocurrency adoption in India. In this context, the perceived technical complexity of cryptocurrencies played a more prominent role than attributes such as relative advantage.

Other studies demonstrate that policy environments and institutional frameworks also shape innovation adoption. Dearing and Cox (2018) argue that government policies, regulatory

incentives, and institutional readiness can influence the rate at which innovations diffuse within societies. For example, policies promoting digital payments or reducing transaction costs may accelerate adoption of digital financial technologies.

These findings highlight an important implication for the application of DOI: while the theory provides a robust framework for analysing innovation adoption, its attributes must be interpreted within the broader socio-economic and institutional context in which the innovation is introduced.

2.6.4 Diffusion of Innovation and Mobile Money

Despite the widespread application of DOI across multiple sectors, relatively few studies have applied the framework specifically to mobile money adoption. Existing studies often focus on individual countries and frequently incorporate only selected attributes of the DOI framework rather than the full set of innovation characteristics. For example, Tobbin and Kuwornu (2011) examine mobile money adoption in Ghana and find that trialability significantly influences adoption decisions. Their findings suggest that individuals are more likely to adopt mobile money when they can test the service without incurring financial costs. In contrast, Osei-Assibey (2015) finds that compatibility and relative advantage were not significant predictors of mobile money adoption among Susu savings users in Ghana. Instead, complexity and trialability played more prominent roles, reflecting users' concerns regarding the usability of mobile money services.

Similarly, David-West et al. (2021) apply the full DOI framework to examine mobile money adoption in Nigeria and report that relative advantage and compatibility were not significant predictors of adoption. The authors attribute these findings to the relatively developed banking sector in Nigeria, where many individuals already possessed bank accounts and therefore did not perceive mobile money as offering substantial additional benefits.

These contrasting findings illustrate how contextual factors such as existing financial infrastructure, regulatory frameworks, and user familiarity with digital technologies influence how individuals perceive innovation attributes. In countries where traditional banking services are widely available, mobile money may not offer sufficient relative advantage to encourage adoption. Conversely, in contexts where banking services are limited, the perceived benefits of mobile money may be more pronounced.

2.6.5 DOI attributes in relation to mobile money

Relative Advantage

Relative advantage refers to perceptions of usefulness of the innovation, how it improves or impacts the user's life (Rogers, 2003). Mobile money allows users to send money, receive money, make payments, get small quick loans in some cases (Ozili, 2018). One of the advantages of mobile money has been allowing local remittances to be conducted securely and efficiently, eliminating the need to give to couriers of family member who had to travel long distances (Mugambi et al., 2014; Lashitew et al., 2019). A good example, is the M-Shwari¹⁵ which has allowed previously unbanked Kenyans to access banking services such as savings, loans, interest allowing a user to transact through M-Pesa but have the comfort of having a bank account (Cook and McKay, 2015; Bundi and Patrick, 2016). Cook and McKay (2015) report that M-Shwari had issued 20.6 million loans amounting to USD \$277.2 million between 2012 to 2014. Due the success of M-Shwari other banks within Kenya started offering a similar product, in addition other jurisdictions such as Tanzania, Uganda, Rwanda and Cote d'Ivoire have introduced similar products (Suri, 2017). Other mobile money platforms allow one to send money or airtime credit to someone who does not have a mobile money account (Cobla and Osei-Assibey, 2018).

Compatibility

Compatibility denotes the extent to which the innovation is consistent with user beliefs and norms. For example, Economides and Jeziorski (2017) find that merchants in Tanzania were willing to pay 1.25% of amount in transaction costs to avoid walking an extra kilometre with cash, similarly they were willing to pay 0.8% of the amount in transaction cost to avoid storing cash at home overnight, allowing them to secure it through mobile money account. Mobile money fits into the life style of merchants providing risk free saving platform, in addition proximity of agents allows for users to travel short distances to transact (Narteh et al., 2017; Batista and Vicente, 2020). Further, villagers who depend on those working in the cities to send them money have agents nearby and collecting remittances is convenient and can be done at any time while the funds are secure in the mobile money account (Alhassan et al., 2021; Asongu and Odhiambo, 2022a).

¹⁵ M-Shwari is a bank account offered in collaboration by Saficom (M-Pesa providers) and Commercial Bank of Africa(CBA) that provides savings and loans for poor people

Complexity

Complexity is the degree to which the use of innovation does not require effort (Rogers, 2003). Mobile money is a product designed for poor people who have not interacted with the financial system before and therefore the systems employed should be easy for them to use and understand (Kalba, 2016). The fact that mobile money is built around simple messaging system (SMS) renders it easy to use, the users does not need to relearn how to use the phone (Asongu and Odhiambo, 2022a). In addition, the requirements for opening a mobile money account require a simple identification, in some countries and therefore the opening procedures are not complicated (Mugambi et al., 2014; Kanobe et al., 2017). For example, in Ghana, all one requires to register for mobile money is a registered sim card for the MNO providing mobile money services (Cobla and Osei-Assibey, 2018).

Observability

Observability examines the degree to which innovations are visible in organisations (Rogers, 2003). Narteh et al. (2017) suggest that a potential user may be influenced to adopt mobile money by observing family and friends using the application, in addition consulting family in decision making would positively influence the decision if more family members use mobile money. Mugambi et al. (2014) suggests that one of the reasons some jurisdictions such as Kenya, Tanzania and Uganda have more mobile money accounts than bank accounts is because users adopt mobile money after they have observed the benefits through their social circle.

Another area where visibility of mobile money has been pronounced is through availability of agent outlets. Asia and Trends (2019) report that there were 9.1 million registered mobile money agents worldwide, providing visibility for mobile money. GSMA reports that in 80 percent of the jurisdictions where mobile money is prominent, the number of agents is more that the number of commercial bank branches (Caputo, 2019). In addition, about 53 percent of those markets host ten times more agents than bank branches.

Trialability

The degree to which one can experiment on a limited basis before making adoption or rejection. A three-year study conducted by Batista and Vicente (2020) in to investigate the impact of introducing mobile money for the first time in Mozambique found that 8 percent of those who tried with using mobile money in the first year, did not use the application again, in

contrast to the 36 percent of users who started using the application in the first year and continued with it through the three year trial.

Trialability can form an important part in decision making depending on the ease of use, security, or how an innovation meets the needs of the users. In relation to mobile money the findings have been different depending on the jurisdiction. In Bangladesh, Mahfuz et al. (2015) found trialability had no significant impact on mobile money; similarly in Indonesia, Indra and Husnita (2022) find trialability had no significant impact on adoption of mobile money. However, Tobbin and Kuwornu (2011) find trialability to be significant in Ghana when considering adoption of mobile money.

While the Diffusion of Innovation (DOI) theory provides a useful framework for understanding how individuals perceive and adopt innovations, it is not the only theoretical approach used to study technology adoption. Several alternative models have been developed within the information systems literature to explain user acceptance of new technologies. Among the most prominent are the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), both of which have been widely applied in studies examining the adoption of digital technologies.

However, these models differ in their conceptual focus and explanatory scope. Whereas TAM and UTAUT primarily examine individual behavioural intentions toward technology use, DOI places greater emphasis on the characteristics of the innovation itself and the broader social and institutional contexts in which adoption occurs. Given that mobile money represents not only a technological platform but also a financial innovation embedded within specific social and economic environments, it is important to evaluate how DOI compares with these alternative frameworks. The following section therefore examines the key features of TAM and UTAUT and assesses their suitability for analysing mobile money adoption relative to the DOI framework.

2.7 Comparison of DOI with other Models

2.7.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), originally proposed by Davis (1989) is one of the most widely used frameworks for examining technology adoption. The model builds on earlier behavioural theories such as the Theory of Reasoned Action (TRA) and proposes that two key factors, perceived usefulness and perceived ease of use, determine individuals' intentions to adopt new technologies. Perceived usefulness refers to the degree to which an

individual believes that a technology will enhance performance or improve efficiency, while perceived ease of use reflects the extent to which the technology is perceived as requiring minimal effort to operate (Marangunić and Granić, 2015). These constructs have been widely applied across studies examining the adoption of digital technologies including online banking, e-commerce platforms, and information systems.

Despite its widespread use, TAM has been criticised for its relatively narrow focus. Shachak et al. (2019) argue that the model simplifies technology adoption by concentrating primarily on cognitive perceptions while overlooking broader contextual factors such as institutional structures, social networks, and cultural influences. In addition, TAM was originally developed to explain technology acceptance in organisational environments, where system use is often linked to job performance rather than voluntary adoption decisions.

These limitations may reduce the explanatory power of TAM when applied to financial technologies such as mobile money. In developing contexts, technology adoption is often shaped by factors beyond perceived usefulness or ease of use, including trust, financial capability, regulatory environments, and social influence. Consequently, while TAM provides insights into individual perceptions of technology, it may offer a limited explanation for innovation adoption within broader socio-economic systems.

Furthermore, several constructs within TAM overlap conceptually with DOI attributes. For example, perceived usefulness closely resembles the concept of relative advantage within DOI, while perceived ease of use corresponds to the attribute of complexity. However, DOI extends beyond these constructs by incorporating additional dimensions such as trialability and observability, which capture the role of experimentation and social learning in diffusion of innovation.

2.7.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

Recognising the limitations of earlier technology acceptance models, Venkatesh et al. (2003) developed the Unified Theory of Acceptance and Use of Technology (UTAUT), which integrates elements from several previous adoption theories including TAM, TRA, and the Theory of Planned Behaviour. UTAUT proposes four key determinants of technology adoption: performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy refers to the perceived benefits of using a technology, while effort expectancy relates to the perceived ease associated with using the system. Social influence reflects the extent to which individuals perceive that important others believe they

should use a particular technology, and facilitating conditions refer to the availability of resources and infrastructure required to support technology use (Venkatesh et al., 2003). Performance expectancy refers to the perceived benefits of using a technology, while effort expectancy relates to the perceived ease associated with using the system. Social influence reflects the extent to which individuals perceive that important others believe they should use a particular technology, and facilitating conditions refer to the availability of resources and infrastructure required to support technology use (Venkatesh et al., 2003).

UTAUT has been widely applied in studies examining the adoption of emerging technologies, including blockchain systems (Liang et al., 2021) and wearable technologies (Talukder et al., 2019). The model's inclusion of social influence and facilitating conditions represents an advancement over TAM by recognising the importance of external factors in shaping technology adoption. However, scholars have also identified limitations in applying UTAUT to financial technologies in developing contexts. One criticism is that the model remains strongly oriented toward organisational and workplace settings, where technological adoption may be influenced by institutional mandates rather than individual choice (Penney et al., 2021). In contrast, mobile money adoption typically occurs in voluntary consumer environments where individuals independently decide whether to adopt or reject financial technologies.

Additionally, UTAUT focuses primarily on behavioural intention rather than the characteristics of the innovation itself. As a result, the model may overlook how individuals evaluate the attributes of new technologies, such as perceived risk, compatibility with existing financial practices, or opportunities to experiment with the technology before adoption. While UTAUT incorporates social influence as a determinant of technology use, it does not explicitly account for the visibility and diffusion of innovations within communities. These processes are particularly relevant in developing regions where social networks often play a crucial role in shaping technology adoption decisions.

2.7.3 Suitability of DOI for Mobile Money Adoption

Comparing these theoretical frameworks highlights important conceptual differences that influence their suitability for analysing mobile money adoption. Both TAM and UTAUT focus primarily on users' behavioural intentions toward technology use, emphasising cognitive perceptions such as usefulness, ease of use, and performance expectations. While these constructs are relevant for understanding technology acceptance, they provide limited

insight into how financial innovations spread within social systems. In contrast, DOI offers a broader analytical framework that captures the interaction between innovation characteristics, communication channels, and social environments. This broader perspective is particularly important when analysing mobile money adoption in developing regions, where social learning, institutional structures, and infrastructural constraints significantly influence adoption decisions.

Another advantage of DOI lies in its focus on innovation attributes. By examining characteristics such as relative advantage, compatibility, complexity, trialability, and observability, DOI provides a structured approach for analysing how individuals evaluate new financial technologies. These attributes are particularly relevant in the context of mobile money, where adoption decisions often depend on perceived convenience, trust, usability, and the visibility of successful use among peers. Furthermore, DOI allows for the integration of additional contextual factors influencing adoption. In the context of this study, financial literacy and digital literacy may shape how individuals perceive innovation attributes such as complexity or relative advantage. Integrating these capability dimensions within the DOI framework therefore provides a more comprehensive understanding of the demand-side factors influencing mobile money adoption.

Taken together, these considerations suggest that while TAM and UTAUT offer valuable insights into technology acceptance, the Diffusion of Innovation framework provides a more suitable theoretical foundation for analysing the adoption of mobile money in sub-Saharan Africa.

2.8 Conclusion

This chapter reviewed the literature on financial literacy, digital literacy, access to financial services, and mobile money adoption, with a particular focus on sub-Saharan Africa. It further examined the Diffusion of Innovation (DOI) theory and compared it with alternative technology adoption models to establish a suitable theoretical foundation for the study. Collectively, the literature demonstrates that while mobile money has significantly expanded access to financial services in sub-Saharan Africa, its adoption and effective use remain uneven and constrained by both demand- and supply-side factors.

The chapter highlights that financial literacy plays a critical role in shaping individuals' financial behaviours and influencing financial decision (Lusardi, 2019). However, evidence

also shows that financial knowledge alone does not necessarily translate into sound financial behaviour or effective use of financial products. This limitation is particularly pronounced among low-income and previously unbanked populations, where individuals may possess basic financial knowledge yet lack the capability or confidence to apply it in practice (Andreou and Anyfantaki, 2021; Muñoz-Céspedes et al., 2021). Despite widespread acknowledgement of the importance of financial literacy, much of the existing literature focuses on general financial inclusion outcomes (Nanziri and Leibbrandt, 2018), with comparatively limited attention paid to how financial literacy specifically affects the adoption and sustained use of mobile money services.

Similarly, the literature on digital literacy underscores its growing importance in the context of digital financial services and the expansion of fintech innovations (Triki and Faye, 2013; Kass-Hanna et al., 2021). While global and regional initiatives have sought to promote digital skills, sub-Saharan Africa continues to face persistent challenges related to infrastructure deficits, high internet costs, limited access to electricity, and uneven integration of digital literacy into education systems (Adarkwah, 2021; Darley, 2001). The review reveals that digital literacy is often treated broadly, with few studies explicitly examining its role in enabling individuals to navigate mobile money platforms, understand transaction processes, or manage digital risks such as fraud and identity theft (Kass-Hanna et al., 2021; Kiconco et al., 2019). Where digital literacy has been studied in relation to mobile money, the evidence remains sparse, fragmented, and largely context specific.

The chapter also demonstrated that access to financial services in sub-Saharan Africa remains constrained particularly through traditional banking channels. Structural weaknesses in the banking sector, high transaction costs, limited physical outreach, and lack of trust have contributed to persistent financial exclusion (Adom et al., 2020; Beck and Cull, 2023). Mobile money has emerged as a transformative innovation capable of addressing some of these barriers by leveraging existing mobile phone infrastructure and agent networks (Demirgüç-Kunt et al., 2022; Burns, 2018). However, the literature suggests that the mere availability of mobile money services does not guarantee adoption or meaningful usage, reinforcing the importance of individual-level capabilities such as financial and digital literacy.

In examining the Diffusion of Innovation (DOI) theory, the chapter established DOI as a robust and flexible framework for analysing the adoption of mobile money. The theory's emphasis on innovation attributes—*relative advantage*, *compatibility*, *complexity*, *trialability*,

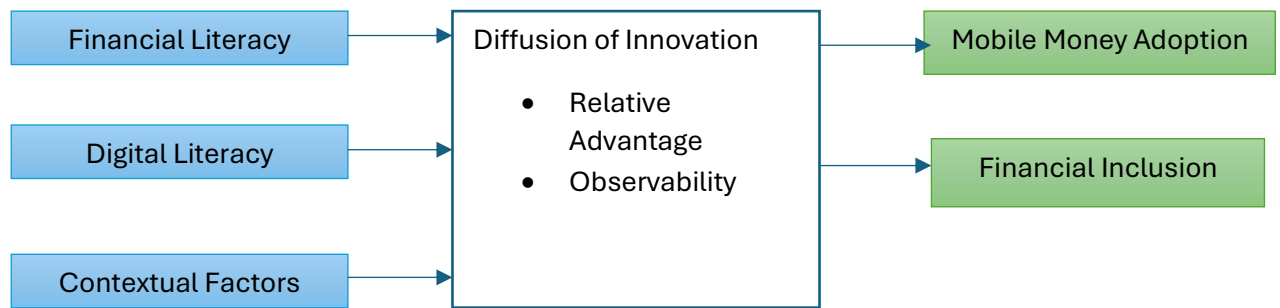
and observability—provides valuable insights into how individuals perceive and adopt financial innovations (Rogers et al., 2014; Rogers, 1968). However, the review also revealed notable gaps in the existing DOI-based mobile money literature. Many studies apply DOI selectively, omitting certain attributes, or focus primarily on country-level analyses without adequately capturing individual-level capabilities and constraints (Tobbin and Kuwornu, 2011; Osei-Assibey, 2015). Moreover, financial and digital literacy are rarely integrated explicitly into DOI frameworks, despite their clear relevance to perceptions of complexity, compatibility, and trialability in mobile money adoption.

Comparisons with alternative models such as TAM and UTAUT further reinforced the suitability of DOI for this study. While TAM and UTAUT have been widely used in technology adoption research, their emphasis on organisational settings, technological acceptance, and limited consideration of cost, risk, and trialability constrains their applicability in low-income, individual-choice contexts such as mobile money adoption in sub-Saharan Africa (Penney et al., 2021). DOI's broader focus on innovation characteristics and social context makes it better suited to capturing the realities faced by financially and digitally constrained populations.

Overall, this review identifies a clear research gap at the intersection of financial literacy, digital literacy, and mobile money adoption in sub-Saharan Africa. Existing studies tend to examine these constructs in isolation, rely heavily on quantitative approaches, or focus on general financial inclusion outcomes rather than adoption processes. There remains limited empirical evidence on how financial and digital literacy jointly shape individuals' perceptions of mobile money attributes and influence adoption decisions within the DOI framework.

Addressing this gap, the present study seeks to examine the role of financial and digital literacy in mobile money adoption in sub-Saharan Africa, using the Diffusion of Innovation theory as the guiding analytical framework. By integrating literacy dimensions into DOI, this research aims to provide a more nuanced understanding of the demand-side factors influencing mobile money uptake and to contribute evidence that can inform policy interventions, financial education strategies, and inclusive digital finance initiatives. Figure 2.8 below illustrates the conceptual framework guiding this research and highlights the relationship between financial and digital literacy, contextual factors, innovation attributes and mobile money adoption. The next chapter outlines the research methodology employed to achieve these objectives.

Figure 2.8: Conceptual Framework for Mobile Money Adoption



3.0 Research Methodology

3.1 Research Philosophy and Design

This section reflects on the dominant research paradigm employed in this thesis. The aim of this research is to investigate the factors that impact mobile money adoption in sub-Saharan Africa and leverages on Rogers (2003) Diffusion of Innovation (DOI) Theory. The research extends the DOI theory to include digital literacy, financial literacy and access to financial services as factors that influence the adoption of mobile money (Kass-Hanna et al., 2021; Domeher et al., 2014; Burns, 2018). Mobile money that originated in Kenya in 2007 and has been adopted by almost every country in the sub-region (Jack and Suri, 2011; Demirgüç-Kunt et al., 2022). Therefore we discuss the research philosophy applied in this study in terms of ontological, epistemological, and methodologies applied in areas of mobile money research, and conclude with the criticisms associated with the positivists approach.

This research uses a mixed methods approach to investigate the factors that impact mobile money adoption. Chapter 4 and 5 are empirical chapters based on statistical analysis, while chapter 6 is a qualitative chapter using thematic analysis to identify themes in mobile money regulations. The reason is to expand the scope of the research through exploring mobile money adoption from a qualitative perspective, qualitative research can highlight findings that would not be identified through quantitative methods (Su, 2018). Further, qualitative research provides a platform to extend the thesis by reviewing the regulatory environment which is difficult to quantify (Su, 2018).

3.1.1 Ontology

Antwi and Hamza (2015) refer to ontology as what can be known or assumed about reality, shaping the research direction. Different fields have different dominant paradigms, for example Burrell and Morgan (1979) offer four philosophical paradigms in organisational analysis: *radical structuralism*, *radical humanism*, *functionalism* and *interpretivism*. On the other hand Saunders et al. (2023) discuss five dominant philosophical paradigms in management and business: *positivism*, *critical realism*, *interpretivism*, *postmodernism* and *pragmatism*. This indicates how different research areas have different dominant philosophical paradigms. This allows researchers to identify which paradigm is dominant in their research field, apply similar philosophical thinking to their hypotheses, and direct their research.

Within the same field exist different philosophical paradigms as stated by Saunders et al. (2023). Most of the research on fintech adoption has followed a positivist approach, assuming that knowledge is quantifiable. For example, Kass-Hanna et al. (2021) investigate how financial behaviour such as saving can be enhanced by digital and financial literacy across seven Asian and African countries. Their underlying assumption is that digital literacy and financial literacy impact financial choices. Our research uses similar assumptions and examines how digital literacy and financial literacy impact fintech usage in 18 sub-Saharan African countries. Our underlying research questions and hypotheses in chapters 4 and 5 suggest that digital literacy and financial literacy are significant in mobile money usage. Further, we quantify our findings by assessing to what extent digital literacy and financial literacy impact mobile money usage.

Other studies such as Nyimbiri (2021) conduct research across 14 sub-Saharan African countries and assume a functional relationship exists between financial inclusion and fintech adoption. Their underlying assumption is that fintech adoption has an impact on financial inclusion. In a different example, Fungáčová and Weill (2015) premise their research on the assumption that demographic considerations such as gender, age and income are positively associated with financial inclusion. The researchers' hypothesis in both studies is based on a positive assumption of what influences financial inclusion. Similarly, chapter 5 of this thesis investigates the impact of demographic variables of financial inclusion. We assume demographic variables have an impact on mobile money adoption. For example, previous studies have found education and income to be positively related to fintech adoption (Nyoka, 2019; Akinyemi et al., 2020). Our research assumes education and income have a positive impact on mobile money adoption.

Batista and Vicente (2020) proposed an experimental approach to the positivist ontology by conducting a randomised control trial in rural Mozambique to test the adoption of mobile money by early adopters, experimental adopters and late adopters. They observe mobile money usage over three years and generate primary data from their experiment. In a different study, Soutter et al. (2019) investigate the adoption of mobile payments in three sub-Saharan African countries through case studies and compiling evidence from interviews to find meaning. This followed an interpretivist paradigm, which aimed to understand how mobile payments are adopted through the experiences of experts by conducting in-depth interviews. While exceptions in research approach such as Batista and Vicente (2020) and Soutter et al. (2019) exist within the field, they are few and the majority of studies use empirical methods to

test the hypothesis and establish a relationship between variables (Demir et al., 2022; Asuming et al., 2019; Sha'ban et al., 2020).

Chapter 6 of this study applies a qualitative research methodology by exploring different themes in regulations governing mobile money in six sub-Saharan African countries. While traditionally qualitative research is used to explore and examine new relationships (Kaczynski et al., 2014), our research uses a positivist approach by assuming already set themes exist in regulations and we aim to test the extent to which the themes are prominent in regulations by quantifying the extent to which the themes are present in the regulations. Ontologically, we assume the existence of the themes in regulations and assume they can be summarised to provide meaning to the regulations (Su, 2018). We therefore assume the presence of the themes in regulations has a positive impact on mobile money adoption (Burns, 2018).

3.1.2 Epistemology

Epistemology discusses the researchers' view of knowledge and how that knowledge is communicated with others (Antwi and Hamza, 2015). Previous studies that have focused on adoption of fintech have used secondary data to investigate relationships between the variable of interest and other independent variables. For positivists, epistemology involves testing relationships between data and explaining the relationships they have found using set or established theories and laws (Antwi and Hamza, 2015). Further, Saunders (2023) further explains that a positivist epistemology emphasises research that is observable and measurable. For example, Demir et al. (2022) combine data from World Bank, IMF and Global Findex Database to test the relationship between inequality, fintech and financial inclusion. Their hypothesis seeks to establish that fintech usage decreases inequality and increases financial inclusion. In line with their assumptions, they find that an increase in fintech uptake can result in reduction of inequality by 18%-23%, and therefore indirectly increasing financial inclusion. Chapter 4 of this research combines data from World Bank, IMF and International Telecommunication Union (ITU) to create a single dataset to quantify the relationship between mobile money adoption and digital literacy, financial inclusion and access to finance. The dataset allows us to test hypotheses stating that mobile money adoption increases as digital literacy and financial inclusion increase and as financial access decreases.

Similarly, Nyimbiri (2021) propose a positive relationship between financial inclusion and fintech and sets about using empirical evidence to prove there is a positive relation between

the two variables. They find that an increase in 1 unit of mobile money agents, results in 54.7 increase in adults using financial service. Our research uses Rogers' Diffusion of Innovation Theory (1968) which states that 47-89% of the variance in the adoption process can be explained using five innovation attributes; *relative advantage*, *complexity*, *compatibility*, *observability* and *trialability*. Our findings in chapter 4 reveal that 27-71% increase in mobile adoption in sub-Saharan Africa can be attributed to attributes such as value of transactions which represents *relative advantage*. Similarly, we present quantifiable results in chapter 5 where we explore the relationship between mobile money usage and demographic variables. For example, our results reveal that a 1% increase in digital literacy would result in a 0.49% increase in use of mobile money to pay bills.

From the positivist qualitative perspective, the epistemologically this thesis searches for existence of themes in regulations using thematic analysis and summarises and determines patterns from the findings (Su, 2018). In chapter 6 we use content analysis to classify textual data in regulations using pre-existing codes compiled from literature to identify prominent themes in regulations (Salmona et al., 2015). The review reveals how often a theme is discussed in the document indicating the importance of the theme (Bowen, 2009).

3.1.3 Methodologies

Most studies conducted in the field of mobile money adoption have used secondary data compiled from existing sources such as IMF and World Bank, positivists embrace that knowledge is objective, therefore by compiling secondary data they separate any bias they may have during data collection. In addition, using existing methods and drawing on empirical results means their conclusions are not subjective but based on evidence. Our own research uses secondary compiled from pre-existing datasets to test our proposed hypotheses. For the first dataset, we compile data from World Bank- World Development indicators; IMF – Financial Access Survey and International Telecommunication Union – ICT indicators to test the relationship between fintech adoption and financial access, digital literacy, and financial inclusion. Previous studies have used similar datasets to test their hypotheses relating to financial inclusion and fintech (Demir et al., 2022; Kass-Hanna et al., 2021; Jajah et al., 2022). Our second dataset is extracted from World Bank Global Findex database to test the relationship between financial inclusion, and financial and digital literacy. Previous studies have used the Global Findex database to investigate factors that impact financial inclusion (Allen et al., 2016; Kass-Hanna et al., 2021; Demirgüç-Kunt and Klapper, 2012).

Within the research area of fintech adoption in sub-Saharan Africa, most of the research has been conducted at a country level. For example, a lot of research has focused on Kenya as the pioneers of mobile money (Mbiti and Weil, 2015; Jack et al., 2013; Warsame and Ileri, 2022; Kusimba, 2015). Other studies have focused on comparing Kenya with other countries such as Uganda or Tanzania when analysing different aspects of mobile money (Paelo and Roberts, 2022; Suárez, 2016; Jason, 2016; Fanta and Kingstone, 2021). Further, other research has departed from the focus on Kenya and concentrated on in-country factors that have impacted mobile money adoption or financial inclusion, for example Eswatini (Myeni et al., 2020); Ghana (Cobla and Osei-Assibey, 2018; Senyo et al., 2021; Narteh et al., 2017); Uganda (Munyegera and Matsumoto, 2016; Kiconco et al., 2019; Bongomin and Ntayi, 2020b). There is limited research that has examined factors that affect fintech, specifically mobile money adoption and usage on a cross-country spectrum (Akinyemi et al., 2020; Reynolds et al., 2023). Our research investigates the factors that impact mobile money adoption and usage on a broader sub-region focus. The aim is to look at a holistic picture of mobile money across the sub-continent and to find results that can be generalised and applied to other jurisdictions not in the sample for our study.

Within all the studies conducted the main method used has been empirical methodologies. Most studies have used different types of regression analysis such as quantile regressions (Demir et al., 2022); probit regressions (Kass-Hanna et al., 2021); logit regressions (Domeher et al., 2014) and linear regressions (Allen et al., 2014) to test their proposed models. Similarly, our study uses empirical analysis and more specifically, linear regression to test our hypotheses which has been employed in chapter 4 and chapter 5.

There are different methods that can be used in positive qualitative research to collect data such as case studies, interviews, observation and documents. These methods have been used in different mobile money research across different countries (Lashitew et al., 2019; Yu and Ibtasam, 2018; Mogaji and Nguyen, 2022; Otieno et al., 2016). Chapter 6 of this thesis uses mobile money regulations as a source of data to conduct thematic analysis with the purpose of examining how regulations impact mobile money adoption. Prior studies identify six key theme that constitute good mobile money regulations: *customer due diligence* (Suri, 2017; Aron, 2017); *trust account* (Suri, 2017; Di Castri, 2018); *interoperability* (Burns, 2018; Suri, 2017); *agent management* (Madise, 2019; Bahia et al., 2020); *transaction limits* (Suri, 2017; Madise, 2019); *consumer protection* (Aron, 2017; Martin, 2019). The regulations are

coded in *NVivo*, and themes are analysed to determine prominence and similarity between documents.

3.1.4 Criticism of Positivism

There exist different dimensions of criticism of the positivist approach. One interesting view was presented by Ryan (2015) who argues that positivism is more of a culture than a paradigm. This is because most of the findings in positivist research are generalisations or implications rather than absolute truth. Ryan (2015) states that people who are trained a certain way will share common beliefs and practices as people living in a community, however over time some cultural elements are retained while others have changed or evolved. Ryan (2015) argues that positivism has evolved as a culture over time, particularly how the paradigm is viewed in different areas of study. For example, legal positivism posits that “the validity of the law is based on ‘legal procedures’ rather than criteria that conform to the ‘natural law’” (Ryan, 2015 p 418). On the other hand, positivism in theology can mean “the assertion of divine revelation as the given reality” (Ryan, 2015 p 418). Both areas, while embracing the positivists paradigm view knowledge and reality differently.

Schinckus (2015) views of the positivist approach to researcher focus within the field of finance. He argues that while the assumptions in finance research are rooted in positivism, the methodologies do not follow a positivist approach. He argues that positivists “believe that scientific knowledge should be empirically founded and logically true” (Schinckus, 2015, p 104). Hypotheses developed in finance are often based on a theory or assumption that the researcher wants to test. The researcher assumes the hypotheses is true and proceeds to test it. Schinckus (2015) argues that the truth or falsehood of hypotheses is only determined after an experiment and are not based on any truth or law and therefore do not conform to positivist way of thinking. They argue that positivism is founded on theoretical laws that must be supported by empirical evidence. Therefore, accepting theories to be true before testing them empirically is not in line with the core logical positivist approach.

In conclusion, despite criticisms and different research methods applied in finance, positivism remains the dominant paradigm in the field. Other research has followed a more interpretivism approach to research through the use of randomised control trials and case study analysis (Batista and Vicente, 2020; Soutter et al., 2019), most research in the field follows empirical analysis through quantitative research methods to determine the relationships

between variables (Demir et al., 2022; Kass-Hanna et al., 2021; Sha'ban et al., 2020; Allen et al., 2014).

3.2 Data description and collection methods

This section describes the data used in this thesis. The aim is to investigate the relationship between adoption of mobile money in sub-Saharan Africa by using the DOI theory and extending it to include other factors such as digital and financial literacy (Kass-Hanna et al., 2021), access to financial services (Asongu, 2018b) and financial inclusion (Jajah et al., 2022).

This study comprises two data sets. The first data set has been compiled from IMF Financial Access Survey Data¹⁶; World Bank World Development Index¹⁷ and International Telecommunications Union (ITU)¹⁸ digital indicators data (IMF, World Bank and ITU Dataset). The data spans a period of eleven (12) years from 2010 to 2021. This dataset is used in the statistical analysis in chapter 4. The second set of data is compiled microdata from the World Bank Global Findex Database¹⁹ survey for 2014, 2017 and 2021 (Global Findex Dataset). Despite, World Bank Global Findex data being available from 2011, the study leaves out the 2011 dataset because the dependent in the data, mobile money account was first compiled from the 2014 survey. The second dataset forms the base for statistical analysis in chapter 5.

3.2.1 Data Compilation process

Data was initially collected and compiled for 47 countries in sub-Saharan Africa for this study. Out of the 47 countries, 29 countries were selected across both datasets, removing countries that were missing more than half the data for the specified period. The final 29 countries are listed in the Table 2.1 below. The countries were compared across the two data sets and finally narrowing the selection to 18 countries. These countries were found in both datasets and for Global Findex dataset, the country should have reported at least two of the

¹⁶ IMF Financial Access Survey was launched in 2009 with aim of providing supply side data for financial inclusion to allow cross-country comparison

¹⁷ World Development Index is collected by World Bank and measure access to different developmental indicators world-wide

¹⁸ ITU is the UN specialised agency on ICTs and provides data for the global ICT usage around the world

¹⁹ Global Findex Database measures people's use of financial services over time, the data consists of surveys for 2011, 2014, 2017

three years. The final datasets comprise data from 18 countries and are abbreviated by alpha-3 code²⁰ as listed in Table 3.1 below.

Table 3.1: Summary of data compilation for countries in data sample

	Country	Code	IMF WB ITU Dataset	Global Findex Dataset	Final Countries in Datasets
1	Benin	BEN		x	
2	Botswana	BWA	x	x	x
3	Cameroon	CMR	x	x	x
4	Central African Republic	CAF		x	
5	Chad	CHD	x		
6	Democratic Republic of Congo	DRC		x	
7	Gabon	GAB		x	
8	Ghana	GHA	x	x	x
9	Guinea	GIN	x	x	x
10	Kenya	KEN	x	x	x
11	Madagascar	MDG	x	x	x
12	Malawi	MWI	x	x	x
13	Mali	MLI		x	
14	Mauritania	MRT		x	
15	Mauritius	MUS	x	x	x
16	Mozambique	MOZ	x	x	x
17	Namibia	NAM	x	x	x
18	Niger	NER		x	
19	Nigeria	NGA	x	x	x
20	Republic of Congo	COG	x	x	x
21	Rwanda	RWA	x	x	x
22	South Africa	ZAR	x	x	x
23	Senegal	SEN		x	
24	Sierra Leone	SLE		x	
25	Tanzania	TNZ	x	x	x
26	Togo	TOG		x	
27	Uganda	UGN	x	x	x
28	Zambia	ZMB	x	x	x
29	Zimbabwe	ZWB	x	x	x

Note: Table 3.1 above depicts the selection of countries in the data set based on data availability and completeness

3.3 IMF, World Bank ITU Dataset

According to the World Bank Global Findex Survey (2021), mobile money accounts grew from 12% to 33% between 2014 and 2021 in sub-Saharan Africa (Demirguc-Kunt et al., 2022), reflecting a growth rate of 17% in mobile money accounts, and accounting for the highest proportion of mobile money accounts worldwide. Comparatively, financial institution accounts in the sub-continent grew from 29% to 40% during the same period, representing a growth rate of 11% (Demirguc-Kunt et al., 2022). From the IMF Financial Access survey data

²⁰ Alpha-3 code is a short code used to uniquely identify a country and is used by IMF, World Bank and ITU.

(2021) thirteen countries in our sample had more mobile money accounts than bank accounts (IMF, 2022).²¹ The data suggests higher growth in mobile money accounts, compared to financial institution accounts, across the sub-continent.

To examine the determinants of mobile money adoption we compile a cross-country data set for the period from 2010 to 2021 for eighteen sub-Saharan African countries, using data from the IMF Financial Access Survey (IMF), World Bank Development Indicators (WB) and International Telecommunications Union (ITU) Information Technology Indicators. Prior to analysing data, the data was standardised using the normal distribution. Table 3.2 summarises the data definitions, data sources and related studies.

3.3.1 Variable selection

Dependent Variable

This study investigates the adoption of mobile money by looking at the demand and supply side of mobile money. Previous studies have used number of bank accounts as a proxy for measuring adoption of financial services (Jajah et al., 2022; Chikalipah, 2017; Demir et al., 2022; Demircuc-Kunt et al., 2022). This study adopts the same reasoning and represents mobile money adoption on the demand side by *registered mobile money accounts*.²² The supply side of mobile money is represented by *registered mobile money agents*²³. Alternate variables of active mobile money accounts and active mobile money agents were considered; however, some countries did not report active users and different jurisdictions measure active usage differently (Di Castri and Gidvani, 2014). Therefore, for standard measurements and consistency register mobile money accounts and registered mobile money agents are used.

Explanatory Variables

Digital literacy is proxied by *active mobile broadband subscriptions*. Africa Development Bank (ADB) suggests low digital literacy is an important factor in accessing digital financial services (Triki and Faye, 2013). Active mobile broadband subscription was

²¹ South Africa and Mauritius reported more banks accounts than mobile money accounts. Data for Tanzania, Cameroon and Mozambique had not been posted at the time the data was extracted.

²² A registered mobile money account is an account registered with a resident mobile money service provider that is primarily accessed using a mobile phone and can be used for basic financial transactions, including peer-to-peer transfers, bill payments, merchant payments and international remittances (wherever allowed) (IMF, 2019 p.6)

²³ A registered mobile money agent outlet can be a person, quasi-corporation, corporation or a machine that facilitates mobile money account registration, cash-in cash-out transactions, and customer support. Small retail shops and other retailers typically serve as agents in low-income and emerging economies (IMF, 2019 p.6).

used in a study by Kass-Hanna et al. (2021) to represent use of digital services. Further, in 2022 GSMA reported 64 percent smart phone adoption in sub-Saharan Africa and 23 percent mobile internet subscribers at the end of 2021 (GSMA, 2022). One of the few studies that have focused on digital literacy and the adoption of mobile money was conducted by Kass-Hanna et al. (2021) who posit that for active participation in the digital economy, one requires knowledge and skills to operate digital gadgets such as phones and tablets. Basic digital skills are needed to operate a mobile money account.

Financial Services availability is proxied by the *number of financial institution branches*. Access to financial services can be measured by the availability of bank branches; the more visible financial service access points means individuals are more likely to utilise banking services (Inoue and Hamori, 2016). Previous studies have used bank branches to represent availability of banking services. This study draws on the prior research and expands financial services availability to include deposit taking microfinance institution branches, credit unions and cooperatives and other deposit taking institutions as they provide financial intermediation services that the unbanked can access (Kass-Hanna et al., 2021; Van et al., 2021; Inoue and Hamori, 2016; Sha'ban et al., 2020).

Financial inclusion is proxied by *deposit accounts*. Previous studies on financial inclusion have used bank account or financial institution accounts to proxy financial inclusion (Demir et al., 2022; Demirgüç-Kunt and Klapper, 2013; Chikalipah, 2017). The success of mobile money in Kenya is estimated to have resulted in 194,000 people moving out of poverty, representing two percent of the population (Suri and Jack, 2016). Other findings similar to the statistical data in Kenya find financial inclusion to have a significant impact on economic growth and poverty reduction (Sethi and Acharya, 2018; Sarker, 2001). Bilan et al. (2019) posit that financial inclusion promotes the use of digital financial services and encourages financial innovation.

Table 3.2: Data field definitions and proxies for IMF, World Bank and ITU Dataset

Field Label	Definition	Source	Previously Used
<i>Dependent Variables</i>			
Number of registered mobile money accounts	An account registered with a resident mobile money service provider that is primarily accessed using a mobile phone and can be used for basic financial transactions, including peer-to-peer transfers, bill payments, merchant payments and international remittances (wherever allowed)	IMF	Sha'ban et al. (2019)
Number of registered mobile money agent outlet	a person, quasi-corporation, corporation, or a machine that facilitates mobile money account registration, cash-in cash-out transactions, and customer support. Small retail shops and other retailers typically serve as agents in low-income and emerging economies	IMF	
<i>Digital literacy</i>			
Active Mobile-broadband subscriptions per 100 inhabitants	Active mobile broadband subscriptions via a card, USB modem or handset	ITU	
<i>Financial Inclusion</i>			
Deposit accounts with financial institutions	Refers to all resident nonfinancial corporations (public and private) and individuals in the household sector who are the owners of deposit accounts in a financial institution. While calculating the number of depositors at each type of financial institution	WB	Jajah et al. (2022); Sha'ban et al. (2020); Van et al. (2021); Chikalipah (2017)
<i>Financial Services Access</i>			
Financial institution branches	Includes branches of financial institutions that have financial intermediary as their principal activity such as commercial banks, credit unions and cooperatives, deposit taking microfinance institutions, other deposit takers. Non-deposit taking microfinance institutions and insurance companies are excluded from the sample.	WB	Kass-Hanna et al. (2021); Sha'ban et al. (2020); Van et al. (2021) Fanta and Makina (2019)
<i>Relative Advantage</i>			
Value of mobile money transactions (during the reference year)	Refers to the total amount (in millions of domestic currency) of mobile money transactions carried out by customers of all mobile money service providers during the reference year.	IMF	Sha'ban et al. (2019)
<i>Observability</i>			
registered mobile money agents per km ²	can be a person, quasi-corporation, corporation or a machine that facilitates mobile money account registration, cash-in cash-out transactions, and customer support per 1000 km ²	IMF	
<i>Control Variables</i>			
GDP Growth	Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for	WB	Demir et al. (2022)

	depreciation of fabricated assets or for depletion and degradation of natural resources.		
Employment	Refers to the percentage of adults in employment	WB	Sha'ban et al. (2020)
Urbanisation	Urban population refers to people living in urban areas as defined by national statistical offices. The data are collected and smoothed by United Nations Population Division.	WB	Lashitew et al. (2019)

Mobile money attributes of *relative advantage* and *observability* are proxied by the *value of mobile money transactions* and *registered mobile money agents per km²*. One of the challenges in identifying proxies for mobile money attributes was that there were significant inconsistencies in data reported by countries for variables such as volume of mobile money transactions, average number of mobile money transactions per active mobile money account, outstanding balances on active mobile money accounts (IMF, 2022). However, for the purposes of this study the two proxies chosen were the most consistently reported by the countries in our sample. In addition, allow to test for the impact of innovation attributes as proposed by Rogers (2003). We follow a similar method of testing two attributes as adopted by Tobbin and Kuwornu (2011) who investigated the impact trialability and relative advantage on mobile money adoption in Ghana into their study. Different studies have highlighted different attributes of mobile money such as; secure and efficient remittances (Mugambi et al., 2014; Lashitew et al., 2019); ease of use given that the service is built around simple messaging system (SMS) technology (Asongu and Odhiambo, 2022a); the potential to be adopted because of observability; a user can observe their family and friends using mobile money (Narteh et al., 2017); and the convenience of agents availability to facilitate withdrawal and deposit of funds (Economides and Jeziorski, 2017). Our study focuses on relative advantage and observability.

Control Variables

Control variables used in similar studies are considered for inclusion in our analysis. Specifically, *GDP growth* is used to reflect income growth and is expected to be positively associated with adoption of mobile money. As income grows, it is expected that people need financial services to manage their finances and therefore participate more in the financial system (Beck, 2016; Demirgüç-Kunt and Levine, 2009; Demir et al., 2022). *Employment* is used in our study because as economic activity increases, employment also increases and with it demand for financial services (Sha'ban et al., 2020). Thus, employment levels are expected to be positively associated with mobile money adoption (Sha'ban et al., 2020).

Urbanisation refers to the percentage of a population living in urban areas. The more urbanised, the more active an economy and therefore individuals have a higher propensity to interact with the financial system (Lashitew et al., 2019). Urbanisation is expected to be positively related to adoption of mobile money.

3.3.2 Matrix of correlations for variables (IMF, World Bank ITU Dataset)

To test for multicollinearity, we compile the correlation matrix presented in the Table 3.3 below. The correlation matrix indicates generally low to moderate relationships among the variables, suggesting limited risk of multicollinearity. Registered mobile money accounts are moderately positively correlated with deposit accounts ($r=0.540$), indicating complementary relationship between digital and traditional financial inclusion mechanisms. Active mobile broadband displays a weak positive association with registered mobile money accounts ($r=0.095$), implying that connectivity alone does not directly translate into mobile money adoption.

Registered mobile money agents per km² are moderately associated with deposit accounts ($r=0.393$), indicating that agent density may play an important role in expanding financial access. Urbanisation shows a moderate positive correlation with deposit accounts (0.377) and branches ($r=0.304$), suggesting that traditional financial services remain more developed in urban settings.

Overall, the correlations are below conventional multicollinearity concern thresholds, supporting inclusion of these variables in the regression analysis. None of the correlations exceed 0.6, suggesting that multicollinearity is unlikely to pose a significant concern in empirical models.

Table 3.3 Matrix of Correlations for IMF, World Bank and ITU Dataset

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Registered MM Accounts	1.000								
(2) Active Mobile Broadband	0.095	1.000							
(3) Deposit accounts	0.540	0.286	1.000						
(4) Branches	0.210	0.138	0.254	1.000					
(5) Value of MM transactions	0.292	-0.069	-0.006	0.543	1.000				
(6) Reg MM agents per km ²	0.264	0.214	0.019	0.393	0.181	1.000			
(7) GDP Growth	0.061	-0.158	-0.019	-0.069	0.010	0.090	1.000		
(8) Urbanization	0.123	-0.023	0.377	0.304	-0.028	-0.123	-0.065	1.000	
(9) Employment	0.200	-0.588	-0.277	0.029	0.042	0.202	0.100	-0.244	1.000

3.3.3 Model Specification for Chapter 4 (IMF, World Bank ITU Dataset)

To examine the factors that affect adoption of mobile money, we run OLS regression using the equation below. Equation examines the association of mobile money adoption with digital literacy, financial inclusion, financial services availability and mobile money attributes of relative advantage and observability a set of control variables.

$$MMA_{c,t} = \alpha + \beta_1 DL_{c,t} + \beta_2 FI_{c,t} + \beta_3 FSA_{c,t} + \beta_4 MMRA_{c,t} + \beta_5 MMOB_{c,t} + \sum_{k=1}^k \rho_k X_{k,c,t} + u_{c,t}$$

Where *MMA* denotes mobile money adoption, which is represented by mobile money account ownership; *DL* refers to digital literacy, the ability to understand and interact with digital technology; *FI* represents to financial inclusion, the ownership of a financial institution account; *FSA* signifies access to financial services through availability of financial institution branches; *MMRA* indicates mobile money attribute of relative advantage; *MMOB* represents mobile money attribute of observability; and *X* embodies a collection of control variables used in this study. Finally, u_c is the error term.

3.4 Global Findex Dataset

To address our research questions, we obtain data from the World Bank Global Findex Database²⁴ survey for 2014, 2017, and 2021. The survey has been conducted every three years since 2011, and “contains indicators on access and use of formal and informal financial services and digital payments” (Dermiguc-Kunt *et al.*, 2022, page XIX). The database has been extensively used to investigate the determinants of financial inclusion globally with a particular focus on financial institution or bank accounts (Allen *et al.*, 2016; Mohammed *et al.*, 2017; Demirgüç-Kunt and Klapper, 2012; Fungáčová and Weill, 2015; Asuming *et al.*, 2019). Specifically, our study uses 2014, 2017 and 2021²⁵ data and focuses on mobile money usage as an indicator for financial inclusion for eighteen sub-Saharan African countries²⁶. For purposes of grouping countries according to the national level of mobile money usage, we adopt the Mobile Money Prevalence Index (MMPI) developed by GSMA (Andersson-Manjang, 2021). The MMPI is a composite index that consists of three dimensions *adoption*²⁷,

²⁴ Global Findex Database provides indicators of financial services usage over time, the data is a subset constructed from surveys for 2014, 2017 and 2021.

²⁵ 2011 data is omitted because it did not include mobile money usage data.

²⁶ The country data compiled for this chapter matches the countries in the first empirical chapter for this PhD thesis.

²⁷ The number of mobile money accounts per adult, is described as the mobile money penetration rate.

*activity*²⁸, and *accessibility*²⁹ of mobile money. The purpose of this division is to allow countries to be grouped according to how established mobile money is in the country and to enable countries with similar levels of mobile money uptake to be analysed. In addition, this allows for generalisation in findings to be applied to countries with similar mobile money prevalence.

The Global Findex survey is submitted as a questionnaire to 1000 respondents in each country, with response categories as below. For our analysis we remove all data with “Don’t Know” and “Refused to answer”. The yearly survey covers approximately 1000 respondents in 150 economies worldwide. Out of 48 countries in sub-Saharan Africa, 26 countries participated in the survey for all three years and therefore had more comprehensive data. However, the list was reduced to 18 countries to match countries that were analysed in Chapter 4 of this thesis.

Response categories for World Bank Global Findex Survey

Yes	1
No	2
Don’t Know	3
Refused to answer	4

3.4.1 Variable Selection

Dependent Variables

This study investigates the usage of mobile money by analysing three common services of mobile money: (i) sending domestic remittances, (ii) receiving domestic remittances, and (iii) paying utility bills through mobile money. The two most common functions of mobile money usage since its inception have been sending and receiving domestic remittances (Jack and Suri, 2011; Lashitew et al., 2019). Paying bills through mobile phones was used by Demir et al. (2022) to represent fintech use. In addition, GSMA (2023) report that bill payment through mobile money grew by 36% between 2021 and 2022, representing the highest growth in mobile money service and leading to bill payment becoming the third most commonly used mobile money service. We therefore use these common mobile money functions to investigate the factors that impact mobile money adoption as they represent the most common functions

²⁸ The share of registered accounts that are active on a 90-day basis.

²⁹ The number of agents per 100,000 adults.

of mobile money usage and therefore are indicative of financial inclusion through mobile money.

Explanatory Variables

Digital Literacy

Digital literacy is proxied by *users that made payments online*, using the assumption that a user who can facilitate an online payment is digitally literate. We apply the rationale used by Kass-Hanna et al. (2021) who proxied digital literacy with individuals using the internet and active mobile broadband subscriptions. We therefore reason that online payments proxy digital literacy because one needs digital skills to make online payments.³⁰

Financial Literacy

Financial literacy is proxied by measures of respondents who *borrowed* and *saved* by any means within the year. According to Xu and Zia (2012), a majority of the population in developing countries lack basic knowledge of financial products such as loans and savings. This view is supported by Nanziri and Leibbrandt (2018) who report that most people in rural areas of Africa had not heard of a bank account. Therefore, borrowing and saving provide a suitable representation of sufficient levels of financial literacy to operate mobile money.

Demographic Variables

The demographic variables considered for this analysis are gender, education, income, and age. Previous studies that have investigated mobile money also analysed age (Akinyemi et al., 2020; Elena-Bucea et al., 2021) gender (Amoah et al., 2020; Reynolds et al., 2023); education (Akinyemi et al., 2020; Myeni et al., 2020); and income (Marumbwa, 2014; Nyoka, 2019). We therefore employ the same rationale and choose the above demographic variables for this study.

³⁰ Further discussions on digital literacy can be found in section 2.3.6

Table 3.4: Data fields and proxies for Global Findex Dataset

	Field Label	Proxy	Reference
1	gender	gender	Mohammed et al. (2017)
2	age	Age	Mohammed et al. (2017)
3	education	Education	Mohammed et al. (2017)
4	income	Income	Mohammed et al. (2017)
5	made payments online using the internet	Digital literacy	Kass-Hanna et al. (2021)
6	Borrowed	Financial literacy	
5	Sent domestic remittances through mobile phone	Financial inclusion	Myeni et al. (2020); Mugambi et al. (2014)
8	Received domestic remittances through mobile phone	Financial inclusion	Myeni et al. (2020); Mugambi et al. (2014)
9	Paid utility bills through mobile phone	Financial inclusion	Demir et al. (2022)

3.4.2 Matrix of correlations for variables (IMF, World Bank ITU Dataset)

Table 3.5 below show individual level correlation matrix depicting explanatory variables used in Chapter 5 of this thesis. The individual-level correlation matrix shows generally weak relationships among explanatory variables, suggesting a low likelihood of multicollinearity. Digital literacy is positively correlated with financial literacy ($r=0.132$), income ($r=0.145$), and education ($r=0.177$), indicating that individuals with higher socioeconomic and human capital characteristics are more likely to possess stronger digital capabilities.

Education shows the strongest positive correlation with income (0.237), reflecting the expected relationship between educational attainment and earning capabilities. Gender shows weak negative correlations with digital literacy ($r=-0.055$), financial literacy ($r=-0.045$), income ($r=-0.106$), and education ($r=-0.095$), pointing to gender-based differences in access to resources and skills. Overall correlations remain low (all below 0.3), indicating that multicollinearity is unlikely to pose a concern in the regression analysis conducted in Chapter 6.

Table 3.5 Matrix of correlations for Global Findex Dataset

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Digital Literacy	1.000					
(2) Financial Literacy	0.132	1.000				
(3) Gender	-0.055	-0.045	1.000			
(4) Income	0.145	0.062	-0.106	1.000		
(5) Education	0.177	0.082	-0.095	0.237	1.000	
(6) Age Group	-0.044	-0.074	-0.009	-0.036	-0.250	1.000

3.4.3 Model Specification for Chapter 5 (Global Findex Dataset)

To examine the factors that affect mobile money usage we run linear OLS regression using equation (1) below:

$$FI_{c,t} = \alpha + \beta_1 DL_{c,t} + \beta_2 FL_{c,t} + \beta_3 Gn_{c,t} + \beta_4 In_{c,t} + \beta_5 Ed_{c,t} + \beta_6 Ag_{c,t} + u_{c,t}$$

Where *FI* denotes financial inclusion represented by mobile money usage, which is proxied by three different common services available through mobile money (sending mobile money, receiving mobile money, and paying utility bills through mobile money), *DL* refers to digital literacy (the ability to understand and interact with digital technology), *FL* signifies access to financial literacy (proxied by the availability of financial institution branches), *Gn* represents gender (male or female), *In* refers to income levels, *Ed* represents the education level and *Ag* signifies age, finally, u_c is the error term.

Our model is similar to Kass-Hanna et al. (2021) who examined the impact of digital and financial literacy on financial behaviours. We examine the impact of digital and financial literacy on financial inclusion to determine if mobile money usage is representative of financial inclusion. We adapt the assessment of demographic variables from similar studies that have investigated age, gender, income difference and education on financial inclusion (Kass-Hanna et al., 2021; Asuming et al., 2019).

3.5 Econometric methodologies

3.5.1 Problems of endogeneity

Endogeneity refers to “the situation when an explanatory variable is correlated to the error term” (Cameron and Trivedi, 2005 p. 72). Endogeneity can cause problems and render the techniques chosen to address the problems less effective (Lu et al., 2018). This could result in the techniques to address endogeneity being less effective and producing unreliable results. For example we do not use lagged variables in this thesis because for lagged variables to be effective the sample size should be more than 30 countries, this is because a lower number could result in the clustered standard errors not being reliable (Cameron and Miller, 2015). Following direction from previous studies we do not use instrumental variables because regressions based on weak instruments can produce biased results than simple OLS that make for no correction for endogeneity (Larcker and Rusticus, 2010). Rossi (2014) suggests that instrumental

variables should only be used if there are strong valid instruments and there is a clear definitive problem of endogeneity. Other studies have indicated that instrumental variables cause more problems because the estimates become less reliable (Ketokivi and McIntosh, 2017; Murray, 2006). We therefore acknowledge that there may be potential endogeneity in the datasets used in this thesis, however the data is unique and provides a strong basis for comparative analysis across countries in sub-Saharan Africa. Further, secondary data from multilateral organisations such as World Bank and IMF allow for inclusion of a wider range of populations and previously underrepresented countries in research to be investigated (Kumara, 2022; Fleischer and Khalil, 2024). However, we acknowledge that the data only offers proxies for variables and may not accurately represent the areas to be investigated. For, purposes of our research the data is sufficient to provide insights and set the scene for future research that could collect primary data to improve data reliability.

Lu et al. (2018) posit that researchers may use fixed effects model to address problems of endogeneity. We adopt this methodology in this thesis and use country fixed effects and year fixed effects to address endogeneity in our panel data in Chapter 4 and Chapter 5 (Lu et al., 2018; Ketokivi and McIntosh, 2017). Our thesis uses longitudinal panel data in Chapter 4 and survey data in Chapter 5. We adopt country and year fixed effects in Chapter 4 and country fixed effects in Chapter 5 to address endogeneity.

Another source of endogeneity is omitted variables, as it is difficult to capture all the variables that impact mobile money adoption; to address this we use control variables of employment, urbanisation, GDP growth and population. The control variables are used to potentially capture factors that may impact both the dependent and explanatory variables (Lu et al., 2018). Omitted variables are also addressed through the use of fixed effects, which address unobserved heterogeneity (Ketokivi and McIntosh, 2017). Simultaneity, “when the dependent variable and at least one explanatory variable are determined simultaneously” (Wooldridge, 2010 p.55). In Chapter 4 simultaneity may be present as financial inclusion increases, mobile money increases, therefore we use *number of deposit accounts* to measure financial inclusion which does not have a direct association with adoption of mobile money. In Chapter 5 data suggests as financial inclusion increases so does financial literacy and digital literacy. We address this through the choice of proxies that are not directly related to the dependent variable, our proxy for digital literacy *made payments online* represents use of digital skills but not directly related to mobile money usage, similarly our proxy for financial

literacy those who *borrowed* is not simultaneously impacted with mobile money adoption. We therefore address simultaneity through the choice of variables.

3.6 Qualitative methods

In Chapter 6 we adopt qualitative analysis to review themes in regulatory documents to understand the differences between the country-level regulations and guidelines covering mobile money in sub-Saharan Africa. We further identify themes that are classed as important in literature and have discussed in Section 3.6.3 of this chapter. The aim is to provide context and support to the empirical findings in Chapters 2 and 3 by analysing the regulations governing mobile money (Bowen, 2009). We draw themes from the documents to determine the document structure and establish the levels of cohesion between the regulations (Bowen, 2009).

This section discusses the methodology used and analyses undertaken to review the different regulatory documents for each country, with document analysis used to give meaning to the regulatory documents. Document analysis can provide supplementary research data that can be used to verify the findings of previous quantitative research studies (Bowen, 2009), and is suitable for providing supplementary research data to support previous findings. Bowen (2009) suggests that document analysis can be conducted using ‘thematic analysis’, which involves identifying patterns and emerging themes in the data. The reviewer performs coding for each document, which can be based on pre-defined codes to attach meaning to text. We employ thematic analysis using the pre-defined themes identified in Section 3.6.3, based on recommended mobile money regulation areas documented in previous studies.

O'Neill et al. (2018) propose a step-by-step pedagogy for conducting a literature review. We apply a similar methodology, with some streamlining to suit regulatory document review. Our method involves four general steps: selection of regulatory documents, coding regulatory documents, analysing of the regulatory documents and documenting the results. Table 3.6 below shows the 8- Step literature review against our 4- step review for regulations.

Table 3.6: Eight Steps to using NVivo for literature review and four steps to using NVivo for regulation review

8-Steps to Using NVivo for Literature Review		4-Steps to Using NVivo for Regulation Review	
Step 1	Set up NVivo Project	Step 1	Select regulatory documents and import into NVivo
Step 2	Searching Literature using NCapture Tool		
Step 3	Sort Literature, Prepare End Note, Importing into NVivo		
Step 4	Classifying literature creating a snapshot of your NVivo project	Step 2	Code themes in regulatory documents
Step 5	Visualisation	Step 3	Analyse and visualise coded themes from regulatory documents
Step 6	1 st level Descriptive and Topic coding of literature review themes		
Step 7	Summarise your NVivo Project	Step 4	Document findings of results
Step 8	Write up		

Note: Table 3.6 shows the 8-Step method for literature review in *NVivo* from O'Neill et al. (2018) and the condensed 4-step method the study uses to review regulatory documents. The table shows which steps from the 8-Step method have been condensed when conducting the regulation review.

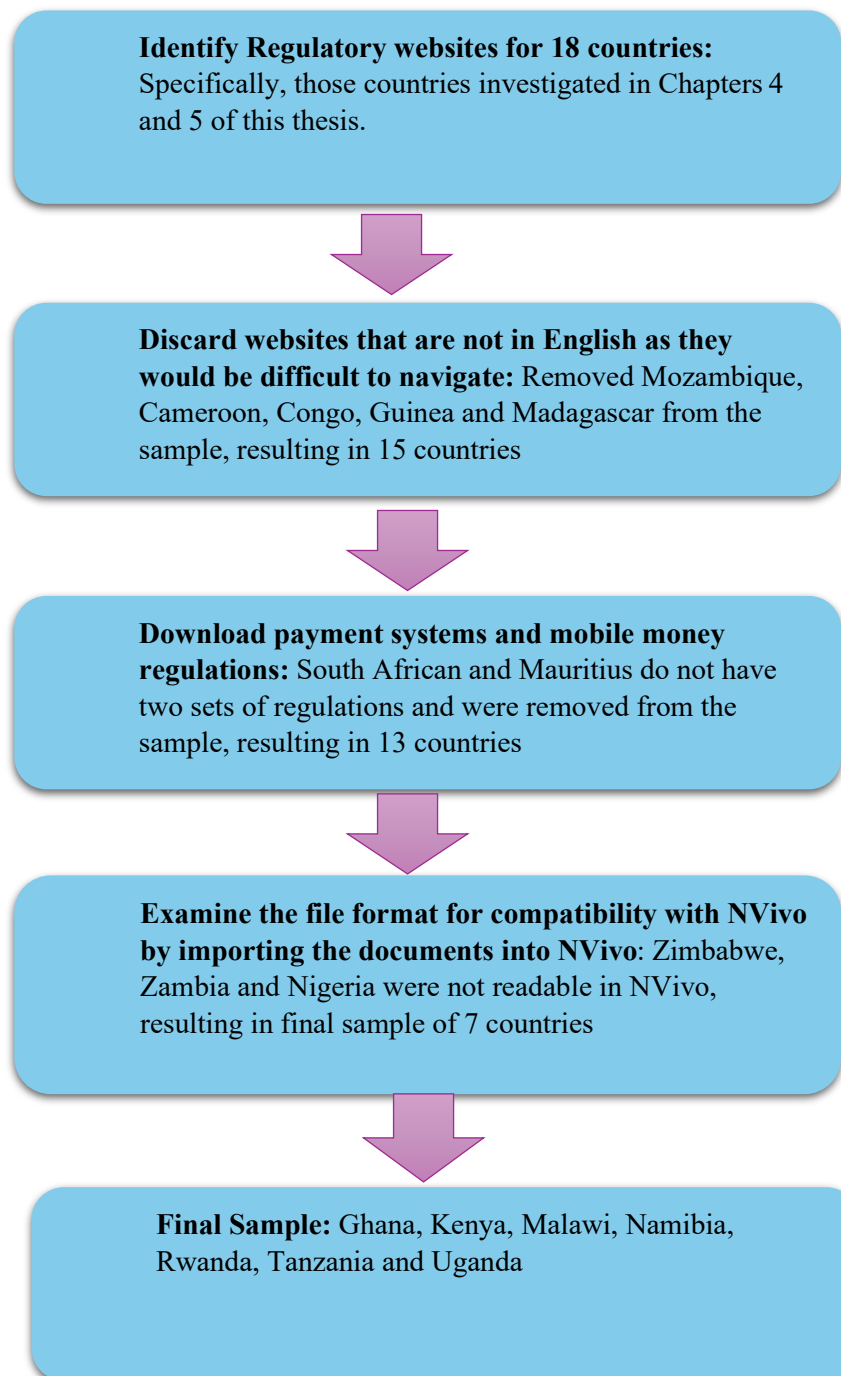
We condense the method into four broad steps because our documents are readily available in the public domain and therefore do not require extensive searching and sorting (Bowen, 2009). Secondly, our documents are pre-classified by the type of regulation (payment systems and mobile money) and would not need to be reclassified. Further, the study uses pre-determined themes identified from previous studies around mobile money regulation, therefore themes do not need to be identified as a separate step. *NVivo* supports documents to be imported, sorted and analysed qualitatively to establish probable meaning from the data (Dhakal, 2022). After the data has been coded, the groups of codes can be used to conduct data analysis, such as comparing the structure of documents and identifying the most commonly-coded themes in each document (Dhakal, 2022).

The remainder of this section is structured as follows. Section 3.6.1 discusses the first step which is the selection of regulatory documents used in this study. Section 3.6.2 follows with the second step, coding themes in the regulatory documents. Section 3.6.3 discusses the third step, the analysis and visualisation of results. The final step, documenting the findings is discussed in the results section 3.5, 3.6 and 3.7 and section 3.8 concludes.

3.6.1 Step 1: Selection of regulatory documents

We first identified the regulatory authorities that provide oversight for mobile money in the countries listed in Chapters 2 and 3, before extracting a list of payments systems regulations and mobile money guidelines from the countries' regulatory websites. Websites and documents in French and Portuguese (Mozambique, Cameroon, Congo, Guinea, Madagascar) were discarded as it was difficult to identify and translate the correct documentation into English. Some countries (for example, South Africa and Mauritius) do not have separate regulations for national payment systems and electronic/mobile money and were also discarded. The file format of regulations for Zambia, Zimbabwe and Nigeria was not readable in *NVivo* due to poor quality and thus these countries were also excluded from this study. The final sample comprised of seven countries: Ghana, Kenya, Malawi, Namibia, Rwanda, Tanzania, and Uganda. Figure 3.1 below shows the process adopted in selecting the regulatory documents.

Figure 3.1: Process of selecting regulatory documents for analysis



Note: Figure 3.1 depicts the document selection process and rationale used to filter out countries from the original sample.

After selecting the regulatory documents, the documents are imported into *NVivo* in either PDF or Microsoft Word (.docx) format to allow for coding. The documents were categorised into two categories: payments systems regulations and electronic money regulations. The purpose of this was to allow ease of processing of the groups of documents (O'Neill et al., 2018). A final list of the documents imported used for our analysis is provided in Table 3.7.

Table 3.7: National Payment Systems and Mobile Money Regulations

	National Payment systems	E-Money/Mobile Money
1	Ghana Payment Systems and Services Act (2019)	Guidelines for E-Money Issuers in Ghana (2015)
2	Kenya National Payments Systems Regulations (2014)	Kenya E-Money Regulations (2013)
3	Malawi National Payment Systems Act (2014)	Guidelines for Mobile Payments Systems in Malawi (2011)
4	Namibia Payment Systems Management Act (2023)	Guidelines for Electronic Money Issuers in Namibia (2019)
5	Rwanda Law Governing the Payment Systems (2021)	Rwanda Regulations Governing the Electronic Money Issuers (2022)
6	Tanzania National Payment Systems Act (2015)	Tanzania Electronic Money Regulations (2015)
7	Uganda National Payment Systems Act (2020)	Uganda Mobile Money Guidelines (2013)

Background of mobile money and regulations in sample countries

This section provides contextual background to the inception of mobile money in the seven jurisdictions. As documented in Chapter 4, most sub-Saharan African countries introduced mobile money between 2007-2014 (Scharwatt et al., 2014; Suri, 2017). Most of the countries followed the approach taken by Kenya and introduced regulations after mobile money had been in operation for several years, allowing mobile money to develop before providing regulatory oversight (Argent et al., 2013; Jack and Suri, 2014). The background for each country provides understanding on how mobile money and the regulatory environment evolved.

Ghana

Mobile money was launched in Ghana in 2009, which followed issuance of Guidelines of E-Money Issuers in Ghana in 2015 (Amon, 2022). Mobile money in Ghana is regulated by the Bank of Ghana. The advent of mobile resulted in a change in the payment systems landscape in the country which necessitated the revision of the Payment Systems Act (2003) to Ghana Payment Systems and Services Act (2019) to govern all payment systems including mobile money (Amon, 2022). The regulator, Bank of Ghana took a deliberate position of categorising mobile money as fintech and an enabler to achieving financial inclusion (Senyo et al., 2022). The active involvement of the regulator resulted in creating an environment where mobile money could thrive.

Kenya

Kenya pioneered mobile money in 2007, however the regulator Central Bank of Kenya did not issue regulations till 2013. Because of the newness of mobile money Central Bank of Kenya took a learning approach and decided to observe how the innovation evolved before moving to issue governing regulations (Suri, 2017). The Central bank of Kenya issued the National Payments Systems Regulations (2014) and the Kenyan E-Money Regulations (2013) to govern mobile money operations. Kenya did a “test and learn” approach to mobile money regulations and focused on promoting mobile money to send domestic remittances which was instrumental to the success of mobile money in the country (Argent et al., 2013).

Malawi

Malawi introduced mobile money in 2012, the regulator Reserve Bank of Malawi issued guidelines in 2011 before the introduction of mobile money (Madise, 2019). The jurisdiction revised the National Payment Systems regulations in 2014 to other aspects including mobile money. In 2014, two years after mobile money had been introduced the country reported 4% mobile money account ownership (Demirgüç-Kunt et al., 2022). Despite mobile money being launched and offering the promise of financial inclusion, adoption in Malawi has been low, some scholars have suggested this is due to poor regulation which is not enforced (Madise, 2014).

Namibia

Mobile money was introduced in Namibia in 2014 by Mobile Telecommunications Limited (MTC) (Matongela, 2014). The uptake has not been as prominent in the country largely because a lot more people own bank accounts, in 2021 Namibia reported 66% of

people with a financial institution account (Demirgüç-Kunt et al., 2022). Namibia followed the trend of most countries in our sample and issued Namibia Payment Systems Management Act (2023) and Guidelines for Electronic Money Issuers (2019) after mobile money had been launched.

Rwanda

Mobile money in Rwanda was launched in 2011 and by October 2012 11.5 percent (1.2 million people) had registered on mobile money (Argent et al., 2013). Approximately 10 years after the launch of mobile money Rwanda introduced Rwanda Law Governing the Payments systems (2021) and Rwanda Regulations Governing the Electronic Money Regulations (2022). Their wait-and-learn approach to introducing regulation is synonymous with the approach taken by Kenya after mobile money was introduced (Jack and Suri, 2011).

Tanzania

Mobile money in Tanzania was launched in 2009 and enjoyed considerable success, by the end of 2012, 35% of households had at least one mobile money account (Abiona and Koppensteiner, 2022; Economides and Jeziorski, 2017). Bank of Tanzania issued the Tanzania National Payment Systems Act (2015) and Tanzania Electronic Money Regulations (2015) to govern the regulatory environment of mobile money. Low literacy levels in Tanzania had a negative impact on mobile money adoption, however regulators allowed interoperability across all mobile money platforms which contributed to the success of mobile money (Suri, 2017).

Uganda

Mobile money was introduced in Uganda in 2009 and by June 2012 the country reported over 17.6 million subscribers (Munyegera and Matsumoto, 2016). Munyegera and Matsumoto (2016) attribute the rapid adoption of mobile money in Uganda to the rapid adoption of mobile phones, which increased from 52% to 73% between 2009 to 2012. This increased use of mobile money for bill payments (school fees, utility bills, transport) (Ndiwalana et al., 2010). Mobile money is governed by the Uganda Mobile Money Guidelines (2013) and the National Payment Systems Act (2020).

3.6.2 Step 2: Theme Identification and coding

Depending on the financial landscape, countries could focus on different areas of importance in their regulations. Prior studies have identified six key areas that constitute good mobile money regulation: *customer due diligence* (Suri, 2017; Aron, 2017); *trust account to*

manage customer funds (Suri, 2017; Di Castri, 2018); *interoperability of mobile money systems* (Burns, 2018; Suri, 2017); *management of mobile money agents* (Madise, 2019; Bahia et al., 2020); *setting transaction limits on accounts* (Suri, 2017; Madise, 2019); and *promoting consumer protection* (Aron, 2017; Martin, 2019). Different jurisdictions will have different areas of focus, for example in Kenya the focus on sending domestic remittances was instrumental in the success of mobile money in the country (Argent et al., 2013). However, the remittance model failed in Tanzania because of low financial literacy levels. Interoperability proved more important in Tanzania, allowing interoperability across all mobile money platforms in the country was instrumental to the success (Suri, 2017). The remainder of this discusses each of the themes in detail.

Customer Due Diligence

Customer Due Diligence (CDD) also known as Know Your Customer (KYC) involves obtaining personal information about customers before entering into a business service or agreement (Di Castri, 2018). The process involves screening and running various background checks on customers to assist businesses in establishing the credibility of their customers (FATF, 2012-2020). The Financial Action Task Force (FATF) recommends screening customers to combat Money Laundering and Terrorist Financing (ML/TF) risks. FATF recommendations “allow for simplified due diligence to process low-risk customers, products, and services” (Jayasekara, 2021, p.151), however, regulators often stand on the side of caution when it comes to enabling regulation for fear of opening loopholes that could be exploited (Celik, 2021). Di Castri (2018) argues that the ML/TF risks posed by mobile money are low because customers are usually low income and transactions are low in value, therefore customers can be allowed to undergo simplified due diligence. In addition, he posits that because the transactions are electronic, they can be easily monitored, and criminal activity can be caught. A report published by GSMA on mobile money found improved access to digitalised payments in nine countries that applied flexible KYC onboarding requirements during the Covid-19 pandemic (Anderson-Manjang and Nghavi, 2021). However, Malady (2016) states that security issues in digital transactions are a concern for regulators, therefore simplified KYC should be avoided to mitigate against customers who may undergo simplified KYC to exploit the system.

Know Your Customer (KYC) or Customer Due Diligence (CDD) requirements can serve as a deterrent to financial inclusion efforts, particularly for the poor who often lack appropriate documentation (Arner et al., 2019). Arner et al. (2020) propose digital

identification as a pillar for financial inclusion. However, for the poorest countries this is a challenge as customers do not have formal identification and implementing digital identification can be costly due to infrastructural challenges (Hollanders, 2020). Most applications allow customers to register online or through mobile phones so that customers do not need to visit physical structures for registration. This is a challenge, however, for less developed countries in Africa, where internet is expensive and literacy levels are low (Yermack, 2018).

Consumer Protection

With the penetration of fintech products in the financial sector, regulators need to address the issues of consumer protection. Consumer protection regulation “is designed to protect the ability of consumers to make informed choices among competing options, by ensuring that consumers are protected from coercion, deception, and other influences that are difficult to guard against” (Averitt and Lande, 1997, p. 716-717). Consumer protection is essential, particularly when dealing with the vulnerable segment of society, that is, low-income, poor communities that are largely financially illiterate (Sanderson et al., 2018; Garz et al., 2021). Financially underserved or excluded customers often lose trust in products when they encounter problems they perceive to be significant, for example, application disconnecting and failing to login (Bongomin and Ntayi, 2020b). Garz et al. (2021) further explain that in some situations financial innovation has the potential of doing more harm to customers through fraud, lack of understanding of charges, and collusion among others. A consumer could unintentionally subscribe to an expensive service that they do not need without knowing what they have done and lose money through the process. In addition, consumers may not have adequate knowledge to get themselves out of such a situation.

The Africa Development Bank (ADB) reported a case in Bolivia in the early 2000s where consumers were left over-indebted and service providers maximising their profits, largely due to financial illiteracy, unethical practices, and an inadequate regulatory framework (Hannig and Jansen, 2010). To avoid similar situations, regulators have taken the initiative to formulate consumer protection policies and regulations, that need to be adhered to by new market entrants. Zimbabwe launched a National Financial Inclusion Strategy whose core pillars include consumer protection with the aim of emphasising the importance of financial inclusion (Sanderson et al., 2018). The World Bank recommended strengthening consumer protection and supervisory capacity in the Middle East and North Africa (MENA) region (Pearce, 2011). Practical examples of implementing consumer protection regulation include Kenya and Peru.

Kenya enacted the Consumer Protection Act in 2012, however, there are still deficiencies in specific-product security and a shortfall as to which regulatory body should enforce the provisions of the Act (Malala, 2013; Malala, 2018). In contrast, regulators in Peru implemented successful consumer protection oversight where the regulator monitors consumer protection policies and procedures of financial institutions, holding them accountable (Hannig and Jansen, 2010). Having a consumer protection regulation in place, while recommended, should be enforced by a strong oversight function to ensure institutions are complying with the consumer protection requirements.

Interoperability

Interoperability can exist at many levels within the mobile money system. On the one hand, interoperable systems enable customers to transact with any provider with minimum or no charges (Aron, 2017). On the other hand, interoperable mobile money systems interface with other systems within the payment systems landscape, such as banks, utility providers, and international remittance agencies among others (Paelo and Roberts, 2022). The interoperability of mobile money can benefit both customers and mobile money service providers because it allows seamless transactions, provides a platform for customers to transact, and ensures that the platform is sustainable (Di Castri, 2018). The challenge is whether to force interoperability through regulation or let the market evolve and define interoperability levels that support competition between different mobile money suppliers and benefit customers (Di Castri, 2018; Madise, 2019). Interoperability can occur at different levels, with most regulators requiring bank-to-mobile money provider interoperability. This is because in most countries there is an overlap between users who use bank services and mobile money services, necessitating seamless transfer between the two (Paelo and Roberts, 2022). However, account-to-account interoperability, where accounts are provided by different mobile money suppliers is not enforced. Some scholars argue that for the full benefits of digital financial services to be realised account-to-account interoperability should be enforced (Aron, 2018).

In Malawi, a customer can transfer funds between different providers, but you cannot transact using the same service, that is one cannot use an agent for a different network to deposit money into their account (Madise, 2019). Kenya implemented full interoperability of mobile money services in April 2018 after regulators waited for the market to mature (Paelo and Roberts, 2022). Another important aspect of interoperability is allowing international remittances. In Rwanda, over \$76 million in international remittances has been received through mobile money (Argent et al., 2013). Regulation can prevent interoperability barriers

from being erected by competitive service providers who could monopolise the market (Paelo and Roberts, 2022).

Transaction Limit

Mobile money regulators often seek to maintain the integrity of the system by setting transaction limits to curb mobile money fraud (Di Castri, 2018). Transaction limits can be set depending on the customer risk levels, low-risk customers with minimum KYC requirements will often have lower limits (Suri, 2017). Because transactions through mobile money are usually low in value, the limits do not harm low-risk users (Burns, 2018). Setting transaction limits helps curb ML/TF risks by allowing patterns to be detected; breached limits on customer accounts to be identified; and agents transacting beyond the limit amount to maximise commissions to be reprimanded (Argent et al., 2013). However, criminals can split transactions between multiple accounts and send lower limits to avoid being detected (Di Castri, 2018). Other regulators such as the Bank of Uganda require transaction limits to be set by the mobile service provider, should the provider want to increase the limits they must seek regulatory approval (Katusiime, 2021). In Malawi, mobile money providers can set transaction and daily limits provided they adhere to AML/CFT regulations (Madise, 2019). Argent et al. (2013) argue that including mobile money limits in the law ensures transparency and does not stifle development because mobile money transactions are usually small the limits do not constrain the customers.

Transaction limits have been set at the corporate level to enable companies to pay salaries through mobile money in some jurisdictions (Aron, 2017; Argent et al., 2013). In Rwanda, the Bank of Rwanda approves transaction limits when granting a mobile money license. Companies that pay salaries through mobile money are granted higher limits to allow high transfers into their employee accounts (Argent et al., 2013). Similarly in Kenya to facilitate more digital payments, the transaction limits for customer-to-business payments were revised (Aron, 2017). This allows customers to pay for goods in bulk, purchase fuel and other commodities directly from businesses without worrying about lower limits that are imposed on person-to-person transfers. The merchant is required to seek approval from the Central Bank of Kenya to allow the high transaction limits.

Trust Account

Trust accounts are there to facilitate the integrity of the mobile money system: the amount of mobile money in circulation should always be the same as the amount held in trust

(Di Castri, 2018; Madise, 2019). Regulation governing trust accounts not only encompasses how it operates but also whether interest can be earned on the account and how the interest is distributed (Suri, 2017). Most African countries earn money on the trust account. For example, in Malawi and Tanzania interest is distributed to the mobile money account holders, and in Kenya it is given to charity (Suri, 2017). Regulators require support consumer protection by protecting funds in trust accounts from creditors or bankruptcy (Di Castri, 2018). Madise (2019) cites that failure to protect the funds could lead to problems should the bank or mobile money provider become insolvent. Some jurisdictions require opening more than one trust account, especially where the market is mature and the amounts are large (Aron, 2017). The auditability of trust accounts further mitigates money laundering risks and breaches in transaction limits (Katusiime, 2021).

Agent Management

Agents are an integral part of mobile money network as they are the customer facing. Agents need to be trained to deliver quality customer service and be able to monitor ML/TF risks. An important aspect of agent monitoring is agent non-exclusivity, allowing agents to transact with multiple mobile money service providers can be beneficial for customers and mobile money service providers (Madise, 2019). However, Di Castri (2018) argue that agent exclusivity can be perceived as a strategy for competition. Regulation should provide for improving allowing the ease of developing an agent network thereby supporting financial inclusion by increasing mobile money access points (Suri, 2017). The number of agents in Kenya, Tanzania and Uganda is almost triple the number of bank branches due to enabling regulations covering mobile money agents (Suri, 2017).

In Kenya the National Payment Systems Regulations were revised in 2014 to prohibit agent exclusivity, however, the pioneers of mobile money, Safaricom had signed exclusivity agreements with their agents before the regulations were put in place creating barriers for other market entrants (Paelo and Roberts, 2022). The regulators had to intervene to enforce agent non-exclusivity. To avoid similar occurrences Bank of Rwanda mandated agent non-exclusivity when mobile money services were first introduced (Argent et al., 2013). A common requirement in regulations is the training of agents to ensure that they conduct adequate customer due diligence at onboarding, and are aware of transaction limits and ML/TF risks (Di Castri, 2018). Training and providing agent oversight is the responsibility of the mobile money provider (Argent et al., 2013; Aron, 2017). Regulators can help enhance consumer protection

by requiring agents to disclose transaction fees to ensure customers are not overcharged (Di Castri, 2018)

Themes identified from literature are summarised in Table 3.8 below.

Table 3.8: Themes coded in NVivo, focus areas and related journal articles

Theme (coded in NVivo)	Focus Area	Related Journal Article
Transaction limit	Reporting aggregate transactions, transaction limits, daily limits	Suri (2017); Aron (2017); (Argent et al., 2013; Burns, 2018)
Trust Account	Trust account, interest distribution	Suri (2017); Di Castri (2018); (Madise, 2019)
Interoperability	Interoperability, international remittances, platform interoperability	Suri (2017); Di Castri (2018); (Aron, 2018)
Money Laundering	Know Your Customer and AML/CFT considerations	Martin (2019); Bahia et al. (2020); Argent et al. (2013)
Agent Management	Agent monitoring, training, exclusivity	Aron (2017); Suri (2017); Madise (2019); Martin (2019); Bahia et al. (2020)
Consumer Protection	Consumer Protection and financial inclusion	Bahia et al. (2020); Aron (2017); Martin (2019)

Document analysis has been used in studies to identify patterns and themes across documents to give them meaning (Wood et al., 2020). We use *NVivo* software to examine the fourteen regulatory documents highlighted in Table 4.2 above and broadly code the text into the themes documented in Table 4.3 above. Coding text involves categorising the text into sections and grouping those sections under identified themes (Dhakal, 2022). The process of coding involves reading through the documents and identifying themes, which are then recorded through codes in *NVivo* (Azeem et al., 2012). The coded themes represent the topics found in the documents that are under the themes identified in Table 3.6, and these are subsequently used in the analysis to compare and isolate similarities and differences between the documents. The coded themes are used to compare similarities between countries governing payment systems and mobile money regulations and identify differences in country regulations.

Furthermore, the thematic analysis allows us to conduct a cross-country analysis of the payment systems and mobile money regulations

3.6.3 Step 3: Analysing the Regulatory Documents

We employ two main methods to assess the themes coded in the regulatory documents. Firstly, we use comparison diagrams to determine similarities in the coding structure of the regulatory documents. This allows us to assess similarities between regulatory documents. Secondly, we examine the frequency of coded themes to determine which themes are prominent in the documents in each jurisdiction. This analysis allows us to identify which themes are more important for each country.

Comparison diagram analysis

Comparison diagrams show how themes connect two or more documents, with more codes connecting the documents signifying a greater similarity in the key issues addressed by the documents (O'Neill et al., 2018). We use the comparison diagrams to determine the similarity between the themes coded in the payment systems and mobile money regulations thereby reducing regulatory ambiguity (Easley and O'Hara, 2009). The comparison diagram shows which themes connect which documents and allow assessment of how similar documents are. This study uses comparison diagrams to show how themes are connected between the payment systems and mobile money regulations. This allows a review of the structure of the documents based on coding and allows the determination of which themes are prominent in the regulatory documents. The main purpose of using a comparison diagram is to show where two documents are similar and where they are different concerning discussed themes (O'Neill et al., 2018).

The comparison diagram is supported by the Jaccard Coefficient which provides a measure of the similarities in the themes present in the two documents (O'Neill et al., 2018). Lau et al. (2003) propose a similarity analysis that compares a set of government regulations to determine how similar they are. They produce a similarity score between 0 and 1. The Jaccard coefficient ranges from 0 (no similarity) to 1 (identical sets). Previous clustering and similarity studies interpret Jaccard values using threshold ranges to facilitate interpretation of similarity strength. For example, clusters with Jaccard similarity values above 0.6 indicate meaningful and strong similarity (Tang et al., 2021; Sánchez et al., 2023). Similarly, cluster stability research considers values above approximately 0.5 as representing moderate similarity (Ferris et al., 2025). Koutras et al. (2024) suggests that coefficients below 0.3 represent weak similarity among samples. Based on these conventions, this study interprets Jaccard similarity as low

(0.0–0.300), moderate (0.301–0.600), and high (>0.600) to evaluate cohesion among regulations.

Evaluating the similarity between both regulatory documents has the potential to provide insights into the cohesion between regulations, and possibly provide ways of reducing ambiguity aversion experienced by individuals wishing to open mobile money accounts or firms wanting to provide mobile money services (Easley and O’Hara, 2009), where ambiguity aversion can arise from “unbanked” or “underbanked” individuals who could choose not to participate in mobile money if the ambiguity between regulations is perceived as too high (Easley and O’Hara, 2009).

Frequency of coded themes

The frequency of coded themes reveals the number of themes coded in a document and allows the identification of themes that are more important to a particular jurisdiction. Further, the analysis allows separation of prominence of themes by documents. This review allows determination on how often a theme is discussed in the document, which could indicate how important the coded theme is to that jurisdiction (Bowen, 2009). The charts produced give a visual representation of the coded themes in the document. This assists in giving meaning to the data and interpreting the structure of the themes in the document (O'Neill et al., 2018). Further, to conduct a cross-country analysis we standardise the frequencies of the themes documented in the payment systems and mobile money regulations.

3.7 Step 4 - Results

This section documents the results of the qualitative document analysis presented by country. We analyse the structure of each document by country and compare the payment systems regulations and electronic money regulations to see if common themes are available in each document. We also look at the correlation between themes within the documents and the correlation of the documents the same. The following discussion highlights the findings for each of the countries examined in this study. Our results are based on Figure 3.2 and Figure 3.3. Figure 3.2 represents the comparison diagrams for the payment systems and mobile money regulations for the countries in our sample and Figure 3.3 displays the bar charts of the number of coded themes in each regulatory document. Results for individual countries in our sample are represented by Panel A-G in both Figure 3.2 and Figure 3.3.

3.7.1 Ghana

Comparison diagrams of documents

We investigate the prominent themes in the payment systems and mobile money regulations by conducting an in-country document analysis. Figure 3.2: Panel A below represents the structure of the themes coded between the payment systems and mobile money regulations in Ghana. The comparison diagram compared the themes coded in two documents and highlights the structure of the documents based on the coded themes. Figure 3.2: Panel A reveals that themes of *anti-money laundering*, *consumer protection*, *transaction limit*, *trust account* and *agent management* are highlighted in both documents. However, *interoperability* is only discussed under payment systems regulations which state that interoperability is not mandatory but optional. This is supported by the payment systems act;

“A person who is licensed as a payment service provider by the Bank of Ghana in accordance with this Act may provide the following services:

(f) facilitation of interoperability of payment systems and services among payment systems providers;” (Ghana, 2019, p.10)

The Jaccard coefficient measuring the coding similarity between the two documents is high (0.813), indicating a strong similarity between the themes presented in the two regulations. This could indicate less ambiguity between the documents and, therefore, a clearer harmonisation between what is prescribed in the payment systems and electronic money regulations, resulting in less ambiguity aversion and therefore more adoption of mobile money (Easley and O’Hara, 2009). For example, the wording of consumer protection in both documents illustrates the similarities between the themes addressed in the documents.

Payment systems regulations

“An electronic money issuer, a payment service provider, or an agent of the electronic money issuer or the payment service provider shall adhere to the universal principles on consumer protection including

(c) sufficient and accessible information to customers on the rights and responsibilities of the customers” (Ghana, 2019, p.32)

E-money guidelines

“E-money issuers are under strict obligation to fully adhere to any rules issued by the Bank of Ghana pertaining to consumer protection as well as such basic principles of consumer protection such as:

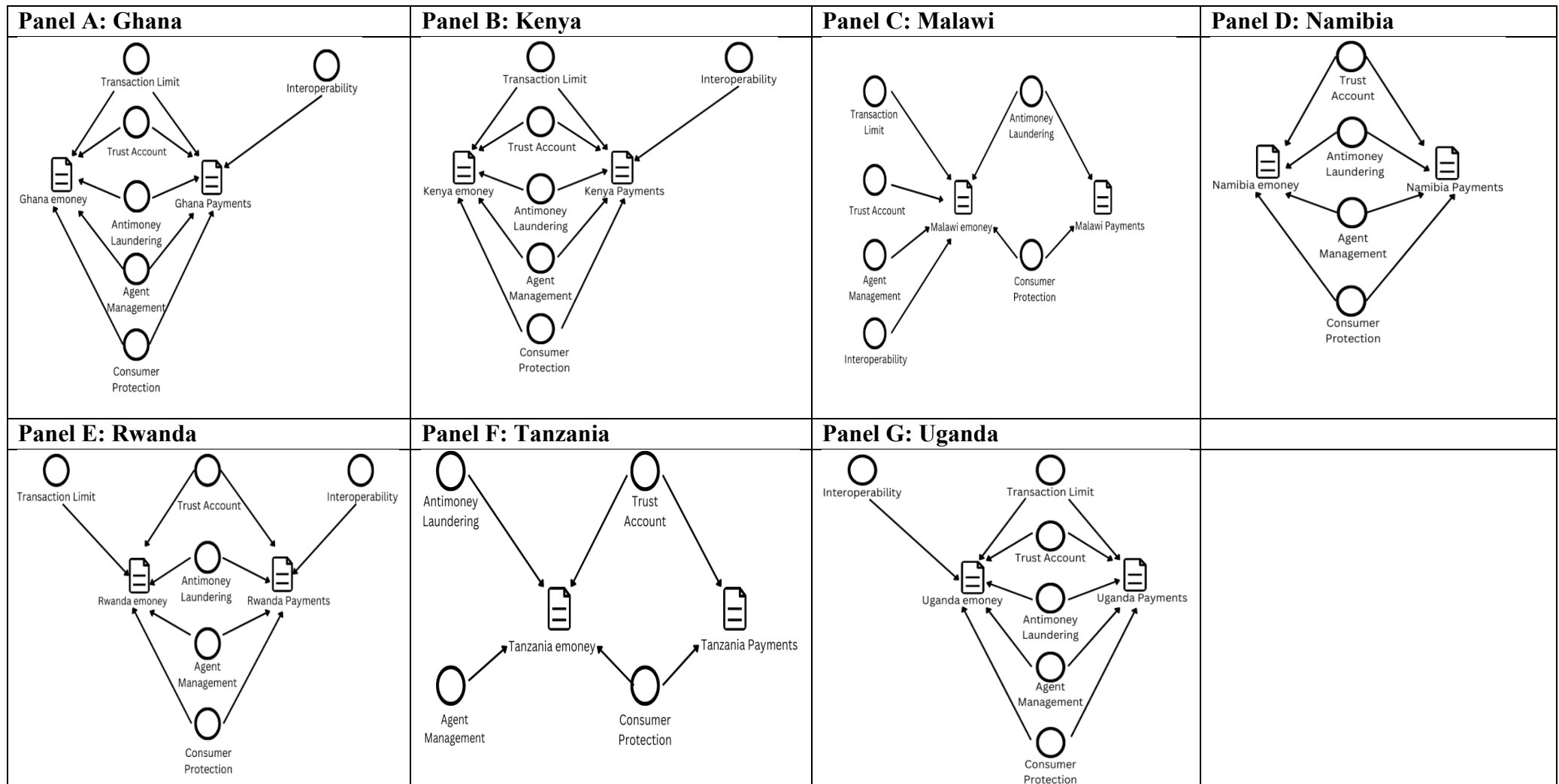
(1) Equitable, honest, and fair treatment of all customers, notably, vulnerable groups such as the illiterate, women and the physically challenged.” (Ghana, 2015, p.19)

Both the payment systems regulations and e-money guidelines highlight the need for providers to protect consumers. This removes any ambiguities that could result from consumer protection issues and could work to provide potential users with the assurance that the regulations are customer centric.

Comparison of the number of coded themes per type of regulation

We review the number of coded themes in regulations and guidelines to assess in which document the themes are more prominent. Figure 4.3 Panel: A below shows a comparison of themes coded for payment systems regulations and electronic money guidelines in Ghana. The results indicate that adherence to *transaction limits* is very important in Ghana. The payment system regulations provide the general provisions of transaction limits, whereas the electronic money regulations provide the detailed provisions as illustrated by the two quotations below:

Figure 3.2: Comparison diagrams depicting coded themes for the countries in the sample



Note: Figure 3.2 above represents the structure of themes coded in the payment systems and mobile money regulations across seven countries in sub-Saharan Africa. Panel A represents Ghana; Panel B represents Kenya; Panel C represents Malawi; Panel D represents Namibia; Panel E represents Rwanda; Panel F represents Tanzania and Panel G represents Uganda.

Figure 3.3: Comparison of themes coded in regulations and guidelines for countries in the sample



Notes: Figure 3.3 shows bar graphs representing the number of coded themes for payment systems and mobile money regulations. Panel A represents Ghana; Panel B represents Kenya; Panel C represents Malawi; Panel D represents Namibia; Panel E represents Rwanda; Panel F represents Tanzania and Panel G represents Uganda.

Payment Systems

“An account is subject to a maximum balance limit, an aggregate daily transaction limit and an aggregate monthly transaction limit determined by the Bank of Ghana.” (Ghana, 2019, p.59)

“An electronic money issuer who fails to comply with the transaction limit specified in this section, is liable to pay to the Bank of Ghana an administrative penalty of five thousand penalty units.” (Ghana, 2019, p. 24)

E-money Guidelines

“Customer e-money accounts have been categorised in three levels as part of a risk-based approach to KYC. Minimum KYC accounts, intended as a first step towards financial inclusion for the unbanked, are subject to very low transaction limits and correspondingly low documentation requirements, while Medium KYC accounts have intermediate transaction limits and documentation requirements and Enhanced KYC accounts give access to high limits but come with bank grade account opening requirements. Furthermore, over-the-counter transactions have been categorized separately.” (Ghana, 2015, p.8)

The mobile money guidelines further stipulate the amounts allowed to be transacted in each category. This could provide a basis to remove any uncertainty on the amounts allowed to be transacted using mobile money. As per quotations above, mobile money transactions are subject to maximum balance limit, daily transaction limit and monthly transaction limit. Further, penalties are imposed to issuers who do not adhere to the limit. Setting transaction limits helps monitor money laundering operations and protects the integrity of the financial system (Madise, 2019).

The results show that emphasis on *consumer protection* and *agent management* in Ghana is important in the payment system regulations. Madise (2019) highlights the importance of managing agents in line with *consumer protection* as agents are the ones who interact with the customers.

3.7.2 Kenya

Comparison diagrams of documents

We investigate the prominent themes in the payment systems and mobile money regulations by conducting an in-country document analysis. Figure 3.2 Panel: B below represents the structure of the themes coded between the payment systems and mobile money regulations in Kenya. Figure 3.2 Panel: B reveals that themes of *anti-money laundering*, *consumer protection*, *transaction limit*, *trust account* and *agent management* are highlighted in both documents. However, *interoperability* is discussed under payment systems regulations and not under the mobile money guidelines. In Kenya, interoperability is mandatory and requires the payment service provider to have interoperable systems as per the quotation below;

“A payment service provider shall use systems capable of becoming interoperable with other payment systems in the country and internationally.” (Kenya, 2014, p.701)

The Jaccard coefficient measuring the coding similarity between the two documents is high, 0.786, indicating that there is a strong similarity between the themes presented in the two documents. Therefore, there is minimal grey area in the regulations governing mobile money in Kenya.

Comparison of the number of coded themes per type of regulation

Panel B of Figure 3.3 shows comparisons of themes coded for payment systems and electronic money regulations in Kenya. The results reveal a stronger emphasis on *trust account*, *consumer protection* and *agent management* in the payment regulations whereas the electronic money regulations are skewed towards *consumer protection* and *agent management*. Emphasis on agent management in both documents signifies the importance of agent management. Failure to provide adequate agent oversight could result in fraud and agents taking advantage of consumers (Gilman and Joyce, 2012; Akomea-Frimpong et al., 2019). The payment systems regulations stipulate how payment service providers are liable for the conduct of their agents, while the example from the E-money regulations stipulates how payment service providers should ensure agents comply with the anti-money laundering regulations. The emphasis is on payment service providers providing oversight over mobile money agents.

Payment systems regulations

“A payment service provider is liable to its customers for the conduct of its agents, performed within the scope of the agency agreement.” (Kenya, 2014, p.699)

Electronic money regulations

“E-money issuers shall ensure that they and their agents comply with the applicable provisions of the Proceeds of Crime and Anti-Money Laundering Act and the regulations issued in terms of the said Act.” (Kenya, 2013, p.9)

Clear cohesion and provisions within the regulations can result in a less ambiguous and enabling regulatory environment that promotes mobile money adoption (Jack and Suri, 2014).

3.7.3 Malawi

Comparison diagram of documents

Panel C of Figure 3.2 above represents the structure of coded themes within the two regulatory Malawi. There is a clear disconnection of themes, with the only prominent themes

in both documents being *anti-money laundering* and *consumer protection*. The other themes of *trust accounts*, *transaction limits*, *agent management*, and *interoperability* are covered in mobile money regulations. The Jaccard coefficient is low, 0.167, indicating that there is limited similarity between the themes presented in the documents. This could result in a “non-enabling” environment because there could exist ambiguities between the two regulations (Burns, 2018).

Because guidelines are not enforceable, enforcing the provisions may be a challenge in Malawi. For example, in Malawi, because interoperability is not enforceable through the Act, but supported in the guidelines, the two mobile money providers reached an interoperability agreement by themselves (Madise, 2019). The quotation below suggests the technology to be interoperable should be available, but the regulation does not state the cost of not being interoperable. The quote below on interoperability is taken from the mobile payment guidelines.

“The technology deployed to deliver mobile payments services should comprise a set of interoperable infrastructure modules that work seamlessly across heterogeneous networks.” (Malawi, 2011, p.13)

Comparison of the number of coded themes per type of regulation

We review the number of coded themes in the regulations and guidelines to assess which themes are more prominent per document. Panel C of Figure 3.3 above shows a comparison of themes coded for payment systems regulations and mobile money guidelines in Malawi. The results indicate that despite the payment systems regulations covering *anti-money laundering* and *consumer protection* the coverage is minimal. This suggests that the main regulatory document governing mobile money in Malawi is the mobile money guidelines. The most prominent themes in the guidelines are consumer protection and agent management. Managing agents properly can ensure that consumers are protected (Di Castri, 2018; Madise, 2019). For example, the mobile payments guidelines provide that customer identity should be secure through the mobile money system.

“The activation process, which should be through secure messaging systems, should ensure integrity and security of customer’s identity;” (Malawi, 2011, p.18)

Failure to secure a customer’s identity could result in fraud which would compromise the integrity of the mobile money system (Fitzhenry, 2022). Customer knowledge that they are protected against fraud could encourage more uptake of mobile money.

3.7.4 Namibia

Comparison diagram of documents

Panel D of Figure 3.2 above represents the structure of the coded themes in the payment systems and mobile money regulations. The diagram shows that the four themes of *trust accounts*, *anti-money laundering*, *agent management* and *consumer protection* are discussed in both documents, however, *interoperability* or *transaction limits* are not discussed. Despite the regulations for Namibia focusing on only four of the six themes, the Jaccard coefficient is 0.571 signifying a moderate correlation between themes prominent in the two documents. This signifies that there are moderate similarities between the themes coded in the payment systems and mobile money regulations. For example, Namibia requires mobile money providers to open a special deposit account to protect against loss (Di Castri, 2018). The provisions below show the importance of trust accounts in both the regulations and guidelines.

Payment systems

“A payment service provider must open and maintain a separate trust account at a banking institution to hold and facilitate the transfer of funds exchanged for electronic money solely for the benefit of the electronic money users.” (Namibia 2023, p.19)

E-money guidelines

“A notification from a banking institution and an application from a non-bank institution must be accompanied by the following information and documentation relating to the e-money services:

Provide proof that a separate trust banking account is established to safeguard funds pooled for the purpose of providing e-money services;” (Namibia, 2019, p.4)

Harmonising important themes in the payment systems and mobile money regulations could remove ambiguities in regulations and create an “enabling” environment (Burns, 2018). The omission of transaction limits and interoperability for Namibia could mean that regulators did not need to address these because the issue of interoperability was resolved amongst market players as the market grew. Further, due to low subscribers on mobile money platforms in Namibia transaction limits were not an area of concern (Demirgüç-Kunt et al., 2022).

Comparison of the number of coded themes per type of regulation

Figure 3.3 Panel: D above shows the number of coded themes in each document. The results indicate that the most prominent theme in the mobile money guidelines is *agent management* followed by *consumer protection*. The mobile money issuers are required to

provide oversight of their agents and would be held accountable if the agents are negligent or non-compliant as highlighted below;

“As the regulated institutions, issuers of e-money or other payment instruments are held responsible for actions taken by agents acting on their behalf. These include actions taken both with respect to customers (such as negligence or fraud in the provision of services) and with respect to regulators (such as (non)compliance with AML/CFT, customer privacy, or other regulations).” (Namibia, 2019, p.10)

3.7.5 Rwanda

Comparison diagram of documents

Figure 4.2 Panel: E above reveals that *trust account*, *anti-money laundering*, *agent management* and *consumer protection* have been highlighted in both documents. The main difference in terms of highlighted themes is that *transaction limits* are covered in the mobile money regulations and *interoperability* is covered in the payment systems regulations. The Jaccard coefficient of 0.455 signifies a moderate similarity between the themes in the documents, further supporting observations that not all themes are coded in both documents. The reason *transaction limits* are only highlighted in the mobile money regulations could be because transaction limits are specific to mobile money and therefore the mobile money regulations provide details that pertain only to mobile money and not other payment systems instruments. This is supported by the quote below which states that the wallet holders limit should be in line with the size of the transactions;

“An e-money issuer shall ensure that the e-money account holder’s wallet and transaction limit adopted is commensurate with the purpose and size of the transaction.”(Rwanda, 2022, p.31)

Similarly, interoperability impacts the entire payment system and is covered under payment systems regulations. The National Bank of Rwanda provides oversight over the payment system in Rwanda (Rwanda, 2021). The quote below highlights how payments highlight the role of National Bank of Rwanda concerning interoperability.

“The National Bank of Rwanda establishes regulations determining procedures by which payment service providers enter into an arrangement with the operators to achieve interoperability of payment accounts with the payment system.” (Rwanda, 2021, p.19)

Comparison of the number of themes coded per type of regulation

Figure 3.2 Panel: E above reveals the frequencies of the themes coded for payment systems regulations and mobile money guidelines in Rwanda. The results indicate that *trust account* in the mobile money regulations, with 44 coded references. Trust accounts hold the

equivalent cash amount to the mobile money in circulation and require adequate regulations to prevent mismanagement and fraud (Ahmed et al., 2016; Suri, 2017). The board audit committee of a mobile money service provider is required by law to conduct an annual audit of the trust account. This emphasises the need for board oversight on trust accounts, as supported by the extract from the payment systems regulations in Rwanda;

“The board audit committee shall:

- (i) provide an annual audit report of the financial statements including trust accounts.***
- (ii) ensure clear separation between the trust funds and the funds of the emoney issuer.” (Rwanda, 2022, p.19)***

3.7.6 Tanzania

Comparison diagram of documents

Figure 3.2 Panel: F above highlights the coding structure of the payment systems and mobile money regulations in Tanzania. Tanzania regulatory documents highlight four main themes *anti-money laundering, agent management, trust account* and *consumer protection*. The documents have a Jaccard coefficient of 0.333, signifying moderate similarity between the themes highlighted in the regulations. The moderate levels of similarity are due to only two themes covered in both documents. The payment systems and mobile money regulations cover themes of *trust account* and *consumer protection*. However, electronic money regulations only cover *anti-money laundering* and *agent management*. This could be because there are specific provisions on anti-money laundering and agent management that only pertain to mobile money and not the entire payment systems landscape.

For example, there are specific requirements for electronic money agents that are only applicable to mobile money issuers. In some jurisdictions agent non-exclusivity is enforced, while in others it is left to the market to decide (Argent et al., 2013; Paelo and Roberts, 2022). A common provision specific to mobile money issuers is to ensure that their agents are trained adequately to conduct customer due diligence at onboarding, observe correct transaction limits and identify fraudulent transactions among others (Aron, 2017; Argent et al., 2013). The Tanzanian mobile money regulations emphasise the need to train agents as the responsibility of the electronic money issuer;

“An electronic money issuer shall be responsible to-

(a) conduct training for the agents and the operations of the agency business including internal controls, accounting, risk management, consumer protection and anti-money laundering and combating financing of terrorism;” (Tanzania, 2015a, p.15)

Comparison of the number of themes coded per type of regulation

The results indicate the prominence of *trust account* followed by *agent management* in the Tanzanian regulations. *Trust account* is very pronounced in both regulatory documents emphasising the importance of managing customer fund. Bank of Tanzania (the financial regulator) requires that mobile money operators distribute the interest earned on trust accounts to the mobile money account owners, based on the account balance (Ahmed et al., 2016). Other provisions include proving financial statements, prescribing the legal amount a bank can hold in its trust account (Tanzania, 2015a). Similar, provisions are echoed in the payment systems regulations that prohibit an electronic money provider from prohibit an electronic from using funds in the trust account for its operations and other activities (Tanzania, 2015b). Provisions listed below from both the payment systems and mobile money regulations emphasise the importance of maintaining a trust account. Further, the provision in the mobile money regulation refers to the overarching Payments Systems Act to remove any ambiguities that may arise when implementing trust accounts.

Payment systems

“A licenced payment system provider who is a non-bank or non-financial institution licenced as an electronic money issuer shall be required to open and maintain a trust account in accordance with this Act.” (Tanzania, 2015, p.24)

Electronic money regulations

“An electronic money issuer shall not issue electronic money without opening a trust account or a special account in accordance with these Regulations and the Act.” (Tanzania, 2015a, p.11)

3.7.8 Uganda

Comparison diagram of documents

Figure 3.2 Panel: G above represents the comparison diagram to highlight the structure of the structure of the themes coded in the documents. The diagram shows five themes *transaction limit, trust account, agent management, anti-money laundering and consumer protection* present in both documents. The Jaccard coefficient of 0.533 represents moderate similarity in the themes presented in the regulatory documents. The moderate levels of

similarity are due to the five themes covered in both documents. However, *interoperability* is only discussed in mobile money guidelines. This could be because the issues relating to mobile money *interoperability* need separate redress from the encompassing payment systems landscape.

The Bank of Uganda (the regulator) mandates interoperability for all mobile money providers and requires that their systems be able to interface with other payment systems (Uganda, 2015). The provision is aimed at facilitating the growth of mobile money adoption locally and internationally;

“Mobile money service providers shall utilize systems capable of becoming interoperable with other payment systems in the country and internationally, in order to facilitate full interoperability.” (Uganda,2015,p.12)

Comparison of the number of themes coded per type of regulation

We review the coded themes in regulations and guidelines to assess the prominence of the themes in the two documents. Figure 3.3 Panel G above shows the number of coded themes for the mobile money guidelines and the national payment systems. The results show that *trust account* is most prominent in the payment systems regulations, whereas *consumer protection* and *agent management* are more prominent in the mobile money guidelines. Similar to Rwanda and Tanzania, trust account facilitate the safety of consumer funds and safeguard against fraud (Di Castri, 2018; Madise, 2019). Every electronic money issuer in Uganda is required to open a trust account to maintain customer funds;

“An electronic money issuer approved under subsection (3), shall open a trust account with a financial institution or microfinance deposit-taking institution for the purpose of maintaining funds of a customer.” (Uganda, 2020, p.19)

3.8 Code book development and Challenges

One of the challenges experienced during coding was identifying coding categories to include in the codebook. To develop the codebook we identified themes that were relevant to the research question and specifically focused on mobile money adoption (Roberts et al., 2019). On reviewing literature themes were selected that were relevant to individual user choices to adopt mobile money. This study used a deductive approach where pre-defined themes were brought to the data rather than an inductive approach (Braun and Clarke, 2021). Braun and Clarke (2021) suggest that analysis can be weak if themes are not coherent, lack evidence and try to do too much, to minimise this effect themes were chosen that were emphasised in three or more studies as important to mobile money adoption.

Another challenge was lack of inter-coder reliability as the coding process was conducted by a sole coder. Church et al. (2019) posit that multiple coders can reveal ambiguities and inconsistencies, they can also lead to prioritising consensus over nuanced interpretation and diminish objectivity (Halpin, 2025). To overcome this we use reflexive thematic analysis where a sole coder is acceptable because themes are pre-defined therefore minimising coder bias (Braun and Clarke, 2006).

3.9 Conclusion

This chapter provides an overview of the research methodology used in this thesis. The chapter highlights the research philosophy governing the research and data collection methods and variable selection. The chapter discusses the two datasets used in Chapter 4 and Chapter 5 and the qualitative method employed in Chapter 6 of this thesis. Furthermore, the chapter highlights the limitations and challenge faced and strategies used to overcome the limitations.

This chapter outlines the methodological framework adopted to investigate the factors that impact mobile money adoption and the role of regulatory ambiguity in shaping the adoption and use of mobile money services. Guided by the research questions and the broader objective of understanding complex institutional and behavioural dynamics, the study employed a mixed-methods design that integrates quantitative and qualitative approaches within a pragmatic research paradigm.

The quantitative component provided a structured means of identifying patterns, relationships, and trends in mobile money adoption, enabling the study to assess how digital and financial literacy impact mobile money adoption. Complementing this, the qualitative component offers deeper insight into how key stakeholders, particularly regulators and users interpret and navigate regulatory ambiguity in practice. Together, these methods allowed for triangulation, strengthening the validity of the findings and enabling a more nuanced understanding than either approach could achieve independently.

The chapter also details the sampling strategies, data collection instruments, and analytical techniques employed to ensure methodological transparency and robustness. Attention was paid to problems of endogeneity, data reliability, and validity, recognising the sensitivities associated with financial inclusion, regulatory governance, and participant trust.

Overall, the methodological choices reflect the interdisciplinary nature of the research problem and align closely with the study's theoretical and empirical aims. The mixed-methods

approach is especially well suited to capturing both the measurable effects of regulation and the lived experiences and interpretations that shape mobile money adoption. Chapters 4, 5 and 6 build on this methodological foundation by presenting and analysing the empirical findings, drawing together quantitative results and qualitative insights to address the research questions in a coherent and integrated manner.

4.0 Mobile money adoption in sub-Saharan Africa: A Diffusion of Innovation (DOI) Approach

4.1 Introduction

This chapter investigates the extent to which mobile money innovation attributes such as the value of transactions and availability of mobile money agents, in conjunction with digital literacy, financial inclusion, and financial access impact the adoption of mobile money across Sub-Saharan Africa through the DOI framework. Further, DOI is used to examine how mobile money adoption has progressed through time, examining periods of fintech initiation (2010-2014)³¹, implementation period (2015-2018), and the Covid-19 period (2019-2021). To do so, this study uses mobile money to represent a technology-driven innovation that promotes accessibility and financial inclusion and can be integrated into existing financial systems.

4.2 Theoretical Background

A unique contribution of this study is the application and expansion of Rogers (2003) Diffusion of Innovation (DOI) theory to include factors that influence the adoption of mobile money. Rogers (2003) identifies four elements that are critical in the uptake of innovations under DOI; the innovation itself, communication medium, time, and social setting. According to Rogers (2003) an innovation involves a new concept, idea, service or product. The innovation itself does not necessarily have to be new but it must be new to the individual adopting it. This rationale makes DOI suitable for mobile money, as it would be a new financial product for any first-time user. Further, the innovation attributes play an important role in the adoption process. Rogers (2003) proposes that the five innovation attributes *relative advantage*, *complexity*, *compatibility*, *observability* and *trialability*, explain 47-89 % of the variance in the adoption process. For purposes of this study, we do not examine all five attributes but focus on *relative advantage* and *observability*. Similar studies have examined two or more attributes include *relative advantage* and *complexity* (Gangwar et al., 2015); *complexity* and *compatibility* (Fatoki, 2020); and *relative advantage*, *complexity* and *compatibility* (Ayo et al., 2016). This is because sometimes not all attributes may be present. We further examine the time mobile money has been operational and the social setting which is represented by the countries within which the mobile money operates. This is because our data set supports the time the innovation has been available from initiation (2010- 2021),

³¹ Mobile money was adopted by most sub-Saharan African countries between 2010-2014, the service was registered in 81% of countries by end 2014 (Scharwatt *et al.*, 2014).

innovation attributes of value of transactions (relative advantage) and agent availability(observability) and the different social settings of the individual countries as subcategorised through levels financial development.

This study extends the original DOI model by incorporating digital literacy, financial inclusion, and financial access. Kass-Hanna et al. (2021) suggest that digital literacy is important in determining financial behaviour, particularly for developing countries where digital literacy levels are low, while Bilan et al. (2019) propose that financial inclusion has an impact on the uptake of alternative financial services. Some studies also suggest that mobile money will thrive where the banking sector is less efficient because mobile money can reach individuals where banks do not provide services (Soutter et al., 2019; Burns, 2018). The literature regarding the original DOI model and each of these extensions is discussed in the following subsections. Subsections 4.2.1 and 4.2.2 discuss the mobile money attributes of *relative advantage* and *observability* as they relate to the DOI model; section 4.2.3 discusses digital literacy; section 4.2.4 discusses financial inclusion; and lastly, section 4.2.5 discusses the availability of financial services.

4.2.1 Relative Advantage

Relative advantage refers to perceptions of usefulness of the innovation; in other words, how it improves or impacts the user's life (Rogers, 2003). Mobile money allows users to send money, receive money, make payments, and in some jurisdictions access microcredit (Ozili, 2018). One of the advantages of mobile money has been enabling local remittances to be sent securely and efficiently, eliminating the need to send money physically through couriers or family member who had to travel long distances (Mugambi et al., 2014; Lashitew et al., 2019). Other mobile money providers have partnered with banks to offer basic bank services such as savings and credit, and the ability to send money to someone without a mobile money account; this allows a user to transact through mobile money and also maintain simple bank account (Di Castri and Gidvani, 2014; Muthiora, 2015; Cobla and Osei-Assibey, 2018). The value of mobile money transacted represents how useful mobile money is in carrying out financial transactions. This leads to our first hypothesis:

H₁: Relative advantage has a positive effect on mobile money adoption in sub-Saharan Africa.

4.2.2 Observability

Observability examines the degree to which innovations are visible in organisations (Rogers, 2003). Narteh et al. (2017) suggest that a potential user may be influenced to adopt mobile money by observing family and friends using the application. In addition, consulting family members in decision making would positively influence the decision if a higher proportion of those family members use mobile money. Mugambi et al. (2014) suggest that one of the reasons some jurisdictions - such as Kenya, Tanzania, and Uganda - have more mobile money accounts than bank accounts is because users adopt mobile money after they have observed the benefits through their social circle. Another area where visibility of mobile money has been pronounced is through availability of agent outlets. The latest GSMA³² report indicates that there are over 17.4 million mobile money agents worldwide, with an annual growth of 41% from 2021 to 2022 (GSMA, 2023). Further reports from GSMA conclude that in 80 per cent of the jurisdictions where mobile money is prominent, the number of mobile money agents is approximately 10 times higher than commercial bank branches (Caputo, 2019). Observability can therefore have a positive effect on mobile money adoption, leading to our second hypothesis:

H₂: Digital literacy has a positive effect on mobile adoption in sub-Saharan Africa.

Additional factors that influence fintech adoption

In our study, we extend the original DOI model by incorporating digital literacy, financial inclusion, and financial access as additional factors that would impact fintech adoption. This section explains why each of the additional factors have been incorporated into our study.

4.2.3 Digital Literacy

Digital literacy is important in giving users the confidence to use digital financial services (Kass-Hanna et al., 2021), and is prominent in most developed countries, where it has been incorporated into education systems, retail services, entertainment, and almost the different segments of the economy. In contrast, digital resources are not incorporated into daily lives within developing countries, with systems remaining manual and fraudsters taking advantage of the limited digital knowledge of users (Reddy et al., 2022; World Bank, 2022).

³² GSMA (Global System for Mobile Association) is a global non-profit organisation that represents the interest of mobile network operators worldwide, with over 750 mobile network operators as full members of the association.

The World Bank reports that, despite having mobile broadband coverage, 43 per cent of the world's population remained unconnected, primarily due to a lack of knowledge, awareness, and digital skills (Houngbonon et al., 2021; World Bank, 2022). In addition, the African Development Bank (ADB) suggests that the lack of digital knowledge is a hindrance to uptake of digital financial services (Triki and Faye, 2013).

Digital literacy supports the ability to operate technological gadgets. Therefore, if users encounter challenges navigating through mobile money applications and menus, they would not be willing to adopt the innovation (Kalba, 2016). Some studies have highlighted the importance of digital literacy for developing countries, for example, Sinha et al. (2018) proposed that poorer countries lack technology skills which could result in a low uptake of digital products. Kass-Hanna et al. (2021) suggest that digital literacy is important in determining financial behaviour, particularly in developing countries where digital literacy levels are low. Combined, these arguments suggest that in our second hypothesis, digital literacy has a significant impact on fintech adoption:

H₃: Digital literacy has a positive effect on fintech adoption in sub-Saharan Africa.

4.2.4 Financial Inclusion

Financial inclusion concerns the provision of access to affordable financial products to those who do not have access to formal financial services, in order to reduce poverty (Demirguc-Kunt et al., 2018; Senyo and Osabutey, 2020). Ozili (2018, p 458) defines financial inclusion as “the process of ensuring individuals, especially poor people, have access to basic financial services in the formal financial system”. Mobile money is a financial product that allows the “unbanked” to be included into the formal financial system and provides basic financial services (Gosavi, 2018; Jack and Suri, 2014; Akinyemi et al., 2020). Studies have found that increased financial inclusion is associated with increased economic growth, poverty reduction and inequality reduction, and therefore increases demand for financial services (Sethi and Acharya, 2018; Mohammed et al., 2017). It is expected that increased financial inclusion therefore increases volumes transacted through alternative finance platforms, and therefore increases adoption of financial innovation (Bilan et al., 2019).

H₄: Financial inclusion has a positive effect on mobile money adoption in sub-Saharan Africa.

4.2.5 Availability of Financial Services

Adoption of mobile money in South Africa has been found to be low, primarily due to an efficient and developed banking sector (Soutter et al., 2019). Similarly, Burns (2018) proposed that one of the reasons South Africa and Mauritius have low levels of mobile money adoption is because banks have more reach and presence in rural areas, resulting in over 80 percent of the population in both jurisdictions maintaining a financial institution account. Existing financial markets that provide sufficient products and access to banking premises without having to walk long distances, manage to attract more customers than those that keep their presence in urban areas (Mookerjee and Kalipioni, 2010). Therefore, it is proposed that jurisdictions where the financial sector is more developed, with easy access to financial services, will be characterised by low mobile money adoption rates.

H5: Availability of financial services has a negative impact on adoption of mobile money in sub-Saharan Africa.

4.3 Data and Methods

Data for this chapter is compiled from IMF Financial Access Survey Data³³; World Bank World Development Index³⁴ and International Telecommunications Union (ITU)³⁵ digital indicators data (IMF, World Bank and ITU Dataset). The data spans a period of eleven (12) years from 2010 to 2021. Detailed description of the data variables and meanings are discussed in Chapter 3 Section 3.3.

Regression Model

To examine the factors that affect adoption of mobile money, we run OLS regression using the equation below. Equation examines the association of mobile money adoption with digital literacy, financial inclusion, financial services availability and mobile money attributes of relative advantage and observability a set of control variables.

$$MMA_{c,t} = \alpha + \beta_1 DL_{c,t} + \beta_2 FI_{c,t} + \beta_3 FSA_{c,t} + \beta_4 MMRA_{c,t} + \beta_5 MMOB_{c,t} + \sum_{k=1}^k \rho_k X_{k,c,t} + u_{c,t}$$

³³ IMF Financial Access Survey was launched in 2009 with aim of providing supply side data for financial inclusion to allow cross-country comparison

³⁴ World Development Index is collected by World Bank and measure access to different developmental indicators world-wide

³⁵ ITU is the UN specialised agency on ICTs and provides data for the global ICT usage around the world

Where *MMA* denotes mobile money adoption, which is represented by mobile money account ownership; *DL* refers to digital literacy, the ability to understand and interact with digital technology; *FI* represents to financial inclusion, the ownership of a financial institution account; *FSA* signifies access to financial services through availability of financial institution branches; *MMRA* indicates mobile money attribute of relative advantage; *MMOB* represents mobile money attribute of observability; and *X* embodies a collection of control variables used in this study. Finally, u_c is the error term.

4.3.1 Descriptive Statistics

This section discusses the descriptive statistics of the data used in this study. Table 4.1 represents the categorisation of countries in the sample according to the IMF FDI. Categorisation of countries in this way enables assessment of the factors that affect mobile adoption within groups of countries characterised by similar financial development and thus allows for us to determine the factors that affect mobile money adoption. Sub-Saharan African is categorised by low financial development, making access to finance a hurdle in economic growth (Kablan, 2010). Financial solutions that can overcome infrastructural challenges provide opportunities for financial access and for small businesses to grow (Mlachila et al., 2013). Countries with similar FDI will have similar financial sector characteristics, thus allowing for more effective comparison.

Table 4.1: Categorisation of countries by IMF Financial Development Index

FDI less than 0.10	FDI over 0.10 -0.20	FDI above 0.20
Cameroon	Congo	Nigeria
Tanzania	Rwanda	Botswana
Malawi	Mozambique	Namibia
Guinea	Kenya	Mauritius
Madagascar	Ghana	South Africa
Uganda	Zambia	
	Zimbabwe	

Note: Table 4.1 categorisation of countries according to the IMF FDI. Countries with an FDI < 0.1 are categorised as Low FDI countries. Countries with an $0.1 < \text{FDI} < 0.2$ are categorised as Medium FDI countries and countries with $\text{FDI} > 0.2$ are categorised as High FDI countries.

Table 4.2 depicts descriptive statistics of the entire dataset used in this study. The mean registered mobile money accounts is 9.6 million across the subcontinent, with a range between 3,439 and 68.0 million. This is due to the rapid growth of mobile money across the region from 2010 to 2021 (Demirguc-Kunt et al., 2022). As a pioneer of mobile money, Kenya reported 68 million mobile money accounts in 2021, however other countries have followed closely behind and report over 15 million registered mobile money accounts; Ghana (48.3 million); Tanzania (41.4 million); Uganda (32.8 million); Zambia (19.3 million); Nigeria (23 million); Rwanda (15.9 million); Cameroon (15.6 million); and Zimbabwe (15.6 million). In contrast the lowest numbers of registered money accounts were reported by Mauritius (211,906); Namibia (3.4 million); Botswana (3.5 million); and Congo (3.6 million)³⁶.

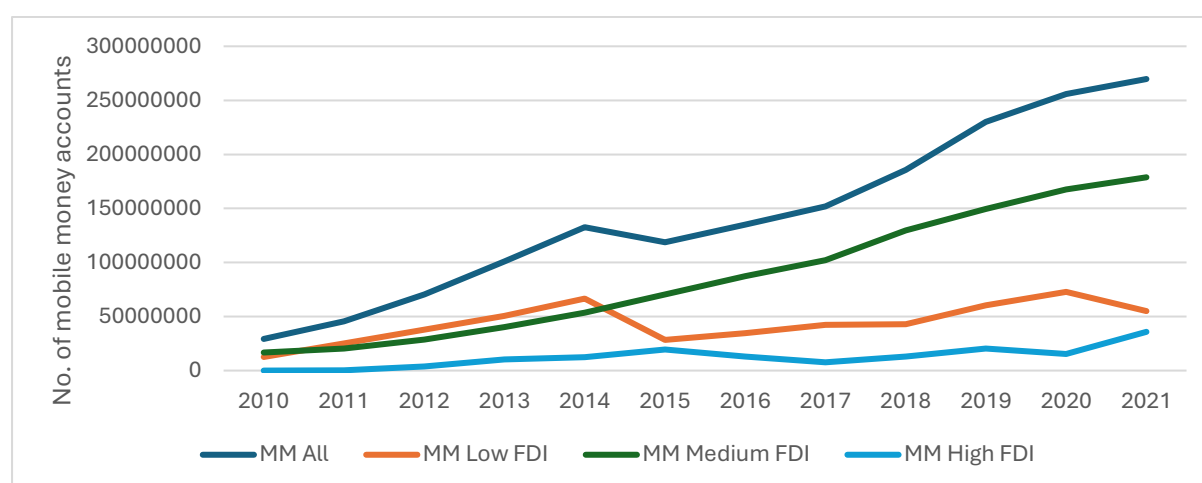
³⁶ Country- level descriptive statistics are in Appendix A (Table A1)

Table 4.2: Descriptive statistics for IMF, World Bank and ITU Dataset

Variable	Obs	Mean	Std. Dev.	Min	Max
Registered MM account	179	9641209	12447024	3439	68000000
Registered MM agent	163	68835.313	105180.05	4	620178
Active mobile money broadband	204	29.5	27.153	0	115.7
Deposit Account	200	9134085.2	16823745	0	72629200
Branches	209	2150.074	2944.418	49	23195
Value of MM transactions	167	7737084.7	22346740	.148	1.570e+08
Registered MM agent per km ²	165	389.858	870.42	0	5317.106
GDP Growth	216	1.538	4.127	-14.599	19.939
Urbanisation	216	13328185	20805947	515916	1.126e+08
Employment	216	65.327	13.511	35.13	86.03

Financial Development Groups	<u>FDI less than or equal 0.1</u>		<u>FDI between 0.1 and 0.2</u>		<u>FDI greater than 0.2</u>	
	Obs	Mean	Obs	Mean	Obs	Mean
Registered MM account	66	8953941.2	66	14894903	47	3228780.4
Registered MM agent	60	69387.6	62	95366.081	41	27907.39
Active mobile money broadband	81	13.753	66	31.567	57	49.482
Deposit Account	76	3270477.5	72	10733837	52	15488933
Branches	77	1905.026	72	2065.09	60	2566.533
Value of MM transactions	66	17942779	56	1216273.7	45	883520.32
Registered MM agent per km ²	60	256.955	64	669.997	41	147.061

In relation to FDI groups, medium FDI countries report the highest average mobile money accounts (14.9 million); followed by low FDI countries (8.9 million) and the relatively high FDI countries (3.2 million). Figure 2.1 shows the uptake of mobile money accounts from 2010 to 2021 across the sample and within the FDI based sub-categories. Figure 4.2 shows changes in the number of mobile money agents over the same period.

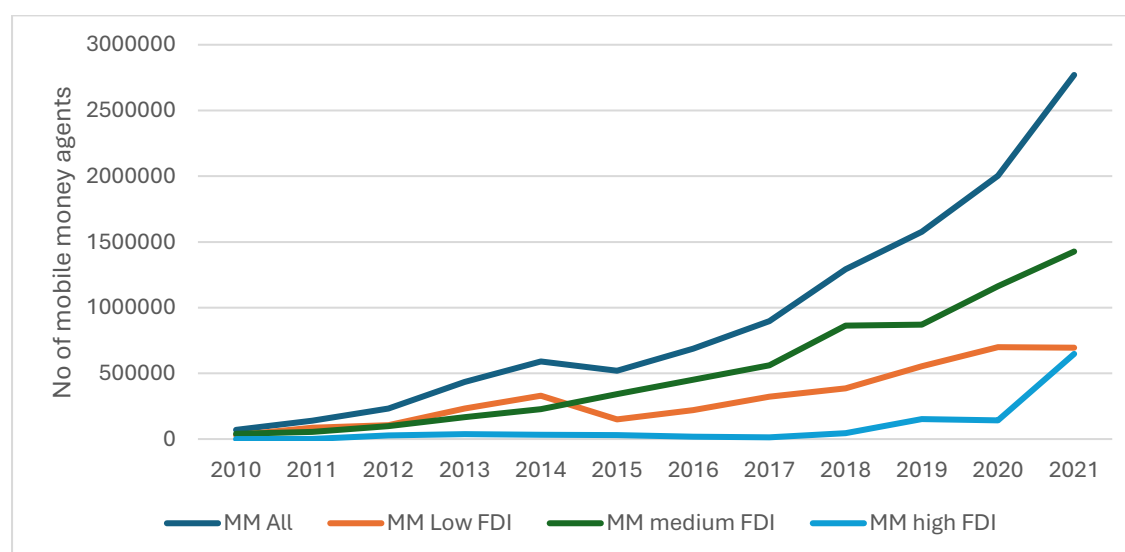
Figure 4.1: Movement in mobile money accounts across 18 sub-Saharan African countries

Note: Data was compiled using IMF Financial access survey, countries are divided into three categories, low financial development, medium financial development, and high financial development.

The mean value of registered mobile money agents is 68,835 with a minimum of 4 agents reported and a maximum of 620,178. Nigeria reports the highest number of registered mobile money agents, followed by Ghana (580,000) and Uganda (475,755). However, despite having a high volume of mobile money accounts and agents, Nigeria is still one of the lowest countries when it comes to adoption of mobile money, primarily due to the high population of the country (Mare et al., 2022). In terms of FDI categorization, medium FDI countries report the highest average number of agents (95,366); followed by low FDI countries (69,387) and finally the lowest figure is from high FDI countries (27,907). Figure 4.2 shows the increase in number of mobile money agents across the whole sample and across FDI categories between 2010 to 2021.

GSMA reports that the common access to internet in sub-Saharan Africa is through mobile phone (Awanis et al., 2021). The mean number of active mobile broadband subscriptions is 29.5, while the maximum number of subscriptions is 115.7. This indicates that in several jurisdictions some people have more than one mobile broadband subscription. The maximum number of mobile broadband subscriptions is reported by South Africa, followed by Mauritius (108.7 percent). The relatively high FDI countries report average mobile broadband subscription levels of 49.4 percent; followed by the medium high FDI countries (31.6 percent) and low FDI countries (13.7 percent).

Figure 4.2: Movement in mobile money agents across 18 sub-Saharan African countries



Deposit accounts have been widely used in different studies to represent financial

inclusion (Demir et al., 2022; Chikalipah, 2017; Demirgüç-Kunt and Klapper, 2012). This study reports the mean number of deposit accounts across the sample as 9.1 million, with a minimum of zero accounts and a maximum of 72.6 million accounts. The maximum number of deposit accounts is reported by Kenya. Not surprisingly relatively high FDI countries report the highest average deposit accounts (15.4 million); followed by medium FDI (10.7 million) and finally by low FDI countries (3.3 million).

In terms of financial institution branches, the mean number of branches reported is 2,150, with a maximum of 23,195 branches and a minimum of 49. Uganda reports the highest number of financial institution branches largely due to microfinance entities, followed by South Africa (15,363) (Okumu, 2007). Relatively high FDI countries reported the highest number of financial institution branches (2566); followed by medium FDI countries (2056); and low FDI countries (1905).

The final set of variables represent mobile money attributes these are derived from Diffusion of Innovation theory which discusses the innovation attributes of relative advantage, compatibility, observability, complexity and trialability to have a significant impact on adoption of the innovation (Rogers, 2003; Rogers et al., 2014). In this dataset the value of mobile money transactions and registered mobile money agents per km² represent mobile money attributes. The mean value of mobile money transactions is USD7.7 million, while the maximum is observed in Guinea (USD15.7 million), followed by Uganda (USD13.9 million). Low FDI countries report the highest mean value of mobile money transactions (USD 17.9 million), followed by medium FDI countries (USD 12.1 million) while relatively high FDI countries report the lowest (USD883,000). The mean registered mobile money agents per km² is 389, with a minimum of 0 and a maximum of 5317. Medium FDI countries report mean registered agents per km² as 670; followed by low FDI countries at 257 and relatively high FDI countries at 147.

4.4 Empirical Results

4.4.1 Impact of innovation attributes on mobile money adoption

We use OLS regressions to assess the impact of innovation attributes on adoption of fintech (represented by mobile money accounts). Table 4.3 below reports regression results on assessing the impact of innovation attributes of *relative advantage (value of transactions)* and *observability (agent availability)* on the mobile money adoption on the entire sample. In model (1) to (4) examines the impact of attributes without digital literacy, financial inclusion and

access to financial services to test the impact of mobile money attributes on their won. Model (5) investigates the impact of other factors (digital literacy, financial inclusion and access to financial services) without including mobile money attributes combined with control variables; and finally, model (6) examines mobile money adoption with all the factors.

Table 4.3 Impact of innovation attributes on mobile money adoption

	MM adoption (1)	MM adoption (2)	MM adoption (3)	MM adoption (4)	MM adoption (5)	MM adoption (6)
Digital Literacy (Active MM Broadband)					0.146*** (0.687)	0.088 (0.057)
Financial Inclusion (Deposit Account)					0.687*** (0.075)	0.697*** (0.073)
Financial Access (branches)					0.131** (0.058)	-0.103 (0.085)
Relative Advantage (value of transactions)	0.393*** (0.080)		0.218** (0.088)	0.115 (0.088)		0.163 (0.104)
Observability (Agent availability)		0.485*** (0.072)	0.412*** (0.075)	0.356*** (0.072)		0.234*** (0.054)
GDP Growth				-0.011 (0.083)	-0.011 (0.052)	-0.022 (0.055)
Urbanisation				0.866** (0.343)	2.826*** (0.593)	2.362*** (0.607)
Employment				-0.722* (0.436)	0.434 (0.301)	0.289 (0.031)
Constant	0.134*** (0.010)	0.119*** (0.009)	0.117*** (0.010)	0.475 (0.292)	-0.496** (0.204)	-0.367* (0.216)
Observations	163	165	154	154	162	145
R-Squared	0.141	0.218	0.253	0.352	0.721	0.751
Country Fixed effects	Y	Y	Y	Y	Y	Y
Year Fixed effects	Y	Y	Y	Y	Y	Y

Note: Table 4.3 reports regression results for the impact of innovation attributes on mobile money (MM) adoption. Relative advantage is measured by value of transactions, observability is measured by agent availability, digital literacy is measured by active mobile broadband subscriptions, financial inclusion is measured by deposit accounts and financial access is measured by financial institution branches. GDP growth per capita, urbanization and employment are control variables added to the model. The dependent variable fintech adoption is measured by mobile money accounts. Regressions are run investigating impact of innovation attributes model (1) to (4); without attributes (model (5)) and with all factors (model (6)). Coefficients are reported with standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Results in Table 4.3 support hypothesis **H₁** and **H₂** as relative advantage and observability have a positive impact on mobile money adoption in sub-Saharan Africa. The coefficient for relative advantage, 0.393 is positive and significant at the 1% level in model (1), similarly the coefficient of observability, 0.485 is positive and significant at the 1% level in model (2). In model (3) the combined effect of the two attributes, results in both the relative advantage and observability being positive and significant with observability showing stronger effects at the 1% level and coefficient of 0.412. In model (4) with the addition of the control

variables relative advantage loses its significance however observability remains significant at the 1% level with a coefficient of 0.356. These findings suggest that observability is an important factor in mobile money adoption supporting hypothesis **H₂**. Our findings are similar with previous research that found that users were willing to pay mobile money transaction costs to avoid walking long distances to banks (Economides and Jeziorski, 2017). The ability to see mobile money agents around the user would influence mobile money adoption. When combined with other factors the observability remains positive and significant in model (6), with a coefficient of 0.234. The results suggest that a 23-48% increase in mobile money adoption could be attributed to 1 point increase in observability.

Model (5) shows a review of the impact of the other factors without mobile money attributes. On their own digital literacy, financial inclusion and access to finance are significant at the 5% level or above. Existing level of financial inclusion having a higher effect on mobile money adoption. Introduction of observability and relative advantage in model (6) results in digital literacy and financial access losing significance, however existing levels of financial inclusion remain significant at the 1% level with a coefficient of 0.697. This supports hypothesis **H₄** that financial inclusion has a positive impact on mobile money adoption. Further, observability has strong effects with a coefficient of 0.234 at the 1% level.

And introduction of control variables show urbanisation is positive and significant at the 1% level in models (4), (5) and (6). As cities develop and more people migrate from rural to urban areas the demand for financial services increases and therefore the demand for mobile money also increases (Lashitew et al., 2019).

4.4.2 Analysis of factors impacting mobile money adoption from 2010-2021

Our analysis divides the time into three main categories, 2010-2014 (initial phase); 2015-2018 (operational phase) and 2018-2021(Covid-19 phase). A review of the evolution of mobile money indicates that most sub-Saharan African countries introduced mobile money between 2010-2014, indicating an initial period of mobile money adoption (Scharwatt et al., 2014; Suri, 2017). During the operational period (2015-2018) mobile money underwent an evolution through by transitioning from basic peer-to-peer functions of sending and receiving remittances into new functions and features such as interoperability between mobile money providers, digital micro-credit, utility bill payment and international remittance among others (Tembo and Okoro, 2021; Adaba et al., 2019; Centellegher et al., 2018). During the Covid-19

phase governments put in place initiatives to improve mobile money adoption as a way of mitigating the risk presented by cash-based transactions. Some of the initiatives that were employed include reduction and removal of transaction fees, government use of mobile money for social payments and Covid-19 support schemes, regulatory reform by increasing transaction limits and allowing remote registration and simplified KYC (Ozili, 2022; World Bank, 2021; IMF, 2020).

This section examines the factors that impact mobile money adoption over the last twelve years, by examining progression through the initial phase (2010-2014), operational phase (2015-2018) and Covid-19 phase (2019-2021). The division in years aims to analyse factors that impacted mobile money adoption in the initial inception phase, the years following the initial phase prior to Covid-19 pandemic and finally the impact of Covid-19 on mobile money adoption. This is because during 2019-2021 there was a surge in mobile money adoption (Figure 2.1) and governments in sub-Saharan Africa made deliberate policies to encourage mobile money adoption such as; reducing transaction fees, increasing transaction thresholds and encouraging social cash transfers through mobile money (Demirgüç-Kunt et al., 2022). For example, countries such as Zambia, Malawi, Tanzania used mobile money to transfer cash to vulnerable households for relief against the pandemic; whereas in Kenya transaction cost for person-to-person transfers were removed during the pandemic period (Akinyemi et al., 2020). Further countries looking to introduce mobile money for the first time could examine the initial phase to see which factors were important in mobile money adoption. This would allow policy makers and governments to enable an operating environment that would encourage mobile money adoption.

Table 4.4 reports OLS regression results across the year groups for mobile money adoption. The results for the initial adoption phase of mobile money indicate that relative advantage is significant at the 1% level during this phase with a coefficient of 1.372. These findings support **H₁** that relative advantage is important in mobile money adoption. This is because during mobile money inception the attribute such as perception of usefulness of mobile money would have a significant impact on mobile money adoption (Rogers, 2003). During the early stages of mobile money sending and receiving remittances eliminated the need to send cash physically through couriers, becoming one of the most important reasons for mobile money adoption (Mugambi et al., 2014; Lashitew et al., 2019). Existing levels of financial inclusion are also significant during the inception stage, however with weaker effects at the 5% level, supporting hypothesis **H₄**.

Table 4.4 Factors impacting mobile money adoption 2010-2021

	MM Adoption (1) 2010-2014	MM Adoption (2) 2015-2018	MM Adoption (3) 2019-2021
Digital Literacy (Active MM Broadband)	0.089 (0.113)	0.254*** (0.086)	-0.128 (0.087)
Financial Inclusion (Deposit Account)	0.331** (0.121)	0.309 (0.205)	0.747*** (0.186)
Financial Access (branches)	0.232 (0.251)	0.024 (0.116)	-0.131* (0.076)
Relative Advantage (value of transactions)	1.372*** (0.131)	0.053 (0.256)	0.056 (0.087)
Observability (Agent availability)	0.255 (0.168)	0.047 (0.123)	0.136 (0.085)
GDP Growth	-0.052 (0.077)	0.043 (0.087)	-0.016 (0.034)
Urbanisation	0.937 (0.833)	0.867 (1.064)	9.845*** (1.567)
Employment	-0.086 (0.230)	2.032** (0.781)	0.101 (0.383)
Constant	0.010 (0.165)	-1.354** (0.523)	-0.640* (0.320)
Observations	49	42	54
R-Squared	0.920	0.598	0.823
Country Fixed effects	Y	Y	Y
Year Fixed effects	Y	Y	Y

Note: Table 4.4 reports regression results for the impact of relative advantage, observability, digital literacy, financial inclusion, and financial access on mobile money adoption between 2010-2021. Digital literacy is measured by active mobile broadband subscriptions, financial inclusion is measured by deposit accounts and financial access is measured by financial institution branches. GDP growth per capita, urbanization and employment are control variables added to the model. The dependent variable fintech adoption is measured by mobile money accounts. The regressions are run on mobile money demand, model (1) represents 2010 to 2014; model (2) represents 2015 to 2018 and model (3) represents 2019-2021. Coefficients are reported with standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Further, the results suggest that digital literacy is significant and positively related to mobile money adoption, at the 1% level during the operational pre-Covid 19 phase (2015-2018) for mobile money. The coefficient for digital literacy is 0.254, this was the period when more functionalities beyond sending and receiving remittances were introduced, such as bill payment, international fund transfers which would require more digital skills. These findings support hypothesis **H3** that digital literacy is significant in mobile money adoption. Further,

during the inception of mobile money, results suggest that digital literacy was not significant. This could be because early adoption could have been more influenced by social setting, observing friends and family using mobile money rather than skills (Dearing and Cox, 2018). In addition, initial mobile money services only offered cash transfer mechanism, as the innovation evolved over time more functionality such as micro credit, bill payment, international transfers began to emerge that required more digital skills (Scharwatt et al., 2014). Sub-Saharan Africa lags behind in digital skills required to operate fintech applications, Delaporte and Bahia (2022) report that in 2021 61% of adults in sub-Saharan Africa did not use mobile internet despite having access largely due to lack of digital skills. Further, across the sample the average percentage of population using mobile broadband is 41% while the average population using the internet in 2021 was 31% (ITU, 2022). The results are consistent with prior findings that suggest that basic digital skills or the ability to operate digital devices improves the adoption of mobile money (Kass-Hanna et al., 2021).

During the Covid-19 phase results show that financial inclusion is significant at the 1% level with a coefficient of 0.747, further supporting hypothesis **H4**. Existing levels of financial inclusion have a strong effect resulting in more mobile money adoption, this could be because of government interventions to reduce cash transactions by providing pandemic relief through mobile money and removing transaction costs to facilitate easier and cheaper transactions, resulting in a higher need for mobile money adoption (Akinyemi et al., 2020).

Control variables do not show significant effects in model (1) and model (2), however in model (3) urbanisation is significant at the 1% level. These results mirror results in Table 4.1 model (6).

4.4.3 Analysis of factors affecting fintech adoption (countries grouped by IMF Financial Development Index (FDI))

Countries are analysed by IMF FDI to further allow generalisations to be made based on the levels of financial development. Countries with similar financial development capability are analysed and results can be applied to other countries that are not included in the sample. The level of financial development is associated with economic growth and innovation (Hassan et al., 2011), in addition mobile money has been found to have an impact on financial development (Muganyi et al., 2022). We therefore investigate the level of mobile money adoption based on financial development of countries in sub-Saharan Africa and our findings are presented in Table 4.5.

4Results indicate that for High FDI countries none of the factors are significant for mobile money adoption. This is because of these countries reporting high levels of bank accounts and therefore individuals are more likely to own a bank account for financial transactions than a mobile money account (Demirgüç-Kunt et al., 2022). However, results show that urbanisation is significant at the 1% level for mobile money adoption. As people move from rural areas to urban areas, mobile money would serve as a medium for adoption.

Medium FDI countries reveal that existing levels of financial inclusion have are significant for mobile money at adoption at the 1% level with a coefficient of 0.458, supporting hypothesis **H4**. This supports our findings in section 4.3.1 and 4.3.2, increasing financial inclusion, increases mobile money adoption. Countries with high mobile money usage such as Kenya, Rwanda and Ghana are in this group and report higher levels of mobile money accounts compared to bank accounts (Demirgüç-Kunt et al., 2022). Further results indicate that observability through availability of mobile money agents is significant at the 1% level with a coefficient of 0.197. This provides further evidence supporting hypothesis **H2**. Jurisdictions where mobile money agents are more than financial institution branches have reported higher numbers in mobile money accounts compared to financial institution accounts due to easy and convenient access to agents (Caputo, 2019). Urbanisation is a key driver of mobile money adoption in Medium FDI countries, as rural areas develop, mobile money provides a medium for financial transactions.

Low FDI countries report that only digital literacy is significant at the 5% level with a coefficient of 0.068, supporting hypothesis **H3**. Results indicate that other factors are not significant. Low FDI countries have poor access to internet and digital financial services resulting in low digital skills. Enhancing the digital skills could result in more uptake of mobile money. Studies have shown that use of mobile money require low digital knowledge (Suri, 2017; Jack and Suri, 2011), therefore digital skills programs could lead improved access to financial services through mobile money adoption.

Table 4.5 Factors impacting mobile money adoption for Low, Medium and High FDI countries

	High FDI	Medium FDI	Low FDI
Digital Literacy (Active MM Broadband)	-0.135 (0.171)	0.062 (0.070)	0.068** (0.027)
Financial Inclusion (Deposit Account)	0.214 (0.528)	0.458*** (0.084)	-0.265 (0.319)
Financial Access (branches)	-0.243* (0.137)	0.169 (0.131)	0.447 (0.360)
Relative Advantage (Value of transactions)	0.123 (0.100)	-1.959* (1.135)	-36.662 (27.472)
Observability (Agent availability)	0.558 (0.373)	0.197*** (0.060)	-0.038 (0.057)
GDP Growth	0.033 (0.137)	0.002 (0.061)	0.018 (0.026)
Urbanisation	4.813*** (1.100)	8.602*** (1.060)	1.236 (1.103)
Employment	-0.657 (0.514)	-0.160 (0.445)	0.083 (0.154)
Constant	0.260 (0.379)	-0.400 (0.363)	-0.182 (0.126)
Observations	48	62	35
R-Squared	0.798	0.938	0.310
Country Fixed effects	Y	Y	Y
Year Fixed effects	Y	Y	Y

Note: Table 4.5 reports regression results for the impact of relative advantage, observability, digital literacy, financial inclusion, and financial access on mobile money adoption on countries grouped by FDI. Digital literacy is measured by active mobile broadband subscriptions, financial inclusion is measured by deposit accounts and financial access is measured by financial institution branches. GDP growth per capita, urbanization and employment are control variables added to the model. The dependent variable is mobile money adoption measured by mobile money accounts. Regressions are run on mobile money demand, model (1) represents low FDI countries, model (2) represents medium FDI countries and model (3) represents high FDI countries. Coefficients are reported with standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

4.5 Robustness Test

4.5.1 Re-estimate Table 4.3 using mobile money agent as dependent variable

To test robustness, we use an alternate variable number of mobile money agents (supply side of mobile money) to represent mobile money adoption. (Allen et al., 2016; Demirgüç-Kunt and Klapper, 2012). We re-estimate Table 4.3 using the number of mobile money agents

as the regressor. The results are reported in Table 4.4 below. Results are like our findings in Table 4.1 above and support hypothesis **H₁** and **H₂** as observability and relative advantage have a positive impact on mobile money adoption in sub-Saharan Africa. Model (1) reveals that relative advantage is significant at the 1% level with a coefficient of 0.563. Similarly, model (2) reveals that observability is significant at the 1% level with a coefficient of 0.635. Model (6) also reflects our findings in Table 4.1 on the demand side of mobile money and shows financial inclusion is positively significant at the 1% level supporting hypothesis **H₄**.

Table 4.6 Re-estimate Table 4.1 -Impact of innovation attributes on mobile money adoption

	MM adoption (1)	MM adoption (2)	MM adoption (3)	MM adoption (4)	MM adoption (5)	MM adoption (6)
Digital Literacy (Active MM Broadband)					0.182** (0.074)	0.068 (0.075)
Financial Inclusion (Deposit Account)					0.196* (0.102)	0.210** (0.095)
Financial Access (branches)					0.383*** (0.081)	0.096 (0.110)
Relative Advantage (value of transactions)	0.563*** (0.113)		0.406*** (0.103)	0.307*** (0.092)		0.257* (0.136)
Observability (Agent availability)		0.635*** (0.086)	0.547*** (0.087)	0.488*** (0.075)		0.347*** (0.070)
GDP Growth				0.052 (0.090)	0.036 (0.077)	0.026 (0.074)
Urbanisation				2.339*** (0.357)	3.804*** (0.831)	3.835*** (0.079)
Employment				0.153 (0.455)	0.441 (0.418)	0.510 (0.404)
Constant	0.087*** (0.012)	0.064*** (0.011)	0.052*** (0.012)	-0.345 (0.304)	-0.649** (0.293)	-0.680 (0.280)
Observations	152	163	152	152	148	143
R-Squared	0.157	0.273	0.350	0.549	0.552	0.633
Country Fixed effects	Y	Y	Y	Y	Y	Y
Year Fixed effects	Y	Y	Y	Y	Y	Y

Note: Table 4.6 reports regression results for the impact of innovation attributes on mobile money (MM) adoption. Innovation attributes are measured by value of transactions and agent availability, digital literacy is measured by active mobile broadband subscriptions, financial inclusion is measured by deposit accounts and financial access is measured by financial institution branches. GDP growth per capita, urbanization and employment are control variables added to the model. The dependent variable fintech adoption is measured by mobile money agents. Regressions are run investigating impact of innovation attributes model (1) to (4); without attributes (model (5)) and with all factors (model (6)). Coefficients are reported with standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Combined effects of mobile money attributes in model (3) reveal significant coefficients at the 1% level, relative advantage (0.406) and observability (0.488). The addition of control variables in model (4) lessens the effects of the mobile money attributes, however they remain significant at the 1% level. Combined with the effects of other variables in model

(6) show relative advantage loses its significance, however, observability remains significant at the 1% level with a coefficient of 0.347, supporting hypothesis **H₂**.

4.5.2 Re-estimate Table 4.2 Factors impacting mobile money adoption 2010-2021

Table 4.7 below re-estimates Table 4.2 using mobile money agents as the dependent variable. Results show similar effects to Table 4.2. Model (1) confirms the impact of financial inclusion on mobile money adoption, with a coefficient of 0.514 at the 1% level, supporting hypothesis **H₄**. In addition, relative advantage is also significant at the 1% with a coefficient of 1.150, confirming our previous findings and hypothesis **H₁**. Results for digital literacy in model (2) further confirm hypothesis **H₃** that digital literacy is significant in mobile money adoption, like our findings in Table 4.2 model (2)

Table 4.7 Re-estimate Table 4.2 - Factors impacting mobile money adoption 2010-2021

	MM adoption (1) 2010-2014	MM adoption (2) 2015-2018	MM adoption (3) 2019-2021
Digital Literacy (Active MM Broadband)	0.041 (0.80)	0.196*** (0.050)	-0.359** (0.149)
Financial Inclusion (Deposit Account)	0.514*** (0.086)	0.184 (0.120)	-0.159 (0.322)
Financial Access (branches)	0.050 (0.179)	-0.010 (0.068)	0.211 (0.129)
Relative Advantage (value of transactions)	1.150*** (0.093)	0.281* (0.150)	0.094 (0.148)
Observability (Agent availability)	0.176 (0.120)	0.191** (0.072)	0.484*** (0.146)
GDP Growth	-0.014 (0.055)	0.000 (0.051)	0.016 (0.061)
Urbanisation	-0.417 (0.593)	2.565*** (0.624)	14.128*** (2.672)
Employment	0.014 (0.164)	2.600*** (0.458)	0.450 (0.664)
Constant	0.003 (0.118)	-1.901*** (0.307)	-1.085* (0.546)
Observations	49	42	52
R-Squared	0.931	0.860	0.814
Country Fixed effects	Y	Y	Y
Year Fixed effects	Y	Y	Y

Note: Table 4.5 reports regression results for the impact of innovation attributes, digital literacy, financial inclusion, and financial access on mobile money adoption between 2010-2021. Digital literacy is measured by active mobile broadband subscriptions, financial inclusion is measured by deposit accounts and financial access is measured by financial institution branches. GDP growth per capita, urbanization and employment are control variables added to the model. The dependent variable fintech adoption is measured by mobile money agents. The regressions are run on mobile money supply, model (1) represents 2010 to 2014; model (2) represents 2015 to 2018 and model (3) represents 2019-2021. Coefficients are reported with standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

4.5.3 Re-estimate Table 4.3 Factors impacting mobile money adoption in low, medium and high FDI countries.

Table 4.6 below re-estimates Table 4.3 above using mobile money agents as the dependent variable for low, medium and high FDI countries. The results in model (2) support **H₂** for medium FDI countries, reflecting our findings in Table 3 model (2). Robustness tests fail for model (1) and model (3).

Table 4.8 Re-estimate Table 4.3 - Factors impacting mobile money adoption for Low, Medium and High FDI countries

	MM adoption (1) High FDI	MM adoption (2) Medium FDI	MM adoption (3) Low FDI
Digital Literacy (Active MM Broadband)	-0.244* (0.137)	-0.031 (0.105)	0.008 (0.006)
Financial Inclusion (Deposit Account)	-0.466 (0.423)	-0.202 (0.126)	-0.048 (0.067)
Financial Access (branches)	-0.043 (0.110)	-0.079 (0.201)	-0.185** (0.076)
Relative Advantage (value of transactions)	0.144* (0.080)	-2.072 (1.698)	-6.291 (5.788)
Observability (Agent availability)	1.590*** (0.298)	0.379*** (0.090)	0.010 (0.012)
GDP Growth	-0.205* (0.110)	0.082 (0.101)	0.004 (0.005)
Urbanisation	5.134*** (0.880)	14.939*** (1.594)	-0.006 (0.232)
Employment	0.600 (0.411)	0.807 (0.669)	-0.027 (0.032)
Constant	-0.698** (0.303)	-1.581*** (0.545)	0.036 (0.027)
Observations	48	60	35
R-Squared	0.939	0.860	0.694
Country Fixed effects	Y	Y	Y
Year Fixed effects	Y	Y	Y

Note: Table 4.5 reports regression results for the impact of innovation attributes, digital literacy, financial inclusion, and financial access on mobile money adoption on countries grouped by FDI. Digital literacy is measured by active mobile broadband subscriptions, financial inclusion is measured by deposit accounts and financial access is measured by financial institution branches. GDP growth per capita, urbanization and employment are control variables added to the model. The dependent variable is mobile money adoption measured by mobile money accounts. Regressions are run on mobile money demand, model (1) represents low FDI countries, model (2) represents medium FDI countries and model (3) represents high FDI countries. Coefficients are reported with standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

4.5.4 Re-estimate Table 4.1 Factors impacting mobile money adoption excluding Kenya from the sample

As a further robustness test we re-estimate Table 4.1 excluding Kenya from the sample as Kenya is the most influential country in mobile money usage (Demirgüç-Kunt et al., 2022; Jack and Suri, 2011). Results are reported in Table 4.7 below. The results are like our findings

in Table 4.1 and Table 4.4; observability maintains high significance at the 1% level supporting hypothesis **H₂** throughout the analysis. Relative advantage is significant in models (1) and model (3) and starts losing significance at the introduction of control variables. In the absence of relative advantage and observability, financial inclusion has a positive impact on mobile money adoption at the 1% level.

Table 4.9 Re-estimate Table 4.1 Impact of innovation attributes on mobile money adoption (Excluding Kenya)

	MM adoption (1)	MM adoption (2)	MM adoption (3)	MM adoption (4)	MM adoption (5)	MM adoption (6)
Digital Literacy (Active MM Broadband)					0.154*** (0.052)	0.116* (0.059)
Financial Inclusion (Deposit Account)					0.795*** (0.296)	0.485* (0.291)
Financial Access (branches)					0.125* (0.067)	-0.081 (0.088)
Relative Advantage (value of transactions)	0.376*** (0.063)		0.207*** (0.064)	0.163** (0.064)		0.180* (0.103)
Observability (Agent availability)		0.419*** (0.053)	0.375*** (0.054)	0.346*** (0.052)		0.238*** (0.054)
GDP Growth				-0.047 (0.061)	-0.022 (0.052)	-0.032 (0.055)
Urbanisation				0.838*** (0.251)	2.785*** (0.642)	2.582*** (0.646)
Employment				0.003 (0.328)	0.667** (0.307)	0.545* (0.317)
Constant	0.102*** (0.008)	0.089*** (0.007)	0.086*** (0.008)	0.007 (0.217)	-0.642*** (0.206)	-0.541** (0.219)
Observations	151	153	142	142	150	133
R-Squared	0.212	0.315	0.373	0.415	0.577	0.597
Country	Y	Y	Y	Y	Y	Y
Fixed effects						
Year Fixed effects	Y	Y	Y	Y	Y	Y

Note: Table 4.3 reports regression results for the impact of innovation attributes on mobile money (MM) adoption excluding Kenya from the sample. Innovation attributes are measured by value of transactions and agent availability, digital literacy is measured by active mobile broadband subscriptions, financial inclusion is measured by deposit accounts and financial access is measured by financial institution branches. GDP growth per capita, urbanization and employment are control variables added to the model. The dependent variable fintech adoption is measured by mobile money accounts. Regressions are run investigating impact of innovation attributes model (1) to (4); without attributes (model (5)) and with all factors (model (6)). Coefficients are reported with standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

4.6 Discussion

Our empirical results indicate that innovation attributes of relative advantage and observability are important in mobile money adoption supports hypothesis **H₁** and **H₂**. Our results are like previous findings that showed that users are more likely to adopt an innovation that they find useful and fits into their everyday lives (Mugambi et al., 2014; Lashitew et al., 2019). The value of mobile money transactions indicates how mobile money fits into everyday lives and therefore how useful it is for transactions. Our findings support that users will adopt an innovation if found useful relative advantage explains 11% - 40% of the adoption. Another area where our innovation attributes play an important role is through observability, proxied by the number of mobile money agents per km². Results indicate that increasing access point for mobile money results in high uptake of the innovation. Our results suggest that observability, access of mobile money through agents, explain 23% - 49% of mobile money adoption. Countries where mobile money has thrived such as Kenya, Ghana, Uganda, report over ten times more mobile money agents compared to bank branches (Caputo, 2019). In sub-Saharan Africa mobile money agents are a common occurrence and provide the convenience of transacting without having to walk long miles, particularly in areas where there is no financial institution infrastructure (Economides and Jeziorski, 2017; Batista and Vicente, 2020; Narteh et al., 2017).

Further, our results support that existing levels of financial inclusion are a strong driver for mobile money adoption. Financial inclusion has been found to have significant effects on economic growth, reducing inequalities and women empowerment with strong impact on low-income jurisdictions (Sethi and Acharya, 2018; Mohammed et al., 2017). Our results support hypothesis **H₄** and show that existing levels of financial inclusion can act as a driver for increasing financial inclusion through mobile money adoption. Government initiatives to increase financial inclusion by lowering transaction costs, promoting women access and encouraging social cash transfers through mobile money could have a positive effect on mobile money adoption (Demirgüç-Kunt et al., 2022). We find that existing levels of financial inclusion are particularly important during the Covid-19 period. This is a period where governments such as Zambia, Malawi and Tanzania used mobile money for social cash transfers to provide relief against the pandemic; other jurisdiction such as Kenya removed transactions costs for person-to-person transfers (Akinyemi et al., 2020).

Across the results digital literacy does not show strong effects for mobile money adoption. Notable influence of digital literacy is during the period of 2015-2018 where mobile

money was operationalised. This could be because of initially mobile money services only offered cash transfers but as more functionality such as micro credit, bill payments, international transfers which required more digital skills were required (Scharwatt et al., 2014). Another reason for the lack of strong effects of digital literacy could be because of mobile money has been influenced by social setting and therefore digital skills to operate are learnt by observing friends and family use the application (Dearing and Cox, 2018). At the country level digital literacy has a strong impact on Medium FDI countries. This grouping has countries high in mobile money adoption such as Kenya, Uganda and Ghana. In these countries it is easier to get access to digital knowledge due to lower mobile broadband costs (GSMA, 2022). In contrast Low FDI countries such as Malawi, Congo, Madagascar are characterised with poor infrastructure, high internet costs and electricity challenges which have a negative impact on development of digital skills (Nedungadi et al., 2018). At the policy level countries that wish for mobile money to evolve and be an alternative to owning banks accounts should invest in digital literacy programs to ensure users are aware of risks associated with mobile money operations.

4.7 Conclusion

DOI theory suggests that the attributes of an innovation are one of the main contributing factors for users to adopt an innovation. Innovation attributes that fit into a user's lifestyle, improves efficiency, allows the user to test the functionality, provides services the user deems to be advantageous and fits into their lifestyle, are most likely contribute to the user making the choice to adopt the innovation. Mobile money is a key financial innovation that has the potential to bring the unbanked and financially underserved into the formal financial sector and has seen notable success in sub-Saharan Africa. The attributes of mobile money combined with other factors such as digital literacy, financial inclusion and access to financial services can influence the adoption of mobile money.

This chapter investigated the relationship between mobile money adoption and financial inclusion, digital literacy, financial access, and mobile money attributes (represented by value of mobile money transactions and agent availability) for 18 sub-Saharan countries. The investigation used data from 2010-2021, compiled from the World Bank, IMF, and ITU databases. Further, countries were divided into three categories according to the IMF FDI, with the purpose of grouping countries with similar levels of financial development and assessing how mobile money adoption fairs across these countries. We incorporate a degree of robustness to our findings, through an investigation of mobile money adoption with mobile money agents

as the dependent variable, alongside mobile money accounts, thus evaluating mobile money adoption from both the demand and supply side.

This study begins to highlight some cross-country differences that offer possible explanations for why mobile money adoption is not uniform across sub-Saharan Africa. One of the major challenges for the study was availability of data to represent mobile money adoption and mobile money attributes. Further studies could include other factors such as financial literacy and increase the scope of mobile money attributes investigated. In addition, country specific studies could provide more insight at country-level. Our study begins to highlight how mobile money can be used to enhance financial inclusion. In Chapter 5 we explore further the use of mobile money as a measure for financial inclusion.

5.0 Mobile money as a measure of financial inclusion in sub-Saharan Africa

5.1 Introduction

This chapter examines mobile money usage as a direct indicator of financial inclusion and seeks to understand how demographic characteristics, financial literacy, digital literacy and country-level mobile money sophistication influence three types of usage – sending, receiving and bill payments. The chapter aims to answer the general research question *Can mobile money be used to measure financial inclusion in sub-Saharan Africa?* This chapter applies digital literacy from the extended DOI framework introduced in Chapter 4, and incorporates financial literacy in investigating financial inclusion.

5.2 Theoretical Background

As discussed in Chapter 2 Section 2.1.1 there is no formal definition of financial inclusion. Different scholars have provided different definitions of financial inclusion. Ozili (2018 pp 458) defined financial inclusion as “the process of ensuring individuals, especially poor people have access to basic financial services in the formal financial system”, emphasising access to finance by the poor. Senyo and Osabutey (2020, pp 2) explained financial inclusion as “as access to useful and affordable financial services and products such as payments, deposits, insurance and loans by organisations and individuals”, emphasising on the products usefulness and affordability and the nature of financial products. In contrast to the previous definitions, Park and Mercado (2018, pp 185) financial inclusion in terms of ‘*accessibility*’, ‘*availability*’ and ‘*usage*’ of formal financial services for all to reduce financial exclusion. On the other hand, Hollanders (2020) argued that ‘*usage*’ was more reflective of how valuable and beneficial a service is to a user. Demir et al. (2022) support the view of ‘*usage*’ as being more reflective of financial inclusion as availability and accessibility do not reflect how many people are using the service. Usage of financial services include functions such as investing in businesses, saving money for future purchases such as a house, education or medical treatment (Demirgüç-Kunt and Klapper, 2013). This chapter supports the view of ‘*usage*’ and therefore discusses financial inclusion in terms of using financial services. Usage of mobile money is important because it captures behaviour rather than just access and therefore different types of usage represent increasingly complex forms of engagement with the financial system (Suri, 2017).

This study seeks to investigate the factors that impact financial inclusion in sub-Saharan Africa. Mobile money provides cost-effective and efficient money transfers, easy access to agents, a facility for paying bills and a platform to facilitate savings (Shirono, 2021), therefore it is expected for users to utilise mobile money for daily financial transactions where no alternative exists. Mobile money usage in sub-Saharan Africa is the highest globally and has shown improved levels of financial inclusion across the sub-continent (Demirgüç-Kunt et al., 2022; GSMA, 2023). However, despite government initiatives and interventions from international bodies to promote financial inclusion through money usage, some countries report low adoption rates (Demirguc-Kunt et al., 2022). We therefore seek to explore the factors that impact financial inclusion across sub-Saharan Africa.

Specifically, the study investigates how existing levels of digital and financial literacy and demographic variables impact mobile money usage. Based on prior research, discussed in each of the following sub-sections, we propose that financial inclusion is impacted by: (i) digital literacy, (iii) financial literacy, and (iv) user demographics such as age, education, income, and gender. For example, older generations may be less likely to engage with mobile money because they are less inclined to have digital skills to use digital innovations (Elena-Bucea et al., 2021). Further, mobile money providers enforce a transaction limit in some jurisdictions, which could result in higher-income individuals not adopting the innovation. Alternatively, these individuals are more likely to prefer the use of a bank account (Amoah et al., 2020; Marumbwa, 2014).

5.3 Hypothesis Development

5.3.1 Digital Literacy

Digital literacy is essential for effective operation of digital gadgets and innovations. Navigating through mobile money applications and user menus requires a degree of technological skill and, if users perceived the technical knowledge required to use fintech to be too advanced, they would not be comfortable using the innovation (Kalba, 2016; Kass-Hanna et al., 2021), presenting a barrier to mobile money adoption. A lack of digital skills has been proposed as a key hindrance to the uptake of digital financial services, and therefore other researchers have suggested that digital literacy could impact the levels of mobile money usage (Triki and Faye, 2013; Sinha et al., 2018)³⁷. In sub-Saharan Africa, poor infrastructure and low-connectivity have resulted in slow acquisition of digital skills compared to other developed

³⁷ For further, discussion on digital literacy refer to Chapter 2, section 2.3.6

H₁: Digital literacy positively influences financial inclusion in sub-Saharan Africa through mobile money usage.

5.3.2 Financial Literacy

Financial literacy is important for financial well-being, planning and making sound financial decisions, assessing risks associated with financial products, and choosing financial products and services that meet one's needs (Dewi et al., 2020b; Lusardi, 2019; Lusardi and Mitchell, 2011b; Bongomin et al., 2020b). Mobile money products are designed for vulnerable members of society characterised as having low financial literacy (Saka-Helmhout et al., 2020; Gabor and Brooks, 2017). Bongomin et al. (2020a) suggested that low financial literacy levels are the result of limited channels to provide financial education for consumers, while researchers have shown that increased financial literacy improves understanding and uptake of financial products (Domeher et al., 2014; Hussain and Sajjad, 2016). For developing regions such as sub-Saharan Africa, financial literacy is associated with empowering people to make their own financial decisions (Bongomin et al., 2020b; Andreou and Anyfantaki, 2021).

H₂: Financial literacy positively influences financial inclusion in sub-Saharan Africa through mobile money usage.

5.3.3 Demographic Variables

Studies investigating the relationship between adoption of mobile money with gender have revealed different results, dependent on the jurisdiction. Reynolds et al. (2023) suggests that in countries where mobile money is more established (such as Kenya, Tanzania, and Uganda) gender is not a significant determinant of adoption. Conversely, in countries where mobile money is emerging (such as India, Nigeria, and Pakistan) men are more likely to use mobile money than women. This is largely because men are more likely to have a source of income and represent a larger share of financial responsibility in the household (Lotto, 2018; Reynolds et al., 2023). Further, GSMA (2022) report a decrease in the gender gap in recent years, however statistics show that 28% women in low- and medium-income countries are less likely to own a mobile money account.

H_{3a}: Women are less likely to use mobile money services in sub-Saharan Africa

Education

People who completed primary school and above are more likely to adopt digital financial services as they have the skills and knowledge to use and understand technology-related innovations (Elena-Bucea et al., 2021). In sub-Saharan African countries where mobile money is emerging, lack of usage has been associated with lack of product awareness, poor training, fear of fraud, and lack of technology awareness, which can be improved by education (Akinyemi et al., 2020). Myeni et al. (2020) posit that in Eswatini, those with tertiary education had an 18.5% likelihood of using mobile money compared to 10% with a secondary education. This is similar to findings in Ghana suggesting that, increasing educated people by 10% would increase mobile money usage by 24% (Amoah et al., 2020). This study proposes that education has a positive effect on mobile money usage.

H_{3b}: Higher level of education positively impacts the use of mobile money to achieve financial inclusion in sub-Saharan Africa

Income

People have a greater demand for financial services as income increases because they can spend more on financial products. Nyoka (2019) report that the richest 20% in South Africa were 3.5 times more likely to have a mobile money account than the poorest 20%. Conversely, Amoah et al. (2020) find that as income increased adoption of mobile money in Ghana decreased, largely because the cap³⁸ on amounts that can be transferred through mobile money was viewed as a deterrent for high-income users. Similarly, in Zimbabwe, an increase in income was significantly and negatively associated with using mobile money (Marumbwa, 2014). Therefore, this study seeks to investigate the impact of income on mobile money usage in sub-Saharan Africa.

H_{3c}: Higher level of income positively impacts the use of mobile money to achieve financial inclusion in sub-Saharan Africa

Age

Age is an important determinant of digital innovation adoption because digital natives grow up with technology, whereas the older generation may be uncomfortable adopting new technology and changing existing habits (Elena-Bucea et al., 2021). Prior studies on mobile money have found that age is an important factor in using mobile money. For example, Akinyemi et al. (2020) find that younger people are more likely to adopt mobile money, while

³⁸ Some jurisdictions set a limit on the maximum amount of money that can be transacted through mobile money.

Elena-Bucea et al. (2021) posit that users over 54 are more likely to have lower levels of digital skills and knowledge, and therefore are less likely to use digital innovation. Chamboko (2022) find that in Zimbabwe the rate at which the youth adopted digital financial services was low because they had lower income and high internet costs were high. Further, Lotto (2018) argue that older men are more likely to adopt mobile money because they have jobs and can afford to invest in technology. We therefore seek to examine the role of age in mobile money usage.

H_{3d}: Adults younger than 55 are more likely to use mobile money service to achieve financial inclusion

5.4 Data

To address our research questions, we obtain data from the World Bank Global Findex Database³⁹ survey for 2014, 2017, and 2021. For purposes of grouping countries according to the national level of mobile money usage, we adopt the Mobile Money Prevalence Index (MMPI) developed by GSMA (Andersson-Manjang, 2021). The purpose of this division is to allow countries to be grouped and analysed according to how established mobile money. In addition, this allows for generalisation in findings to be applied to countries with similar mobile money prevalence. Detailed variable selection is documented in Chapter 3 Section 3.4.

Regression Model

To examine the factors that affect mobile money usage we run linear OLS regression using equation (1) below:

$$FI_{c,t} = \alpha + \beta_1 DL_{c,t} + \beta_2 FL_{c,t} + \beta_3 Gn_{c,t} + \beta_4 In_{c,t} + \beta_5 Ed_{c,t} + \beta_6 Ag_{c,t} + u_{c,t}$$

Where *FI* denotes financial inclusion represented by mobile money usage, which is proxied by three different common services available through mobile money (sending mobile money, receiving mobile money, and paying utility bills through mobile money), *DL* refers to digital literacy (the ability to understand and interact with digital technology), *FL* signifies access to financial literacy (proxied by the availability of financial institution branches), *Gn* represents gender (male or female), *In* refers to income levels, *Ed* represents the education level and *Ag* signifies age, finally, u_c is the error term.

³⁹ Global Findex Database provides indicators of financial services usage over time, the data is a subset constructed from surveys for 2014, 2017 and 2021.

Our model is similar to Kass-Hanna et al. (2021) who examined the impact of digital and financial literacy on financial behaviours. We examine the impact of digital and financial literacy on financial inclusion to determine if mobile money usage is representative of financial inclusion. We adapt the assessment of demographic variables from similar studies that have investigated age, gender, income difference and education on financial inclusion (Kass-Hanna et al., 2021; Asuming et al., 2019).

5.4.1 Descriptive Statistics

The categorisation of countries in the sample according to the GSMA MMPI is provided in Table 3.1. Categorisation of countries in this way enables assessment of the factors that affect mobile adoption within groups of countries clustered by similar financial development and thus allows us to determine the factors that affect mobile money adoption on a region-wide, rather than at individual country, level.

Table 5.1: Categorisation of countries by MMPI

High MMPI (> 0.80)	Medium MMPI (0.79-0.60)	Low MMPI (<0.60)
Ghana	Botswana	Madagascar
Kenya	Cameroon	Malawi
Rwanda	Guinea	Nigeria
Tanzania	Mozambique	Mauritius
Uganda	Zambia	Namibia
Zimbabwe		South Africa
Congo		

Note: This table represents categorises countries according to GSMA MMPI, representing countries of high MMPI, medium MMPI and low MMPI.

Demographic distribution of respondents

Table 5.2 below shows the distribution of respondents, for each survey year, according to their gender, education, income group, and age. Panel A of Table 5.2 describes the distribution of respondents by demographic variables categorised by year. This has been done to enable analysis based on year. Panel B of Table 5.2 represents the demographic distribution of respondents categorised according to MMPI index. The purpose is to allow analysis of countries to be grouped according to how established mobile money is in various jurisdictions to allow analysis and distinguish factors that impact financial inclusion based on similar levels of fintech usage. The total sample in our study has 48,796 respondents, over data collected in 2014, 2017 and 2021.

Panel A of Table 5.2 reports 48,796 adults responded to the survey (16,632 in 2014, 17,433 in 2017, and 14,371 in 2021). Female respondents represent 53.6% of respondents from

our sample. On average, most respondents attained education beyond secondary school level (56.7%). However, the highest number of respondents with a secondary school education or above was reported in 2021, with a majority (63.3%) completing secondary education or above, compared to 36.5% reporting as having had primary school education or below. This could signify improved attainment of education across the countries as the years have progressed. Across the sample, most of the respondents were between 15-34 years old and the least number of respondents were above 55 years old.

Panel B of Table 5.2 indicates that the distribution of male and female respondents across the countries is almost the same. The sample reports approximately 46% male respondents in all country groups and approximately 54% female respondents across all country MMPI groups. Not surprisingly, Low MMPI countries report the highest proportion of respondents who attained a secondary school education or above (63%). This is largely because the countries in this group include Namibia, South Africa and Mauritius which have higher literacy levels and development index overall. Income distribution across the countries is similar, with approximately 52% of the respondents in the bottom 60% of the income band and approximately 48% of respondents in the top 40% across all the country groups.

Table 5.2 Demographic distribution of Respondents

Panel A: Distribution of respondents by gender, education, income and age categorised by year								
	Total		2014		2017		2021	
Variable	Freq	Perc	Freq	Perc	Freq	Perc	Freq	Perc
<i>Gender</i>								
Male	22,593	46.30	7,910	47.56	7,833	44.93	6,850	46.50
Female	26,203	53.70	8,722	52.44	9,600	55.07	7,881	53.50
Total	48,796		16,632		17,433		14,731	
<i>Education</i>								
Primary	21,144	43.33	7,837	47.12	7,906	45.35	5,401	36.66
Secondary and above	27,652	56.67	8,795	52.88	9,527	54.65	9,330	63.34
Total	48,796		16,632		17,433		14,731	
<i>Income</i>								
Bottom 60%	25,400	52.05	8,649	52.00	9,150	52.49	7,601	51.60
Top 40%	23,396	47.95	7,983	48.00	8,283	47.51	7,130	48.40
Total	48,796		16,632		17,433		14,731	
<i>Age</i>								
15-24	14,412	29.54	4,600	27.66	5,316	30.49	4,496	30.52
25-34	14,367	29.44	4,920	29.58	5,082	29.15	4,365	29.63
35-44	8,624	17.67	2,909	17.49	3,083	17.68	2,632	17.87
45-54	5,196	10.65	1,902	11.44	1,741	9.99	1,553	10.54
55-64	3,386	6.94	1,243	7.47	1,192	6.84	951	6.46
Over 64	2,811	5.76	1,058	6.36	1,019	5.85	734	4.98
Total	48,796		16,632		17,433		14,731	

Panel B: Distribution of respondents by gender, education, income, and age by MMPI

	Total		High MMP		Medium MMPI		Low MMPI	
Variable	Freq	Perc	Freq	Perc	Freq	Perc	Freq	Perc
<i>Gender</i>								
Male	22,593	46.30	7,806	46.76	5,832	46.40	8,955	45.85
Female	26,203	53.70	8,886	53.24	6,737	53.60	10,580	54.16
Total	48,796		16,692		12,569		19,535	
<i>Education</i>								
Primary	21,144	43.33	7,846	47.00	6,044	48.09	7,254	37.13
Secondary and above	27,652	56.67	8,846	53.00	6,525	51.91	12,281	62.87
Total	48,796		16,692		12,569		19,535	
<i>Income</i>								
Bottom 60%	25,400	52.05	8,793	52.68	6,463	51.42	10,144	51.93
Top 40%	23,396	47.95	7,899	47.32	6,106	48.58	9,391	48.07
Total	48,796		16,692		12,569		19,535	
<i>Age</i>								
15-24	14,412	29.54	5,103	30.57	4,084	32.49	5,225	26.75
25-34	14,367	29.44	5,184	31.06	3,643	28.98	5,540	28.36
35-44	8,624	17.67	2,936	17.59	2,098	16.69	3,590	18.38
45-54	5,196	10.65	1,692	10.14	1,219	9.70	2,285	11.70
55-64	3,386	6.94	942	5.64	822	6.54	1,622	8.30
Over 64	2,811	5.76	835	5.00	703	5.59	1,273	6.52
Total	48,796		16,692		12,569		19,535	

Note: Panel A of Table 5.2 reports the distribution of respondents by gender, education, income, and age group for the sample as a whole and divided by each year the survey was taken. Panel B reports the distribution of respondents by gender, education, income and age group for the sample as a whole and by countries divided by MMPI.

Distribution of respondents who responded ‘yes’ to financial inclusion questions

Table 5.3 summarises the respondents who answered ‘yes’ to the financial inclusion questionnaire data by year. Panel A of the table reports respondents by year, whereas Panel B reports respondents by categorised according to MMPI. Further Panel C and Panel D report respondents who responded ‘yes’ by demographic variable grouping. Panel C categorises responses by gender, income, and education, whereas Panel D categorises responses by age group.

Data reported in Panel A reveals a steady increase in financial institution account ownership from 2014 to 2021, from 39.3% to 45.1%. This is representative of an increase in financial inclusion across our sample. In addition, there is a significant increase in the proportion of respondents making online payments during the same period from 3.45% to 21.3%, indicating higher levels of digital literacy. Results indicate a significant increase in payment of utility bills using mobile money from 2014 to 2021, from 13.4% to 45.1%. This supports reports from GSMA (2022) indicating that bill payment was the fastest growing mobile money service at the end of 2021.

Panel B reports the proportion of respondents who responded positively to financial inclusion questions according to MMPI category. Countries with a low MMPI report the highest proportion of respondents with financial institution accounts (52.3%) which is largely influenced to some degree by countries such as Mauritius (89.4%), South Africa (71.2%) and Namibia (77.0%) that report high financial institution accounts⁴⁰. Not surprisingly countries with high MMPI report very high proportions of mobile money usage through sending remittances (77.3%), receiving remittances (70.5%) and paying utility bills through mobile money (47.8). This is not surprising as this group constitutes countries where mobile money usage in the sub-region is highest. In comparison low MMPI countries report 27.3% sent domestic remittances; 29.5% received domestic remittances; and 15.3% paid utility bills using mobile money. The mobile money usage statistics for low MMPI countries are below the average reported for the whole sample.

⁴⁰ See Appendix B Table B2

Table 5.3: Summary of distribution of respondents who answered ‘yes’ to financial inclusion questions

Panel A: Respondents who responded ‘yes’ by year							
Variable (% age +15)	Total	2014	2017	2021			
Online Payments	10.60	3.40	8.37	21.34			
Saved	60.09	62.30	58.26	59.76			
Borrowed	55.64	58.38	51.10	57.93			
Sent Remittances (Mobile Money)	50.86	40.88	62.21	46.36			
Received Remittances (Mobile Money)	48.40	38.18	62.26	38.69			
Paid utility bills (Mobile Money)	28.88	13.37	28.87	45.05			
Panel B: Respondents who responded ‘yes’ by MMPI							
Variable (% age +15)	All	High MMPI	Medium MMPI	Low MMPI			
Online Payments	10.60	12.62	9.23	9.74			
Saved	60.09	63.50	56.71	59.34			
Borrowed	55.64	59.57	55.77	52.20			
Sent Remittances (Mobile Money)	50.86	77.33	40.82	27.26			
Received Remittances (Mobile Money)	48.40	70.47	37.63	29.53			
Paid utility bills (Mobile Money)	28.88	47.83	28.87	15.32			
Panel C: Respondents who responded ‘yes’ by gender, income, and education							
Variable (% age +15)	Total	Gender		Income Band		Education	
		Male	Female	Bottom 60%	Top 40%	Primary	Secondary and above
Online Payments	10.60	12.42	9.03	6.31	15.24	4.35	15.37
Saved	60.09	62.96	57.61	51.91	68.96	50.02	67.79
Borrowed	55.64	58.03	53.06	52.71	58.83	50.98	59.21
Sent Remittances (Mobile Money)	50.86	51.48	50.17	44.92	54.57	45.54	53.29
Received Remittances (Mobile Money)	48.40	49.62	47.32	42.95	52.84	41.42	52.25
Paid utility bills (Mobile Money)	28.88	30.80	27.03	22.23	33.06	10.68	32.54
Panel D: Respondents who responded ‘yes’ by age group							
Variable (% age +15)	All	15-24	25-34	35-44	45-54	55-64	Over 64
Online Payments	10.60	9.26	13.76	12.16	8.95	7.12	3.66
Saved	60.09	56.20	66.93	62.74	58.72	53.90	46.85
Borrowed	55.64	53.22	62.02	59.95	53.93	46.99	35.33
Sent Remittances (Mobile Money)	50.86	53.81	55.38	47.66	45.28	38.28	31.85
Received Remittances (Mobile Money)	48.40	48.36	54.31	49.22	45.60	36.81	28.35
Paid utility bills (Mobile Money)	28.88	35.52	34.28	28.82	21.93	15.08	10.43

Note: Panel A of Table 3.3 represents a summary of the respondents who responded ‘yes’ to the financial inclusion questionnaire by year. Panel B reports the percentage of respondents who responded ‘yes’ to the financial inclusion questionnaire by MMPI. Panel C reports the respondents who responded ‘yes’ to the financial inclusion questionnaire according to gender, income band and education. Panel D represents the percentage of respondents who responded ‘yes’ according to age group.

Panel C below reports the distribution of respondents who responded positively to the survey questions by gender, income, and education. Overall, male users represented the highest proportion of respondents with a bank account, making online payments, saving, and borrowing, using mobile money to send or receive domestic remittances, and paying bills through mobile of money. This could be because in most developing countries men are more likely to have a source of income and represent a larger share of financial responsibility in the household (Reynolds et al., 2023; Lotto, 2018). 53.4% of top-income earners reported owning a financial institution account compared to 32.6%.

However, the biggest differences among demographic groups are between those with primary education or less and those with secondary education and above. 56.0% of those with secondary education and above reported having a bank account compared to 25.0% of those with primary education or less. This supported by findings that suggest find that those with a secondary or tertiary education are more likely to use financial services (Bongomin et al., 2017; Domeher et al., 2014). Similarly, data indicates a higher proportion of respondents with secondary school education and above used mobile money services, sending remittances (53.3%), receiving remittances (52.3%) and paying utility bills (32.5%). This supports findings that suggest that education improves uptake of digital financial services (Elena-Bucea et al., 2021; Akinyemi et al., 2020; Amoah et al., 2020).

Panel D of Table 5.3 above depicts the respondents who responded 'yes' to the survey questions on financial inclusion by age group. Noticeably, respondents between 15 and 24 have the lowest proportion of financial institution accounts (32.3%). This could be because this respondents in this age group are young and cannot afford to maintain a financial institution account (Chamboko, 2022). However, the age group 15-24 is the highest proportion of users who paid utility bills through mobile money (35.5%). This could be because a financial institution account is not affordable, mobile money is easily affordable for the group to transact through, supporting findings that younger people are more likely to adopt mobile money (Akinyemi et al., 2020). Further, users above age 55 report the lowest usage of mobile money services. This is because this because users may lack the digital skills and knowledge to operate fintech services (Elena-Bucea et al., 2021).

5.5 Empirical Results

5.5.1 Association of demographic variables with financial literacy and digital literacy

Table 5.4 represents the association of demographic variables, gender, education, income and age with digital literacy and financial literacy. We run OLS regressions to investigate the relationship between our key variables of interest with the demographic variables. Initial findings reveal that the coefficient for gender is -0.018, is significant at the 1% level for model (1), signifying that men have higher levels of digital literacy compared to women. Our results are like other findings which suggest that due to cultural and social inequalities men have more access to technology than women and therefore exhibit more digital literacy (Elena-Bucea et al., 2021). Further, higher levels of education and income are associated with higher levels of digital literacy at the 1% level. Elena-Bucea et al. (2021) suggest that innovation can appear more complex if education levels are low. Therefore, higher levels of education can result in ease of use of the innovation. Further, higher levels of income mean that people can afford and access more technological innovations (Akinyemi et al., 2020).

Table 5.4: Association of demographic variables with financial and digital literacy

	Digital Literacy (1)	Financial Literacy (2)
Gender	-0.018*** (0.003)	-0.035*** (0.004)
Education	0.090*** (0.003)	0.048*** (0.005)
Income	0.064*** (0.003)	0.038*** (0.005)
Age group		
25-34	0.039*** (0.004)	0.083*** (0.005)
35-44	0.040*** (0.004)	0.072*** (0.007)
45-54	0.018*** (0.005)	0.016*** (0.008)
55-64	0.007 (0.006)	-0.048*** (0.009)
Over 64	-0.016** (0.006)	-0.159*** (0.010)
Constant	0.032*** (0.032)	0.539*** (0.009)
Observations	48,796	48,796
R-Squared	0.048	0.025

Note: Table 5.4 represents the association of demographic variables on our key explanatory variables, digital literacy (1), financial literacy through saving (2) and financial literacy through borrowing (3). Demographic variables are represented by gender, education, income and age. Regressions are performed on the whole sample of 18 countries. Coefficients are reported with standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Financial literacy results are like digital literacy results. The coefficient for gender is negative and significant at the 1% level in model (2) at -0.035. This suggests that financial literacy is higher in men than in women. These results resonate with other studies around the globe that found men have higher levels of financial literacy compared to women (Klapper et al., 2015; Fanta and Kingstone, 2021). Scholars have suggested that this is a result of a lack of access to communication channels that would enhance financial literacy for women (Bongomin et al., 2020a). In most developing countries women are viewed as caregivers and do not manage household finances. Further, education is positively significant in financial literacy at the 1% level. The coefficient, 0.048 is positive, indicating that as education levels increase financial literacy increases. Our findings support similar findings by Lusardi and Mitchell (2014) who posit that education improves financial literacy. Other studies have found that educated people are more likely to adopt financial products compared to those with little or no education (Domeher et al., 2014).

Model (1) and model (2) reveal that consumers between 25-55 have higher levels of financial and digital literacy. These ages represent the working class who pay more bills, require more financial services and therefore are more likely to possess higher digital and financial knowledge (Triki and Faye, 2013). Our results support findings that financial literacy decreases for people aged 55 and above (Finke et al., 2017; Xu and Zia, 2012).

5.5.2 Impact of digital literacy, financial literacy, and demographic variables on financial inclusion

Table 5.5 represents OLS regression results using the measures of financial inclusion, sending and receiving mobile money and paying bills using mobile money as dependent variables. Results indicate that digital literacy is significant and positive across the whole sample for models (1), (2) and (3), supporting hypothesis **H₁**. The coefficient for digital literacy is highest and positive at the 1% level across all models: 0.192 in the case of model (1), 0.167 in model (2) and 0.413 in model (3). Our findings provide evidence for hypothesis **H₁**, a 1% increase in digital literacy is associated with an 0.41% increase in people paying utility bills using mobile money. Our findings lend weight to conclusions drawn in previous studies, in regard the significance of digital literacy as a driver for financial inclusion to be achieved through use of fintech innovations (Triki and Faye, 2013; Kass-Hanna et al., 2021). Sub-Saharan Africa is characterised as having low digital skills, therefore for financial inclusion policies to take effect and mobile money usage to thrive, such policies should target increasing digital literacy (Darley, 2001). In 2019 the World Bank established Digital Economy for Africa

(DE4A) to promote digital literacy within the continent (World Bank, 2022). Further digital literacy could be implemented as part of the education curriculum to enhance digital skills (Sefton-Green et al., 2009). Countries such as Ghana and Kenya have developed country-level digital strategies to enhance digital knowledge (World Bank Group, 2019; MoICT-Kenya, 2019). Our findings support the need for countries to promote digital literacy programs for financial inclusion.

Table 5.5 Analysis of factors that impact financial inclusion

	Sent Mobile Money (1)	Received Mobile Money (2)	Paid Utility Bills (3)
Digital Literacy (Paid online)	0.192*** (0.012)	0.167*** (0.012)	0.413*** (0.007)
Financial Literacy (Saved)	(0.047)*** (0.010)	0.078*** (0.008)	0.062*** (0.007)
Gender	-0.008 (0.008)	-0.001 (0.007)	-0.017*** (0.006)
Education	0.105*** (0.009)	0.114*** (0.008)	0.065*** (0.007)
Income	0.051*** (0.008)	0.053*** (0.007)	0.020*** (0.006)
Age			
25-34	0.012 (0.010)	0.040*** (0.009)	-0.009 (0.008)
35-44	-0.021* (0.011)	0.017 (0.011)	-0.016* (0.009)
45-54	-0.022 (0.014)	0.006 (0.014)	-0.040*** (0.011)
55-64	-0.058*** (0.018)	-0.043*** (0.016)	-0.053*** (0.012)
Over 64	-0.088*** (0.022)	-0.094*** (0.017)	-0.063*** (0.014)
Constant	0.355*** (0.013)	0.300*** (0.011)	0.127*** (0.010)
Observations	13172	15291	16543
R-Squared	0.055	0.060	0.203
Country Fixed Effects	Y	Y	Y

Note: Table 5.5 represents the impact of digital literacy, financial literacy, and demographic variables on financial inclusion. Digital literacy is represented by payment of bills using the internet, financial literacy is represented by saving, demographic variables used are gender, education, income, and age. Financial inclusion is represented by sending mobile money (1), receiving mobile money (2), paying utility bills (3). Regressions are performed on the whole sample of 18 countries. Coefficients are reported with standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Further, results indicate that financial literacy is significantly and positively associated with financial inclusion across all three models, at the 1% level, supporting hypothesis **H₂**. However, the effects of financial literacy are less compared to digital literacy as the coefficients for financial literacy are relatively smaller. Increasing financial literacy would increase mobile money usage, thereby increasing financial inclusion. Miller et al. (2009) suggest that financial literacy is particularly important for sub-Saharan Africa in mobile money usage due to the rapid development of financial innovations. Chikalipah (2017) posit that two-thirds of financially excluded individuals lack financial knowledge to make financial decisions, therefore increasing financial literacy would increase usage of mobile money across the sub-continent. Our findings support that increase in financial literacy would improve financial inclusion and thus support prior evidence that an increase in financial literacy improves financial inclusion (Domeher et al., 2014; Bongomin et al., 2020a).

An examination of demographic variables reveals that income and education are significant across all models at the 1% level. This implies that people in the top 40% of income band are more likely to be financially included compared to the lower 60%, supporting hypothesis **H_{3c}**. Previous studies have found income to be significant in financial inclusion. Sanderson et al. (2018) find that financial inclusion was driven by income. More specifically, our findings are similar to findings by Nyoka (2019), who find that the richest 20% were more likely to use mobile money compared to the poorest 20%, thereby increasing financial inclusion. Similarly, higher levels of education are positively related mobile money usage, however with lower coefficients compared to income, supporting hypothesis **H_{3b}**. Increasing education by 1% to secondary level or above would increase sending mobile money by 10.5%; receiving mobile money by 11.4%; and bill payments by 6.5%.

In response to hypothesis **H_{3a}** gender is not significant for sending and receiving mobile money but is significant for bill payments. Results indicate that women are less likely to pay bills using mobile money. This could be because in some emerging economies men are more likely to be the ones working and therefore paying bills. Further, results indicate that people age groups 55 and above are less likely to use mobile money supporting hypothesis **H_{3a}**. This could be because this group has fewer technical skills and are therefore less likely to engage in digital financial services.

5.5.3 Impact of digital literacy, financial literacy, and demographic variables on financial inclusion (analysis based on year)

Table 5.6 below depicts all three financial inclusion variables across the three years represented by the data: 2014, 2017 and 2021. The purpose is to investigate the factors that impact financial inclusion by analysing and comparing the progression through the years. Our study uses the years the data was collected, to analyse financial inclusion. This assessment provides insights into the significance of factors that may have changed across the years. Further, this analysis identifies assessment of areas still needing policy redress. Models (1) - (3) represent sending mobile money in 2014, 2017, and 2021 respectively; models (4) - (6) represent receiving mobile money in 2014, 2017 and 2021; finally, models (7) – (9) represent paying utility bills in 2014, 2017 and 2021.

The results indicate that across the three years digital literacy is significant and positive at the 1% level, providing further evidence supporting **H₁**. Results indicate progressively high coefficients for bill payment using mobile money, indicating stronger effects for the function. The coefficient, for bill payment in 2021 is 0.385, signifying that 1% increase in digital literacy would result in increased in financial inclusion through bill payments by 0.39%. The findings are supported by GSMA (2022) reports that bill payment is the fastest growing mobile money service and grew by 36% between 2021 to 2022. Further, digital literacy facilitates growth in uptake of fintech services (Kass-Hanna et al., 2021). The increase in coefficient from 2014 to 2021 (0.248, 0.326, 0.385) indicates that digital literacy is becoming more central to mobile money usage particularly for complex functions such as bill payments.

Financial literacy is significant at the 1% level for all models except model (3) and (6), which represent 2021 for sending and receiving mobile money. The results show that from 2014 to 2021 the coefficient for financial literacy decreases in magnitude and 2021 the significance declines for sending and receiving remittances. The decline in significance could reflect how established the two mobile money functions are, as users become familiar with the functions the need for financial literacy decreases. Our results show that in response to **H₂** financial literacy was significant during the early years of mobile money usage for the common functions, however as people become more familiar with operating mobile money, significance decreases. Kiconco et al. (2019) suggested that users with low financial literacy skills are most likely to gain skills through social network and memorise the actions required due to simplicity

of the functions. Sending and receiving domestic remittances are the initial functionality in the mobile money design and therefore, the easiest and most frequently operated services (Nyimbiri, 2021; Suri, 2017; Travis et al., 2018). Further, as more users adopt the innovation, functionalities are communicated through the social network, family and friend can teach those with limited skills (Rogers et al., 2014). Financial literacy was more significant during the inception years of mobile money; however, the influence is not as significant as digital literacy. At a policy level the World Bank Global Financial Inclusion and Consumer Protection Survey (2017) revealed that countries such as Botswana, Rwanda and Zimbabwe mandate their financial institutions to provide financial literacy training to their customers (World Bank, 2017). Further, other countries such as Namibia, Tanzania and Zambia have introduced financial literacy programs with the aim of disseminating financial knowledge to those who are marginalised (World Bank, 2017).

Like the findings in Table 5.6 gender is not significant across the years, contrast to **H3a**. This reveals that the use of mobile money across the years has not been dependent on gender. Despite males displaying more digital and financial literacy usage is not impacted by gender. Income is positive and significant across the years at the 1% level for bill payment supporting **H3b**. Further, it is significant at the 1% level for sending and receiving remittances in 2014 and 2017, however, it begins to lose its significance for sending and receiving mobile money in 2021. This may be because of more users subscribing to the service even though they do not have a formal income. For example, parents can use mobile money to send money to their dependents in school or to support relatives living in the village (Jack et al., 2013).

Older age groups have stronger negative effects for paying bills using mobile money, particularly for 2017 and 2021. The coefficients for age group 55 – 64 are -0.074 and -0.070 for 2017 and 2021 respectively, while for age group over 64 the coefficients are -0.076 and -0.111 indicating a risk of not being financially included for older people. Our findings support hypothesis **H3a**, showing that older individuals are significantly less likely to engage in digital financial services, underscoring the importance of target inclusion strategies for older age groups.

Table 5.6 Analysis of factors that impact financial inclusion by year

	Sent mobile money			Received mobile money			Pay utility bills		
	2014	2017	2021	2014	2017	2021	2014	2017	2021
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Digital Literacy (Paid online)	0.184*** (0.020)	0.161*** (0.015)	0.179*** (0.031)	0.196*** (0.021)	0.117*** (0.016)	0.216*** (0.030)	0.248*** (0.016)	0.326*** (0.014)	0.385*** (0.012)
Financial Literacy (Saved)	0.071*** (0.014)	0.063*** (0.013)	0.041 (0.027)	0.116*** (0.011)	0.055*** (0.012)	0.050** (0.023)	0.041*** (0.010)	0.084*** (0.011)	0.087*** (0.013)
Gender	-0.008 (0.010)	-0.009 (0.011)	-0.029 (0.024)	-0.007 (0.009)	-0.010 (0.011)	0.002 (0.021)	-0.012 (0.008)	-0.040*** (0.010)	-0.010 (0.011)
Education	0.117*** (0.012)	0.011*** (0.013)	0.026 (0.027)	0.107*** (0.011)	0.102*** (0.013)	0.062** (0.024)	0.053*** (0.010)	0.045*** (0.011)	0.100*** (0.014)
Income	0.049*** (0.011)	0.064*** (0.011)	0.051** (0.024)	0.058*** (0.010)	0.059*** (0.011)	0.030 (0.022)	0.021** (0.009)	0.042*** (0.010)	0.030** (0.012)
Age									
25-34	0.014 (0.013)	0.020 (0.013)	0.050* (0.030)	0.030** (0.012)	0.036*** (0.013)	0.043 (0.027)	0.028** (0.012)	-0.002 (0.013)	-0.020 (0.015)
35-44	-0.003 (0.015)	-0.015 (0.016)	0.012 (0.036)	0.010 (0.014)	0.014 (0.016)	0.018 (0.032)	0.013 (0.013)	-0.014 (0.015)	-0.016 (0.017)
45-54	-0.012 (0.018)	-0.010 (0.021)	0.059 (0.045)	-0.011 (0.017)	0.026 (0.021)	0.047 (0.039)	0.002 (0.015)	-0.048*** (0.018)	-0.046** (0.020)
55-64	-0.057** (0.023)	-0.016 (0.027)	0.033 (0.051)	-0.049** (0.020)	-0.065*** (0.024)	0.048 (0.045)	0.011 (0.017)	-0.074*** (0.020)	-0.070*** (0.024)
Over 64	-0.086*** (0.028)	-0.080** (0.033)	0.047 (0.069)	-0.090*** (0.022)	-0.122*** (0.027)	0.038 (0.052)	0.002 (0.020)	-0.076*** (0.022)	-0.111*** (0.027)
Constant	0.233*** (0.018)	0.433*** (0.018)	0.341*** (0.036)	0.187*** (0.015)	0.463*** (0.017)	0.238*** (0.031)	0.027* (0.015)	-0.160*** (0.017)	0.168*** (0.020)
Observations	5775	5734	1663	6859	6447	1985	5279	6158	5106
R-Squared	0.062	0.065	0.035	0.081	0.054	0.046	0.067	0.139	0.239
Country Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: Table 5.6 represents the impact of digital literacy, financial literacy, and demographic variables on financial inclusion for 2014, 2017, 2021. Digital literacy is represented by payment of bills using the internet, financial literacy is represented by saving, demographic variables are represented by gender, age, education, and income. Financial inclusion through mobile money sending is represented by models (1)–(3); receiving mobile money by models (4)–(6); bill payment by models (7)–(9). Coefficients are reported with standard errors in parentheses. ***p<0.01, **p<0.05, *p<0

5.5.4 Impact of financial inclusion, digital literacy, financial literacy, and demographic variables financial inclusion (analysis based on MMPI)

Table 5.4 reports regression results, based on country Mobile Money Prevalence Index (MMPI). MMPI measures the sophistication of mobile money usage in a country and will facilitate comparison between markets and allow granular analysis of factors impacting mobile money usage in countries with similar usage levels (Andersson-Manjang, 2021). The grouping allows us to investigate the factors that impact financial inclusion through mobile money usage on countries with similar levels of mobile money prevalence. This analysis highlights specific factors that may not be visible when looking at the sample but could present themselves on a cluster level analysis. Previous studies have investigated behaviours based on country Gini coefficient to assess countries with similar levels of income (Demir et al., 2022) and high⁴¹ and low⁴² income countries as defined by World Bank (Sha'ban et al., 2020). Our findings are presented in models (1) to (9). Models (1) to (3) represent findings for sending mobile money for High MMPI, Medium MMPI and Low MMPI countries respectively; models (4) to (6) represent receiving mobile money for High MMPI, Medium MMPI and Low MMPI countries and finally models (7) to (9) represent paying utility bills for High MMPI, Medium MMPI and Low MMPI countries.

For all country groups and mobile money functions, sending mobile money, receiving mobile money, and paying utility bills through mobile money and digital literacy are significant at the 1% level. Low MMPI countries report high and positively significant coefficients for digital literacy, the coefficient for sending mobile money is 0.364, 0.295 for receiving mobile money, and 0.429 for paying utility bills. In support to **H₁**, digital literacy is significant across all country groups, however stronger in effects for Low MMPI countries. This could be because in Low MMPI countries mobile money usage is low and therefore the impact of increasing digital literacy on financial inclusion is large. According to World Bank Global Findex Survey 2021 15% of people in Low MMPI countries paid utility bills using mobile money compared to 48% in high MMPI countries (Demirgüç-Kunt et al., 2022). Therefore, increasing digital skills would be most transformative for low MMPI countries where baseline access and infrastructure is weaker compared to high MMPI countries where digital skills still matter but returns are lower due to already high adoption. Increasing digital literacy would enable more

⁴¹ High income countries included high and upper-middle income countries

⁴² Low income countries included low and lower-middle income countries

participation from Low MMPI countries in mobile money usage. Therefore, policies in Low MMPI countries aiming to improve mobile money usage should aim at improving digital skills.

Specifically, for paying utility bills all country groups report relatively high coefficients for digital literacy, 0.354 (high MMPI), 0.479 (medium MMPI) and 0.429 (low MMPI) at the 1% level, reinforcing the need for digital literacy across all countries supporting **H₁**. To some extent, this may be due to the rising frequency of bill payments within recent years, which requires more technical skills when compared with functions such as sending and receiving, which users are likely to be more familiar with. In addition, high MMPI countries report high digital literacy coefficients significant at the 1% level, 0.364 (sending); 0.295 (receiving); 0.429 (bill payments), across all mobile money functions compared to low and medium MMPI. This could be because of more mobile money functionality available in these countries such as paying school fees, subscriptions, retail goods and services and international and cross border remittances that require higher digital skills.

Results indicate that financial literacy is significant in High MMPI countries across all mobile money usage functions. Our findings support hypothesis **H₂** highlighting that at the country specific level, financial literacy has a positive effect on mobile money usage. Financial literacy is significant at the 5% and above for Low MMPI countries. However, in relation to our previous findings the coefficients are smaller than digital literacy.

Table 5.7 Analysis of factors that impact financial inclusion by Mobile Money Prevalence Index (MMPI)

	Sent mobile money			Received mobile money			Pay utility bills		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Digital Literacy (Paid online)	0.034** (0.017)	0.248*** (0.025)	0.364*** (0.020)	0.041** (0.018)	0.243*** (0.026)	0.295*** (0.021)	0.354*** (0.014)	0.479*** (0.016)	0.429*** (0.010)
Financial Literacy (Saved)	0.075*** (0.015)	0.014 (0.021)	0.033** (0.015)	0.012*** (0.013)	0.036** (0.017)	0.058*** (0.013)	0.070*** (0.014)	0.083*** (0.015)	0.045*** (0.008)
Gender	-0.016 (0.011)	-0.035** (0.017)	0.016 (0.012)	-0.022** (0.011)	-0.012 (0.015)	0.034*** (0.012)	-0.043*** (0.012)	-0.028** (0.013)	0.008 (0.007)
Education	0.092*** (0.013)	0.127*** (0.020)	0.117*** (0.015)	0.116*** (0.012)	0.128*** (0.018)	0.107*** (0.015)	0.069*** (0.014)	0.088*** (0.015)	0.046*** (0.009)
Income	0.032*** (0.012)	0.064*** (0.018)	0.058*** (0.013)	0.046*** (0.011)	0.044*** (0.016)	0.060*** (0.012)	0.019 (0.013)	0.012 (0.013)	0.022*** (0.008)
Age									
25-34	0.020 (0.014)	0.008 (0.021)	-0.003 (0.016)	0.062*** (0.014)	0.048** (0.019)	0.004 (0.015)	-0.007 (0.015)	-0.022 (0.016)	-0.004 (0.011)
35-44	0.015 (0.017)	-0.052** (0.024)	-0.050*** (0.018)	0.046*** (0.017)	0.020 (0.023)	-0.029 (0.018)	-0.003 (0.018)	-0.031* (0.018)	-0.015 (0.012)
45-54	0.024 (0.022)	-0.041 (0.032)	-0.061*** (0.022)	0.039* (0.021)	0.007 (0.029)	-0.040* (0.022)	-0.041* (0.022)	-0.078*** (0.023)	-0.021 (0.013)
55-64	-0.027 (0.029)	-0.089** (0.038)	-0.073*** (0.027)	-0.009 (0.024)	-0.054* (0.033)	-0.077*** (0.025)	-0.040 (0.028)	-0.110*** (0.026)	-0.034** (0.014)
Over 64	-0.091** (0.037)	-0.118** (0.048)	-0.075** (0.033)	-0.126*** (0.027)	-0.051 (0.035)	-0.091*** (0.029)	-0.079** (0.032)	-0.082*** (0.031)	-0.048*** (0.016)
Constant	0.627*** (0.019)	0.273*** (0.028)	0.100*** (0.022)	0.504*** (0.017)	0.213*** (0.023)	-0.116*** (0.019)	-0.306*** (0.021)	0.113*** (0.021)	0.011 (0.013)
Observations	5324	3263	4585	6276	3901	5114	5294	3855	7394
R-Squared	0.028	0.071	0.111	0.061	0.064	0.083	0.146	0.248	0.248
Country Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: Table 5.7 represents the impact of digital literacy, financial literacy, and demographic variables on financial inclusion for Low, Medium and High MMPI countries. Digital literacy is represented by payment of bills using the internet, financial literacy is represented by saving, demographic variables are represented by gender, age, education and income. Financial inclusion through mobile money sending is represented by models (1) to (3); receiving mobile money by models (4) to (6); bill payments by models (7) to (9). Coefficients are reported with standard errors in parentheses. ***p<0.1, **<0.05, *p<0.1.

Education is significant at the 1% level or less for all country classifications for all mobile money functions. Those who have been educated to secondary school level or above are more likely to use mobile money compared to those with a primary education or less. Education enhances the ability to use mobile money across all country groups. This supports hypothesis **H3b**, education is significant for mobile money adoption. Similarly, income is significant at the 1% level particularly for sending and receiving mobile money at all MMPI levels supporting hypothesis **H3c**. This supports findings from other studies which found that education and income are significant drivers of financial inclusion (Akinyemi et al., 2020; Elena-Bucea et al., 2021; Lotto, 2018).

Results indicate that age groups 55 and older are less likely to use mobile money for all the functions particularly in Low MMPI countries providing evidence for **H3d**. This could be because these age groups are more likely to have bank accounts and use banking services more than mobile money. However, younger people between ages 15-24 may be more likely to use mobile money to manage their accounts because they have lower sources of income. Because of low mobile money prevalence, there is room to increase financial inclusion through mobile money adoption by targeting the youth. For High MMPI countries age is not significant for sending mobile money or bill payments. This could be because of the high spread of mobile money within these countries such that it is commonly used by all age groups (Reynolds et al., 2023). However, for age groups 25-34 and 35-44 age is significant at the 5% level or lower in receiving mobile money. Countries with higher levels of mobile money sophistication, for example Rwanda and Kenya have approved companies that pay salaries through mobile money (Argent et al., 2013). Therefore, these age groups represent the working class and therefore are significant in High MMPI countries.

5.6 Robustness Tests

5.6.1 Re-estimate using mobile money account ownership as dependent variable

To test robustness, we substitute the financial inclusion measure for mobile money usage with the mobile money account ownership (Allen et al., 2016; Demirgüç-Kunt and Klapper, 2012). The results are reported in Table 5.8 below. We check for robustness on three levels, firstly we estimate the model with mobile money account as the regressor on the whole sample as depicted in Table 5.5 (model (1)); secondly, we re-estimate Table 5.6 (model (2), (3), (4)) based on year analysis using mobile money account as the regressor; lastly we run regressions based on countries divided by MMPI as depicted in Table 5.7 to test robustness at country group level.

Table 5.8: Re-estimation of factors that impact financial inclusion (mobile money account)

	Mobile money Account	Mobile money account (analysis by years)			Mobile Money account (analysis by MMPI)		
		2014	2017	2021	High	Medium	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Digital Literacy (Paid online)	0.374*** (0.006)	0.289*** (0.14)	0.338*** (0.011)	0.312*** (0.009)	0.278*** (0.011)	0.445*** (0.012)	0.433*** (0.009)
Financial Literacy (Saved)	0.147*** (0.004)	0.101*** (0.005)	0.157*** (0.006)	0.209*** (0.007)	0.225*** (0.007)	0.131*** (0.007)	0.090*** (0.005)
Gender	-0.021*** (0.004)	-0.019*** (0.005)	-0.040*** (0.006)	-0.020*** (0.007)	-0.041*** (0.007)	-0.021*** (0.007)	-0.004 (0.005)
Education	0.126*** (0.004)	0.089*** (0.006)	0.119*** (0.007)	0.141*** (0.008)	0.139*** (0.008)	0.160*** (0.008)	0.087*** (0.006)
Income	0.064*** (0.004)	0.066*** (0.005)	0.073*** (0.006)	0.069*** (0.007)	0.080*** (0.007)	0.063*** (0.007)	0.046*** (0.005)
Age							
25-34	0.036*** (0.005)	0.039*** (0.007)	0.038*** (0.008)	0.037*** (0.009)	0.062*** (0.009)	0.021** (0.009)	0.020*** (0.007)
35-44	0.027*** (0.005)	0.021*** (0.008)	0.025*** (0.009)	0.043*** (0.010)	0.057*** (0.010)	0.021** (0.010)	0.005 (0.008)
45-54	0.003 (0.006)	0.006 (0.009)	-0.001 (0.011)	0.014 (0.012)	0.035*** (0.013)	-0.025* (0.013)	-0.008 (0.009)
55-64	-0.011 (0.008)	-0.006 (0.011)	0.002 (0.013)	-0.024 (0.015)	0.013 (0.016)	-0.015 (0.015)	-0.029*** (0.010)
Over 64	-0.043*** (0.008)	-0.016 (0.011)	-0.045*** (0.014)	-0.071*** (0.017)	-0.058*** (0.017)	-0.025 (0.016)	-0.044*** (0.011)
Constant	0.076*** (0.005)	0.022*** (0.007)	0.102*** (0.009)	0.127*** (0.010)	0.178*** (0.010)	0.037*** (0.009)	0.021*** (0.008)
Observations	48769	16632	17433	14731	16692	12569	19535
R-Squared	0.178	0.104	0.163	0.223	0.172	0.220	0.182
Country Fixed Effects	Y	Y	Y	Y	Y	Y	Y

Note: Table 5.5 represents the re-estimation of digital literacy, financial literacy, and demographic variables on financial inclusion for Tables 5.2, 5.3 and 5.4. Digital literacy is represented by payment of bills using the internet, financial literacy is represented by saving, demographic variables are represented by gender, age, education, and income. Financial inclusion is represented by financial institution account ownership. Model (1) represents regressions against the whole sample; models (2) –(4) represents re-estimate for each year of the survey, 2014, 2017, 2021; bill and models (5) –(7) represent re-estimation for each group of countries based on MMPI. Coefficients are reported with standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.

Table 5.8 model (1) reconfirms our findings in Table 5.5, digital literacy and financial literacy are significant in financial inclusion through mobile money adoption. Results resonate with our previous findings that show digital literacy to have a greater effect on mobile money adoption. The coefficient of 0.374 is large and significant at the 1% level. Financial literacy is significant however to a lesser extent compared to digital literacy with a coefficient of 0.147 at the 1% level. Education and income are significant at the 1% level with income having lower effects indicating that income facilitates mobile money adoption but is less critical with a low coefficient of 0.064.

We re-estimate Table 5.6 for each year of the survey, 2014, 2017 and 2021. The results are reported in Table 5.8 model (2), (3) and (4). Our results are like the findings in Table 5.6; digital and financial literacy are significant across the three years of analysis. Digital literacy has higher effects compared to financial literacy emphasising the importance of digital literacy in mobile money participation. Further, education is significant at the 1% level and so is income. Similarly, Table 5.8 model (5), (6) and (7) re-estimate Table 5.7 for countries grouped according to MMPI. Results resonate with Table 5.7 indicating the importance of digital and financial literacy, with digital literacy showing greater significance for low and medium MMPI countries, signifying the importance of digital literacy in improving usage of mobile money services. Education and income are significant at the 1% level across all models and gender is not significant for Low MMPI countries. Table 5.7 reported gender was not significant in Low MMPI countries for sending mobile money and bill payments.

5.6.2 Re-estimate excluding Kenya from the sample

Kenya is the highest mobile money user globally with 97% mobile money account ownership reported in 2021 (Demirgüç-Kunt et al., 2022). To test robustness, we remove Kenya from the sample and results are reported in Table 5.9 below for Table 5.5 and Table 5.10 for Table 5.6. The results are reported in Table 5.9 below. Table 5.9 model (1) investigates using sending mobile money as the dependent variable; model (2) investigates receiving mobile money and model (3) investigates paid utility bills as the dependent variable.

Table 5.9: Re-estimation of factors that impact financial inclusion (excluding Kenya)

	Sent Mobile Money (1)	Received Mobile Money (2)	Paid Utility Bills (3)
Digital Literacy (Paid online)	0.233*** (0.013)	0.203*** (0.013)	0.434*** (0.008)
Financial Literacy (Saved)	0.041*** (0.010)	0.073*** (0.009)	0.060*** (0.007)
Gender	-0.008 (0.008)	0.000 (0.008)	-0.015** (0.006)
Education	0.115*** (0.010)	0.117*** (0.009)	0.061*** (0.007)
Income	0.055*** (0.009)	0.058*** (0.008)	0.020*** (0.006)
Age			
25-34	0.010 (0.010)	0.040*** (0.010)	-0.011 (0.008)
35-44	-0.023* (0.012)	0.013 (0.012)	-0.022** (0.009)
45-54	-0.023 (0.015)	0.007 (0.014)	-0.042*** (0.011)
55-64	-0.066*** (0.019)	-0.049*** (0.016)	-0.058*** (0.012)
Over 64	-0.091*** (0.023)	-0.088*** (0.018)	-0.073*** (0.014)
Constant	0.308*** (0.014)	0.260*** (0.012)	0.101*** (0.011)
Observations	11906	13943	15301
R-Squared	0.064	0.065	0.214
Country Fixed Effects	Y	Y	Y

Note: Table 5.9 represents the impact of digital literacy, financial literacy, and demographic variables on financial inclusion excluding Kenya from the sample. Digital literacy is represented by payment of bills using the internet, financial literacy is represented by saving, demographic variables used are gender, education, income, and age. Financial inclusion is represented by sending mobile money (1), receiving mobile money (2), paying utility bills (3). Regressions are performed on the whole sample of 18 countries. Coefficients are reported with standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Results in Table 5.9 reflect our findings in Table 5.5. Firstly, digital and financial literacy are significant at the 1% level with digital literacy showing stronger effects for mobile money usage. Education and income are significant at the 1% level indicating that people with higher education and higher income levels are more likely to adopt mobile money. Further, age groups above 55 years old are less likely to participate in mobile money usages.

Table 5.10: Re-estimate analysis of factors that impact financial inclusion by year (excluding Kenya)

	Sent mobile money			Received mobile money			Pay utility bills		
	2014	2017	2021	2014	2017	2021	2014	2017	2021
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Digital Literacy	0.210***	0.193***	0.187***	0.218***	0.139***	0.209***	0.257***	0.360***	0.393***
(Paid online)	(0.022)	(0.017)	(0.033)	(0.023)	(0.018)	(0.032)	(0.016)	(0.015)	(0.013)
Financial Literacy	0.068***	0.065***	0.033	0.115***	0.057***	0.046**	0.038***	0.080***	0.089***
(Saved)	(0.015)	(0.014)	(0.028)	(0.012)	(0.013)	(0.023)	(0.009)	(0.011)	(0.014)
Gender	-0.003	-0.009	-0.044*	-0.005	-0.011	0.001	-0.012	-0.033***	-0.010
	(0.011)	(0.012)	(0.025)	(0.010)	(0.012)	(0.022)	(0.008)	(0.010)	(0.0120)
Education	0	0.117***	0.049*	0.109***	0.107***	0.055**	0.037***	0.047***	0.105***
	##].124***	(0.014)	(0.028)	(0.012)	(0.014)	(0.025)	(0.010)	(0.012)	(0.015)
	(0.013)								
Income	0.051***	0.071***	0.061**	0.061***	0.068***	0.039*	0.022**	0.043***	0.029**
	(0.012)	(0.012)	(0.025)	(0.010)	(0.012)	(0.022)	(0.009)	(0.010)	(0.012)
Age									
25-34	0.017	0.021	0.047	0.032**	0.039***	0.038	0.029**	-0.006	-0.026
	(0.015)	(0.014)	(0.031)	(0.013)	(0.014)	(0.028)	(0.012)	(0.013)	(0.017)
35-44	-0.002	-0.016	0.014	0.008	0.010	0.011	0.010	-0.020	-0.024
	(0.017)	(0.017)	(0.037)	(0.015)	(0.017)	(0.033)	(0.013)	(0.015)	(0.018)
45-54	-0.007	-0.011	0.052	-0.006	0.023	0.046	-0.003	-0.049***	-0.046**
	(0.020)	(0.023)	(0.046)	(0.018)	(0.023)	(0.040)	(0.015)	(0.018)	(0.021)
55-64	-0.062**	-0.019	0.024	-0.058***	-0.069***	0.042	0.005	-0.075***	-0.080***
	(0.024)	(0.030)	(0.052)	(0.021)	(0.025)	(0.046)	(0.017)	(0.020)	(0.025)
Over 64	-0.086***	-0.081**	0.031	-0.088***	-0.112***	0.035	-0.009	-0.083***	-0.125***
	(0.030)	(0.035)	(0.071)	(0.023)	(0.028)	(0.053)	(0.018)	(0.023)	(0.028)
Constant	0.165***	0.386***	0.330***	0.132***	0.423***	0.242***	0.010	0.120	-0.144***
	(0.020)	(0.020)	(0.038)	(0.016)	(0.018)	(0.032)	(0.015)	(0.017)	(0.021)
Observations	5198	5172	1536	6221	5868	1854	4892	5697	4712
R-Squared	0.066	0.073	0.041	0.083	0.059	0.042	0.075	0.150	0.245
Country Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: Table 5.10 represents the impact of digital literacy, financial literacy, and demographic variables on financial inclusion for 2014, 2017, 2021 excluding Kenya from the sample. Digital literacy is represented by payment of bills using the internet, financial literacy is represented by saving, demographic variables are represented by gender, age, education, and income. Financial inclusion through mobile money sending is represented by models (1) –(3); receiving mobile money by models (4) –(6); bill payment by models (7) –(9). Coefficients are reported with standard errors in parentheses. ***p<0.01, **p<0.05, *p<0

Table 5.7 above re-estimates Table 5.3 analysis based on each year of the survey excluding data for Kenya from the sample, models (1) - (3) represent sending mobile money in 2014, 2017, and 2021 respectively; models (4) - (6) represent receiving mobile money in 2014, 2017 and 2021; finally, models (7) – (9) represent paying utility bills in 2014, 2017 and 2021. Results confirm our findings in section 5.4.3 of this chapter. Digital literacy maintains a high coefficient across the years with particularly high significance for bill payments at the 1% level. Financial literacy is significant in 2014 and 2017 and begins to lose significance in 2021 for sending and receiving mobile money, however, remains a significant predictor for bill payments across all years. Education is significant with relatively higher coefficients for sending and receiving mobile money in 2014 and 2017, but the coefficient is smaller in 2021. This could be because of users being accustomed to these functions and the widespread of mobile money across the years. The data displays opposite education effect with bill payments where the coefficient increases and becomes more significant in 2021, supporting earlier assumptions that as time as progressed bill payments have become more sophisticated and therefore used more by people with higher education.

Further results show age exclusion for age groups over 55 for sending and receiving mobile money in earlier years 2014 and 2017, however for the two functions age is insignificant in 2021. The reversal is true for paying utility bills with age being significant for age groups over 45 in 2017 and 2021, which could result in digital exclusion for these age groups on bill payments.

5.7 Discussion

Our research support **H₁** digital literacy is a driving factor in mobile money usage. This implies that for mobile money to thrive and financial inclusion to be achieved through mobile money governments at the policy level should invest in programs to promote digital literacy. Digital skills are essential in operating digital financial services (Lee, 2021; Kass-Hanna et al., 2021). The significance of digital literacy is more pronounced for “*bill payments using mobile money*”, which could be a result of more challenging navigation through the bill payment process compared to *sending* and *receiving mobile money*, with a greater level of digital skills required as a result (Malady, 2016). Therefore, policies that aim to promote financial inclusion through use of fintech could target improving digital skills. Countries in sub-Saharan African should develop digital strategies that incorporate ways to improve digital knowledge to empower the population to use digital services and products. Some initiatives in the sub-region include the World Bank initiative Digital Economy for Africa (DE4A) established to promote

digital literacy (World Bank, 2022). Countries high in mobile money usage such as Kenya and Ghana have adopted strategies to increase digital skills across primary, secondary and tertiary education through DE4A initiative (World Bank, 2022).

Our results further reveal that financial literacy is important in use of mobile to achieve financial inclusion, providing evidence for **H₂**. Lack of financial awareness that could result in a lack of confidence when engaging with financial services (Malady, 2016; Gabor and Brooks, 2017). In this respect, our findings are aligned with prior literature that finds financial literacy to have a positive impact on financial inclusion (Domeher et al., 2014; Bongomin et al., 2020a). Across the years financial literacy loses its significance for *sending* and *receiving remittances through mobile money*. This could be because the services have been offered since the inception of mobile money and therefore users are familiar and comfortable using them (Malady, 2016; Jack and Suri, 2011). In addition, due to the ease of use of the services, new users can learn how to operate by observing friends and family and other communication channels (Rogers, 2003). Factors such as age and income lose significance for '*sending mobile money*' and '*receiving mobile money*' in 2021, which further supports our conclusions that, as time goes by, usage is communicated across all age groups through various communication channels, and therefore usage decisions may be influenced by social surrounding rather than financial skills (Malady, 2016; Rogers, 2003). Further at a policy level, our findings suggest that supplying financial products is not enough there is need to invest in financial awareness programs that educate people on benefits and functionalities of financial services and products (Bongomin et al., 2017).

In addition, our research reveals insights into the impact of demographics on mobile money usage and financial inclusion supporting hypotheses **H_{3a}**, **H_{3b}**, **H_{3c}** and **H_{3d}**. Firstly, across the sample results indicate that gender is not significant in achieving financial inclusion through mobile money usage, however gender shows significance in specific instances; gender is important in bill payments, indicating that women are less likely to pay bills through mobile money. This is also particularly visible in High MMPI. This could be because in most sub-Saharan African countries men are the main income earners and therefore responsible for bill payments (Lotto, 2018; Reynolds et al., 2023). Empowering women through mobile money could improve the gender balance in bill payments and encourage women participation.

Income and education show consistent importance in mobile money usage across all functions. Results indicate that high income and high levels of education increase mobile money usage supporting **H_{3b}**. Education improves product awareness and technology awareness and therefore usage of mobile money (Akinyemi et al., 2020). Similarly, with

education, our study reveals that increasing income, increases mobile money adoption, supporting **H_{3c}**. Other sub-Saharan African countries such as South Africa, Ghana and Eswatini found that those with higher income were more likely to use mobile money because increase in income increases demand for financial services (Nyoka, 2019; Akinyemi et al., 2020; Elena-Bucea et al., 2021).

Lastly, age is a significant driver for financial inclusion through mobile money adoption supporting **H_{3d}**. Our results indicate that age groups over 55 years old are less likely to use mobile services, this could be because they are less likely to be comfortable with adopting new technology such as mobile money (Elena-Bucea et al., 2021). Further, age has stronger effects in 2017 and 2021 for bill payments with age groups over 55 less likely to pay bills using mobile money, this represents a risk of excluding older people. At the country level age is important for Low MMPI countries for sending and receiving mobile money. These results indicated that there is potential for financial inclusion by incorporating older age groups. Countries such as Namibia, South Africa, Tanzania have devised financial inclusion strategies to include minority groups such as the elderly, pensioners, small scale farmers with the aim of boosting financial inclusion (MOF-Namibia, 2018; Treasury-RSA, 2013; TNCFI, 2017). Other jurisdictions could adopt similar strategies to boost financial inclusion of the elderly.

Finally, our study reveals that at the policy level, countries in sub-Saharan Africa should continue to invest in financial and digital literacy programs to promote inclusive finance. Similar recommendations were made by Kass-Hanna et al. (2021) for emerging economies to promote digital and financial literacy programs.

5.8 Conclusion

This chapter investigates the relationship between financial inclusion (measured through mobile money usage) and digital literacy, financial literacy, and demographic variables (gender, education, income, age) for eighteen sub-Saharan countries. Previous studies have proposed that fintech could facilitate financial inclusion in sub-Saharan Africa where infrastructural challenges deter formal financial services from establishing access point (Hollanders, 2020). The chapter set out to highlight the aspect of usage of fintech through the functions of '*sending mobile money*', '*receiving mobile money*' and '*paying utility bills*' as being compatible with a user's financial needs and therefore being more representative of financial inclusion (Park and Mercado, 2018; Demir et al., 2022). Further countries are sub-

divided into three categories based on GSMA MMPI, with the purpose of enabling generalisation of countries with similar levels of mobile money usage to be made.

Our research begins to highlight the impact of fintech use on financial inclusion, however further research could explore other mobile money functions such as '*receiving wages*' through mobile money to explore how fintech is used as an alternative to owning a bank account. Further, we have examined common demographic variables that could impact fintech usage. However, there may exist in-country differences such as regulation, inflation, unemployment that could have a hinder mobile money usage. In Chapter 6 we analyse regulations governing mobile money in sub-Saharan Africa to determine the impact on mobile money adoption.

6.0 Impact of payment systems and mobile money regulations on mobile money adoption.

6.1 Introduction

This chapter examines how the design, structure and coherence of mobile money regulations and payment systems frameworks in seven sub-Saharan African countries relate to mobile money adoption described in Chapter 3 Section 3.6. The chapter aims to answer the research question *What is the impact of mobile money regulations in sub-Saharan Africa?* In doing so the chapter examines the one element of the contextual factors that impact mobile money adoption as depicted in the conceptual framework in Chapter 2 Figure 2.8. The chapter originally set out to explore extended DOI elements of financial and digital literacy, however different themes that have an impact on individual decision-making during adoption of innovation such as *consumer protection* and *trust accounts* emerged during the analysis.

Regulation defines the rules and laws within which financial products and services operate. The advent of fintech resulted in market disruption which has led to regulators grappling with policies and regulations on how to manage fintech (Treleaven, 2015; Hollanders, 2020; Omarova, 2020). The challenges posed by regulating fintech concern customer due diligence; capital requirements; consumer protection; the provision of risk management oversight, amongst others (Arner et al., 2020; Imam et al., 2022; Ozili, 2021). Fintech products that are aimed at increasing financial inclusion are targeted at customers who have never interacted with the financial system (Demirgüç-Kunt and Klapper, 2012). Having neither the financial know-how nor technical know-how leaves them vulnerable and unaware of their legal obligations and the obligations of the service providers (Räisänen and Tuovinen, 2020; Eynon and Geniets, 2016). Laws and regulations need to be put in place to ensure that the products operate within the legal environment; customers are protected from fraud and abuse, and neither customer nor supplier is disadvantaged because of the fintech product. Hodson (2021) argues that the impact fintech has prior to being established paves the way for the regulations that govern them.

As discussed in Chapter 2 Section 2.1.7 One of the influencing factors of mobile money uptake has been how regulators have responded to the innovation. Regulators can create an environment where mobile money can thrive (Burns, 2018), and the uptake of mobile money has been strongest where the regulatory environment was “enabling” (Soutter et al., 2019; Burns, 2018). A country that has led the way in terms of mobile money adoption, Kenya, took

a “test and learn approach”, such that even though mobile money was launched in 2007, regulations were not put into place until 2013. One of the issues encountered with regulating mobile money during its inception in Kenya was a lack of clarity about whether the financial regulator or telecoms regulator was responsible for oversight of mobile money activities as the innovation (Vlcek, 2011). However, due to the grey area within the law, the Central Bank of Kenya (financial regulator) had no powers to stop the telecommunications company from providing mobile money and decided to observe rather than amend the law to prevent telecoms from providing mobile money (Burns, 2018). In contrast, other, jurisdictions such as Nigeria, took a position to restrict the provision of mobile money service to banks, implying that telecommunications companies needed to partner with banks if they wanted to provide mobile money (Lepoutre and Oguntoye, 2018). Subsequently, this had a negative impact on the uptake of mobile money in the country because of disagreements between banks and telecommunications companies. Mobile money success has been experienced in markets where mobile money was allowed to take its own shape and regulation responded to the market dynamics created by the innovation (Soutter et al., 2019).

This chapter examines the differences in regulations that govern mobile money operations across seven sub-Saharan African countries. Specifically, this chapter aims to assess how regulations in Kenya, Ghana, Malawi, Namibia, Rwanda, Tanzania, and Uganda have influenced mobile money adoption at the country level and might influence adoption in future. This analysis has the potential to inform other jurisdictions with similar social-economic landscapes to the countries in our sample on areas to include in their regulations. Further, areas that are prominent in regulations inform other countries on which areas to emphasise when amending or drafting their regulations. Having clear regulations that address areas of concern to consumers can result in consumers having more trust in financial products and therefore reducing consumer uncertainty in adopting mobile money.

Specifically, this study is restricted to payment systems regulations and mobile money or electronic money regulations, where ‘*regulations*’ encompasses acts gazetted by parliament, guidelines issued by financial system regulators, and any other regulatory documents issued by the regulatory authorities. We focus on payment systems and mobile money regulations because in all said jurisdictions stated above, the mobile money regulations are issued under the payment systems regulations and therefore, we expect a degree of similarity between the two pieces of legislation. To conduct this analysis, the qualitative data analysis software *NVivo* is used to analyse regulations at the document-level, specifically examining document

similarities and inconsistencies, comparing themes presented in the documents, and assessing the most significant areas covered by regulation in each jurisdiction. This is important as it informs other regulators of best practice and helps identify areas of regulation ambiguity that could impact mobile money adoption (Easley and O'Hara, 2009).

Mobile money has had a positive impact in sub-Saharan Africa resulting in job creation, reduced poverty, and increased GDP (Jack and Suri, 2014; Lashitew et al., 2019). Countries such as Kenya, Tanzania, Uganda and Rwanda report more mobile money accounts than bank accounts (Demirgüç-Kunt et al., 2022). Our findings in Chapter 2 revealed that digital literacy and financial literacy had a positive impact on mobile money adoption. Further, our analysis in Chapter 3 shows that mobile money has the potential to be used as a measure for financial inclusion. Given that prior studies indicate that regulation has a significant impact on mobile money adoption in the financial sector (Akinyemi et al., 2020; Baganzi and Lau, 2017a), this chapter reviews the regulations surrounding mobile money in seven sub-Saharan Africa countries, investigating how mobile money regulation is structured and the extent to which such regulation could impact mobile money adoption.

Initially, the study was designed to investigate the extent to which the factors that are found to impact mobile money adoption, highlighted in Chapters 2 and 3 (financial and digital literacy and financial inclusion), are prominent in mobile money regulations. The purpose of conducting qualitative analysis was to complement the empirical results documented in Chapters 4 and 5. Through the course of this analysis, it became clear that regulation governing mobile money focuses on factors such as interoperability, transaction limits, trust accounts, consumer protection, agent management and anti-money laundering, with comparatively less focus on those determinants of mobile money adoption identified in the earlier chapters of this thesis. As a result, the focus of this research pivoted towards an examination of how the different jurisdictions address these themes in their mobile money regulations. Further, the chapter highlights the contextual background to the inception of mobile money and the formulation of the payment systems and mobile money regulations in each of the seven jurisdictions, therefore complimenting research conducted in the prior chapters.

Regulations and policies provide the governance structure within which businesses, consumers, and other stakeholders must operate. How regulation is framed influences social life and provides a way of understanding social practices governing specific areas (Wood et al., 2020). Regulations also prescribe particular areas important for businesses, customers, and

other stakeholders to carry out their operations (Treleaven, 2015). We therefore adopt document analysis to understand differences between the country-level regulations and guidelines governing mobile money in sub-Saharan Africa, and to identify themes that are classed as important in the literature concerning mobile money regulation. The process of analysing documents involves selecting sections, sentences, and paragraphs from a document and categorising them into meaningful themes based on the content analysis (Bowen, 2009). In qualitative analysis, document analysis is often neglected in favour of case studies and interviews (Wood et al., 2020). Where it is used, it is often employed in conjunction with other research methods to add more context and credibility to the original findings (Bowen, 2009).

The themes drawn from document analysis allow researchers to gain insights into the structure of the documents and determine which themes have been highlighted. We restrict our focus to payment systems regulations⁴³ because mobile money operates within the payment systems of a country, and therefore provisions within those regulations pertain to mobile money (Malaguti, 2015). In addition, we also look at mobile money regulations⁴⁴ because for each of the jurisdictions under review, the mobile money regulations are issued under the payment systems regulations. The payment systems regulations focus on the wider payment ecosystem including retail payment systems and instruments which govern smaller value transactions and provide alternative means to cash payments, of which mobile money is included (Malaguti, 2015). On the other hand, mobile money regulations specifically govern the mobile money operating environment and provide rules that pertain to mobile money (Maurer, 2012). To avoid conflict between the two pieces of legislation there is a need for some level of cohesion between the payment systems and mobile money regulations. This study provides a comprehensive look at how the two pieces of regulation are structured at the country level but also provides a cross-country analysis of comparing the structure between the seven different jurisdictions.

Our main contributions are fourfold. Firstly, we analyse country-level mobile money-related regulations to identify common themes in line with the proposed areas of importance identified in the relevant literature. This analysis allows us to determine which areas of regulations are more heavily focussed-upon, and therefore deemed more important, in the

⁴³ Payment systems regulations ensure a fair, efficient and competitive payment systems for consumers and businesses (Malaguti, 2015)

⁴⁴ Mobile money regulations ensures a safe, efficient and accessible mobile financial services system for consumers and mobile money service providers (Jack,2011)

jurisdiction. Through this analysis, we are also able to perform a comparison between the regulations governing payment systems and electronic/mobile money, thereby allowing an assessment of the similarity of the documents. Our analysis identifies themes such as *consumer protection* and *trust account* to be prominent across both mobile money and payment systems regulations across most of the countries in our sample.

Secondly, to our knowledge, this is the first study that has compared common themes and concepts within regulations governing mobile money in seven sub-Saharan countries. Previous studies have looked at regulation on an individual country basis, such as the case for Rwanda (Argent et al., 2013), Uganda (Kanobe et al., 2017; Macmillan et al., 2016), and Ghana (Tagoe, 2016). Our methodology can be used applied to different fields where innovations or products can be governed by a set of more than one regulation that could result in regulation ambiguity. Our research begins to provide insights into how to measure document similarity and identify areas where there is strong cohesion between regulations using *NVivo*.

Thirdly, our research informs policymakers aiming to review or amend their payment systems and/or mobile money regulations. Our findings suggest that greater cohesion between the regulations results in higher mobile money adoption and reduces regulation ambiguity (Easley and O'Hara, 2009). Policymakers in countries that do not have legislation governing mobile money can draw from our findings to get insights on how to structure their regulations while addressing the six themes prominent in mobile money. Further policy makers can determine whether provisions should be localised to the specific mobile money regulations or encompass the broader payment systems regulations depending on the socio-economic environment.

Lastly, we contribute to existing literature which investigates the extent to which mobile money regulation could influence mobile money adoption in sub-Saharan Africa. For example, countries with cohesion between regulations can reduce areas of ambiguity and allow the market to evolve (Jack and Suri, 2011). We also contribute to literature offering an initial qualitative exploration on the structure of the mobile money regulatory environment in sub-Saharan Africa. We expand discussions on the importance of themes to be addressed in mobile money regulations and emphasise the importance of including focusing regulations on these themes.

The remainder of this chapter is structured as follows. Section 6.2 documents the theoretical background. Section 6.3 discusses data and methods used in this study. Section 4.4

follows with the findings. Sections 4.5 and 4.6 discuss results from a cross-country perspective, before Section 4.7 concludes.

6.2 Theoretical Background

As discussed in Chapter 2 Section 2.1.7 regulatory environment within which mobile money operates is important because regulation influences social lives and provides a way of understanding how specific areas are governed (Wood et al., 2020). Regulations define areas that are important for businesses, customers and other stakeholders to carry out their operations (Treleaven, 2015). This chapter examines six themes derived from literature that constitute good mobile money regulations: *customer due diligence* (Suri, 2017; Aron, 2017); *trust account to manage customer funds* (Suri, 2017; Di Castri, 2018); *interoperability of mobile money systems* (Burns, 2018; Suri, 2017); *management of mobile money agents* (Madise, 2019; Bahia et al., 2020); *setting transaction limits on accounts* (Suri, 2017; Madise, 2019); and *promoting consumer protection* (Aron, 2017; Martin, 2019).

6.3 Data and Methods

This section analyses payment systems and mobile money regulations from seven sub-Saharan African countries. Specifically, how regulations in Kenya, Ghana, Malawi, Namibia, Rwanda, Tanzania and Uganda have influenced mobile money adoption at a country level. We use NVivo to conduct thematic analysis and document the similarity of documents within a jurisdiction using the Jaccard coefficient; the frequency of coded themes to reveal the structural comparison between regulatory documents and the prominence of themes across the documents. Detailed methodology and results are documented in Chapter 3 Section 3.6 and 3.7.

6.4 Empirical Results

6.4.1 Similarity of themes in payment systems and mobile money regulations.

This study uses the Jaccard Coefficient to measure the similarity between themes in payment systems and mobile money regulations discussed in Chapter 3 Section 3.6.3. The Jaccard Coefficient can be defined as “a correlation coefficient for measuring similarity between sample sets (Samanthula and Wei, 2016, pp 591)”. The coefficient has been applied to different studies such as similarities between chemical compounds (Cao et al., 2010);

similarity of text in documents (Puspaningrum et al., 2020); and comparison of online platforms (Choi et al., 2025) among others. The Jaccard Coefficient can be used to provide a measure for the similarity in themes present in two documents (O'Neill et al., 2018). Evaluating the similarity between the regulations provides insights into the cohesion between regulations and provides ways of reducing ambiguity aversion which can be experienced by individuals wishing to open mobile money accounts or firms wishing to provide mobile money services (Easley and O'Hara, 2009). The table below summarises the Jaccard Coefficient measuring the similarity between payment systems and mobile money regulations in each country. The detailed country results and comparison diagrams are documented in Chapter 3 Section 3.6.

Table 6.1: Jaccard coefficient depicting similarity between payment systems and mobile money regulations

Country	Jaccard Coefficient	Similarity
Ghana	0.813	High
Kenya	0.786	High
Namibia	0.571	Moderate
Rwanda	0.455	Moderate
Tanzania	0.333	Moderate
Uganda	0.533	Moderate
Malawi	0.167	Low

Note: Table 6.1 above shows the similarity between payment systems and mobile money regulations across seven sub-Saharan African countries.

Our results in Table 6.1 above show high level of similarity between the payment systems and mobile money regulations in Kenya and Ghana. The results indicate a high Jaccard Coefficient between the two regulations for the two countries. A high similarity between the documents could be indicative of high mobile money adoption. Both Kenya and Ghana are among countries with high mobile money adoption levels (Demirgüç-Kunt et al., 2022). Namibia, Rwanda, Tanzania and Uganda show a moderate similarity between the documents while Malawi displays a low similarity between the documents. Rwanda, Tanzania and Uganda have high mobile money adoption rates, however mobile money adoption in Namibia is low, this signifies that the coefficient alone is not a determinant of mobile money adoption.

6.4.2 Cross-Country Analysis of Regulatory documents

This section analyses the structures of the comparison diagrams presented in Figure 4.2 above. The comparison diagrams compare the themes prominent in each country's payment systems and mobile money regulations. Table 4.4 below summarises which themes are covered in the payment systems and mobile money regulations across the seven countries. This provides

a holistic view of the structure of the documents regarding the key areas which should be covered in regulations and allows us to conduct a cross-country comparison of the themes. The themes covered in both regulations are denoted by ‘Y’. The purpose of this table is to provide a view of how connected the structure of the two documents is, therefore allowing conclusions to be drawn based on the relationship of the documents.

6.4.3 Structural comparison of the regulatory landscape

Table 6.2: Structure of harmonised themes present in both payment systems and mobile money regulations

	Ghana	Kenya	Malawi	Namibia	Rwanda	Tanzania	Uganda
Agent Management	Y	Y	-	Y	Y	-	Y
Money Laundering	Y	Y	Y	Y	Y	-	Y
Consumer Protection	Y	Y	Y	Y	Y	Y	Y
Interoperability	-	-	-	-	-	-	-
Transaction Limit	Y	Y	-	-	-	-	Y
Trust Account	Y	Y	-	Y	Y	Y	Y

Note: Table 6.2 represents the structure of the themes present in both payment systems and mobile money regulations for Ghana, Kenya, Malawi, Namibia, Rwanda, Tanzania, and Uganda. The Y denotes where the themes are present in both regulations

Table 6.2 reveals similar structures between payment systems and mobile money regulations in Ghana, Kenya, and Uganda: themes of *anti-money laundering*, *consumer protection*, *transaction limit*, *trust account* and *agent management* are highlighted in both documents for these countries. Coverage of five out of the six themes in both regulatory documents signifies greater similarity in the key issues addressed in the documents (O'Neill et al., 2018), this has a positive impact on reducing regulation ambiguity (Easley and O'Hara, 2009) and therefore improving mobile money adoption as all three countries were found to have high levels of mobile money adoption (Ghana 60%; Kenya: 69%; Uganda; 54%) (Demirgüç-Kunt et al., 2022). Further, our findings in Chapter 3 reflect that these countries have high mobile money prevalence and therefore achieve financial inclusion through mobile money. Regulatory themes covered in both payment systems and mobile money regulations signify greater similarity between key regulatory provisions and therefore could have a positive impact on mobile money adoption and financial inclusion (O'Neill et al., 2018).

Further observations reveal that Namibia and Rwanda regulations focus on *trust accounts*, *anti-money laundering*, *agent management* and *consumer protection*. However, despite having similarly structured regulations the uptake of mobile money in the two jurisdictions is significantly different. In 2021 the World Bank reported 43% mobile money account ownership and 66% bank account ownership in Namibia (Demirgüç-Kunt et al., 2022).

Namibia has a high level of financial institution accounts and therefore relatively higher levels of financial inclusion through bank account ownership. Uwamariya et al. (2021) report that by 2018, 74% of Rwandans had a mobile money account. This reflects our findings in Chapter 4 and Chapter 5, for countries with relatively high financial development such as Namibia mobile money uptake will be lower compared to countries with relatively lower financial development such as Rwanda, where mobile money uptake is higher. However, the cohesion between the two regulations supports an enabling regulation with fewer ambiguities allowing mobile money growth.

Tanzanian regulations offer a unique structure with *trust account* and *transaction limit* as the only two themes present in both regulations. Tanzania reported 45% mobile money account ownership compared to 23% financial institution account ownership in 2021 (Demirguc-Kunt et al., 2022). This could suggest that there are other factors such as existing levels of financial inclusion, and digital and financial literacy, as identified in Chapter 2 that impact the adoption of mobile money. Further despite lack of cohesion in the regulatory documents, the uptake of mobile money could be influenced by other neighbouring countries in the region that have cross border trade agreements with Tanzania and high uptake of mobile money such as Kenya, Uganda, and Rwanda (Domingo et al., 2023).

Malawi also presents a unique structure in regulations; themes of *consumer protection* and *anti-money laundering* are covered in both payment systems and mobile money regulations. The structure of the regulatory documents shows that there is limited cohesion between the documents which may lead to ambiguity in mobile money governance. In 2021, Malawi reported low levels of financial inclusion represented by 20% financial institution account ownership and 34% mobile money account ownership. Our findings in Chapter 4 and Chapter 5 suggest improving digital and financial literacy would improve the uptake of mobile money however, the lack of cohesive regulations on mobile money could bring ambiguity and contribute to low uptake of mobile money.

The view presented from Tanzania and Malawi is inconclusive as limited cohesion between regulations does not necessarily signify low mobile money uptake. However, it does support that other factors could have more influence on mobile money uptake.

6.4.4 Cross Country analysis of theme prominence in regulations

Evidence presented in Chapter 3 Section 3.7 suggests that the prominence of themes in the regulations varies according to the jurisdiction. Different jurisdictions focus on

different themes in regulations depending on the areas perceived to be important for that jurisdiction. To investigate this further we conduct a cross-country analysis of the payment systems and mobile money regulations by standardising the frequencies documented in Chapter 3 Figure 3.3. The purpose is to assess the weighting of the themes in each document and determine which areas the regulations put more emphasis on across all the countries. Themes are standardised using the formula;

$$\text{Proportion of coded references (p)} = \frac{\text{number of coded references (f)}}{\text{total number of coded references (n)}} \times 100$$

Where f is the number of coded references for a particular theme and n is the total number of coded references in the document.

The formula is applied to the themes coded in the payment systems regulations, mobile money regulations; and finally combined view of coded themes in both regulatory documents to give an overview of the mobile money regulatory environment. The results are documented in Table 6.3 in this section. We deem proportions between 0-29% as low prominence of themes; 30- 59% signifies medium theme importance and 60-100% represents high theme importance. The purpose of standardising the frequencies is to generate relative frequencies that allow us to assess the payment systems and mobile money regulations across the seven countries in the sample. Further, the analysis allows the identification of which regulatory document discusses the themes more. Section 6.4.5 discusses the payment systems regulations; section 6.4.6 assesses the mobile money regulations.

6.4.5 Cross-Country analysis of coded themes in payment systems regulations

We analyse the prominence of themes in the payment systems regulations across the seven countries in Table 6.3 Panel: A below. The results indicate that consumer protection is highly prominent in Malawi payment systems regulations with 83% of the coded themes focusing on *consumer protection*. *Consumer protection* is moderately prominent in Kenya and Namibia. 32% of the coded themes in Kenya payment systems regulations and 50% of coded themes in Namibia payment systems regulations pertain to consumer protection. The payment systems regulations in the three jurisdictions emphasise the need to have a payment system environment that treats customers fairly and equitably (Malawi, 2014; Kenya, 2014; Namibia, 2023). Consumer protection can enable trust in a product allowing users to adopt the product and feel confident, thereby promoting financial inclusion (Bongomin and Ntayi, 2020b). It has been suggested that *consumer protection* is important when dealing with vulnerable people in

society who are largely financially illiterate (Sanderson et al., 2018; Garz et al., 2021). Findings in Chapter 4 and Chapter 5 indicate the importance of financial literacy in the adoption of mobile money and achieving financial inclusion. Therefore, the prominence of consumer protection could have an indirect link to protecting users with low financial literacy rates.

Table 6.3: Proportion of coding references in payment systems regulations

Panel A: Themes in Payment Systems Regulations

	Ghana	Kenya	Malawi	Namibia	Rwanda	Tanzania	Uganda
Agent Management	26%	25%	0%	13%	31%	0%	16%
Money Laundering	18%	10%	17%	0%	6%	0%	7%
Consumer Protection	30%	32%	83%	50%	25%	24%	18%
Interoperability	2%	4%	0%	0%	19%	0%	0%
Transaction Limit	7%	4%	0%	0%	0%	0%	7%
Trust Account	17%	26%	0%	38%	19%	76%	51%

Panel B: Themes in Mobile Money Regulations

	Ghana	Kenya	Malawi	Namibia	Rwanda	Tanzania	Uganda
Agent Management	17%	35%	24%	51%	13%	28%	29%
Money Laundering	20%	8%	14%	9%	6%	16%	15%
Consumer Protection	25%	35%	27%	36%	2%	18%	32%
Interoperability	0%	0%	8%	0%	0%	0%	1%
Transaction Limit	30%	15%	16%	0%	11%	0%	9%
Trust Account	8%	8%	11%	17%	69%	70%	13%

Panel C: Combined proportions of themes in both regulatory documents

	Ghana	Kenya	Malawi	Namibia	Rwanda	Tanzania	Uganda
Agent Management	21%	29%	21%	41%	16%	20%	24%
Money Laundering	19%	9%	14%	6%	6%	11%	11%
Consumer Protection	27%	33%	35%	40%	6%	20%	26%
Interoperability	1%	2%	7%	0%	4%	0%	1%
Transaction Limit	20%	9%	14%	0%	9%	0%	8%
Trust Account	12%	18%	9%	13%	59%	49%	30%

Note: Table 6.3 represents coded references for payment systems regulations for Ghana, Kenya, Malawi, Namibia, Rwanda, Tanzania, and Uganda. Highly coded themes are highlighted in green and moderately coded themes are highlighted in yellow.

The results reveal that *trust account* is a highly important theme in Tanzanian regulations with a proportion coding of 76%. In Tanzania, the central bank requires mobile money operators to pay interest earned on trust accounts to mobile money account owners based on the balance of the account (Ahmad et al., 2020). Uganda and Namibia put moderate emphasis on *trust accounts* in their payment systems regulations, represented by proportion 51% and 38% respectively. *Trust accounts* facilitate safeguarding the integrity of the mobile money system by prescribing that the electronic money in circulation should always equal the money in the trust account, focusing on this aspect of regulation can help mitigate fraudulent

transactions (Madise, 2019; Di Castri, 2018). Di Castri (2018) suggests that regulations that focus on *trust account* facilitate consumer protection by protecting the trust account's funds against fraud and bankruptcy because mobile money service providers would not be allowed to use these funds to cover their losses.

Rwanda shows moderate prominence of *agent management* in the payment systems regulations of 31%. An important part of agent management is agent non-exclusivity which allows multiple agents to transact with multiple mobile money service providers (Madise, 2019). Agent exclusivity created barriers to entry in Kenya and regulators had to intervene to ensure there were no barriers to entry (Paelo and Roberts, 2022). To avoid similar occurrences the regulators in Rwanda mandated agent non-exclusivity when mobile money was launched (Argent et al., 2013).

In summary, the results indicate that the most prominent themes coded in payment systems regulations are *consumer protection* and *trust account*. These findings provide insights on themes to include when drafting or reviewing payment systems regulations and highlights the importance of those themes in payment systems regulations. *Consumer protection* enables trust in a product by consumers, provides a platform where consumers are treated fairly and is essential when dealing with vulnerable members of the society who need to feel safe when using financial products (Bongomin and Ntayi, 2020b; Sanderson et al., 2018). *Trust accounts* are important because they help safeguard the integrity of the mobile money system (Di Castri, 2018). Our findings suggest that including trust accounts in payment systems regulation can communicate how interest earned on the account is distributed and how consumer funds are safe-guarded (Suri, 2017; Di Castri, 2018).

6.4.6 Cross-country analysis of coded themes in mobile money regulations

Panel B of Table 6.3 above displays the findings of analysing the prominent themes in mobile money regulations. The analysis provides a platform to compare the proportion of coded themes across regulations that focus on mobile money. Firstly, our findings indicate that *trust account* is important in Rwanda and Tanzania mobile money regulations. 68% of the themes coded in the Rwandan mobile money regulations emphasise the importance of *trust account* management, whereas for Tanzania the total coded themes on *trust account* in the mobile money regulations is 70%. Rwandan mobile money regulations stipulate the need to audit trust accounts (Rwanda, 2022). Similarly, Tanzania mobile money regulations emphasise

the need to audit and publish trust account financial statements (Tanzania, 2015a). The auditability of trust accounts can help mitigate fraud, breaches in transaction limits and money laundering (Katusiime, 2021). Trust accounts hold an equivalent cash amount to the mobile money amount in circulation and therefore require adequate regulations to mitigate mismanagement and fraud and to govern interest earned on the account (Ahmad et al., 2020; Suri, 2017).

Secondly, results show *consumer protection* is important in mobile money regulations. Results indicate a moderate emphasis of *consumer protection* in Kenya, Namibia and Uganda mobile money regulations. In Kenya 35% of coded references in mobile money regulations pertain to consumer protection, 36% in Namibia and 32% in Uganda respectively. Mobile money regulations in all three jurisdictions emphasise the need to have a system in place to handle complaints from customers and include a timeframe in which problems should be resolved (Kenya, 2013; Namibia, 2019; Uganda, 2015). Financially underserved or excluded customers often lose trust in products when they encounter problems, they perceive to be significant (Bongomin and Ntayi, 2020b). Financial innovations such as mobile money have the potential to harm customers through fraud, collusion and other means that take advantage of low financially literate levels (Garz et al., 2021). The advent of mobile money in Uganda created products such as microloans that could be accessible without a contract and necessitated a focus on consumer protection for consumers to understand their legal obligations (Zeija, 2018). Malala (2013) reports a similar situation in Kenya that arose due to the rapid uptake at its inception, however, failed to address consumer protection issues that were necessary to inform consumers of their obligations. Low-income consumers could not protect themselves from the misconduct of agents which led to the loss of income and therefore necessitated ensuring consumer protection when introducing mobile money regulations (Malala, 2013).

Thirdly, *agent management* has moderate importance in mobile money regulations in Kenya and Namibia. Agent management is important because agents interact with customers and therefore need to be trained to provide quality service and monitor risks (Madise, 2019; Di Castri, 2018). 35% of coded references in Kenya mobile money regulations and 51% of coded references in Namibia mobile money regulations cover *agent management*. Both jurisdictions emphasise the need to conduct due diligence when recruiting agents to ensure agents are adequately trained to provide mobile money services (Kenya, 2013; Namibia, 2019). Rapid growth of agents in Kenya were instrumental to the adoption of mobile money in the country (Suri, 2017; Jack and Suri, 2011). By the end of 2012 Kenya reported 76,912 mobile money

agents a figure which rose exponentially to 298,272 by the end 2021 (IMF, 2022). Namibia reported 2039 mobile money agents in 2021 from 199 in 2012 (IMF, 2022). The rapid growth in mobile money agents supports the need for provision in mobile money regulations. Agents need to be trained to conduct adequate due diligence and observe transaction limits to ensure safe mobile money operations (Di Castri, 2018).

Lastly, Ghana is the only country to show moderate importance of *transaction limits* in the mobile money regulations covering 30% coded references. Akomea-Frimpong et al. (2019) report an increase in mobile money-related fraud in Ghana in 2015 which stood at 23 per cent of total mobile money transactions, ranging from \$80 to \$800 per transaction. In an attempt to curb fraud, the regulators introduced comprehensive transaction limits in the regulations and classified customer according to low, medium and high risk with transaction limits commensurate with the customer risk rating (Ghana, 2015). Because transactions through mobile money are usually low in value, the limits do not disadvantage low-risk customers (Burns, 2018). Transaction limits can help curb ML/TF risks and frauds by enabling transaction patterns to be detected; identifying breached transaction limits on customer accounts and isolating agents transacting beyond the limit amount to maximise commissions, thereby strengthening the integrity of the system (Argent et al., 2013).

High and moderately coded themes provide areas of importance in regulations in different jurisdictions. Jurisdictions will focus on a particular area depending on the country needs to promote mobile money uptake (Suri, 2017). Our findings show emphasis on *agent management*, *consumer protection* and *trust account* as important across several jurisdictions. Reviewing or drafting of mobile money regulations should include these themes as specific to mobile money as they speak to the integrity of the mobile money system. Agent management is often localised to mobile money regulations because all mobile money transactions take place through agents (Jack et al., 2013).

6.4.7 Cross-country analysis of coded themes in both regulations

To investigate the prominence of themes coded in both regulations we provide a combined analysis of both regulations with results documented in Panel C of Table 6.3. Conducting an analysis of the themes in both regulations provides a holistic view of the regulations governing mobile money operations. Firstly, the results reveal *consumer protection* is moderately important across the mobile money regulatory environment. These findings are reflective of our findings in section 6.4.5 and section 6.4.6. *Consumer protection* facilitates

trust of consumers in the innovation and provides a platform to address customer complaints (Garz et al., 2021; Bongomin and Ntayi, 2020b). Consumer protection is a moderately important theme in Kenya (33%), Malawi (35%) and Namibia (40%).

Secondly, trust account is moderately important across the mobile money regulatory environment. Trust account is important because regulations facilitates protection of consumer funds in trust accounts from creditors or bankruptcy of mobile money providers (Di Castri, 2018). *Trust account* is a moderately important theme in Rwanda (59%), Tanzania (49%) and Uganda (30%). Lastly, results show that *Agent Management* is moderately important in the Namibia regulatory environment at 41%. *Agent Management* is important in mobile money regulations because agents are customer facing and therefore need to be trained to support customers adequately (Jack and Suri, 2011). Further, mobile money providers should conduct due diligence on agents to prevent fraud and collusion facilitated by agents (Argent et al., 2013).

The combined effect of regulations reduces the importance of some of the themes such as *consumer protection* and *trust account* because they are more prominent in one set of the regulations. For example, in Malawi *consumer protection* is emphasised in the payment system regulations. Similarly, in Rwanda *trust account* is emphasised in the mobile money regulations.

6.4.8 Themes with low coded references

Interoperability and *money laundering* are the least coded themes across the payment systems and mobile money regulations. Jurisdictions such as Namibia and Tanzania do not discuss interoperability in their payment systems and electronic money guidelines. Some studies have suggested that interoperability may evolve naturally as the innovation matures (Donovan, 2012; Argent et al., 2013). Forcing interoperability may be seen as interfering with the market and stifling innovation, with negative impacts on competition (Di Castri, 2018). Different countries have dealt with interoperability in their own way. For example, mobile money was introduced within Kenya in 2007, but interoperability of mobile money was enforced in April 2018 as a result of the main mobile money provider (Safaricom) creating a monopoly and imposing high barriers to entry for new entrants (Paelo and Roberts, 2022). Argent et al. (2013) argue that in Rwanda mobile money regulations were crafted when mobile money was at its infancy, over prescribing interoperability could have resulted in negative impact such as scaring away potential investors and increased transaction costs. In Malawi, the two mobile money providers reached interoperability on their own without the need for

regulators to enforce it (Madise, 2019). As such, interoperability is only recommended in the mobile payment guidelines and not enforced through the payment systems regulations (Malawi, 2011).

Money laundering is undoubtedly important in legislation, however, the limited coverage in this regulation is because each country has an overarching Anti-Money legislation that governs all aspects of money laundering monitoring including mobile money. The payment systems and mobile money regulations refer to that act. However, review of legislation governing anti-money laundering/countering financial terrorism is beyond the scope of this thesis.

6.4.8 Other factors that impact mobile money adoption

While this chapter highlights begins to provide insights into how regulation structure can impact mobile money adoption there exist other factors outside of regulation that could impact mobile money adoption. Different countries have different factors that impact regulations such as globalisation, reduced barrier to entry and increased technological innovations (Hafeez, 2003). Further, there may exist in-country factors that impact mobile money adoption, for example, Tanzania is part of the East African group of countries with Uganda, Kenya and Rwanda and cross-border trade, similar languages, and advances to integrate cross-border payments within the region may influence mobile money adoption (Domingo et al., 2023). Despite, the regulatory structure only incorporating four of the six themes in Tanzania and having a moderate Jaccard coefficient, Chapters 4 and 5 show high mobile money uptake which could be because of lower barriers to entry and cross-border influences from neighbouring countries. Further studies could explore country specific factors in conjunction with regulation.

6.5 Discussion

Our study identifies six key emerging trends across the mobile money regulatory environment in sub-Saharan Africa. Firstly, countries with high Jaccard coefficient show high mobile money adoption rates (Kenya, Ghana), indicating that regulatory cohesion has a positive influence on mobile money adoption. Some countries with moderate similarity have high mobile money adoption rates (Tanzania, Uganda, Rwanda), whereas others such as Namibia do not. This could be an indication that while regulatory cohesion had an impact on mobile money adoption there are other factors that influence mobile money adoption. Countries with low cohesion between regulations exhibit low mobile money adoption (Malawi). This is

indicative of high ambiguity existing between regulations and therefore causing uncertainty among consumers.

Secondly, there is a clear emphasis on *consumer protection* in both the payment systems and mobile money regulations across all countries. Madise (2019) emphasises the importance of consumer protection in mobile money regulations particularly for developing countries where financial literacy is low. Different regulations highlight the need to handle customer complaints, provide a secure and equitable payment system and the need to disclose all charges to customers (Kenya, 2014; Malawi, 2014; Namibia, 2019). Further, different themes such as *transaction limits* and *trust accounts* also have a bearing on consumer protection. Setting *transaction limits* can help monitor money laundering operations, thereby protecting the integrity of the financial system (Madise, 2019). *Trust accounts* hold the equivalent cash amounts to the mobile money in circulation and therefore act to prevent fraud and mismanagement of funds (Ahmed et al., 2016; Suri, 2017).

Thirdly, across regulations *interoperability* is the least emphasised theme, with countries such as Tanzania and Namibia not mentioning it in either regulation. This is mainly because interoperability may evolve naturally as the innovation matures and forcing interoperability may be seen as interfering with the market (Donovan, 2012; Argent et al., 2013). This could reflect regulators choosing to let the market determine the levels of interoperability as regulatory intervention could stifle competition (Di Castri, 2018). In some jurisdictions such as Rwanda, Kenya and Uganda, it is important to specify levels of interoperability to prevent interoperability barriers from materialising (Paelo and Roberts, 2022). In Malawi the two mobile money providers reached interoperability agreements without the need for the regulator to intervene (Madise, 2019)

Fourthly, a holistic look at the themes suggests that countries that address all six themes (*trust account, interoperability, transaction limit, anti-money laundering, consumer protection and agent management*) in their payment systems and mobile money regulations providing cohesion between the regulatory documents, have better mobile money adoption as seen in the case of Ghana, Kenya, Uganda, and Rwanda. Comprehensive coverage of themes in regulations can reduce regulatory ambiguity (Easley and O'Hara, 2009). Further results suggest that countries where all six themes have not been covered in the regulations, such as Tanzania and Malawi, adoption of mobile money could be lower. Ambiguities that exist in the regulatory environment that could impact mobile money adoption (Easley and O'Hara, 2009). However,

other factors such as existing levels of financial inclusion through bank account ownership and levels of digital and financial literacy further impact the adoption of mobile money and found in Chapters 4 and 5. Further, there may exist in-country factors that impact mobile money adoption, for example, Tanzania is part of the East African group of countries with Uganda, Kenya and Rwanda and cross-border trade, similar languages, and advances to integrate cross-border payments within the region may influence mobile money adoption (Domingo et al., 2023).

In addition, at the policy level, our findings inform policymakers representing countries that would want to review and amend their payment systems and mobile money regulations to ensure greater cohesion between the two regulations. Policy makers in countries that do not have legislation governing mobile money can also draw insights from this study on how the structure of their regulation should be developed to avoid ambiguities in regulations. This study further confirms the need to address the six themes (*trust account, interoperability, transaction limit, anti-money laundering, consumer protection* and *agent management*) in regulations to promote mobile money adoption and ensure a safe operating environment. Countries looking to introduce or amend their mobile money regulations could look at the structure of countries such as Kenya, Ghana and Uganda that are similar, report similarities between regulations and report high levels of mobile money adoption.

Lastly, countries should look to the socio-economic factors impacting their financial environment to identify areas that need prominence in regulations, for example, Malawi has a strong focus on *consumer protection*; and Rwanda and Tanzania have a strong focus on *trust account*. In addition, different jurisdictions should assess whether regulatory provisions should encompass the payment systems or focus on the mobile money landscape. For example, issues of *agent management* in Kenya and Namibia are addressed in the mobile money regulations, whereas in Rwanda they are addressed in the payment systems regulations. The degree of emphasis on the importance of the themes differs according to the country. For example, Ghana, Kenya, Rwanda, Tanzania, and Uganda have a strong emphasis on *trust account*. Management of trust account supports consumer protection because funds are accounted for, promotes system integrity, sets rules for distribution of interest earned on the account and helps to curb fraud (Madise, 2019; Ahmad et al., 2020; Suri, 2017). Consequently, these countries also report the highest levels of mobile money users in sub-Saharan Africa (Demirgüç-Kunt et al., 2022).

6.5 Conclusion

This chapter investigated the similarities and differences in regulations governing mobile money operations in seven sub-Saharan African countries. Specifically, the purpose was to examine how payment systems and mobile money regulations have influenced mobile money adoption in the sub-region by answering three research questions. The study was restricted to the payment systems and mobile money regulations because, in all seven countries, the payment systems regulation is the overarching regulation and mobile money regulations are issued under it. Understanding the regulatory environment highlights areas that are important in regulations; provides insights into areas that could cause potential ambiguities which could lead to consumer uncertainty in adopting an innovation. Further coherence in the two sets regulations could be associated with increased mobile money uptake. Our research begins to set the foundations for future in-depth analysis into how regulations could impact financial innovation.

Specifically, we conducted an initial exploration of regulations governing mobile money in sub-Saharan Africa. To conduct this analysis *NVivo* software was used to analyse regulations at the document level, specifically examining similarities and inconsistencies between the documents and identifying the most significant areas covered in each jurisdiction. The six themes (*trust account, interoperability, transaction limit, anti-money laundering, consumer protection* and *agent management*), were identified from previous studies that have recommended redress through mobile money regulations.

Our work provides a qualitative method that can be applied to different fields of study that are governed by two or more regulations to assess the similarities and differences between those regulations. Our study shows that where there is cohesion between two regulations there is reduced regulatory ambiguity and therefore improved uptake of mobile money. We also provide a way of complementing quantitative research that examines the adoption of financial products by supporting it with qualitative research that looks at the regulatory environment. This research provides insights into the regulatory environment in which financial products operate. Our research provides initial exploratory insights into how regulation impacts mobile money. However, the research is limited in that it does not consider how the availability of other financial products and services could have an impact on mobile money adoption. Future research can examine both mobile money adoption and other financial products. Further the

research does not consider the socio-economic environment that could impact how regulations are formulated and how financial products are adopted. Future research could explore the impact of the socio-economic environment and regulations. The next chapter provides the conclusions for this thesis.

7.0 Conclusion

7.1 Thesis Overview

In 2021, sub-Saharan Africa reported relatively lower bank account ownership compared to the global average and the average of other developing countries (Demirgüç-Kunt et al., 2022). The low indicator of financial inclusion emphasises the need to provide financial services to the “underbanked” and “unbanked” (Demirgüç-Kunt and Klapper, 2012). During the same period sub-Saharan Africa reported total mobile money account ownership of 33%, the highest proportion globally (Demirguc-Kunt et al., 2022). This signifies increasing use of mobile money in the sub-region, thereby providing a means to bring the “unbanked” into the formal financial sector by reaching areas where banks cannot reach due to poor infrastructure (Jack and Suri, 2011). This thesis therefore explores the factors that impact mobile money adoption with the aim of providing insights and policy recommendations that would facilitate mobile money adoption and increase financial inclusion in sub-Saharan Africa. The findings of this research are documented in three main empirical chapters discussed in Chapter 4, Chapter 5 and Chapter 6. Our research provides insights that can be applied at the national and international level to aid financial development in sub-Saharan Africa.

Specifically, the first empirical chapter (Chapter 4) explores how mobile money attributes, digital literacy, access to finance and financial inclusion impact mobile money adoption. The chapter investigates the research question: *To what extent do innovation attributes (observability and relative advantage), digital literacy, financial inclusion and access to financial services impact mobile money adoption?* To answer this question, we investigate mobile money adoption through the demand side (mobile money accounts). The findings of this chapter generally support our hypothesis by highlighting that innovation attributes, digital literacy and financial inclusion are important in mobile money adoption. The investigation begins to highlight the significance of mobile money in promoting financial inclusion. We therefore conduct further investigations in the role of mobile money to facilitate financial inclusion in the second empirical chapter (Chapter 5). This chapter investigates our second research question: *Can mobile money be used to measure financial inclusion in sub-Saharan Africa?* To answer this research question, we investigate the role of mobile money using three main functions (sending remittances, receiving remittances and bill payments). We explore the impact of financial and digital literacy and demographic variables (gender, age, education and income) on financial inclusion. Our results generally support that mobile money

can be used a measure for financial inclusion. Further, policies that target the youth, and women have the potential of increasing financial inclusion through mobile money usage. Finally, we explore how the regulatory environment can impact mobile money adoption through the review of regulatory documents. We investigate whether cohesion between payment systems regulations and mobile money guidelines has an impact on mobile money adoption. To do this we conduct a qualitative analysis to assess the cohesion between two mobile money governing regulations in our third empirical chapter (Chapter 6). This analysis investigates the research question: *What is the impact of regulation on mobile money adoption in sub-Saharan Africa?* Our findings reveal that where there is greater cohesion between regulations there is less ambiguity and therefore potential for increased mobile money adoption. Overall, the findings of this thesis generally support the research questions investigated in Chapter 4, Chapter 5 and Chapter 6. Section 7.2 below highlights key findings from this study.

7.2 Contributions and Policy Implications

7.2.1 Theoretical Contributions

Extended Diffusion of Innovation Framework

Firstly, this thesis advances theory by extending Rogers' Diffusion of Innovation (DOI) framework to a cross-country context of fintech adoption in sub-Saharan Africa. While DOI theory has traditionally focused on individual-level adoption decisions and innovation attributes, this study integrates additional structural determinants, namely digital literacy, financial literacy, financial access, and existing levels of financial inclusion, into the DOI framework. By doing so, the thesis develops a broader conceptual model that captures both innovation characteristics and contextual enablers within developing financial systems (depicted in Figure 2.8). The study further adds to knowledge by categorising countries according to the IMF FDI and investigates factors impact mobile money adoption in different economic environments. Specifically, we show that digital literacy has a significant impact on mobile money adoption consistent with findings from other scholars (Kass-Hanna et al., 2021; Demir et al., 2022). Further, we highlight differences between low FDI and high FDI by showing that in countries with low FDI lack of access to financial services provides a platform for mobile money to thrive because it provides an alternative means to accessing financial services compared to high FDI countries where financial services are readily available. These insights begin to highlight in-country differences and provide an understanding on the differences in mobile money adoption rates between countries. Our findings resonate with other

studies that mobile money can provide services where banks are not available (Burns, 2018; Soutter et al., 2019). By extending the framework across FDI categories, we show that the extended framework can be applied to individual countries and across different countries with similar characteristics to enable generalisations to be made.

Mobile money as a measure for financial inclusion

Secondly the thesis contributes to the understanding of financial inclusion measurement through mobile money usage. Traditional measurements of financial inclusion rely heavily on bank account ownership as an indicator of financial inclusion (Park and Mercado, 2018; Sha'ban et al., 2020). However, in many sub-Saharan African countries formal banking penetration remains limited and therefore account ownership does not reflect participation in financial systems. By examining financial inclusion through mobile money usage – specifically sending remittances, receiving remittance and bill payments - we shift the focus of financial inclusion to active engagement with financial services. Theoretically, this challenges bank-centric models of financial inclusion and positions mobile money-based interaction as a means for achieving financial inclusion. By categorising countries by MMPI we can provide a granular analysis of mobile money usage based on the development of the sector. In so doing this thesis allows countries with similar usage levels to be analysed. Our findings are like other studies that posit that digital and financial literacy have a significant impact on financial inclusion (Triki and Faye, 2013; Kass-Hanna et al., 2021). This thesis therefore contributes to understanding financial inclusion in a broader usage-based and context-sensitive analysis.

Cohesion of mobile money regulations

This thesis conceptualises regulatory cohesion as part of the regulatory environment shaping mobile money adoption. By examining the alignment between common themes in payment systems and mobile money regulations, the thesis introduces regulatory coherence as a determinant for mobile money adoption. To our knowledge this is the first study that provides an analysis of two regulations (payment systems regulations and mobile money guidelines) governing mobile money adoption. As an exploratory study we develop a four-step method for reviewing common themes in regulations governing mobile money based on an eight-step method developed by O'Neill et al. (2018). Our results indicate that to reduce regulatory ambiguity, there should be strong cohesion between the two regulations and all the themes under consideration should be covered in the regulations.

7.2.2 Empirical Contributions

This thesis provides novel empirical evidence on mobile money adoption and financial inclusion across 18 sub-Saharan African countries. It offers one of the most comprehensive cross-country analyses of mobile money adoption in the sub-region, moving beyond the more common single-country case studies. By combining data from World Bank, IMF and ITU the study identifies how determinants of mobile money vary across time and across different levels of financial development. Our findings highlight that innovation attributes of *relative advantage* and *observability* are important in mobile money adoption, effects of digital and financial literacy; the role of existing levels of financial inclusion, the impact of demographic variables and how regulations could potentially impact mobile money adoption.

A second important aspect of the contextual findings highlighted through this study, highlighting how factors impacting mobile money differ across different periods and different country context. We therefore examine mobile money adoption across different time periods and group countries based on the FDI and MMPI. Our study also highlights how the in-country regulatory structure impacts mobile money adoption. Below are specific empirical findings in detail.

Impact of innovation attributes on mobile money adoption

Our results reveal that mobile money attributes have a positive impact on mobile money adoption. Rogers (2003) proposes that the five innovation attributes (*relative advantage*, *complexity*, *compatibility*, *observability* and *trialability*), explain 47% to 89 % of the variance in the adoption process. We investigate the impact of mobile money attributes on mobile money adoption in line with DOI theory, specifically focusing on *relative advantage* and *observability*. To do this, registered mobile money accounts⁴⁵ and registered mobile money agents⁴⁶ are used to represent both the demand and supply side of mobile money adoption. Our study finds that *relative advantage* proxied by the value of transactions accounts for between 21% to 40% increase in mobile money adoption. *Observability* proxied by agent availability explains 23% to 49% of mobile money adoption. Combined our results support the theory that mobile money

⁴⁵ A registered mobile money account is an account registered with a resident mobile money service provider that is primarily accessed using a mobile phone and can be used for basic financial transactions, including peer-to-peer transfers, bill payments, merchant payments and international remittances (wherever allowed) (IMF, 2019).

⁴⁶ A registered mobile money agent outlet can be a person, quasi-corporation, corporation or a machine that facilitates mobile money account registration, cash-in cash-out transactions, and customer support. Small retail shops and other retailers typically serve as agents in low-income and emerging economies (IMF, 2019).

attributes play a significant role in mobile money adoption, because they reflect how useful the mobile money is to the user. Therefore, how users perceive mobile money to meet their financial needs would impact mobile money adoption.

Impact of digital and financial literacy

Kass-Hanna et al. (2021) find that digital and financial literacy are important significant in adoption of mobile money. In most sub-Saharan African countries digital literacy is low due to poor infrastructure and high cost of internet (Reddy et al., 2022). Digital literacy is important in operating fintech products. Financial literacy is important for financial well-being, planning and making sound financial decisions and choosing financial products (Dewi et al., 2020b; Lusardi, 2019; Lusardi and Mitchell, 2011b; Bongomin et al., 2020b). Poor financial literacy can result in lack of confidence in engaging with financial products (Malady, 2016). Our findings in Chapter 4 and 5 suggest that increasing digital and financial literacy increases mobile money adoption. However, digital literacy displays stronger effect than financial literacy. This is because increasing levels of digital and financial skills could potentially increase the skills to operate mobile money (Kass-Hanna et al., 2021). Our findings are similar to other studies that suggest that digital and financial literacy facilitate financial inclusion through fintech usage (Lee, 2021; Triki and Faye, 2013). Improving digital and financial literacy is particularly important in improving financial inclusion through mobile money in countries with low levels of financial development and mobile money usage.

Impact of demographic variables

Demographic variables of gender, age, income and education have been shown to influence mobile money adoption. Our findings on gender in Chapter 5 are similar to Reynolds et al. (2023). In countries where mobile money is emerging gender was significant in determining mobile money adoption. Therefore, establishing policies that target women could potentially improve mobile money adoption. This is because in countries where mobile money is emerging men are more likely to have mobile money accounts because they have a source of income and have more financial responsibilities (Lotto, 2018; Reynolds et al., 2023). Increasing access to mobile money amongst women would increase financial inclusion. Further, our results indicate that the youth (ages 15-24) in countries where mobile money is low are less likely to have bank accounts because they may not have a source of income (Akinyemi et al., 2020), therefore mobile money can provide a platform for them to access financial services thereby improving financial inclusion. Policies aiming to improve financial inclusion should create an environment where the youth can own mobile money accounts.

Impact of regulations

We review the impact of payment systems regulations and mobile money regulations on mobile money adoption in Chapter 6. Prior studies have identified six key areas that constitute good mobile money regulation: *customer due diligence* (Suri, 2017; Aron, 2017); *trust account to manage customer funds* (Suri, 2017; Di Castri, 2018); *interoperability of mobile money systems* (Burns, 2018; Suri, 2017); *management of mobile money agents* (Madise, 2019; Bahia et al., 2020); *setting transaction limits on accounts* (Suri, 2017; Madise, 2019); and *promoting consumer protection* (Aron, 2017; Martin, 2019). This study analyses the regulations to determine whether the presence of the themes in the regulations has an impact on mobile adoption and reduces regulatory ambiguity. Further, we examine the impact of cohesion between the payment systems and mobile money regulations, which are the regulations governing mobile money operations examined in this study. Our findings suggest that in countries where there is cohesion between the two sets of regulations, mobile money adoption is high. Further, the results support that individual country's socio-economic environment can have an impact on mobile money adoption in conjunction with the mobile money regulations. Different countries, have different prominent themes in the regulations depending on areas of importance.

7.2.3 Context specific empirical contributions

This thesis provides context-specific empirical contributions by demonstrating how the determinants of mobile money adoption and usage vary systematically across time, levels of financial development, levels of mobile money penetration and regulatory structures in sub-Saharan Africa. Rather than treating adoption drivers as uniform across contexts, this study shows that their significance is dependent on structural and temporal conditions.

i) Mobile money adoption across time

Our results suggest that mobile money adoption determinants evolve across different stages of market development. During the inception stage (2010-2014), the innovation attribute of *relative advantage* was the most significant driver of adoption. The finding aligns with DOI theory, which posits that innovations are more likely to be adopted when they are perceived as superior to existing alternatives (Rogers, 2003). In the early stages, mobile money offered clear functional advantages over informal and traditional remittance channels which were often costly, insecure and geographically constrained (Jack and Suri, 2011). The

perceived safety, speed and reduced transaction costs of mobile money therefore constituted a compelling reason to adopt mobile money (Hornuf et al., 2025).

In contrast, during the operational phase (2015-2018), *digital literacy* emerged as a statistically significant determinant of mobile money adoption. This period coincided with the maturation of mobile money platforms and expansion of services beyond basic peer-to-peer transfers. As providers introduced additional functionalities such as bill payments and cross-border remittances, the complexity of transactions increased (Osabutey and Jackson, 2024). The shift from simple remittance transfers to multifunctional digital platforms likely increased the technical demands placed on users, increasing the need for digital capability.

These findings demonstrate that adoption drivers can be stage dependent, *relative advantage* dominates during early adoption whereas *digital literacy* becomes more important as technological sophistication of services increases.

ii) *Mobile money adoption across countries with different levels of financial development (FDI)*

Across different countries the level of financial development significantly impacts mobile money adoption patterns. In relatively highly financially developed countries, mobile money adoption is comparatively lower. This suggests that where formal banking infrastructure is established and bank account ownership is widespread, the incremental value of mobile money is reduced. In such contexts, mobile money does not necessarily represent a strong *relative advantage* over existing financial services.

In contrast, digital literacy is particularly significant in countries with low financial development. These countries are often characterised by limited digital infrastructure, low internet penetration and restricted access to formal financial services, all of which constrain digital capability (Nedungadi et al., 2018). In these environments, improved digital skills are closely linked to the ability to access and utilise mobile-based financial services.

In medium financial developed countries, existing levels of financial inclusion positively influence mobile money adoption. This finding suggests a complementary dynamic, as formal participation increases, individuals may become more comfortable engaging with financial technologies. *Observability*, which is proxied by *agent density per km²* is a significant mobile money adoption driver for this group. Higher agent availability enhances visibility and accessibility, thereby reinforcing adoption through social diffusion mechanisms (Rogers et al., 2014; Caputo, 2019). Importantly, several of the regional leaders in mobile money usage such as Kenya and Ghana fall within this medium-development category, suggesting that an intermediate level of financial infrastructure may create the necessary conditions for mobile money expansion.

iii) *Mobile money usage across time*

Beyond adoption, this thesis makes a distinct contribution by analysing determinants of mobile money usage as a measure for financial inclusion. The findings indicate digital literacy remains consistently significant across time and becomes increasingly important for more complex financial activities such as bill payments. This reinforces the argument that financial inclusion through mobile money is contingent not merely on access, but the ability to engage with digital interfaces. In contrast financial literacy, while initially important, declines in significance over time for functions such as sending and receiving remittances. This suggests that once users become familiar with basic transactional functions, the importance of formal financial knowledge decreases relative to digital competence.

Further, income and education are significant determinants of mobile money usage. Higher income and improved educational attainment are associated with greater engagement in digital financial services. These findings are consistent with prior research demonstrating that socioeconomic advancement enhances the demand and uptake of digital financial services (Amoah et al., 2020; Akinyemi et al., 2020). However, this thesis extends that literature by demonstrating how these effects interact with digital capability and technological maturity across time.

iv) *Mobile money usage across countries with different levels of mobile money usage (MMPI)*

By classifying countries according to levels of mobile money prevalence, this thesis reveals the determinants of mobile money usage in specific country context. Digital literacy is particularly significant in countries with low and medium mobile money prevalence. In these contexts, limited ecosystem maturity may require users to possess stronger digital competencies to navigate emerging systems. As systems become more mature, the strength of digital literacy may decline.

Education remains significant across all country groups, however its effect is stronger in low and medium prevalence countries. This suggests that general human capital plays a role in facilitating early and intermediate usage. Our findings resonate with studies that have suggested that in high mobile money prevalence countries demographic variables are not significant (Reynolds et al., 2023).

These findings highlight that mobile money sophistication shapes the importance of individual-level determinants. Policy interventions aimed at increasing usage must therefore be tailored to ecosystem maturity rather than uniformity across countries.

v) *Regulatory context and mobile money adoption*

This thesis also demonstrates that regulatory structure plays a measurable role in shaping adoption outcomes. Countries exhibiting stronger cohesion between payment systems regulations and mobile money guidelines show higher levels of mobile money adoption. Regulatory alignment likely reduces uncertainty, enhances institutional trust and clarifies operational boundaries for mobile money providers and users (Easley and O'Hara, 2009). In addition, the inclusion of customer-centric regulatory themes such as *consumer protection* provisions and *trust account* requirements is positively associated with mobile money adoption. These provisions may reduce perceived risk and strengthen user confidence in digital systems.

This finding contributes to literature by empirically linking regulatory coherence to innovation diffusion outcomes, extending beyond firm-level or consumer-level determinants to include institutional design as a structural driver of adoption.

7.2.3 Policy Implications

Our study has several policy implications on how mobile money adoption can be enhanced to improve financial inclusion. Firstly, this thesis highlights that barriers to mobile money adoption can be removed by implementing policies that support improving digital and financial literacy. Facilitating easy access to digital and financial knowledge can improve mobile money adoption and enable policy makers to lower barriers to financial inclusion (Kass-Hanna et al., 2021). Digital literacy enables users to be familiar with mobile money and financial literacy aids in making sound financial decisions (Triki and Faye, 2013; Lusardi and Mitchell, 2011b). Secondly, our study reveals that mobile money adoption differs depending on a country's FDI. Countries with lower FDI should encourage establishment of mobile money agents in areas where there is limited access to financial services to provide an alternative means to access finance. Policymakers should consider lowering barriers of entry for mobile money providers and mobile money agents to improve uptake of mobile money.

Thirdly, our study supports that mobile money usage is a medium through which financial inclusion can be measured. Our findings highlight that in low MMPI countries women, and the youth (15-24) have lower access to mobile money services. For instance, countries with low MMPI such as Malawi and Mozambique reported 13.4% and 6.6% women used mobile money in 2021, respectively. In contrast these countries reported relatively higher mobile usage for men, 21.9% and 14.3%, during the same period. Governments in countries with low MMPI should develop policies that target the youth and women to increase access to financial services and therefore promote financial inclusion.

Lastly, our findings inform policymakers representing countries that would want to review and amend their payment systems and mobile money regulations to ensure greater cohesion between the two regulations. Policy makers in countries that do not have legislation governing mobile money can also draw insights from this study on how the structure of their regulation should be developed to avoid ambiguities in regulations. This study further confirms the need to address the six themes (*trust account, interoperability, transaction limit, anti-money laundering, consumer protection* and *agent management*) in regulations to promote mobile money adoption and ensure a safe operating environment. Countries looking to introduce or amend their mobile money regulations could look at the structure of countries such as Kenya, Ghana and Uganda that are similar, report similarities between regulations and report high levels of mobile money adoption.

7.3 Limitations

As a study with two empirical chapters that use secondary data sources, there are limitations based on the data collection. The first dataset is compiled from the IMF Financial Access Survey, the World Bank Development Indicators and the International Telecommunications Union ICT Indicators. All databases have wide data coverage, making them useful for this study, however there were gaps in the data due to countries being non-responsive or failing to submit information to the organisation in some years. Further, due to the nature of the data variables we were exploring in this study, some measures such as innovation attributes had to be inferred as direct measures were unavailable. To overcome these limitations, countries that had no data were removed from the initial sample. Further, we explain that the variables used imply the properties of the innovation and therefore reflect the innovation attributes.

The second dataset was compiled from the World Bank Global Findex Survey 2014, 2017 and 2021. The survey reflects a snapshot in time of 1000 respondents for each country, which could represent a small sample size considering the large populations of the subject countries (Demirguc-Kunt et al., 2022). To overcome this challenge, we group countries into three main categories based on the MMPI which provides a larger sample size for comparison. Further, the data was also limited due to the nature of the survey as some respondents did not respond to the survey questions, or provided responses such as ‘I don’t know’. We therefore cleaned the data by removing vague and non-responsive data points and limited the data used in the analysis to ‘yes’ or ‘no’ responses.

Our third data source comprises regulatory documents. The main limitation here is that regulations are not originally designed as data sources (Wood et al., 2020). However, regulations influence lives and provide a way of understanding social practices governing different areas (Wood et al., 2020). We, therefore, conduct a cross-country comparison of regulations, however each jurisdiction may have its own methodology for formulating regulations that was not taken into consideration. The way regulations are formulated could inform the nature of the regulation and therefore impact the results of our study. To counter this, we did not assess at the structure of the regulations but rather the common themes across all documents based on recommendations in literature. Further, this was an exploration study and therefore, limited by the number of countries in the study.

Another challenge that was presented by the data was the use of proxies to represent variables. Because our data is secondary data, direct measures of variables were not available apart from demographic variables used in Chapter 5. We therefore used proxies that have been used in previous studies to represent the variables under investigation in both Chapter 4 and Chapter 5. We further acknowledge that the proxies used may depend on the institutional context and not be generalisable across all countries, for example across sub-Saharan Africa mobile money is a primary financial access channel, but within the region in other jurisdictions it may be a complimentary service and not central to the financial sector.

Further, we acknowledge that endogeneity presents a key limitation to this study as explanatory variables may be correlated with the error term, potentially leading to biased estimates. While several techniques such as lagged variables and instrumental variables are commonly used to address endogeneity, they were not adopted in this study due to the limitations related to the sample size. To address the issue of endogeneity the study employed country and year fixed effects to mitigate unobserved heterogeneity and partially address endogeneity concerns. Additional steps were taken to reduce omitted variable bias through the inclusion of relevant control variables. The use of unique cross-country data from sources such as World Bank and IMF provides valuable comparative insights, particularly for underrepresented regions such as sub-Saharan Africa.

This study provides findings into the determinants of mobile money adoption which can be generalised across different countries in sub-Saharan Africa. However, in making generalisations each country has unique characteristics that may impact mobile money adoption. For instance, the extent of trade agreements with other countries; infrastructure and levels of development; the quality of the education system; and the political stability are factors that are unique to different jurisdictions. Therefore, in making generalisations, in-country characteristics should be considered.

7.4 Suggestions for further study

This thesis provides empirical evidence into factors that impact mobile money adoption in sub-Saharan Africa. Our research provides a holistic view of mobile money adoption across 18 sub-Saharan African countries, investigating the impact of mobile money attributes, digital and financial literacy and financial services access. We proxy mobile money attributes using *value of transactions* and *mobile money agents per km²* to represent measures of *relative and observability*. However, because our variables are proxies, future research could improve the

measure of innovation attributes by conducting a survey of which attributes user associate with mobile money. Further, research incorporating all five attributes would give a better picture of the impact of mobile money attributes as a determinant for adoption. In addition, future research could focus on individual countries and conduct random sampling to assess mobile money adoption at a country level to highlight country specific factors impacting adoption.

Our research highlights the use of mobile money to measure financial inclusion. Our results reveal the factors which impact financial inclusion through mobile money usage. However, financial inclusion through mobile money is considered separate from financial inclusion through bank account ownership. Future studies could look at a holistic view of financial inclusion and explore ways to provide a holistic measure of financial inclusion that combines bank account ownership and mobile money account ownership. This measure would give a more complete measure of financial inclusion in sub-Saharan Africa.

Our study provides an exploratory approach to the impact of regulation on mobile money adoption. Future studies can explore the quantitative impact of regulatory environment on mobile money adoption, this is because different countries have different factors that impact regulation such as globalisation, reduced barriers to entry and increased technology innovations (Hafeez, 2003). Further, mobile money has two prevalent models, MNO-led⁴⁷ and Bank-led⁴⁸ models which have not been considered in this study (Shirono, 2021). Our study assesses the regulations themselves, however incorporating the strength of the regulatory environment into this study could improve the findings and give context to environment in which the regulations operate. One of the drawbacks of our exploratory study is the small sample size due to availability of countries with pairs of regulations. The research could be conducted with one set of regulations across a larger sample of countries.

Overall, this thesis provides a useful foundation of input to future research interrogating the determinants of new fintech innovation adoption. More broadly, it provides insights into factors that impact the adoption of financial innovations.

⁴⁷ MNO-led model mobile money is issued by mobile network providers

⁴⁸ Bank-led model mobile money is issued by the bank and the MNO can partner with the bank to provide mobile money services

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