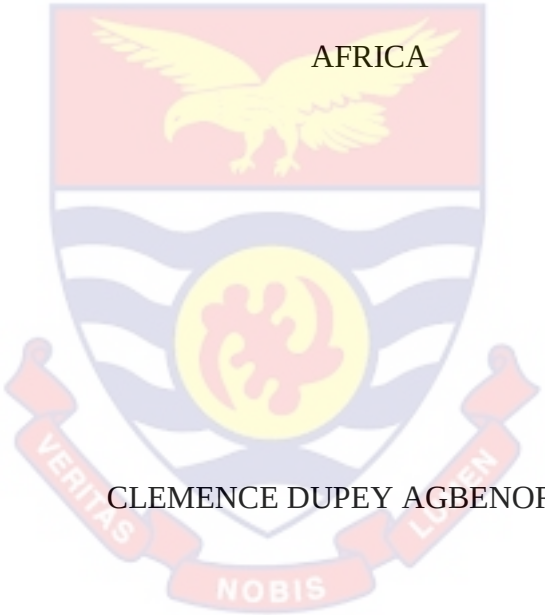
UNIVERSITY OF CAPE COAST

DIGITAL FINANCIAL INCLUSION, BANKING SECTOR REGULATIONS, AND POVERTY REDUCTION IN SUB-SAHARAN AFRICA



CLEMENCE DUPEY AGBENORXEVI

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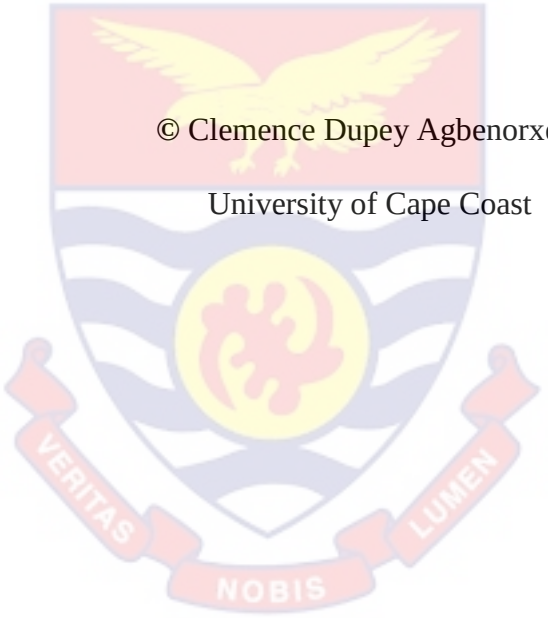

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DIGITAL FINANCIAL INCLUSION, BANKING SECTOR REGULATIONS, AND POVERTY REDUCTION IN SUB-SAHARAN AFRICA

BY

CLEMENCE DUPEY AGBENORXEVI

Thesis submitted to the Department of Finance of the School of Business, College of Humanities and Legal studies, University of Cape Coast, in partial fulfilment of the requirement for the award of Doctor of Philosophy degree in Business Administration

MARCH 2024

DECLARATION

Candidate's Declaration

I hereby declared that the Thesis is the result of my own original work and that no part has been presented for another Degree in this University or elsewhere.

Candidate's Signature:…… Date: …….

Name: Agbenorxevi, Clemence Dupey

Supervisors' Declaration

We hereby declared that the preparation and presentation of the Thesis were supervised in accordance with the guidelines on supervision of Thesis laid down by the University of Cape Coast.

Principal Supervisor's signature: ……..…… Date:……

Name: Prof. John Gartchie Gatsi

Co- Supervisor's signature: …… Date:……

Name: Prof. Samuel Kwaku Agyei

ABSTRACT

Law and finance theory explains how legal regime and financial development affect economic growth and poverty reduction relationship. Nonetheless, poverty remains a critical issue in sub-Saharan African economies. This thesis investigates the role of banking sector regulation dimensions on the relationship between digital financial inclusion and poverty reduction in 25 SSA economies using annual unbalanced panel data from 2014 to 2020. The analysis employed was system general method of moments and quantile method of moments with fixed effects. It emerged that digital financial inclusion and banking sector regulation separately promotes poverty reduction. Further, the findings revealed that some dimensions of banking sector regulations contribute to enhance digital financial inclusion. Also, institutional quality positively moderates between banking sector regulation and digital financial inclusion. Banking sector regulations interact significantly with digital financial inclusion to reduce poverty in SSA economies. Digital financial inclusion significantly reduces poverty level across the all quantiles of poverty distribution. Policymakers, regulators and international institutions should design and implement policies that enhance digital financial inclusions such as mobile money initiatives, and mobile cellular subscriptions, which can enhance poverty reduction at each quantile of poverty distribution. Banking regulatory frameworks should be crafted to embrace policies and sound practices that engender growth effect and inclusivity into financial system, thereby promoting digital financial inclusion and leading ultimately to alleviate poverty. It is therefore recommended that central banks in SSA should concurrently implement digital financial inclusion initiatives and banking sector regulations aimed at reducing poverty.

KEYWORDS

Banking Sector Regulations

Digital Financial Inclusion

Institutional Structures

Poverty reduction

Quantile regression

Sub-Saharan Africa

System Generalized Method of Moments

ACKNOWLEDGEMENTS

It is by measured and exceptional assistance given by many people in varied ways that make this study a success. I remain exceptionally thankful to my supervisors: Prof. John Gartchie Gatsi, and Prof. Samuel Kwaku Agyei, for their support, suggestions, and corrections which have culminated in this work. I am indeed indebted to them for all the knowledge and experience they shared with me, Prof and Prof, I am thankful.

To my colleagues Drs: Selasi Hevi, Derick Akude and John Kwame Akuma, I am grateful for your immerse contributions and guidance. Not forgetting my friends and relations, I am thankful for your kind assistance, criticism, motivation and self-believe you offered me, especially Rev. Fr Stephen Agbenorxevi (SVD), Joshua Sosu, Dr Elikplim Kwami Afetorgbor and Nicholas Gborse. To my wife, Mrs Deborah Dupey, I am grateful for your sacrifices and affections for this academic journey.

DEDICATION

To Deborah Dupey (my wife), Jemima Fafali Mensah (My Child), and Daniel Worlanyo Worwornyo (Deceased)

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LIST OF ABBREVIATIONS

2SGMM	Two-Step System Generalised Methods of Moments
2SLS	Two-Stage Least Squares
ACH	Automated Clearing House
ACW	Activity restrictions
ARDL	Autogressive distributed lag-bounds
ATM	Automated Teller Machine
BSR	Banking sector regulations
CA	Capabilities Approach
CGAP	Consultative Group to Assist the Poor
CPI	Consumer Price Index
CPW	Capital stringency
DCP	Domestic Credit provided to Private sector
DFI	Digital Financial Inclusion
DFID	Department for International Development
DFIINDEX	Digital financial inclusion index
DFS	Digital Financial Services
DIR	Deposit interest rate
EAC	Eastern African Community
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West African States
EFT	Electronic Funds Transfer
EMI	Electronic Money Issuer
ETW	Entry restrictions
EU	European Union

EXW	Exit restrictions
FAO	Food and Agriculture Organisation of United Nations
FD	Financial Development
FinTech	Financial Technology
FSW	Financial safety net
G20	Group of Twenty (20)
GDP	Gross Domestic Product
GDPPC	GDP per capita growth
GFC	Global Financial Crisis
GFDD	Global financial development database
GG2P	Digitizing government to person
GMM	Generalised Methods of Moments
GPFI	Global Partnership for Financial Inclusion
ICRG	International Country Risk Guide
ICT	Information and Communication Technology
IFS	International Financial Statistics
INDINTER	Individual using internet as percentage of total population
IMF	International Monetary Fund
IQ	Institutional Quality
LDW	Liquidity diversification
LIC	Low-Income Country
LIML	Limited Information Maximum Likelihood
LMI	Low Middle Income
LTF	Legal Theory of Finance
MA	Monetary Approach

MENA	Middle East and North Africa
MFIs	Microfinance Institutions
MOBC100	Mobile cellular subscription per 100
NGOs	Non-Governmental Organizations
NRMMA	Number of registered mobile money agents
NRMMU	Number of registered mobile money users
OLS	Ordinary Least Squares
PA	Participatory Approach
PCSE	Panel Corrected Standard Errors
PCW	Price control
PPP	Purchasing Power Parity
PSAV	Political stability and absence of violence
REM	Remittance inflows
SCW	Supervision quality
SDG	Sustainable Development Goals
SEA	Social Exclusion Approach
SIA	Strategic Impact Advisors
SMC	Stock Market Capitalisation
SMEs	Small and Medium Enterprises
SSA	Sub-Saharan Africa
TRW	transparency requirement
UN	United Nations
UPI	Upper-middle- Income
USAID	United States Agency for International Development
VA	Voice and accountability

VAR	Vector Autoregressive
VECM	Vector Error Correction Model
WB	World Bank
WDI	World Development Indicator

CHAPTER ONE

INTRODUCTION

Introduction

Globally, banking sector regulation has attracted huge research attention among academics, political class, as well as public and private actors within the socio-economic cycles following the 2007-2009 global financial crisis. Financial crises pose threat to socio-economic well-being of Welfare-States as they tend to bring about persistent recession with concomitance heterogeneity across countries and households (da Silva et al., 2022). In essence, there has been re-regulation of financial systems to deal with the consequences emanating from crises associated with the financial system. For the last decade, re-regulation occurring in the financial systems across the globe have been targeted at reducing systemic vulnerability, lessening disproportionate risk–taking behaviour by financial institutions/intermediaries. Also, the consequences of financial sector reforms owing to re-regulation aim at preventing financial crises from hurting the real sector and individual.

Banking sector regulation is relevant for the enhancement of financial/banking system stability, general financial service efficiency and promotion of efficient risk-taking behaviour (Hoque & Liu, 2023; Mateev et al., 2023). These regulations help facilitate financial inclusion and, in turn speed up economic growth leading to shared socio-economic prosperity and reduced dependency due to poverty (Anarfo et al., 2020). Compared with other regions of the world, economies in SSA are festered with poverty (Mukalayi & Inglesi-Lotz, 2023). Yet, Sub-Saharan African countries contribute largely to world natural resources. Thus, economies in SSA require

paradigm shift in financial service and product design and delivery to enable them enhance access to less expensive and more convenient accounts, mobile banking, money transfer instruments, digitally enabled financial services and products that are targeted at disadvantaged groups of people to meet their financial needs thereby promoting inclusive growth.

Empirical studies have established that digital financial inclusion (DFI) facilitates financial inclusion. Thus, DFI spurs inclusive growth as it is geared towards participation of all including underserved sections of societies in economic activities. It is apparent that for inclusive growth to drive poverty reduction successfully, relevance of DFI and moderating effects of banking sector regulations are essential. Thus, this thesis highlights the pivotal role of dimensions of banking sector regulations between DFI and poverty reduction. Therefore, the thesis empirically analyzed whether poverty reduction characteristic of DFI can be strengthened by the dimensions of banking sector regulations.

Background to the Study

The poor are often identified by low monetary and non-monetary income poverty levels. Poverty, a condition where people or individuals are deprived of the basic resources and essentials require for a certain standard of living, remains a major challenge among African countries (Ofori-Abebrese et al., 2020;Tita & Aziakpono, 2017). The group of people who by World Bank's definition live on less than US$2.15 a day are classified as extremely poor (Emara & Mohieldin, 2022). Mostly, they lack access to basic necessities of life, including clean water, proper housing, healthy food, proper medical attention, and better education among others (Koomson et al., 2020; Tita &

Aziakpono, 2017) as well as low per capita gross domestic product growth (World Bank, 2018). High rate of extremely poor across the globe with specific focus on developing economies raise concerns among policymakers, governments and international development partners. In view of Allen *et al.* (2018) and World Bank (2022), goal of reducing global extreme poverty to less than 3 percent by the end of 2030 (Lakner et al., 2022) seems impossible.

The sub-Saharan Africa (SSA) region accounts for 62% of the extremely poor across the globe (Christensen, 2023). This is partly because the steady progress made in three decades leading to downward trend in extremely poor population from 54% in 1990 to 41% in 2015 was reversed by huge population growth (World Bank, 2019; Jolliffe et al., 2022). Also, partly because COVID-19 pandemic pushed more people into extreme poverty globally (Lakner et al., 2022). In light of this trajectories in extreme poverty, the first goal of United Nations (2015)'s Sustainable Development Goals(SDGs) which aims to end poverty in all form everywhere appears threatened.

Prior to the adoption of the SDGs, poverty in developing countries was centered more in the Asian region than SSA. In the 1990s, three regions that accounted for majority of the global poor population are East Asia, the Pacific region, followed by South Asia and then Sub-Saharan Africa. The 2015 World Bank report states that 50% of global poverty was in East Asia whilst SSA had 15% (World Bank, 2015). However, recent data show that there is a shift in regional concentration of poverty in the world. The 2023 World Bank report states that at 534 million (approximate 47.8%) of the global poor population can be found in SSA (World Bank, 2023; UNDP, 2023).

Thus, a reversal of this cycle may be required for the world to attain goal one of SGDs which articulates eradication of poverty by 2030. For poverty alleviation reasons, myriads of targets of SDGs acknowledge contributions of inclusive finance. Specifically, one of the targets of goal 1 of the SDGs is geared towards promoting access to new technology and financial services so that equal right to economic resources is established. Similarly, Goal 8(10) articulates how building the capability of home-grown financial institutions can promote and expand access to services and products of financial system. Likewise, Goal 9(3) highlights importance of enhancing the capability of domestic financial institutions could result in promotion and broadening of the availability of banking, insurance, and financial services. This is particularly significant for small-scale industries, small to medium-sized enterprises and the poor with the aim of fostering their growth and development (Chen & Divanbeigi, 2019). The G20 additionally pledged to promote greater financial inclusion by enforcing certain principles for Digital Financial Inclusion.

Prior to the new millennia, poverty reduction strategies did not include the elements of the fourth industrial revolution (4IR). These elements have revolutionized the financial landscape in the world economy. With the help of the digital technology associated with the 4IR many of the hitherto unbanked population can now access financial services through digital platforms. Thus, alleviating poverty could be achieved through the adoption of digital financial inclusion factors. Digital financial inclusion complemented by the banking sector regulation dimensions may be the panacea for poverty reduction

Digital financial inclusion is relevant for inclusion, achievement of balance between fairness and efficiency and economic growth. The relevance of DFI for inclusive growth and poverty alleviation is grounded in established growth theories (Whajah et al., 2019; Adeosun et al., 2020). Specifically, the new growth theories emphasize essential roles of innovation and technological progress in growth process (Lucas, 1988; Romer, 1990; Baafi & Asiedu, 2025). Studies of Baafi and Asiedu (2025) and Huang et al.(2024) have indicated the relevance of financial innovation to growth. Undeniably, finance is an integral part of the growth process as it determines the extent to which households can have and make use of economic opportunities. The supply-leading hypothesis thus argues that finance underscores activities that lead to growth (*see*, Misati, et al., 2024). The inclusive growth dynamics and poverty alleviation implications of finance make it imperative to consider DFI as critical tool for addressing issues problems of poverty alleviation.

Digital financial inclusion (DFI) has become a topical global development issue due to its relevance to inclusive growth, economic growth and poverty reduction. The Sustainable Development Goals (SDGs) of United Nation amplified poverty alleviation implications of DFI for inclusive growth and sustainable development (Kamran et al., 2023; Mader, 2018). Therefore, countries across the globe are urged to emphasize policies and programs that bring DFI to the centre stage of inclusive and economic growth agenda in order to reduce poverty levels (Lee et al., 2023; Xun et al., 2020).

Poverty alleviation in economic regions such as sub-Saharan African economies depends on similar economic growth paths, increase levels of digital financial inclusion and access to finance for credit growth. In essence,

as noted by Croxson *et al.* (2022), expansion of financial services is being facilitated via digital platforms such as fintech entrants, telecom operators and incumbent financial institutions increasing patronage of platform-based business models. These digital platforms have the potential to lower cost and promote financial inclusion. However, just like traditional banks, fintech and big tech platforms are controlled through regulatory frameworks such as licensing, regulatory reporting, deposit insurance, capital requirement and supervision (Crisanto et al., 2021).

Banking sector regulation and supervision play crucial roles in financial deepening and promoting financial inclusion agenda (Fouejieu et al., 2020). According to Asutay et al. (2020) banking sector regulations such as entry restrictions, deposit insurance, financial safety nets, capital stringent requirement and restriction on bank activities, and their associated poverty alleviation activities is threatened by myriad of challenges affecting digital financial inclusion. Challenges that pose threat to digital financial inclusion include problem of asymmetric information which is severe in emerging economies (Hainz & Nabokin, 2019), cybercrime (Khan et al., 2023), digital financial illiteracy and market failures (Amari & Anis, 2021), as well as regulatory deficiencies regarding customer protection (Besong et al., 2022).

However, implementation of regulations in banking sector has some level of implications for financial inclusion in emerging economies. For example, implementing stronger capital and liquidity regulations can contribute to the establishment of a more resilient banking system that allows innovations necessary for provision of digital financial services. Stricter regulatory standards may also result in smaller fluctuations in output, leading

to improved overall welfare even in the absence of banking crises. However, it is important to recognize that the capital and liquidity requirements imposed by regulations can be costly for banking institutions, potentially affecting their ability to provide finance. This can manifest as increased borrowing costs or reduced loan volumes ultimately impacting access to finance. The contraction of credit can have detrimental effects on any economy, but the impacts is particularly pronounced in emerging markets due to their less developed capital markets and higher levels of financial exclusion (Gurrea-Martínez & Remolina, 2019).

Intuitively, an underserved population's poverty situation is acknowledged to be influenced by myriad of factors. According to Sen (2000), absence of varied set of capabilities, namely: security, capacity to participate in established economic system, and political system can contribute to poverty not only because of insufficient income, but also due to lack of economic freedom. Capability is deemed as the freedom that people have to select from a set of feasible functioning (Basu & Lòpez-Calva, 2011). It entails tangible and intangible resources and services at the disposal of people that may include income, skills, rights and material objects (Robertson, 2015). The concept is key for poverty reduction as it provides perspective for freedom, justice and well-being (Robertson & Picard, 2021). Within the context of capability approach, the use of DFI has the potential of enhancing underserved and low-income households' capability by providing them with different means to accumulate savings, deal with financial risks, and invest in education or entrepreneurial endeavour (Wandeda et al., 2023). Access to credit and availability of saving facilities may help alter people's choices and freedom to

participate in digital financial-led inclusive growth, drives enablement of the poor, disadvantaged and low-income households.

It is possible to explain implication of DFI for poverty alleviation from the consequentialist moral viewpoint. In its broadest sense, consequentialism asserts that the moral value of an action is solely determined by the outcomes or consequences that it brings to the individual involved (Guay, 2005). In view of Kear (2013), the assertion of a right to access financial products signifies a longing to create a more equitable, compassionate, and considerate approach towards the pervasive financialisation of various facets of existence. Within context of poverty alleviation, digital financial inclusion based on consequentialism characterised digital financial inclusion practices that focus on reduction of transaction cost, information asymmetry and moral hazard and other benefits for outcomes rather than financial exclusion. Also, consequentialist view maintains that lowering interest rate will enhance financial situation of the poor and that rate must be utility maximising and should include long-run access to financial services (Hartarska & Cull, 2023).

Related to implications of banking sector regulations for digital financial inclusion is the essential roles of quality of institutions. For example, empirical results of Sodokin et al.(2023)'s study underscore relevance of high and effective institutions quality in promoting stable and secured banking sector regulations. Further, prior studies articulate contribution of institutional quality in shaping the effects of banking sector regulations on stability. In particular, Bermpei et al.(2018) noted that institutional quality moderates the effect of banking sector regulation on profit stability and profitability. Additionally, the claim that institutional quality can boost implementation of

capability of banking regulation and supervision thereby ensuring stability in the banking system has led to development of institutional quality-regulatory enforcement hypothesis (Bermpei et al., 2018; Haldane & Neumann, 2017). Thus, this accentuates possible conditioning effect of institutional quality on the impact of banking sector regulations on digital financial inclusion.

The advent of the fourth Industrial revolution (4IR) has enhanced the provision of financial services through the integration of digital technologies. Consequently, the availability and accessibility to financial resources has been enhanced. Since poverty is predominantly a problem of lack of financial resources and essentials for minimum standard of living, the study posits that an enhanced digital financial inclusivity complemented by effective banking sector regulations may provide the mechanism to reverse the high rate of extreme poverty in SSA. In light of complexities in conceptualizing poverty, the role of advancement in financial technologies, especially digital financial inclusion, aiming to address poverty becomes critical. Thus, this study will demonstrate the linkage between digital financial inclusion and poverty reduction, and the role of banking sector regulations on the relationship between digital financial inclusion and poverty reduction.

Statement of the Problem

The focus of the problem statement is that though SSA was experiencing notable progress in reducing poverty, which was reflected in the lowering of percentage of extremely poor population to thirty-four percent in 2018 from fifty-six in 1990 (World Bank, 2020), yet SSA region accounts for 534 million (approximate 47.8%) of the global poor population (World Bank, 2023; UNDP, 2023). Marxian traditional view explains poverty to be as

a result of market failures and discriminiations based on class and groups (Davis & Sanchez-Martinez, 2014). This view is further affirmed by the neo-classical view which argues that poverty is caused by such factors including market failures, lack of credit markets, obstacles to education and job impediments (Mhlanga, 2022). These causes suggest that discrimination, unequal opportunities and inequality result in social exclusion. Key to social exclusion is the phenomenon of financial exclusion. Significantly, the poors are excluded from the formal financial system (Sha'ban et al., 2020) owing to informationn assymetry, profit maximation motives of firms, inadequate financial instructure, poor institutional sturctures and weak regulatory regimes in SSA to mention just a few. Thus, factors that contribute to poverty include limited access to finance (Neaime & Gaysset, 2018), uneven distribution of income (Churchill & Marisetty, 2020) and social exclusion and deprivation (Liu et al., 2023).

As one of a pivotal policy relevance of most economies, poverty reduction is essential for many. This seems to have fueled the call for formulation of United Nation’s sustainable development goals (SDGs) for poverty reduction purposes. Moreso, all welfare states are encouraged to invest in digital infrastructure or new technologies to facilitate financial inclusion to end poverty in all form by 2030 (Makarenko et al., 2022; UNDESA, 2022). Like many other developing economies across the globe, this call is highly important for Africa where the issue of poverty is topical owing to rising level of poverty on the continent. Notwithstanding the significant strides made in eradicating poverty, the phenomenon continue to rise. This is because the gains made in addressing poverty have been reversed

by the protracted impact of the COVID-19 pandemic (UNCTAD, 2021), the Russia-Ukraine war and huge population growth.

A corpus of policy interventions have been put forth regarding the fight against poverty. Critical to these policy interventions is the worldwide acknowledgement and acceptance of digital financial inclusion as means to end poverty globally (Lee et al., 2023). This finds credence in the new growth and neoclassical theories that acknowledge that financial inclusion spurs long-term economic growth, which turn to promote poverty reduction (Chinoda & Kapingura, 2024). This suggests that improving access to finance to formerly excluded segments of society to productive economic sector, brings about increase in output leading to creation of employment, increase in income, and translate to poverty reduction eventually (Dewi et al.,2018). Additionally, with "trickle-down effect" economic growth translate to redistribution of income, increase in poor household's income, closes inequality gap, and eventually lower poverty levels (Wang & Fu, 2022).

Just as Marxian's traditional view explains how inequality causes poverty, inequality reducing theory posits that financial inclusion promotes participation of all in in formal financial system, particularly earlier excluded or underserved, benefit from improved access to financial services as their income increase, they engage in entreneurial activities and their poverty level drop (Lee et al., 2023). Reinforcing this position, neoclassical theorists contend that financial inclusion and poverty reduction are inversely related (Mhlanga, 2022) which means that the more financially included an individual, a household or a firm is, the more poverty levels reduces.

Empirically, finance-growth empirical discussions seem to have evolved along three lines of arguments. First of them being that finance and growth relationship depends on the measurement of growth (see, Easterly & Levine, 1997). Easterly and Levine (1997) argues that for developing economies such as that of African countries, GDP per capita represents a poor measure of economic growth and advocates for economic growth measures that includes all. Corollary to the change to the sustainable development goals from millennium development goals, the focus of growth research and polices have shifted to strategies that alleviates poverty and ensures prosperity for all (De Jong & Vijge, 2021). In this regard, poverty reduction has become increasingly relevant to developing countries (Wang & Fu, 2022).

The second line of arguments stems from the measurement of finance, with some advancing for financial development measures that capture both institutions and markets of financial system (Svirydzenka, 2016; Haini, 2020), whilst some argues in favour of inclusive finance measures (see; Banerjee et al., 2019). Finally, there are those studies that argue that the relationship between finance and growth depends on some other factors (see; Arcand et al., 2015; Favara, 2003; Olaniyi & Oladeji, 2021; Kutan, et al., 2017; Law et al., 2018). This study does not seek to clarify which school of thought presents an accurate picture of finance-growth nexus, however aligns itself with all to analyse the role of technology in the relationship between financial inclusion and poverty alleviation.

Despite the economic and social value associated with DFI, some studies have argued that the relevance of financial inclusion to poverty alleviation could depend on the level of income (*see;* Ozili, 2018; Demirguc-

Kunt & Klapper, 2013). Demirguç-Kunt and Klapper (2013) demonstrate that the heterogeneity in income levels across economies influences the efficacy of financial inclusion. This was premised on the intuition that the financial inclusion gains associated with higher income individuals tends to be higher than those with lower income levels. Subsequently, as argued by Allen et al. (2016) the tendency is that the poor and lower income groups usually would not benefit more from financial inclusion but financial inclusion rather widens the inequality gap. However, previous studies that examine the financial-inclusion poverty alleviation nexus in developing economies usually assume that there are average poverty alleviation gains from financial inclusion across the SSA economies. This may apply differently for the case of SSA economies as the economies in the region are characterised by heterogeneous levels of poverty.

To contribute to existing studies, this study differentiates itself from Kelikume (2021) that examines how technology contributes to financial inclusion and poverty alleviation relationship in Africa. Specifically, this study makes unique contribution because unlike Kelikume (2021) this study does not look at all forms of technology but focused on technology that is directly relevant to financial inclusion. In that regard, by constructing digital financial inclusion index, this study provides a nuanced knowledge. Again, on basis of originality of the study and to the best of knowledge, this is the first study to provide the first-time evidence on the influence of digital financial inclusion on poverty alleviation across several quantiles, given the heterogeneity of income equality across the sub-region. Finally, this thesis adds to the

burgeoning stock of digital financial inclusion literature in developing economies.

Despite pro-poor effect of digital financial inclusion, limited access to finance hinders inclusive growth of SMEs (Moscalu et al., 2020) and stifles growth in productivity (Bloom et al., 2010). Other factors accounting for capital constraints include weak regulatory systems (Beck & Demirguc-Kunt, 2006), competition (Anzoategui & Rocha, 2010), policy and practices, and high interest rate (Foltz, 2004). Focusing on banking sector regulatory system for instance, banking sector reforms as an aftermath of 2007-2009 global financial crisis have seen introduction of stringent capital requirements among others. Higher capital requirements can stifle access to finance which is particularly a great deal for emerging countries characterised with less developed capital markets and greater problem of financial exclusion (Gurrea-Martínez & Remolina, 2019). This may aggravate already precarious conditions contributing to financial exclusion. For example, it has been noted across the globe that, nearly 1.7 billion of adult population lack access to a bank account (Liu et al., 2021; Risman et al., 2021).

Studies acknowledge based on binding risk-based capital ratio (in light of current Basel standards) that banks in pursuit of credit growth are required to obtain additional capital. Failure of which may lead to breach of minimum regulatory capital requirement rule, and concomitant supervisory sanctions. Since regulatory capital requirement is prescribed as ratio of capital to risk-weighted assets, weakly capitalized banks may attempt to enhance their solvency by merely engaging in cutting back on lending. In the backdrop this, although stringent capital requirement can effectively help contain financial

stability risks, it can inadvertently limit growth-enhancing resources by curtailing credit growth (Imbierowicz et al., 2021; Takáts & Temesvary, 2021; Kanga, 2021).

Emergence of new technologies for improving financial inclusion, for that matter digital financial inclusion, may be plagued with a myriad of challenges. These challenges may range from poor technological support, poor institutional architecture that hinder private investment, weak political, legal and economic conditions, to insufficient banking sector regulations and inadequate infrastructure (Rana et al., 2020; Ngwu et al., 2019; Ediagbonya & Tioluwani, 2023). However, the issue of banking sector regulations seems to be at the center of several financial sector outcomes in many policy discussions (*see*; Lumpkin, 2010). Banking sector regulations could be relevant to digital financial inclusion in four different ways. First, the regulatory architecture should be able to accommodate the innovations in financial inclusion, encourage provision and use of digital financial services, and ensure healthy competition among the providers. Second, since the core mandates of banking sector supervision and regulation includes maintaining banking sector integrity and stability, and eventually customer protection (Barth et al., 2004), the advancement of digital financial inclusion should align with these mandates. Third, policy objectives of banking sector regulations highlighting mitigating of systemic risk are essential for ensuring proper market conduct and adequate protection of borrowers, investors and end-users of financial services. Actions leading to mitigating system risk could have implications for efficient allocation of resources, financial productivity and economic growth (Lumpkin, 2010) and thereby stimulating higher levels of

financial innovations and digital financial inclusion. Fourth, Sinha (2012) conceived financial stability as a necessary but not sufficient condition to attain other financial sector policies objectives. In line with this, Sinha (2012) argues that although prudential policies can deliver financial stability and facilitate growth, it needs to complement other growth imperatives, to channel credit to disadvantage and preferred sectors, protect consumers and spur financial inclusion.

Banking sector regulations without doubt have significant impacts on the global financial crises and country-specific financial crises. Recognizing this fact, there has been a number of regulatory reforms in the banking sector of several economies (Triki et al., 2016). Notwithstanding the financial crises, there have been calls made by academics and policy practitioners to economies in SSA to adopt and comply with a common set of banking regulations (see Ngwu et al., 2019), on the grounds that cross-border banking continues to increase in the region. In as much as cross-border banks are able to effectively perform their role of financial intermediation, they may also drive digital financial inclusion. If adoption of common set of regulations in a continent are able to ensure the sustainability of cross-border banking (Ngwu et al., 2019), it may also exhibit positive influence on digital financial inclusion. In a similar vein, Kodongo (2018) contends that banking sector regulations may harm or advance the ability of financial institutions to provide inclusive financial services within an economy. One of the mechanisms through which banking sector regulations may harm digital financial inclusion is where stringent financial regulations may result in decrease in lending activities of financial institutions resulting in less credit flow to real economy,

and thereby curtailing availability of credit (Gianfagna et al., 2021). Further, stringent capital requirements for instance are transmitted via higher loan rates that is linked to slow credit growth (Zhang & Tressel, 2017; Juelsrud & Wold, 2020). In sharp contrast, stricter banking sector regulations which aim at delivering stable financial system are characterised with reduction in likelihood of banking crises and supply of stable credit to firms and households may ultimately stimulate entrepreneurial activities and investment in human capital and consequently result in creation of employment (de Haan & Sturm, 2017). Also, for sustainable regulatory reform purposes, policies makers are urged to consider essential drivers of economic growth such as credit availability to small and medium-sized enterprises, long-and term financial (Sinha, 2012) which have repercussions for financial inclusion.

Despite the possible relevance of banking sector regulations to digital financial inclusion, the literature in the area is burgeoning. Nevertheless, providing a nuanced understanding on the impact of banking sector regulation for digital financial inclusion is particularly relevant, especially to developing countries like that of SSA that have witnessed a recent increase in digital financial products. Hitherto, extant literature on the influence of banking sector regulation have only provided a limited view of the phenomenon. For instance, Anarfo et al. (2020) find evidence that stringent capital regulations impede financial inclusion in SSA. Nonetheless, digital financial inclusion may be affected by a myriad of banking sector regulations and thus examining the nexus between a number of banking sector regulations and digital financial inclusion could be relevant to policy. However, such evidence is missing in literature.

Empirically, some scholars for example Ofoeda et al.(2022), Ajide, et al.(2022) and Akinlo (2024) articulate importance of institutional quality in addressing banking sector regulations anomalies and ensuring enhancement of digital financial inclusion concurrently. In similar vein, Nutassey *et al.* (2023) give credence to significance of institutional quality in regulation-inclusion relationship. Recognizing these facts, institutional settings can therefore play essential role in facilitating information sharing, efficacy, robustness and enforceability of banking sector regulations. Nevertheless, it might as well bring about unintended consequences by impeding capability of regulatory mechanisms from expanding digital financial services landscape to endemic proportions (Anarfo et al., 2020). Further, Akinlo (2024) reveal that weak institutional quality are drivers of weak financial regulation. In view of this, institutional quality could stifle financial inclusion. In contrast, it may provide sound financial system leading to innovation that will speed up digital financial services. For example, Law and Azman-Saini (2012) indicate that high-quality institution setting espouse financial development. Thus, this study argues that banking sector regulations effect on digital financial inclusion may be conditioned on institutional quality.

Digital financial inclusion is an important research domain to address poverty alleviation. The concept leverages digital technology and digital infrastructure to stretch access to and use of formal financial services by making them affordable and convenient to all. Digital financial inclusion does not only support economic growth (Ozturk & Ullah, 2022) and thereby influence indirectly living standards of the poor. It also contributes to inclusive finance which inclusive finance is crucial to enhance income of underserved

segments of societies (Chen et al., 2022). Many studies have established a link between income and welfare of poor people and their accessibility to a range of appropriate and affordable digital financial services (Demirgüç-Kunt & Singer, 2017; Kim et al., 2018; Ozili, 2018). As asserted by Tabash et al.(2024), equitable access to finance has pro-growth and pro-poor implications, as it reduces income inequality and alleviates poverty.

Juxtaposing literature on banking sector regulations and digital financial inclusion especially in SSA context, we observed that cross-country data that measure poverty alleviation effects of banking sector regulations as well as digital financial inclusion did so individually. We argue that poverty alleviation of digital financial inclusion can be established through interaction between banking sector regulations and digital financial inclusion. Banking sector regulations consist of financial system regulation, regulatory architecture, regulatory culture, intra-agency coordination and regulatory philosophy (Schmulow, 2015). The success of financial system may be attributed to functioning of prudential regulations and regulatory enforcement. For instance, capital stringency and activity restrictions may limit banks' ability to innovate and create new financial products, thereby hampering financial inclusion (Anarfo et al., 2020; De Sousa, 2015).

Focusing on the traditional view that competition reduces market power and cost of financial services but increases the financial services availability (see Berger & Hannan, 1998), stringent entry requirements could stifle competition and impede financial inclusion. Conversely, high exit restrictions could increase competition and improve financial inclusion. Financial safety nets coupled with the use of monetary and fiscal policies as

noted by Greenspan (2001) contribute to eliminate bank runs, assuage financial crises and reduce the number and amplitude of economic contractions, thereby provide depository institutions and participants in financial markets with safety, liquidity and solvency. Inasmuch as financial safety nets are able to drill confidence in the financial system, it could also bolster the degree to which people subscribe to digital financial products. Price controls confines the ability of banks to charge high costs on financial services and thus price controls could advance financial inclusion. Altogether, banking sector regulations could exhibit a first order effect on digital financial inclusion. Notwithstanding the possible relevance of banking sector regulations to digital financial inclusion, the literature in the area is burgeoning. Nevertheless, providing a nuanced understanding on moderating effect of banking sector regulation for digital financial inclusion-poverty alleviation relation is particularly relevant, especially to developing countries like that of SSA that have witnessed a recent increase in digital financial products (Podolski, 2020; Emara & Zhang, 2021).

Several studies examine how banking sector regulations contribute to financial development, influence economic stability and economic growth and promote stable and sound financial system. In contrast, the current study to the best of knowledge represents the foremost study on interaction behaviour of digital financial inclusion and banking sector regulation on poverty alleviation specifically in Sub-Saharan Africa. In backdrop of this, this study is therefore justified by the fact that, unlike the studies of Anarfo et al. (2020) that investigates the implications of financial regulation for financial inclusion, this

study explores how interaction of banking sector regulations and digital financial inclusion affect poverty alleviation.

Further, the focus on digital financial inclusion instead of financial inclusion is also a novelty, and this is because the SSA region has gained the momentum in the delivery of digitalized financial services in recent times. This is because digitalized financial services in SSA has largely been supported by mobile money in recent years (Abeka et al., 2021). For example, GSMA (2024) report demonstrates that SSA has the highest global mobile money adoption, where mobile money has been identified to have contributed significantly to gross domestic product from 2013 to 2022 by over $150 billion. The GSMA (2024) report further claims that in 2023 the SSA region has the most registered mobile money accounts (835 million), Active mobile money accounts (234 million) and registered mobile money agents (contributed the majority) compared with respective global performance of 1.75 billion, 435 million and 18.6 million. Chinoda and Kapingura (2024) also gave credence to the fact that SSA region has the highest mobile money penetration among the six regions across the globe. In comparison with non-digital financial inclusion, digital financial inclusion facilitates financial inclusion, makes access to financial services more accessible, convenient and efficient (Frost et al., 2019). Besides, relative to traditional financial inclusion, digital financial inclusion plays essential role in acquisition of vast non-traditional information which facilitates credit assessment relative to conventional credit bureau (Frost et al., 2019). Finally, with digital financial inclusion, there is extension of financial services to non-financial sector and

provision of diverse credit facilities to individuals, household and enterprises (Ozili, 2018).

Notwithstanding multidimensionality of measures of digital financial inclusion, DFI uses digital platform like mobile money services (Rahman et al., 2024), internet infrastructure (Elouaourti & Ibourk, Unveiling the drivers of Africa's digital financial inclusion journey, 2024), and conduct financial transactions using mobile phones. In addition, individuals adopt mobile phones and access internet to carry out mobile financial services. Since mobile financial services constitute a key driver of digital finance (Goh et al., 2022), this study following Chinoda and Kapingura (2024) employ internet usage, mobile cellular subscription, mobile money agents and mobile money usage to meassure digital financial inclusion. Similarly, mobile money and internet usage have surpassed traditional banking in some countries. The reason for which large share of unbanked population, including the poors, are captured in the formal financial system. Existing studies provided a rather limited view by overlooking access, availability and usage aspects of mobile money and internet technology to measure financial inclusion (Banik & Roy, 2023). This is grounded on fact that key component of DFI are digital devices(e.g., a mobile phone), retail agents(they transmit and receive financial transactions) and digital transaction platform (e.g., internet or retail agent) (Ozili, 2022). Thus, this study looked at implications of digital financial inclusion for poverty alleviation and moderating roles of banking sector regulations in Sub-Saharan Africa.

Purpose of Study

The purpose of this thesis is to investigate the role of dimensions of banking sector regulation in the relationship between digital financial inclusion and poverty reduction in 25 economies in SSA for 2014 to 2020.

Research Objectives

Focusing on the achievement of the aim of the thesis, the following three specific objectives are set:

1. To examine the impact of digital financial inclusion on poverty reduction in sub-Saharan African countries;
2. To investigate the effects of banking sector regulations on digital financial inclusion in sub-Saharan African countries;
3. To examine the moderating effect of institutional quality on relationship between dimensions of banking sector regulation and poverty reduction in sub-Saharan African countries; and
4. To analyse the moderating effect of banking sector regulations on relationship between digital financial inclusion and poverty reduction in sub-Saharan African countries.

Research Hypotheses

1. H1: There is a negative effect of digital financial inclusion on poverty level in Sub-Saharan Africa.

   H1a: Number of registered mobile agents has a negative effect on poverty level.

   H1b: Number of registered mobile money users have negative effect on poverty level;

   H1c: Internet usage has negative effect on poverty level;

H1d: Mobile cellular subscription has negative effect on poverty level

2. H2: There is a positive relationship among banking sector regulations, institutional quality and digital financial inclusion in sub-Saharan Africa.

   H2a: Stringent entry restriction has a positive effect on digital financial inclusion.

   H2b: Stringent activity restriction has a positive effect on digital financial inclusion.

   H2c: Stringent transparency requirement has a positive effect on digital financial inclusion;

   H2d: Stringent exit restriction has a positive effect on digital financial inclusion;

   H2e: Stringent capital restriction has a positive effect on digital financial inclusion;

   H2f: Stringent liquidity restriction has a positive effect on digital financial inclusion;

   H2g: Stringent price control has a positive effect on digital financial inclusion;

   H2h: Stringent financial safety restriction has a positive effect on digital financial inclusion;

   H2i: Stringent supervisory quality has positive effect on digital financial inclusion.

3. H3a: Political stability and absence of violence positively moderate between dimensions of banking sector regulations and digital financial inclusion

H3b: Voice and accountability positively moderate between dimensions of banking sector regulations and digital financial inclusion.

4. H4: Banking sector regulations moderate significantly the relationship between country-level digital financial inclusion and poverty level in Sub-Saharan Africa countries.

   H4a: Stringent entry restriction negatively moderates between digital financial inclusion poverty level;

   H4b: Stringent activity restriction negatively moderates between digital financial inclusion and poverty level;

   H4c: Stringent transparency requirement negatively moderates between digital financial inclusion and poverty level;

   H4d: Stringent exit restriction negatively moderates between digital financial inclusion and poverty level;

   H4e: Stringent capital restriction negatively moderates between digital financial inclusion and poverty level;

   H4f: Stringent liquidity restriction negatively moderates between digital financial inclusion and poverty level;

   H4g: Stringent price control negatively moderates between digital financial inclusion and poverty level;

   H4h: Stringent financial safety restriction negatively moderates between digital financial inclusion and poverty level;

   H4i: Stringent supervisory quality negatively moderates between digital financial inclusion and poverty level.

Significance of the Study

This thesis sought to explain poverty reduction in SSA in terms of digital financial inclusion, banking sector regulations and institutional quality grounded on supply-leading hypothesis, law and finance theory and modern growth theory. Law and finance theory holds that institutional structures could provide robust enforcement and efficacy of implementations of banking sector regulations to avoid market failure by offering collective goods. In the backdrop of this, law and finance theorists are likely to notice in this thesis that dimensions of banking sector regulations will tend to enhance digital financial inclusion through digital infrastructure and digital financial services. The belief is that this thesis has added to the body of knowledge regarding finance-poverty nexus. Focusing on the findings of the thesis, it is expected that digital financial inclusion agenda in the SSA region be redirected to include access, penetration and usage of digital infrastructure and digital financial services to address issues of financial exclusion across the SSA region.

The momentum in the delivery of digitalized financial services in SSA has largely been underpinned by mobile money in recent years (Abeka et al., 2021). Thus, the understanding provided by the thesis on the relationship between digital financial inclusion and poverty reduction on the SSA region will help governments and development agencies to refocus on digital financial technology for poverty alleviation initiatives. This is because it helps to design and implement poverty alleviation agenda by leveraging technology to uplift marginalized communities, reshape economic landscape and foster inclusive growth within the region.

The poverty gap in most SSA economies is wide relative to other regions. Factors enhancing digital financial inclusion do not only shed light on potential strategies for poverty alleviation but also deal with the urgent need to establish more equitable socio-economic conditions within the region the closed the poverty gap. The research identifies dimensions of banking sector regulations that provide digital financial inclusion- enhancing effect. In essence, the current thesis delivers practical insights regarding which of the dimensions of banking sectors regulations economies of SSA and policy makers can either tighten or relax to attain digital financial inclusion goals.

Also, the findings are deemed necessary for assisting practitioners in the banking sector to develop digital financial platforms, digital financial products and services to meet the need of informal and margined segments of society. It will also serve as a guide for formulating policies in the financial sector. Economies will benefit immensely from mass participation in the formal financial systems. More resources in the informal sectors can be mobilized and redistributed to other productive sectors of the economy.

Further, the thesis articulates contribution of digital infrastructure, penetration of mobile money platforms and mobile devices in delivering inclusive finance and poverty alleviation. The thesis strongly asserts that influence of digital financial inclusion on poverty level is conditioned on the presence of banking sector regulations. Focusing on critical assessment of the moderating roles of banking sector regulation reinforces the claim that, maintaining stringent regulations in banking sector could either facilitate or inhibit effect of digital financial inclusion on poverty. In view of this, the

thesis would enlighten the reading public on factors influencing finance-poverty relations.

Related to above assertions, the researcher envisions that the outcomes of the current thesis be becoming a baseline for further investigations of the phenomenon across regions in the world. The outcomes of the thesis promise to whip research interest spanning across regions in the globe in context of financial reforms and implementation schemes.

Delimitation

The empirical setting of this study is countries in Sub-Saharan Africa. The emphasis is laid on digital financial inclusion, banking sector regulations, and poverty in Sub-Saharan Africa. The scope considers how digital financial inclusion as well as banking sector regulations can help address concerns of poverty. The annual data was culled from World Bank and IMF databases. The dataset used covers the period spanning from 2014 to 2020. This period has experienced much development in financial sector particularly adoption and usage of mobile money or penetration of digital finance services and products, coupled with banking sector reforms in the SSA. Further, in this period SSA have experienced growth in GDP yet issues of extreme poverty remain high coupled with concerns for inclusive growth.

In spite of the fact that much empirical literature exist on finance-growth nexus, it is imperative to note that successes witnessed by sector in facilitating economic growth and thereby enhancing quality of social welfare of people in advance economies can be replicated in emerging and developing countries in SSA. Further, not enough literature exists on how digital financial inclusion, and banking sector regulation influence poverty in SSA. Thus, the

literature was limited to available key evidence that suits the argument and analysis advanced by the study. The study was limited to 25 countries in SSA because not all countries have the complete compliment of the variables on the subject matter. Based on geographical regions, four of these countries, namely: Cameroon, Democratic Republic of Congo, the Republic of Congo and Equatorial Guinea are central African counties. Five of them, namely: Botswana, Eswantini, Lesotho, Namibia and South Africa, are southern African countries. There are nine of them, namely: Ethiopia, Kenya, Madagascar, Malawi, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe are Eastern African countries. The rest which are seven: Burkina Faso, Cote d'lvoire, Ghana, Guinea, Mali, Nigeria and Senegal are West African countries. Therefore, delimitation did not pose any adverse challenge on the outcomes of the study.

Limitation of the study

The study has had some limitations to deal with. Firstly, like many empirical studies, the study suffers from the typical limitations of empirical analysis particularly when interpreting the results. For example, the use of proxy variables, as used in this study, in empirical studies have been subject of criticisms. In the case of indicators of poverty used in the empirical analysis, emphasis is laid on defining poverty from monetary approach, which fails to reflect completely the whole picture of multidimensional nature of poverty. Besides, data were collected exclusively on 25 countries in SSA, hence limiting the possibility of generalizing the findings. In addition, the study relied on secondary data since collection of primary data on digital financial inclusion, banking sector regulations, institutional quality and poverty may

pose challenge, and in some instances may be non-existent. Further, qualitative approach such as interviews, observation and focus group discussion could have provided all-round understanding of the reasons underpinning some of the findings of this study.

Definition of Terms

The terms, concepts and variables used in the study are defined as follow:

1. Poverty, the poverty gap, is conceptualised as the percentage by which the poor's median income is below the poverty line. It captures increase in poverty gap at $2.15 ($ 2017 PPP) attributable to out-of-pocket health care expenditure expressed as percentage of $2.15 poverty line.
2. Poverty reduction (defined as poverty gap) entails strategies, initiatives and interventions geared at alleviating poverty and enhancing the standard of living of people, especially those who fall short of poverty line.
3. Digital financial Inclusion is the leveraging financial technology and digital infrastructure to responsibly deliver a suite of bespoke formal financial services to the financially excluded and underserved at a price that is both affordable for customers and sustainable for providers.
4. Banking sector regulation is a set of rules, laws, and guidelines that govern operations, conduct and supervision of banks and other financial institutions within a country or a jurisdiction which could drive innovation, competition and efficiency.
5. Institutional quality has been conceptualised as institutional structures that advance processes leading to selecting, monitoring and changing

governments particularly stable political system devoid of violence and democratic accountability which are capable of creating conducive environment for robust enforcement and efficacy banking sector regulations.

Organization of the Study

This thesis seeks to examine the relationships among digital financial inclusion, banking sector regulation, institutional quality and poverty in Sub-Saharan Africa. In line with this, the thesis was structured and presented in seven chapters. The first chapter introduced the thesis by highlighting the background to the study and the main problem under study, and statement of the problem. It also deals with research objective, research question, significant of the study and outline of the study. Chapter two provides details that entail theories and review of related concepts that undergird the study. Chapter three explains the research methodology that was adopted and philosophical bases of the study. Chapter four encapsulates empirical results, interpretation and discussion of results related to objective one of the thesis. Also, chapter five encapsulates presentation of results, interpretation and discussion of results related to objective two of the thesis. Additionally, the results and their interpretations and discussions regarding objective three of the thesis are presented in the sixth chapter. Finally, seventh chapter presents summary of findings, conclusion and recommendations in line with findings of the thesis.

Chapter Summary

In this chapter, the emphasis was laid on the issues constituting the background of the study. The statement of problem was also described,

defined and conceptualized. Based the statement of the problem, objectives were formulated and corresponding hypotheses were deduced. Further, issue of delimitation and limitation of the study were addressed. And then significance of the study was outlined. The concluding sections of the chapter chronicled how the entire study was organised. Prior to the section dealing with organization was the section that operationalized the key concepts used in the study.

CHAPTER TWO

CONCEPTUAL AND THEORETICAL REVIEW

Introduction

Digital financial inclusion of individual, households and nations has become an attractive research area for most researchers because it plays crucial roles in poverty reduction, reduction of emission into the environment, increase in inclusion and inclusive growth and economic growth. In the contemporary times, some nations are promoting digital transformation in financial industry for digital financial inclusion, which in turn may help them to attain the goals of some SDGs. Research effort has indicated that digital financial inclusion has implications for poverty alleviation.

This chapter encompasses theoretical and conceptual literature review regarding this thesis. Theoretical literature takes into account exploring in-depth knowledge with aim to offer workable theoretical foundation for the thesis. Particularly, theoretical foundations regarding the transmission mechanisms deployed in the thesis (modern economic growth theory, supply-leading theory, law and finance theory and theories of economic regulation) were explored in-depth with the view of providing good appreciation of the phenomenon dynamics. This is to firmly ground the study. The chapter is organised in such manner as review of theoretical literature and conceptual issues that have attracted some research interest, yet has significant gaps that require further scientific investigation. Hence, the chapter highlights what been learnt and what requires further learning regarding the phenomenon.

The study examined the effect of digital financial inclusion on poverty level among countries in SSA spanning the period of 2014 to 2020. Further,

effects of banking sector regulations on digital financial inclusion was explored. Since institutional quality has implications on banking regulations, the thesis assessed the moderating role of institutional quality between banking sector regulation and digital financial inclusion. Additionally, the thesis explored moderating role of banking sector regulation between digital financial inclusion and poverty level of countries in SSA. The theoretical and conceptual literature offer readers contemporary perspectives regarding digital financial inclusion, banking sector regulation and poverty. More so, the literature review highlights concept of institutional quality (political stability, voice and accountability) which are capable of influencing effects of banking sector regulation on digital financial inclusion. The chapter, however, ends with summary of the chapter.

Theoretical Review

This section discusses the theories that underpin the study. Scholars and development economists have emphasized the need of developing a strong financial sector that promotes faster economic growth underpinned by sound theoretical foundations (Ozili, 2020; Khan et al., 2021; Tadele & Sirany, 2021). This research discusses law and finance theory, modern growth theory and economic theories of regulation that underpin financial systems of countries.

Access to finance is critical in everyday economic decisions of economic agents for engaging in productive economic activities. Poverty alleviation through access to finance is consistent with conceptual, policy and evidential claims (Akolgo, 2023). The conceptual claim recognises access to finance as offering a pathway out of poverty. Policy assertion resonates with

instances where traditional banking institutions fail to provide path to financial inclusion, which Fintech is offering (through mobile money services). Meanwhile, evidential claim points to link between a decade and half boom in Fintech and more people having access to financial services, which has pro-poor effects (Akolgo, 2023).

Theories of economic regulation

Theories of economic regulation are credited to a number of scholars (Posner, 1974; Stigler, 1971). These theories have been propounded to explain crisis linked to banking system (Ofori-Sasu et al., 2023). The theories of economic regulation posit that government interventions in markets through enactment and implementation of rules, policies and restrictions can help to achieve specific economic objectives. Some of the objectives articulated through the theories of economic regulation are to ensure fair competition, consumer protection, preventing market failures, promoting public goods, and maintaining market stability. The overarching rationale that underpins economic regulation is conceived to be striking a fine balance that could permit market forces to operate freely with minimum regulation and where possible stepping in to correct market inefficiencies or to protect the interests of various stakeholders. The theories' central task is to throw more lights on how people benefit or suffer burden from regulations, forms of regulations and their corresponding effects on resources allocation (Stigler, 2021).

Posner (1974) however suggests two theories of economic regulation, which are public interest theory and private interest theory. Stigler (1971) on the other hand identified three main theories of economic regulation, which are public good theory, capture theory, and special interest theory. The view

hold by public interest theory of banking regulation is that regulations are promulgated as response to demands of the public to correct inefficiencies or inequitable market practices (Posner, 1974). Indeed, Hantke-Domas (2003) asserts that public interest theory of regulation elucidates that regulation strives for common good of the public at large. Public interest theory of regulation makes certain key assumptions about the nature and purpose of regulation. According to Shleifer (2005) two assumptions underpin public interest theory. The scholar notes that unhindered markets frequently fail as consequence of monopolistic practices or externalities. In addition, the scholar posits that governments are considered benign and capable to address market failures by implementing regulatory measures. Public interest finds expression in banking sector regulation as governments safeguard interest of the public through regulation of banking activities with the aim to promote bank efficiency and mitigate against possible market failure (Barth et al., 2013).

In a related development, prior empirical studies in context of public interest, posit that tighter capital requirement is probable to limit competition and aggressive lending, thereby resulting in reducing bank risk-taking behaviour(Agoraki et al., 2011; Bolt & Tieman, 2004). The hypothesis of market failures aligns with the perspective of public interest in regulation. According to this viewpoint, governments take the initiative to regulate financial institutions with the goal of promoting the effective operation of banks, insurance companies, and financial markets. This is achieved by mitigating or eradicating market failures, ultimately benefiting the general public by ensuring the allocation of resources in a socially efficient manner (Hagos & Asfaw, 2014) and permitting innovations in the financial systems.

From the perspective of private interest on the other hand, banking regulations are instituted or enforced so as to maximise the interest of a particular stakeholder, which in turn reduces bank efficiency (Haque & Brown, 2017). The findings of Mateev et al. (2023) validated private interest view of bank regulation by averring that official supervision index was positively linked to bank credit risk. The authors further noted that market discipline influences bank insolvency risk.

In a study, Harnay and Scialom (2016) argue that economic theories of regulation influence and contribute to shaping banking regulatory policies. Financial institutions, including banks, actively promote and gather savings that fuel the expansion of the economy. By channeling these savings and overseeing their utilization, banks play a crucial part in ensuring efficient resource allocation across the entire economic landscape. Additionally, banks serve as essential sources of liquidity for individuals and businesses, a role that gains utmost significance during periods of economic hardship and turmoil. In essence, it is imperative to effectively regulate activities of banking sector in order to promote and sustain stability, efficiency, and scale of the banking sector, thereby exerting a vital influence on the level and fluctuations of economic growth (Kroszner & Strahan, 2014).

In theory, different types of banking regulations can have varying impacts on income distribution. For instance, stricter capital adequacy requirements and effective enforcement of prudent bank supervision, with the aim to reduce systemic risk and safeguard the economy from financial crises, may potentially lead to a decrease in income inequality. This is because if financial crises primarily harm the poor and capital regulations effectively

mitigate systemic risk, then there must be a reduction in income inequality. Repullo and Suarez (2013), as well as Repullo and Suarez (2008) emphasize this countercyclical consequence of banking regulations in general, including the specific case of Basel II. The existing literature generally supports a negative correlation between banking regulations and inequality (Chambers & O'Reilly, 2022), reinforcing this notion.

However, there is an alternative perspective to consider. Given that capital requirements apply both in favorable and unfavorable economic conditions and that capital can be costly, tighter capital requirements may incentivize banking institutions to advance credit facilities to "safer" individuals and companies rather than relatively poor individuals. This is believed to happen even if the latter are considered creditworthy or have the potential to generate income with the capital. This tendency may be particularly pronounced during periods of financial system and economic apprehension (Fostel & Geanakoplos, 2008).

The current study draws on public interest theory of banking regulation to explain how banking sector regulations influence digital financial inclusion. Public interest theory of banking regulation is crucial in mitigating system risk, ensuring proper market conduct and protecting customers of financial services (Lumpkin, 2010). Attainment of these policy objectives requires financial innovation as a consequence of competitive economy. Innovations are capable of ensuring efficient allocation of resources and effective functioning of financial intermediation processes. Thus, the current thesis argues that public interest theory of banking regulation explains effects of banking regulations on digital financial inclusion through innovations in the

financial sector. In view of the above, the priori expectation is that banking sector regulations should positively relate with digital financial inclusion.

Law and Finance Theory

The fourth and final objective of this thesis is to examine how banking sector regulations impact the relationship between digital financial inclusion and poverty reduction. The law and finance theory was used to understand moderating effect of banking sector regulations. This is because with finance-poverty relationship in the era of digital evolutions, law and finance grounded in legal theory is capable of illustrating how banking sector regulations shape digital financial inclusion effect on poverty reduction.

The Law and finance theory is credited to the seminal works of (La Porta et al., 1998). Though this theory was not originally a finance theory, it has been widely used in different fields including economics. In finance and economics where it has been demonstrated that law and finance theory can help address issues of information asymmetry, moral hazard and private proverty right associated with financial transactions and contracts.

There are channels through which the influence of law and finance theory are transmitted, namely: political mechanisms and adaptability mechanisms (Graff, 2006). The political mechanisms highlight importance of variations in legal traditions in illuminating why priorities are attached to private property right. The adaptability mechanism on the otherhand deals with the capability of the legal system in promoting healthy state between contract needs inherent in an economy and the normative status (Beck & Levine, 2003). In view of Beck and Levine(2003), the capability of legal system to close the gap between contracting needs present in an economy and

normative status is critical to financial system. This is because when this is overdone it may cause impairment to legal system capability in doing so.

Theoretically, central to the prediction of legal theory of law and finance is the postulation by La Porta *et al.(*1998) that legal origin of laws is related strongly to wide range of rules and regulations in addition to economic outcomes. Further, law and finance theory posits that laws on the basis of their legal origin, protection of shareholders and creditors, the laws themselves, and the robust enforcement of rules and regulations are strongly associated with financial development (La Porta et al., 1998). This thus creates path from legal origin through financial sector development to economic growth. With this, recognition of the various aspects of the institutional architecture of the financial sector is particularly important to the development of the financial sector which may eventually improves financial inclusion. However, in a study by Nutassey *et al*. (2023), the findings reveal that stringent regulations on financial sector activities hinder financial development from enhancing financial inclusion. The Authors further reported that regulations promote mass participation in financial system. Practical literature and reality make it clear that fianncial sector is highly sensitive to laws in a nation where these rules are considered as well-organised, fair and enforceable. As noted by Huang (2010) law is critical to financial development because it affects the supply side of financial development.

Some scholars have also demonstrated that law and regulations create conducive environment for financial sector development. For example, the results of Bousnina and Gabsi (2022) reveal that existence of financial sector in a sound legal system permits economic agents to benefit from financial

sector development. Also, Aluko and Ibrahim (2021) pointed out that market regulation boost financial development. The findings of Feng and Yu (2021) show that enhancement in regulatory quality and rule of law associated with lowering of transaction cost, fairer and efficient financial system.

Amidst the institutional architecture of the financial sector, banking sector regulations seemed to have caught the interest of policy makers owing to the several episodes of financial crises. Based on the Law and Finance theory, this study argues that banking sector regulations could represent laws that could affect ability of the financial sector to innovate and develop digital financial products to include more economic agents in the financial system. Hence, based on regulation-inclusion hypothesis, banking sector regulations are expected to positively relate to digital financial inclusion.

Modern Economic theory

Modern economic theory, credited to Robert Solow as theory of capital accumulation in economy, considers changes in economic output are as a result of changes in capital, labour, and technology (Seo, 2023). The theory further acknowledges that growth in productivity and service of a country depends several factors. Key among these factors are physical capital formation, human capital and sustainable ways of harnessing natural resources and financial inclusion. Financial inclusion permits economic agents to find solution to liquidity restriction and channels savings towards productive investments (Pavón, 2021). Scholars such as Gonzalez-Hermosillo et al. (2013) have noted that banks play essential roles in advancing funds for economic activities globally, with one of their core-funding source being retail

deposits. Likewise, Agnese and Vento (2020) claimed that deposits appear stable source of reliable funding for banks.

Economic growth theory is relevant to financial institutions as it conceives banks as powerful tool for improving productive capacity of an economy and source of funding a country especially at economic development (Nwagu et al., 2023). Indeed, economic growth depends on banking sectors ability to harness deposit from savers. The systems' function of advancing debt facilities to promote production and investment have been touted as critical in creating economic expansion in such sectors as agricultural, industrial and trade. Digital financial services and digital infrastructure serve as mean to appreciate asset and promote entrepreneurial activities thereby promoting savings, investment and payment. Therefore, increase digital infrastructure and digital financial services is expected to drive access, penetration and usage of formal financial services leading to asset appreciation and accumulation of capital, which in tend reduce poverty levels. Hence, this thesis expands modern growth theory by introducing innovation by explaining the asymmetric linkage between digital financial inclusion and poverty reduction. In view of this, the supply- leading hypothesis has been explained.

Supply-Leading Hypothesis

One of the objectives of this thesis examines implications of digital financial inclusion on poverty reduction. Hence, to understand poverty reduction in era of proliferation of digital financial services and digital infrastructure, the hypothesis of supply-leading first and foremost requires to be analyzed. This is informed by some empirical studies that have shown that finance is over emphasized. The financial sector of a country is seen as the

primary driver of public service delivery, which is critical to its economic success (Adeyeye et al., 2015). The financial sector allocates financial resources among different economic units, through a process of financial intermediation.

There can be financial development if the financial sector is efficient and if it is not, the economy suffers. The supply-leading theory describes how financial depth promotes economic expansion. Some scholars consider this postulation as "finance-led growth hypothesis" (Masih & Khan, 2011). . The supply-leading hypothesis posits that financial deepening is a key determinant of economic growth. It posits that the growth of the financial sector results in optimal resource allocation (Nguyen, 2022). According to the supply-leading hypothesis, without any feedback from the economy, financial deepening tends to move from finance to economic growth (Adeyeye et al., 2015). To put it another way, economic development relies on a well-developed financial sector. According to Adeyeye et al. (2015), a well-established financial system reduces transaction and monitoring costs while reducing asymmetry information, resulting in improved banking system.

The establishment of a well-developed financial sector enhances the supply of financial services while also increasing accessibility among participants in many economic sectors. The “supply-leading hypothesis” holds that “financial development” facilitates growth in the various sectors of the economy (Adeyeye et al., 2015). This may lead to the creation and expansion of digital financial services and digital infrastructure, which foster greater savings and investments as well as the efficiency of capital accumulation. Ohwofasa and Aiyedogbon (2013) summarized the supply-leading hypothesis

by arguing that a well-functioning financial firm is capable of creating and expanding liquidity, mobilizing savings, increasing capital through of resources, transferring resources from unproductive sectors to more productive and growth-enhancing sectors, promoting skilled entrepreneur response in these contemporary sectors of the economy, and drive total economic efficiency. Overall, the supply-leading hypothesis posits that the extent of financial development of country is a product of the growth in the actual sectors of the economy (Ehigiamusoe & Samsurijan, 2021). Thus, with supply-leading hypothesis, digital financial inclusion being an integral part of financial development, is perceived to enhance economic growth and reduce poverty by supplying pro-growth enhancing resources (Hsueh et al., 2013). As a result, there is the expectation that digital financial services will open up enormous opportunities for the overall economy to grow rapidly and sustainably (Bai & Lei, 2020) leading to poverty reduction. Based on evidence from supply-leading hypothesis, the hypothesis that digital financial inclusion negatively relate to poverty level is formulated and tested.

Summary of Theories Adopted

Three main theories that underpin this thesis were examined. The roles of modern economic theory in articulating poverty alleviation characteristics of digital financial inclusion(DFI) was examined. Also, law and finance theory coupled with theories of economic regulation were employed to shed light on activities of banks or financial institutions as result of their reactions to banking sector restrictions in stimulating digital financial inclusion. Further, law and finance theory was used to explain moderating consequence of institutional quality on DFI. Focusing on these theories, this thesis conjectures

that these theories fundamentally explain influence of DFI on poverty, and moderating effect of banking sector regulations and institutional quality. Within context of this thesis, stricter banking regulations are significant cognates of law and finance theory, where law and finance theory institutes rules, regulations and restriction seeking to protect stakeholder interest in financial systems thereby leading to tighter regulations with concomitant effect on digital financial inclusion and poverty.

Review of Related Concepts

This section entails review of related concepts. Specifically, it highlights the overview of the core concepts of the variables used for the study. This is with view to appreciate effect of digital financial inclusion, banking sector regulation, quality of institution and poverty of countries in SSA. The section deals with digital financial inclusion concept, banking sector regulation, and evolution of financial inclusion in relation to poverty and institutional quality

Digital financial Inclusion

Mostly across developing countries, there is inadequate access to formal financial services, which decreases citizen welfare and social protection, resulting in increasing social tensions and, eventually, slowing the country's economic progress (Naumenkova et al., 2019). In most cases, the adverse financial conditions in developing countries are due to price and non-price obstacles. These constraints increase the proportion of the population who are financially excluded and complicates citizens' access to financial services. Overcoming these impediments is critical for the sustained development of the financial system of these countries. With the deployment

of modern digital technology, more people will have access to public services via online platforms. In view of this, digital financial inclusion technologies, which are centered on providing individuals with high mobility for financial services as opposed to traditional channels and systems, are becoming increasingly popular (Naumenkova et al., 2019; Duvendack & Mader, 2020). It has recently attracted the attention of policymakers and businesses all around the world (Gabor & Brooks, 2020; Lai et al.,, 2020; Ahmad, et al., 2021). In view of Zhang et al. (2020) digital financial inclusion constitutes a bundle of efforts to offer digital access to financial services, particularly to those groups of people regarded as financially unserved at low cost. It provides businesses with mechanisms for savings, capital formation and investment options (Ozili, 2018). Financial services have been considerably improved as a result of digitalization and technological advancements (Vives, 2019).

Digital Financial Inclusion in sub-Saharan Africa

The year 2010 witnessed a significant shift and progress towards digital financial inclusion. Thaddeus et al. (2020), in his study highlighted the significant role of bodies such as the World Bank and the G-20's "Global Partnership for Financial Inclusion (GPFI)" in projecting DFI. Today, policymakers and business leaders are recognizing the significance of digital financial inclusion in reducing poverty and boosting economic growth.

In contemporary times, a number of developing countries have restructured their economic architecture to accommodate digital evolution. This could be explained by the digital transformation witnessed in all facets of economic and non-economic lives across the globe. It is imperative to state

that the main economic purpose of most developing nations is poverty reduction, hence any factor that promotes this course is worthy of exploration. Some scholars have touted the significance of technology-enhanced financial inclusion as a major determinant of economic prosperity (Gul et al., 2024; Zhang et al., 2024). It is imperative to state that digital technologies have shaped service innovation among banking firms, and increased geographical reach of many financial service providers. As evidenced in developed economies, several countries in SSA have embraced digital technologies in the promotion of financial inclusion (Chamboko, 2024; Chinoda & Kapingura, 2024). Further, digital technologies have rapidly accelerated the global adoption and continuous popularity of the concept of financial inclusion.

Also, it is noteworthy to state the relevance of digital financial inclusion in the promotion of Sustainable Development Goal (SDG) for welfare nations across the globe (Mpofu, 2023; Suhrab et al., 2024). Despite some considerable progress made on financial inclusivity, sub-Saharan Africa accounts for approximately 80% of about worldwide 2.5 billion persons who are financial excluded (Sarpong & Nketiah-Amponsah, 2022). Consequently, several countries in SSA to some degree lack the digital infrastructure to promote the level of financial inclusiveness desired to harness the benefits of the phenomenon. The SSA region has been touted as the most economically deprived across the globe (WorldBank, 2018). Nonetheless, some countries within the SSA region such as Ghana, Rwanda, Nigeria and Kenya have made a steady progress in the adoption of digital technologies. These countries seem to have explored the benefits of digital financial technology to boast access to financial services (Mukalayi & Inglesi-Lotz, 2023). This progress is evident in

the Global Findex Data Analytics, which details statistics on digital financial services' subscription world-wide. According to the data, mobile money subscription and other digital financial services reached a rate of 43% among SSA countries in 2017 (Demirgüç-Kunt & Klapper, 2012).

Promoting digital financial inclusion is necessary among SSA countries because it permits deprived households to engage in some form of borrowing, saving, building assets, engaging in sophisticated agriculture activities, and building of sustained economic resilience against external shocks. Further, DFI can enable small and medium enterprises to advance opportunities of growth through well-structured financial facilities. Thus, digital financial inclusion may serve as a crucial catalyst favorable for the sustained prosperity of individuals, enterprises and SSA economies as a whole (Abbas et al., 2024; Zhao & Jiao, 2024).

Thus, economies in SSA require paradigm shift in financial service and product design and delivery to enable them enhance access to low charge accounts, mobile money services, money transfer instruments, digitally enabled financial services and products that are targeted at disadvantaged groups of people to meet their financial needs thereby promoting inclusive growth. In contemporary times, advancement in technologies have provided several opportunities to attain SDGs. Specifically, digital technologies are considered assets relevant for inclusion and attainment of sustainable development goals (Nchofoung & Asongu, 2022; Asongu et al., 2021). On the bases of the arguments advanced, it can be inferred that financial inclusion is not just a policy choice but policy compulsion as it is a bedrock for building a country's financial infrastructure. This is because it facilitates economic

development, growth and sustainable development. For instance, in comparison to other economies, prevalence of mobile money accounts in SSA is phenomenal as 33 percent of adults averagely use mobile money account (Demirgüç-Kunt et al., 2022).

Empirical studies have established that digital financial inclusion (DFI) facilitates financial inclusion. Thus, DFI is a signpost for inclusive growth as it is geared towards participation of all including underserved sections of societies in economic activities. Since SSA economies are predominantly characterised with huge populations and markets, natural resource endowment can help these economies reap the potential of opportunities regarding financial usage. Further, these resources may increase participation of the poor and other underprivileged sections of societies.

Defining Digital Financial Inclusion

Understanding the meaning of financial inclusion is key to defining digital financial inclusion. Mhlanga (2020) simply define financial inclusion as the proportion of adults who have access to financial or banking services. According to the 2017 "Global Findex Survey" 79.9% of the global population aged 15 and above had accounts with financial institutions (Demirguc-Kunt et al. 2017). This represented a significant increase over the previous edition of the study in 2014, which reported 53.1 percent, and 35.2 percent in 2011. This means that 3.5 billion people, or almost half of the world's adult population, are "unbanked or underbanked, with limited or non-transactional financial access". Sharma (2016) stated that establishing a bank account is the first step towards financial inclusion. According to Muneeza et al. (2018), digital transactions are increasingly are becoming more popular banking services.

The World Bank defines digital financial inclusion as the use of cost-saving digital tools to provide formal financial services to financially excluded and underserved population by tailoring such services to meet their needs (Alameda, 2020). According to Wang and He (2020), digital financial inclusion constitutes means of broadening access to and use of formal financial services by the excluded or underserved populace. Likewise, Rasheed et al.(2019) consider digital financial services as formal financial services provided to the excluded and underserved segments of populations by creating digital access to and use of such services. Such services are not only tailored to meet the customers' needs, but also delivered responsibly at a cost considered as affordable to customers and can sustain operations of the service providers. From the foregoing definitions, it is clear that digital financial inclusion encompasses all platforms that enable clients to make payments and store electronic value, not just digital transaction platforms (Peric, 2015). In other words, digital financial inclusion promotes the use of devices that can send information, such as mobile phones, as well as instruments such as payment cards, to connect with other digital devices, such as point-of-sale terminals (Alameda 2020; Mhlanga, 2020).

Indicators of Digital Financial Inclusion

Non-China led and China led indicators inform literature on indicators of digital financial inclusion. Established indicators of DFI entails information about digital economy. In case of Perking University Digital Financial Inclusion Index of China entails information (PKU-DFIIC) about various types of financial services. The measures used in PKU-DFIIC incorporate indicators for level of DFI (Liu et al., 2021) and different dimensions of

China's digital financial inclusion (Guo et al., 2020). The constituents of the PKU- DFIIC are breadth of coverage, depth of use and digital support. The breadth of coverage represents a secondary dimension and it captures account coverage. Account coverage is indicated by the number of Alipay per 10,000 people; Alipay account users as a percent of Alipay account; Number of bankcards linked to each Alipay account. With usage depth, the dimensions including payment business, loan business and insurance number. These are reflected in loan per capita, and number of payment per capita. Digital support takes into account extent of mobility, affordability credit convenience and is indicated by proportion of mobile payment; and average interest rate in relation to personal loan (Yu et al., 2022). Normally, scholars construct sub-index and total of PKU-DFIIC incorporating breadth of coverage, depth of use and degree of financial support.

Related to the indicators of digital financial inclusion, some scholars used access, penetration and usage indicators of provided by providers of digital financial services. In the study of Chinoda and Kapingura (2024), indices of DFI was constructed where the authors followed the work of (Khera et al., 2021). Included in the indices were access, penetration and usage indicators offered by digital financial services providers, namely: Fintech companies, mobile money operators and other operators in financial ecosystem, which are sourced from World Development Indicators (WDI). Specifically, indicators used by these scholars included: percentage of population with access to the internet, mobile subscription per 100 people; number of registered mobile money agents per 10,000 adults; and number of active mobile money account per 1000 adults. These indicators are consistent

with those recommended by upgraded G20 financial inclusion indicator system.

In Sub-Saharan Africa, constructing DFI index appears to be difficulty owing to unavailability of data. Thus, available data in FAS was routinely used to measure the index of DFI. The variables used are related to digital financial services provided by mobile money operators, new entrants to financial sector and fintech companies. Thus, the variables used to construct the digital financial inclusion index were selected from the works of (Chinoda & Kapingura, 2024).

Financial technology developments and its role in financial inclusion

In recent times, research attention has sped up globally on integration of digital financial technology and inclusive finance for an inclusive financial system (Croxson et., 2022; Lee et al.,2023). This is partly because there is advent of fintech-led-Mobile-payment platforms, mobile-based digital payment markets and digital payment technology (Jaiswal et al., 2023). It is also partly because of transformative impact of emerging financial technologies like machine leaning, blochchain and artificial intelligence on traditional financial services (Kou & Lu, 2025). These emerging financial technologies facilitate application of information and communication technology particularly digital technology in financial services industry. In view of these developments, plethora of fintech services are abound in financial service sector. Example of them are electronic money, online wallets, online insurance and digital loaning (Gomber et al., 2018).

In a digital era, evolution of financial technologies seem to evolve around three pillars. These pillars are: 1) availability of huge capital for

investment in technology innovations for financial services; 2) availability and readiness of start-ups to develop new technologies and design new services for financial industry; and 3) ability of these technologies to transform financial intermediation where customers can access financial services beyond brick-and-motar financial system (Gomber et al., 2018). This has actually paved way for innovative financial solutions, thereby addressing traditional constraints to access financial services and reduces financial technology infrastructure gaps (Falaiye et al., 2024).

The advert of financial technology has speed up adoption of financial technologies for innovative financial solutions and use of digital finance. Digital finance deals with provision of all forms of financial services via mobile phones, internet or cards and personal computers linked with a trustworthy digital platform. With digital finance, access to and usage of finance services and quality of financial services in developing economies improve significantly (Mothobi & Kebotsamang, 2024). Drawing evidence from digital financial technology adoption in SSA, Mothobi and Kebotsamang (2024) reveal that mobile money is the predorminant digital financial services use in Tanzania. The authors further acknowldge that mobile money, mobile banking as well as e-wallets do not necessarily require internet to function. Yet, some scholars like Elouaourti and Ibourk (2024) find that access to internet infrastructure and technology play critical role in promoting digital financial inclusion.

In light of above developments, mobile money penetration in sub-Saharan African (SSA) region is the highest compare to other six regions globally between 2013 and 2022 (Chinoda & Kapingura, 2024). Further, the

SSA area has also witnessed increase in cross-border leading across numerous economies (see, Kusi et al.,2022) in the region. These cross-border activities may have implication for cross-border financial intermediation through digital tools. Similarly, in recent times SSA region has gained momentum in delivery of digitalized financial services (Abeka et al.,2021) by using mobile money technologies.

These developments have potentially important implications for sub-Saharan Africa's growing financial inclusion agenda. This is because digital financial inclusion leverage technological platforms like mobile applications and financial technology solutions to deliver financial services (Ozili, 2022) thereby addressing financial access gaps. Mobile money usage according to Bongomin et al (2018) is positively related to financial inclusion in SSA. In a related study, Hofisi (2023) identifies lack of mobile phones as barrier to financial inclusion in SSA. Coffie and Hongjiang (2023) illustrate that money mobile agents, mobile money customers and mobile phones are heterogeneous actors that foster financial inclusion. However, other studies have used other measures like internet banking, online banking, use of point of sales devices and number of automated teller machines as indicators of financial inclusion (Tweneboah & Nsiah, 2024). Yet, the current study argues following earlier works of Inoue (2024), and Chinoda and Kapingura (2024) coupled with aforementioned discussions that internet usage, mobile money agents, mobile phone subscription and mobile money usage are critical digital means through which financial inclusion is facilitated in developing economies.

Banking Sector Regulation

Banking regulation has evolved over the years. The evolution has widely been driven by lending across borders and response to recent and remembered crises (Rognes & Larsson, 2023). For the period spanning from Great Depression (1930s) to 1970s, the focus of bank regulation has been on safety and soundness of market structures, competition and allocation of assets rules and interest rates (Hellwig, 2010). The period covering 1970s to 1980 is characterized with deregulation and bank failures, for example insolvency of Herst bank in Germany in 1977, crisis of saving and loan institutions in the US in 1980s. The response measures have brought about introduction of Basel accord in 1988 with attention directed at capital adequacy requirements. In reality, the market failure and deregulation continued because governments allow banks to price freely and diversify into new financial products and geographical markets.

Rognes and Larsson (2023) assert that the epoch of banking regulation are the classical regime, statist regime and the market regime. Specifically, the market regime spans from the periods of 1970s to present where the aim principally is to restrict inflation. However, the revised form of these regulations permit allocation of credits by market actors based on demand (Rognes & Larsson, 2023). This regulatory regime continues to exist despite the fact that banking regulation has become more harmonized internationally through the Basel framework.

Reforms in banking sector in SSA countries were linked to adoption of Basel I, Basel II and Basel III accords. Basel I accord is believed to have been almost fully subscribed by all countries in SSA. Basel I restricts risk-weighted

asset to 8% as a minimum capital required ratio. This essentially focuses on mitigating credit risks. Basel II accord, on the other hand, accounts for operational risks inherent in determination of minimum capital required ratio and enhances risk-taking behaviour as well as transparency of the banks. Countries such as Angola, Botswana, Malawi, and Mozambique have successfully implemented certain elements of Basel II accord. Further, some economies including Ghana, Kenya, Mauritius, Nigeria, Rwanda, Tanzania, West Africa Economic and Monetary Union (WAEMU) and South Africa have adopted Basel II and Basel III (or certain elements of them, thereby strengthening capital requirement as per Basel II accord and introduce macro-prudential perspective regarding systemic risks.

The dimensions of banking sector regulations as noted by Triki (2017) include: capital stringency, restriction place on activities of banks, entry restrictions, transparency requirements, price control, liquidity and diversification requirements, availability of financial safety nets, quality of supervision and exit restriction. These aspects of banking sector regulations help explain how regulations better explain financial inclusion and poverty alleviation. This is because these regulations can contribute to growth-enhancing effects and better efficiency outcomes of well-functioning banking systems. In brief, stringent enforcement of banking sector regulations is expected to drive competition and foster innovations through which savings, payments, and other financial services would be expanded to underserved or unbanked populace by going beyond traditional channels like motor-and-brick bank branches (Beck et al., 2011).

Concept of Poverty and its measures

By 2030 the SDG has envisioned to end or eradicate poverty. In line with this, in 2013 the World Bank (WB) set forth two goals to guide its development activities globally. Firstly, it envisioned to eradicate extreme poverty. Particularly, this target is highlighted by agenda 2030. To this end, the goal is to reduce extreme poor of the world population. World population of the poor has been expressed recently as the number of people living on less than US$2.15 (revised in 2017) per day 2017 PPP (purchasing power parity) to less than 3 per cent. Secondly, there was the agenda to facilitate shared prosperity by focusing on the promotion of growth of per capita real income.

In the backdrop of the above, there has been significant progress over the years to reduce poverty. This notwithstanding, the population of extremely poor worldwide remain intolerably high. This thus affects attainment of the object of eradicating world poverty. The trajectory of general trends of poverty reduction is presented in figures 1, 2 and 3 below and for regions worldwide 2014 to 2020. On the worldwide level, the number of people living on less than US$2.15 a day (2017 PPP) has been declining since the 1990 (United Nations Development Programme (UNDP), 2023). Inspire of these downward trend in extreme poverty level, South Asia and Sub-Saharan Africa regions failed to halve extreme poverty by 2015(UNDP, 2023; World Bank, 2023). Out of the estimated 1.1 billion multidimensional poor populations across the globe, SSA economies accounted for 534 million (47.6%). Further, of the 22 multidimensionally poor countries in the world, 19 of these countries are located in SSA region, suggesting that SSA is the home of poorest of poor (UNDP, 2023).

Specifically, although sub-Saharan Africa has made some progress in reducing poverty for the period 2014 and 2020 using poverty gap at $2.15 a day (2017 PPP), the level of poverty gap at $2.15 a day (2017 PPP) and poverty gap at $6.85 a day (2017 PPP) remain significantly high compared with other regions of the world (see figures 2 and 3 below). However, at poverty gap at $6.85 a day (2017 PPP) poverty level of South Asia shows the highest followed by SSA. These suggests that critical steps must be taken to identify poverty reduction efforts across SSA economies. The figures 1, 2 and 3 are consistent display a some minimal of level of downward trends in overall poverty for the period of 2014 to 2020 in SSA.

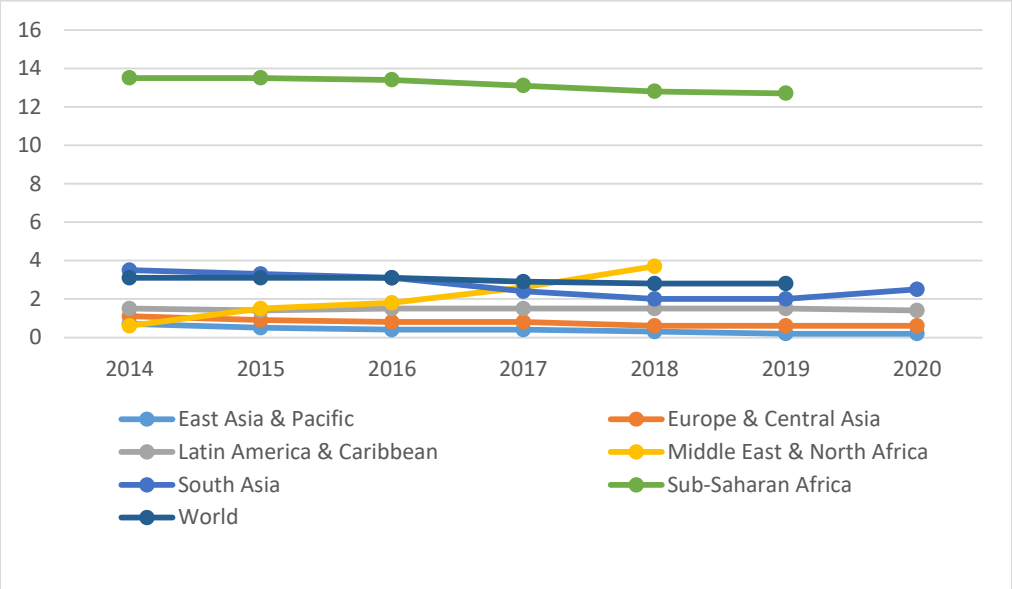

Figure 1: Regional Distribution of Poverty gap at $2.15 a day (2017 PPP) (%)
Source: World Bank (WDI) 2024

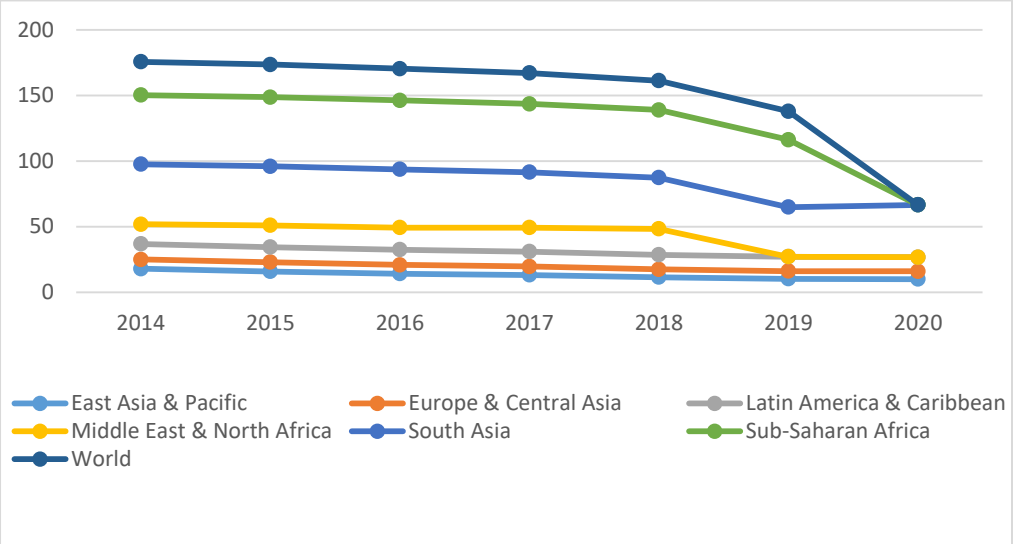

Figure 2: Regional Distribution of Poverty gap at $3.65 a day (2017 PPP) (%)
Source: World Bank (WDI) 2024

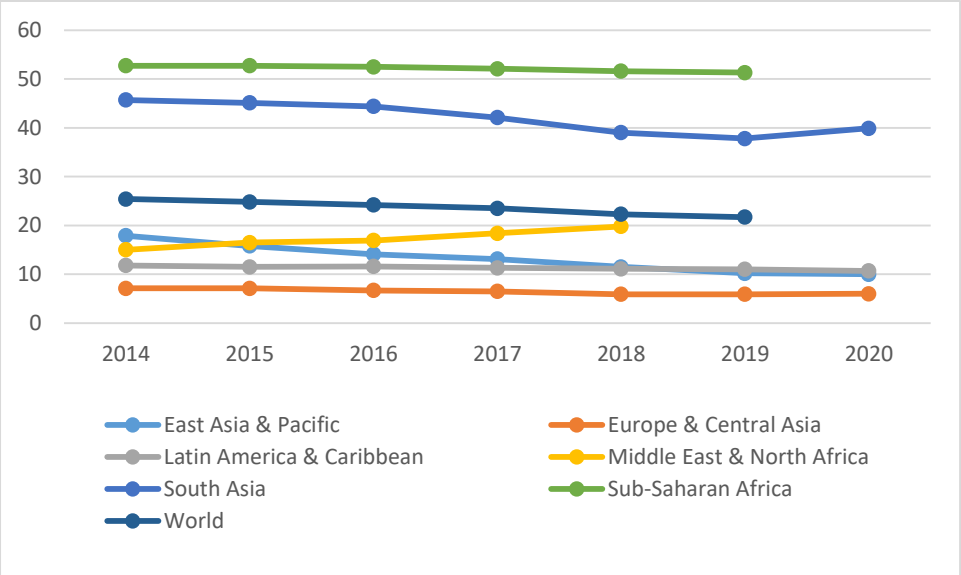

Figure 3: Regional Distribution of Poverty gap at $6.85 a day (2017 PPP) (%)
Source: World Bank (WDI) 2024

There are gamut of factors contributing to poverty. Choudhury and Bagchi (2016) aver that persistent state of poverty and financial hardship in developing countries accounted partly for financial exclusion. Also, poverty deprives poor people of meeting their basic needs including financial services, education, and health (Kandachar & Halme, 2017). Across the globe,

however, it has been reported that an adult population of at least 15 years, representing 1.7 billion, neither has an account with a financial institution nor a mobile money provider (World Bank, 2018). Yet, access to and use of formal financial products and services are key to realizing SDGs. In fact, sustainable usage of formal financial products and services, namely: deposits, savings, payment services; credit and insurance, could help the poor people meet their basic needs.

Critical to access and usage of formal financial services is the penetration of mobile phone and internet usage. Financial imperfections, information asymmetry and credit constrains, are binding on the poor people since they do not have collaterals and credit history that may help relax credit constrains to benefit the poor people (Beck & Levine, 2005). Further, financial development has been variedly measured employing either single or combination of indicators-domestic credit offered to private sector (DCP), domestic credit provided by the banking sector (DCPs), liquid liability (with ranges from M1 to M3), gross domestic savings (GDS), stock market capitalisation (SMC) and bond market(BM).

Key building blocks of measuring poverty include frequency, average depth and dispersion of poverty (Forster, 2006). The number of poor people is ascertained using headcount ratio, which deals with proportion of the population with income on or below the poverty line, for instance, US$2.15 per day, US$3.65 per day or US$6.85per day (World Bank, 2023). By this measure, there is a boundary between the poor or the rich. Another measure that considers the shortfall of the poor from the poverty line is the poverty gap measure. With this, poverty rate of a country can be refined and offer signal

for level of poverty of a country. It actually measures the extent to which people fall below the poverty line as a share of the poverty line.

Approaches to Poverty Measurement

Normally, the concept of poverty and its measurement framework is based on deprivation of income and other resources required to improve quality of life. Beyond this rudimentary conceptualization of poverty, alternative concepts, which are subsistence, basic needs and relative deprivation have been acknowledged. The subsistence view considers physical need of people as basic needs. However, it has been criticised for not considering social needs. The basic need concept attempts to broaden the basic need whereby two more elements were added: minimum consumption of needs of a family and provision of essential services for the larger community. The relative deprivation, on the other hand, acknowledges relativity inherent not only in income and other resources but also material and social conditions. The views of poverty helped to swift attention to multiplicity of conditions that constitute manifestation of failures in various dimensions of life. Thus, the concept of multidimensionality of poverty was hatched yet there has not been agreement regarding definition of poverty. This fuels the multiple approaches to measuring poverty. Four of these approaches have been reviewed in this study, which are monetary, capability, social exclusion and participatory. The approaches present varied policy implications coupled with targeting of the poor as the different approaches identify different people as being poor. Empirical literature seems to have lacked evidence alluding to overlaps between different approaches to poverty. This suggests that there is the

possibility of serious targeting errors where one approach is used in relation to other approaches.

According to Dini and Lippit (2009), the four approaches agree on social roots of poverty, multidimensionality of poverty and acceptable environment of poverty in order to explain complex real-life poverty paradoxes. The following section discusses the four approaches to measuring and interpreting poverty.

The Capabilities Approach (CA)

This approach is also known as Amartya Sen's Capability approach. The concept of capability adds to low income dimension of poverty, a deprivation of basic capabilities. Capability thus refers to examination of individual's actual ability in attaining key functioning which are integral to living (Sen, 2000). Capability deals with individual's actual or substantive freedom to attain such functioning. This approach acknowledges freedom-related indicators for treasured life. Freedom constitutes formal right to have or do something, as well as the idea that one is intrinsically entitled of preferential treatment or benefits (Woldegiorgis, 2020). Critical to the concepts of capabilities are an individual's functioning which explains the person's being and doings, and capabilities (Robeyns, 2006). Capability approach is thus not an alternative approach but a perspective that highlights amassing of material resources or the mental state of people, which are capable of explaining their satisfaction with their own lives. The concept of capability poverty has further evolved into development

Amartya Sen, the Nobel Laureate, contends that everyone is innately privileged and has the freedom to select and enjoy their rights (Dalziel et al.,

2018). That is to say, everyone deserves benefits and special treatments. The approach contends that any form of exclusion and deprivation stems from a failure to exchange one's natural privileges with others (Woldegiorgis, 2020). Sen (1999) argues that famine, for example, arises as a result of people's unwillingness to exchange their natural privileges rather than unavailability of food. Sen (1999) believes that the incapacity of people to exchange their privileges with others explains why famine and starvation influences some section of society while others are having access to food sufficiency. In essence, inclusive development enhances people's freedom of choice while also promoting human potential through their entitlement. According to the World Bank (1991), entitlement encompasses concepts like greater individual freedom, a richer cultural life, more equality of opportunity, higher standards of health, human security, better education, less poverty and a cleaner environment. Woldegiorgis (2020) contends that all people should expect universal entitlements of human rights from states and societies in terms of dignity, justice, and safety.

The Social Exclusion Approach (SEA)

This approach, perhaps, goes beyond economic and material concerns. The United Nations (2016) refers to social exclusion as a state where individuals are incapable to participate fully in social, political, economic and cultural activities including processes leading to and nourishing such state. In view of Burchardt et al. (1999), a socially excluded individual is the one who: (i) is a resident of a geographical area; however, (ii) for some uncontrollable reasons they cannot participate in activities that are considered as normal for other citizens; and even though (iii) are willing to participate. The

consequences of non-participation in activities is connected to deprivation process. The process is characterised by lack of attributes that lead to some suffering and put them at disadvantage position (Higgs & Whites, 2000). Unique to this attribute are income and material resources. Barry (1998) contends that a person is considered being excluded provided the condition (i) and (ii) stated above are met. This approach comes with relativity, agency and dynamics. Relativity in view of social exclusion is explained in relation a particular society. Whereas agency is as a result of actions of an agent or agents, dynamics points to relevance of current and future conditions(Atkinson & Hills, 1998). Furthermore, Room (1999) added multidimensionality as another feature that emphasis how individuals and groups are deprived of one or more dimensions.

The status of poverty, in line with social exclusion perspective, is informed by the assertion that poverty is a result of individuals' relationship with significant broader society which finds expression in the level of integration (Cannan, 1997). The degree of integration can bring about social exclusion or inclusion. Social exclusion approach may or may not drive some group of people into poverty. When social exclusion increases level of economic inequality and reduces impact of economic growth, poverty reduction efforts are stymied. As the excluded individuals are mostly prevented access to material resources, they are likely to fall in categories considered as poor in in terms of income, health, education (DFID, 2005). This is because they lack access to market, services and resources (Ben-Arieh et al., 2014). Consequently, they experience emotional stress as they may not participate in economic activities in their communities. However, the non-poor

persons may as well experience some sort of exclusion. However, it imperative to point out that just as poverty does not necessarily result in exclusion, so it is the case that individuals who are excluded might not equally be considered as being poor (Kenyon et al., 2002; Preston & Rajé, 2007). Thus, this approach to interpreting poverty is rather difficulty relative to other approaches.

Addressing social exclusion demands equal steps in alleviating poverty. This is because Devicienti and Poggi (2011) claimed that the dynamics of social exclusion and poverty are interrelated positively and consequently the two processes are considered mutually reinforcing.

The Monetary Approach (MA)

This approach captures economic growth and material concerns. The monetary approach is rooted in utilitarianism theoretical base. The proponents of this theory measure individual's welfare in terms of satisfaction derived from consuming goods and services (Dini & Lippit, 2009). This approach identifies poverty using a shortfall to a monetary indicator which is key to measuring poverty and is generally adopted by economists(Laderchi, 2000). The traditional monetary approach uses income and expenditure as an indicator of well-being (Bouanani & Belhadj, 2022). Here, inadequate income to meet basic needs at minimum is what helps to identify the poor. The commonest indicators established in literature that have been used as poverty index with this approach include poverty headcount, poverty gap and severity of poverty (Bouanani & Belhadj, 2022). The key element of this approach is poverty line (Saunders et al., 2022). Poverty line refers to a cost of a set minimum level of economic welfare to be attained in order not to be

considered as poor in a particular context (Ravallion, 2016). It seeks to explain what poverty means in a particular society. The presumption with the use of poverty line is that people below the set poverty line in a particular country are considered as poor (Saunders et al., 2022). The line varies from country to country and overtime.

The monetary approach has suffered from some criticisms. Key among them are the fact that it has narrowly focused on income metrics; it has arbitrarily use poverty line in identification of the poor; and it uses household as a unit of analysis meanwhile there exist some intra-household income sharing of a sort (Saunders et al., 2022). Despite these criticisms, the use of monetary approach plays pivotal role by focusing on contribution of household cost in deriving change in poverty.

Participatory Approach (PA)

This approach is all-encompassing and stresses the relevance of locality in interpreting poverty. The participatory approach seeks to explain poverty via economic, political, social and cultural environment of a community and assumes that the poor can fathom and examine their own circumstances. Chambers (1994) refers to this approach as a progressive set of approaches and methods that are capable of enabling community to share, improve and examine their knowledge, plan and act. Further, Chambers (1995, p. 173) suggested that " realities of the poor are local, complex, diverse and dynamic". In essence, these points to complexity and multidimensionality associated with the concept of poverty and its interpretation and measurement. Thus, the call is to construct reality from the localised view point of the poor people and capture the multiple dimensions of the concept of poverty

(Chambers, 1994). In sharp contrast to conventional poverty estimates, for instance capability and monetary estimates, have suffered from some criticisms. Principal among them are that it externally imposed; and it does not consider the view of the poor themselves. However, the participatory approach actively engage the locals (the poor) in decisions concerning them, the locals, and also in implications regarding the magnitude of poverty (Chambers, 1994).

Poverty gap

With reference to discussions on above approaches to poverty, it is acknowledged that there is no consensus regarding what constitute poverty and how poverty is measured. Each approach puts out different perspective on what entails quality of life, fair and just society. Consequently, this creates differences in the definition of poverty. The set of individuals who are considered as deprived is likely to differ greatly based on the approach adopted accuracy of the methods used by each approach. On the backdrop of this, low levels of poverty in view of one approach may concurrently exist with high levels of poverty as result of the use of another approach. Hence, this thesis employed poverty gap as the measure of poverty.

Poverty gap captures the magnitude to which people fall beneath the poverty line as a fraction of the poverty line. It refers to the mean shortfall in income or consumption as result of poverty line, expressed as a share of poverty line and captures the fraction of population considered poor (de Haan et al, 2022). It indicates the mean income gap in the entire population. Following de Haan *et al.* (2022), this thesis employed poverty gap at $2.15 level with the aim of improving upon earlier studies. Unique rationales for

using poverty gap are as follows: Firstly, the use poverty gap insead of poverty headcount (share of population living on less than a certain daily income level) is as a result of the ability of poverty gap to take into account the depth of poverty (Ravallion & Bidani, 1994). In view of this poverty gap has been used as the varaible explained instead of the poorest quintile income growth and headcount poverty. Secondly, poverty gap based on definition of World Bank (2018) where non-poor are considered as having zero shortfall coupled with mean shortfall in income or consumption with reference to poverty line signals comparability across countries. To put differently, poverty gap makes it easy to compare poverty across countries. Finally, it has been argued that with poverty gap both breadth and intensity of poverty are captured (Cepparulo et al., 2017).

Institutional Quality

North (1990) considers institutions as human created constraints that organize political, economic and social interactions. They entail interactions constraints that are informal constraints and formally orchestrated rules that underpin nature of games. Institutions, from time immemorial, are conceived by human beings to guarantee order and lessen uncertainty in exchange. Quality of institutions is critical for financial development and economic growth. Studies have measured institutional quality using such indicators as political stability, rule of law, voice and accountability, regulatory quality, control of corruption and governance effectiveness (Sanga & Aziakpono, 2022; Olaniyi & Oladeji, 2021; Law et al., 2018).

For efficient and robust enforcement of banking sector regulations, effectiveness of institutional structures in creating enabling climate and

environment is critical. Institutional climate embodies institutional qualities, which institutional qualities constitute the rules of the game as they shape human interactions and are key drivers of economic performance (North, 1990). Particularly, in realm of enforcement of regulations in banking sector, stable political system and accountability appear essential in channeling financial resources to productive economic activities necessary for economic growth. Sound institutional framework removes blockages and loopholes in financial systems. Higher values of political stability and democratic accountability measures signal strong institutional quality (Olaniyi & Oladeji, 2021).

Some empirical studies highlight the role of institutional quality in promoting banking sector regulations effectiveness. Klomp and De Haan (2014) demonstrate in their study that high institutional quality enhances effects of liquidity rules and activity restrictions in lowering bank risk taking behaviour. Likewise, Uddin, et al. (2020) reveal that government effectiveness, control of corruption and adherence to rule of law lessen risk exposure and enhances stability. Additionally, from a study by Bermpei *et al.*(2018), it emerges that political stability reinforces positive effect of activity restriction and capital regulation on stability of bank. Thus, sound institutional framework and favorable institutional climate bring about rigorous and robust enforcement of regulatory requirements and supervisory qualities leading to risk-mitigation (Sodokin et al., 2023).

Summary of the related concepts

In this section, concepts and related issues that influence poverty were reviewed. In particular, the section considered digital financial inclusion and

its indicators, banking sector regulation and its indicators, and poverty and its indicators. Other related conceptual issues considered are digital financial inclusion, banking sector regulations and poverty and their respective indicators.

Chapter Summary

This chapter reviewed relevant theoretical and conceptual literature grounding the study. The review demonstrates important connections that could exit among digital financial inclusion, banking sector regulation, institutional quality and poverty reduction. Yet, the review has pointed to existence of some gaps in empirical literature. A gap exists in examining association between DFI and poverty considering technology that promote DFI. Also, there exist a gap in how various dimensions of banking sector regulations affect digital financial. Since existing literature have examined effect of institutional quality on banking regulations, gap exist on how presence of institutional quality could shape effect of banking sector regulations on DFI. This notwithstanding the theoretical foundations that postulates relationship between banking sector regulations and digital financial inclusion. Lastly, there are gaps in how the use of dimensions of banking sector regulations moderate between digital financial inclusion and poverty reduction. This thesis fills all the aforementioned gaps.

CHAPTER THREE

RESEARCH METHODS

Introduction

This chapter provides the details of the methodology this thesis employs to attain the objectives set up for study. The chapter outlines the methodology used to investigate the role of banking sector regulations between digital financial inclusion and poverty reduction relationship. The chapter is structured such that after review of research philosophical issues, description of data and variables, econometric model used to estimate the relationship was presented.

Research Philosophy

Scientific research philosophy encompasses researcher's system of though through which new and reliable knowledge about research object is achieved (Žukauskas et al., 2018). Providing scientific basis for knowledge creation or generation, researchers follow research protocols in designing research strategy, formulating research problem, collecting data, processing, and performing analysis. Philosophy according to Sefotho (2015) must be the driving force that guides thesis. Sefotho (2015) further noted that research philosophy is comparable to roadmap for research without which researcher's inquiry falls short of illuminated direction. It is through rigorous inquiry process that researchers develop knowledge. Knowledge development is influenced by systems of beliefs and assumptions termed research philosophy (Saunders et al., 2016).

Research works are not conducted in philosophical vacuum. There are philosophical stances that underpin research paradigm. A research paradigm

constitutes the fundamental belief system or the worldview that influences researchers. To Kuhn (1962), paradigm entails collections of beliefs, values, and techniques, and significant others shared by a given community. This indicates that members of a given discipline espouse "disciplinary matrix" of "ordered elements of various sorts". In essence, every field has well developed assumptions, belief systems and values that guide the way they come to view the world and generate knowledge. Four of such shared worldviews are variedly considered to be competing for acceptance for choice in research.

The worldview of researchers influences their choice of research approach. For quantitative or qualitative research reasons, Lincoln e al.(2011) are of the view that researchers choice is made among such paradigms as positivism, post-positivism, critical theory and related ideological position and constructivism. Meanwhile, Žukauskas et al. (2018) distinguished four main research philosophies: positivism, interpretivism, pragmatism and realism. Creswell and Creswell (2018) added that post-positivism, constructivism, transformative and pragmatism have been widely discussed in literature. In this regard, Creswell and Creswell further added that worldview and paradigm are used interchangeably. We, thus, adopted the explanation of paradigm by Kuhu (1962) and highlight such paradigms as positivism, post-positivism, interpretivism, constructivism and realism.

Each of these paradigms holds some basic assumptions, beliefs, norms and values that guide an entire research process. Paradigm comprises four elements, namely: epistemology, ontology, methodology, and axiology. Ontology, in an unambiguous term, articulates what Wand and Weber (1993) considered as the nature and structure of the world. It stipulates that there a

form, nature of reality and what can be known about the world. Ontological perspectives are of two main folds: the objective and subjective ontological perspectives. As regard objectivism, reality is reviewed as concrete structures whose existence is external to humans and is out there. It is also straddled with the belief that the world predate individual and exists as a tangible entity irrespective of the actions' of people (Holden & Lynch, 2004).

On the contrary, epistemology is concerned with theory of knowledge and assists researchers to appreciate best ways to gain knowledge of the world (Easterby-Smith et al., 2021). It articulates assumptions regarding knowledge, constituents of acceptable knowledge and different means of inquiry (Hirschheim et al., 1995). Largely so, theory of knowledge and view of reality held by researchers resonates with theoretical perspective and methodology employed in the research processes. Methodology critically considers how the researchers go about in a real research situation to find out whatever they believe can be known. Axiology on the other hand considers the role of values and ethics and their influence on the knowledge creation process. Saunders et al. (2016) emphasized that axiology takes into account ways of addressing both researcher and research participants' values.

Every research paradigm makes use of axiological, ontological, epistemological and methodological assumptions, which are significant and are shared held belief and value systems held by the researchers in a particular field. These elements of research paradigm espouse assumptions, beliefs and values that frame researchers' view of research problem (Nguyen, 2019) and how to go about investigating the problem.

Positivism paradigm seems to have been the common denominator for the like terms as logical positivism, liberal positivism, and logical empiricism. The essence of this is that they share some underlining attributes as an anti-speculative, anti-metaphysics and ambivalent nature of their relation with rationalism (Fillafer & Feichtinger, 2018). Saunders et al. (2016) states that positivism, as philosophical position, involves working with observable social realities which aims at outcome that is law-like generalizations and its undertakings can be independently verified with some degree of certainty. Positivism is credited to a group of early twentieth century philosophers and scientists, namely: Francis Bacon, Auguste Comte and Vienna Circle.

Positivists adopt objectivism epistemology which is driven by orientation that truth residing in objects or things can be independently established (Crotty, 1998). In this case, to fathom reality of phenomenon requires rigorous measurement backed by empirical evidence gathered methodically with the essence to aiding replication (Hamersley, 2013). As axiological perspective is concerned, positivists detach themselves from the reality of phenomenon under investigation or keep their research free of value with the sense that social and physical phenomena exist independently of the social actors (Saunders et al., 2016). Thus, a researcher is assumed not to influence the results or findings of the research. Positivists, from methodological standpoint, employ quantitative methodology which is informed by the need to fulfil the requirements of universal principles and generalisability drive (Bisman, 2010).

Notwithstanding the notoriety of use of positivist paradigm in business and management researches, it was criticized variedly on various fronts

including the field of finance among others. The critique of positivism resulted to development of other philosophical perspectives in research, for instance interpretivism. Interpretivism, sometimes known as anti-positivism (Mack, 2010), argues that truth and knowledge are subjective and are inseparable from culture and experience of the people (Ryan, 2018). Saunders et al. (2016) note that the emphasis of interpretivism is with respect to how different humans are from physical phenomena in the sense that it is humans who create meanings. This, however, is associated with the crave to comprehend and put meaning to beliefs, motives and reasons of social actors so as to bring to the fore the intended meaning of social realities. The position, thus, held by interpretivists in research is that social actors create their knowledge of reality through social constructions. This position supports the assertion that value-free data cannot be obtained as researchers have some preconceptions that inform the research process, and enquirers interact with phenomena of interest as well as human subjects under study. This, thus, creates rooms for perceptions of enquired and enquirer to be altered (Walsham, 1995). Hence, interpretivists consider generation of knowledge to be predicated on the proposition that understanding of actual meaning and interpreting of social entities form an integral part of understanding of and knowledge of the social phenomena in view of which deterministic explanation of human behaviour by creating some causal link between variables was not supported by interpretivism. Instead, interpretivists register real meanings and interpretations actors attribute to phenomena largely due to actors' experience and interaction with significant others in attempt to describe and explain their behaviour (Johnson et al., 2006).

With regard to ontological perspective, interpretivist epitomises relativist ontology with subjectivist epistemology which is aligned with postmodernist perspective (Levers, 2013). In view of relativist ontological realm, Mack (2010) posits that several people are witnesses to social realities and each witness of social reality interprets events differently. Consequently, multiple interpretations or perspectives are offered to an event. In this regard, knowledge is relative to a particular situation and exist in several forms as representatives of reality (Levers, 2013). Also, from the assertion that interpretivism concentrates on complexity, richness, multiple interpretations, and meaning-making, it is obviously known for subjectivism (Saunders et al., 2016) in contrast with positivist's objectivism. Thus, researchers' own assumptions and dogma play pivotal roles in the research process and their attachment to research process are inevitable. This influences researchers with interpretivist philosophical paradigm to adopt empathetic stance. Consequently, interpretivists are obligated to provide understanding, and explanation of social reality through the perspective of different participants (Cohen et al., 2007). This is because they acknowledge intricacies and complexities inherent in human interactions.

Post-positivism paradigm emanates from the criticism of positivism perhaps that there is no such objective way of knowing the world. According to Kuhn (1972), post-positivist science encompasses a reflection of radical shifts in how researchers define and understand reality. In post-positivistic research, the goal primarily as noted by Patton (2003) is to come out with concepts and theories which could aid comprehension of phenomena in natural settings and focus specifically on past exposures, views and comprehensive

needs of all participants. Post-positivist researchers hold the assumption that there is an independent reality to be studied, yet consider that all observations are inherently fallible. As a result of the fallibility of observation, post-positivist research emphasises inferential statistics and assign probability that observe findings are correct (Onwuegbuzie et al., 2009).

Post-positivism from epistemological perspective focuses on the scientific explanation of reality vis-à-vis the reality itself (Fischer, 1998). The underlying premise of post- positivism is to assess the conceptualisation of reality and the manner in which systematic inquiry significantly contributes to social interaction with the aim to shape what is known as knowledge (Fischer, 1998). Contrary to the advocacy of positivism that reality can be known accurately in objective and independent manner, the post-positivism holds that reality can be known approximately (Al-Saadi, 2014). This is because it is possible to construct many different angles of reality.

The author thus argues that indictors of digital financial inclusion, banking sector regulation and poverty can be objectively measured as it is the case with positivists' research paradigm. In this case, to fathom reality of digital financial inclusion, banking sector regulation, and poverty requires rigorous measurement backed by empirical evidence gathered methodically with the essence to aiding replication (Hamersley, 2013). As axiological perspective is concerned, a researcher detached himself from the reality of digital financial inclusion, banking sector regulation and poverty or keep their research free of value with the sense that digital financial inclusion, banking sector regulation and poverty alleviation exist independently of the social actors (Saunders et al., 2016). Thus, the researcher is assumed not to influence

the results or findings of the research. The research, from methodological standpoint, employed quantitative methodology which is informed by the need to fulfil the requirement of universal principle and generalisability drive (Bisman, 2010).

Research Approach

Whether qualitative or quantitative, in view of Champbell et al. (2011) research approaches' overriding objective is to explain phenomena. The considered views on research approach include it seeks to define, criticize, and argue, counter argue regarding the approaches to collect data, analyse data and summarise findings. It is imperative to note that both positivist and constructivist's stands lay claim on whether an instrument deployed for research purposes is more reliable and valid than the other(s). Overall, the two approaches seek to attain the same outcome. In essence, it vital to ensure that a chosen paradigm is in harmony with a suitable research approach. Understanding of these research approaches can help to select suitable research methods. Research approaches broadly can be put into deductive and inductive dichotomy (Saunders et al., 2016). Selecting a particular research approach is predicated on the researcher's worldview. For instance, being a positivist, a researcher is more likely to quantify data of their interest; thus, a quantitative approach will be adopted.

In contrast, a researcher who is an interpretivist will be more inclined to qualification of data; hence, the interpretivist will favour qualitative approach. The pragmatic researcher, on the other hand, is likely to merge both qualitative and quantitative data; and consequently the approach that will be adopted is a mixed method. The qualitative data instruments employed for

collecting data from participants may include observations, open-ended questions and interviews. Others are field notes, focus groups and case studies. With the qualitative approach, participants are deeply engaged. This creates the room to generate huge data and offers in-depth understanding of behaviour even from varied perspectives. Further, it guarantees provision of evidence regarding real life circumstances (Leedy & Ormrod, 2015). Further, in view of Eyisi (2016), qualitative data in the form of pictures and words may constitute integral part of instrument key that positions qualitative research in the realms of generating data that may appear factual and descriptive. Construction and reconstruction of theories originating from data has been considered to be more in line with data generated from a scratch than testing a secondary data (Leedy & Ormrod, 2015). In absence of information or little information about participants, their expressions and experiences are likely to be understood.

Trevena et al. (2013) refer to quantitative research as research that is primarily concerned with analysis of research objectives via numerical measures and analysis of data. As noted by Kothari (2004), a quantitative research approach is grounded in ontological proposition that holds the concept of reality as a function of experience and facts. Cooper and Schindler (2014) posits that quantitative approach employed particularly by researchers who seek to explain, describe and predict a phenomena and at the same time researchers sidestep biasing research results by maintaining a distance in the research. Quantitative research encourages the use of probability sampling technique, and statistical analysis which permits that the research outcomes are, perhaps, generalized to the study population (Cooper & Schindler, 2014).

The use of quantitative research provides many benefits. It is imperative to note that its suitability for large sample size cannot be overemphasized. However, with quantitative research, generalization of research findings can only be made when the results are valid and reliable (Leedy & Ormrod, 2015). Also, Sarantakos (2013) revealed that research procedure is preset or scheduled; thus, this restricts the effectiveness of the research process.

There are some challenges regarding qualitative and quantitative research approaches. To address this concern, a combination of quantitative and qualitative research approaches can made, which will lead to a mixed research method (Johnson et al., 2007). With the mixed method, both quantitative and qualitative researches are combined regarding the collection and analysis of data under investigation.

Several types of mixed research have been established in literature. In case of exploratory mixed design, the research employed the outcome of qualitative data collected and analysed to deal with quantitative data gathering. In view of a mixed method design considered as explanatory sequential, the researcher, on the other hand, gathering of quantitative data and analysis of same to help deal with qualitative data collection issues. It has however been noted that the used of mixed method approach is considered as expensive and time-consuming. Notwithstanding this, the mixed method provides advantages as it integrates efforts of qualitative and quantitative research approach (Cooper & Schindler, 2014).

Following the proposed philosophical view of the thesis and above discussions, a quantitative approach was adopted. The quantitative approach is often regarded as “scientific” approach (Robson, 1993). This approach asserts

that reality exits on the principles of "cause and effect" and that reality can be independently measured. Furthermore, quantitative approach to research requires objectivism. Objectivism can be reality-focused and posits that everything exists independently of consciousness. The key assumption that underpins positivist's stand which is often considered as scientific method. Knowledge generated through this approach is not subjective experience but rather direct experience which can be replicated (Crotty, 1998). For example, by the use of suitable form of empirical inquiries facts, figures and measurable data and quantities can be yielded by employing the data or methods. The outcome of the research is replicable because it involves logically deduced hypotheses and confirmed evidence (Charmaz, 2015). The research mostly starts with theories from which hypotheses are formulated and tested. Testing of hypotheses involves the use of statistical procedures that enable the researcher to draw inference about the population by using sample statistic(Creswell & Creswell, 2018). This research approach ensures that a researcher is detached from the research regarding the phenomenon under study (Denscombe, 2008). Based on the fact that the researcher's direct contact with the participants is not an issue with the approach adopted, possible researcher bias issues in the entire research process has been dealt with. Put differently, quantitative research approach guarantees objectivity, and fairness of the research, and highly promotes participants anonymity (Creswell & Creswell, 2018).

Based on the above discussions regarding quantitative, qualitative and mixed research approaches, following Tweneboah and Nsiah (2024) this thesis deployed quantitative research approach that utilizes data generated from

secondary sources. The period from which the data is drawn spans from 2014 to 2020 mainly due to availability of data for the countries selected. Quantitative research was preferred over qualitative approach due to following reasons. 1) Unlike qualitative research, quantitative research helps to focus on objectivity and collect quantitative measures of poverty gaps, indicators of digital financial inclusion, dimensions of banking sector regulations and institutional quality measures. 2) Though qualitative research provides deep understanding of complex phenomenon within context by focusing on human experience and motivation, it is characterized with skepticism and issues of trust (Creswell & Poth, 2018). 3) On the other hand, quantitative research offers accurate and reliable measurements, which guarantee robust statistical analysis (Queirós et al., 2017). With quantitative approach, numerical analysis was carried out through statistical estimation procedures like two-step generalized method of moment, and quantile regression of method of moment with fixed effect using software such as STATA, or R which is held in high esteem in social sciences, finance and economics research (Bieńkowska & Sikorski, 2024).

Research Design

Saunders et al. (2016) claim on research design takes into account overall plan which underpins the research which entails research strategy, the data collection, the time horizon and the procedure for analysis. Broadly, research design can be conceived to be descriptive, explanatory and exploratory. The concept of descriptive survey is crafted to aid in gathering essential and practical data regarding an existing phenomenon. This makes the research design to be governed by fitness for purpose (Cohen et al., 2018).

Thus, research design organizes research and makes it practical, so that research questions are answered or hypotheses are tested based on evidence and warrant (Cohen et al., 2018). With cause and effect analysis, changes in one variable or set of variables normally independent variables lead to changes in another variable (dependent) in a theoretical model. This analysis helps to establish causal connections between independent and dependent variables. An explanatory research design offers suitable research design for such purpose (Saunders et al., 2016). The theoretical predictions in this study were tested by utilizing causal research design. The causal research design is suitable because the study investigates the impact of digital financial inclusion, banking sector regulations and institutional quality on poverty level.

Population of the Study

The participants or respondents are selected a population or a universe. In view of Cooper and Schindler (2011), a population refers to entire set of elements from which a sample for the purpose of making some inferences can be drawn. Put differently, population is employed to refer to total number of people, countries, companies or phenomena that constitute the focus of research and from which reference are established. The population of this study includes the list of countries in Sub-Saharan Africa.

Focusing on classification based on the World Bank data, the entire Sub-Saharan Africa (SSA) comprises are 48 developing countries. Based on geographical regions, these countries are further categorized as: Central, Eastern, Western and Southern African countries. Table 1 details the countries and their respective geographical regions;

Table 1: Geographical presentation of countries in Sub-Saharan Africa

Region	Countries
Central Africa	Angola, Burundi, Cameroon, the central African Republic, Chad, the Democratic Republic of Congo, the Republic of the Congo, Equatorial Guinea, Gabon, and Sao Tome and Principe
East Africa	Djibouti, Ethiopia, Eritrea, Somalia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, South Sudan, Tanzania, Uganda, Zambia and Zimbabwe
Southern Africa	Botswana, Eswatini (formerly Swaziland), Lesotho, Namibia, South Africa
West Africa	Benin, Burkina Faso, Cape Verde, The Gambia, Ghana, Guinea, Guinea-Bissau, Cote D'lvoire, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo

Sub- Saharan Africa is the Africa south of the Sahara. It excludes Sudan according to the United Nations. The African Union, however, excludes Mauritania rather than Sudan from Sub-Saharan Africa. Made up of countries such as South Africa, Zimbabwe and Botswana in Southern Africa, Kenya, Tanzania, Uganda and the Sudan in East Africa; Ghana, Nigeria, Cote d' Ivoire and Senegal in West Africa as well as the Democratic Republic of Congo, Cameroon and Central African Republic in Central Africa, Sub-Saharan Africa is the largest area of the African continent.

Sub-Saharan Africa, the most populous and the area with the largest landmass in Africa, is renowned for many things. Historically, the sub-continent of SSA was the battle ground of European colonialism and imperialism which saw British Empire growth and French and Portuguese hegemonies and later a proxy battleground for American and Soviet Cold War machinations.

Linguistically diverse but politically and economically homogenous in view of common characteristics of poverty, famine, debt distress, infrastructure deficits and high borrowings coupled with political instability, bad governance and democratic unpredictability, Sub-Saharan Africa is a mixed bag of good and bad.

Blessed with precious minerals such as gold in Ghana, South Africa and the Democratic Republic of Congo; diamond, copper, iron ore, timber resources, fertile land for agriculture and huge deposits of crude oil in Nigeria, Equatorial Guinea, Angola, and Ghana but yet cursed in political leadership, the sub-continent remains a statistical significance for many good and bad references. Sub-Saharan Africa has huge youthful population both as an opportunity and a threat; high birth rate, large volumes of mineral deposits, and the largest share of arable lands. Notwithstanding this fact, the area is referenced for high incidence of poverty, famine, debt unsustainability, weak state institutions and systems, currency volatility, unstable political climates and financial exclusion.

In the context of investigating the relationship among digital financial inclusion, banking sector regulations, institutional quality and poverty, the population of interest was time series observations of indicators of digital financial inclusion, banking sector regulations, institutional quality and poverty of all countries in SSA. In this vein, yearly data was drawn from World Bank database including World Development Indicators (WDI) and International Financial Statistics (IFS) of Sub-Saharan African countries and bankscope spanning from 2014 to 2020. The analysis period provides significant knowledge on access to and usage of formal financial services via

digital channels-mobile money and computers-in Sub-Saharan Africa since 2007.

Sample Size Selection

Challenges exist in establishing criteria that favour inclusion or exclusion of variables or time zones regarding the deployment of secondary data for a study. The criteria develop the protocol for generating dataset and play pivotal role in feasibility with which inclusion or exclusion list in attempt to strike fine balance in determination of suitable sample for a study. The study, first and foremost focus on Sub-Saharan Africa because of the following rationales. The challenge though is that although there has been some consistent GDP growth and growth in some economic indices in much of Sub-Saharan Africa at least within the past decade, it appears this growth is not inclusive. Huge income gaps exist on urban versus rural; men versus women and literate versus non-literate dichotomies. As such, the many poverty reduction efforts in the sub-continent have not done enough in leap frogging many people out of the incidence of poverty. This incidence of poverty coupled with unemployment and underemployment among the teeming and sometimes highly educated youths constitute national and regional security threat to SSA. It is, however, the next potential world food basket, source of trained and qualified labour, fintech growth and tourism hub.

Not every country has data on digital financial inclusion. So, to target such cases that would help to better explain or explore sample, a census was employed. This thesis adopted a census sampling method for study. Creswell (2014) posited that census is where all elements of the accessible population are selected for the purposes of the study. This was to allow for complete

coverage of data for countries to be studied (Kish & Verma, 1986). Based on availability of data, the countries considered are twenty-five (25). With reference to geographical regions of SSA, four of these countries, namely: Cameroon, Democratic Republic of Congo, the Republic of Congo and Equatorial Guinea are central African counties. Five of them, namely: Botswana, Eswantini, Lesotho, Namibia and South Africa, are southern African countries. There are nine of them, namely: Ethiopia, Kenya, Madagascar, Malawi, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe are Eastern African countries. The rest which are seven: Burkina Faso, Cote d'lvoire, Ghana, Guinea, Mali, Nigeria and Senegal are West African countries.

Source of Data

The analysis used secondary data from 2014 to 2020 acquired from the World Bank WDI, IMF and bankscope. The gathered data included digital financial inclusion, banking sector regulations, and poverty level for 25 Sub-Saharan African nations. The research included 25 SSA nations out of 48 because several of the countries omitted had a large number of missing numbers which if included may influence the accuracy of the estimations. The world bank world development indicators, IMF and Bankscope are known worldwide for compiling development indicators. Normally, data from these sources are recognized for credibility and wide usage (Opoku & Yan, 2019). Specifically, with a WDI, there is a metadata, which highlights on how the data was collected and aggregated from micro-level to macro-level.

Data Collection Process and Procedure

The data collected was significantly informed by detailed review of relevant literature. The review aids in identifying key variables. As a consequence of the review, the researcher searched the WDI and other relevant databases through the internet. Careful searched on the internet for various indicators helps to unearth study variables identified in the previous empirical literature. Ensuring that data gathered is fit-for-purpose, search filters were applied and carefully interrogated to enable dataset considered is germane for the current study's purpose.

Dataset suitability was also carried out. This was attained by scrolling through entire dataset established. Being satisfied with the filtered data, the identified dataset was downloaded and stored in excel spreadsheet using the researcher's computer. Backup files for the same data was created by saving multiple copies in Google drive and send through emails. The countries serving as geographical scope of the study data collected are in the SSA region. The entire data collection and processing activities was finalized by the end of May 2023. The timeframe for the dataset spans from 2014 to 2020 highly informed by availability of data. The 2014-2020 period seems to be well aligned with the suitable period for which most recent data across the sampled 25 SSA economies was available. The processes and procedures of data collection deployed in the current study suggest that meticulous and transparent steps were taken to attain integrity in data collection. Below is the detailed description of data used for the study.

Description of data

Measure of digital financial inclusion

Just as financial inclusion, digital financial inclusion has been differently measured using varied indicators. Borrowing from Wang and He (2020)'s definition of digital financial inclusion, we consider digital financial inclusion as a medium of broadening access to and use of formal financial services by the excluded or underserved individual through digital channels including mobile money and financial technologies. This thus implies that financial services are provided through digital channels including mobile money operators, fintech companies, and others are delivered by traditional banks through internet and mobile banking. Further, it shows that digital financial inclusion measures comprise supply-side indicators (access to financial services) and demand-side indicators (usage of financial services). This, therefore, requires that digital means to financial inclusion is considered to compute total financial inclusion. Hence, total financial inclusion index (TFII) comprises both digital and "mortar-and-brick" channels to access to and usage of financial services and products.

These channels to financial inclusion, both through financial institutions, for instance banks, (traditional financial inclusion) and fintech, for example, mobile money (digital financial inclusion) promotes comprehensive financial inclusion. Empirical evidence suggest that earlier researchers employed indicators such as total of automated teller machines for every 100,000 adults and outlets of mobile agents per 100,00 adults as supply-side (access) measures of digital financial inclusion. The demand-side or usage indicators used are: number of mobile money accounts per 1,000 people,

number of mobile transactions per 1,000 adults and number of internet banking transactions per 1,000 adults (Banna & Alam, 2021). Most of the previous studies employed number of automated tellers machines per 100,000 adults to proxy digital financial inclusion. The rationale for the use of ATM is because there exist large amount of data for each country across time on number of ATMs. Also, ATMs are computerized telecommunication devices that facilitates financial institutions' operation regarding easy and convenient conduct of financial transactions.

Another proxy used for digital financial inclusion is remittances. In recent times, there has been heightened use of digital remittances. This is because digital remittances deals with remittances send through payment systems either online or self-assisted means, received into a transaction account like bank accounts, microfinance institutions and mobile accounts (World Bank, 2020). The use of digital remittances does not only guarantee convenient services but also ensure that transactions are fast and less costly (IFAD, 2020). Further, it is essential to note that digital remittances has broad coverage in the digital ecosystem. In view of this, it has gradually but significantly shift circulation of money through cash to digital means with the expectation that progress in financial inclusion agenda may be attained. In essence it permits migrants and beneficiaries of remittances to increase their savings, investments and access to digital fund (GSMA, 2021). Despite widespread and usage of these measures, they failed to account for technology that is relevant for financial inclusion. Thus, this thesis employed digital infrastructure and digital financial services for facilitating financial inclusion. These measures or indicators of DFI reflect access, penetration and usage of

digital financial services as used by (Chinoda & Kapingura, 2024). In line with above, the study used the following measures for digital financial inclusion.

Table 2: Indicators of digital financial inclusion

Variable	Description	Source
INDINTER	Percentage of population with internet	(Khera P. , Ng, Ogawa, & Sahay, 2021)
MOBC100	Mobile subscription per 100 people	(Khera P. , Ng, Ogawa, & Sahay, 2021)
NRMMA	Number of registered mobile money agents per 1,000 adults	(Khera P. , Ng, Ogawa, & Sahay, 2021)
NRMMU	Number of registered mobile money users per 1000 adults	(Khera P. , Ng, Ogawa, & Sahay, 2021)

Source: Author's construct (2023)

Table 3: Measures of banking sector regulation

Variable	Description	Source
Regulatory capital requirement	It captures risk-capital amount banks are expected to maintain risk-taking behaviour.	(Yakubu & Bunyaminu, 2023; Barth, et al., 2004)
Regulatory restriction on bank activities	This measure ascertains whether banks engage in activities such as underwriting securities, offering insurance products, participating in real estate projects, and conducting transactions involving non-financial companies.	(Hoque & Liu, 2023; Barth et al., 2004)
Entry restrictions	This measure entails entry regulatory requirements for banking, foreign banks ownership and issuing of license	(Barth et al., 2004)
Transparency requirement	This measures disclosure requirement needs of banks by	(Hoque & Liu, 2023)

	regulators. It reflects ability of private sector to monitor banks.	
Exit restrictions	Bank solvency	(Triki et al., 2017)
Financial safety net	Financial safety net entails deposit insurance scheme that seeks to protect depositors and encourage individual institutions that provide funding for productive activities by accepting risks.	(Triki et al., 2017)
Liquidity diversification	Liquidity of assets	(Triki et al., 2017)
Price control	Price and fees	(Triki et al., 2017)
Supervision quality	Supervisory resources	(Triki et al., 2017)

Source: Author's construct (2023)

Measure of poverty

In earlier studies, scholars including Donou-Adonsou and Sylwester (2016) and Rashid and Intartaglia (2017) employed multiple indicators of poverty, enveloping both absolute and relative measures of poverty. This is with the view that peculiar characteristics of poverty in SSA may be captured completely. The poverty proxies reflect health, education, standard of living and dimension of livelihood (Wang et al., 2018). Poverty line, which is at $2.15 a day, perhaps is set by factoring in absolute and relative poverty lines. Whilst relative portrays social context, absolute poverty, in contrast figures out people in real need or with greatest need. With absolute poverty, the claim is possibly that minimum standard of living of a person is a function of a person's physiological needs; water, clothing, and shelter. Meanwhile, Poverty goes beyond inability to attain basic needs. Relative poverty, is however related to overall income and this is associated with increases growth in an

economy. This, study thus, contends, in line with Jocliffe and Bird (2019) that, poverty line naturally presents social conditions in view of cost associated with attaining basic needs.

Magombeyi and Odhiambo (2018) also used multiple proxies for poverty alleviation in SSA. The variables used as proxies for poverty are household consumption expenditure per capita, mortality rate of infants, and rate relating to life expectancy. The argument of the authors is that consumption per capita expenditure is used primarily because it is considered more reliable and stable than income. Additionally, it was noted that the use this measure resonate with the definition of poverty by World Bank (1990) which is inability to attain minimal standard of living in relation to basic consumption need. Other measures of poverty identified in literature are headcount and poverty gap.

Borrowing from de Haan et al. (2022), this study employed poverty gap as a measure of poverty. In essence, unlike headcount poverty, poverty gap accounts for depth of poverty. Often times, it is considered as inadequacy in income or consumption with regard to poverty line usually denoted by percentage of poverty in particular using proportion of population considered as poor.

Control variables

Other variables that are not pertinent to explaining poverty reduction yet could have some effects on poverty proxy employed in the study are controlled. The rationales for control variables are discussed as follow. For instance, trade openness is used simply because it facilitates foreign direct investment, which in turn could influence job creation. Further, since

economic growth plays redistributive effect grounded in pro-poor theories, it is essential for poverty reduction. Inflation, measured by changes in Consumer Price Index, was also controlled for. Further, gross domestic product per capita capturing countries income was as well included in the control variable. Inflation and GDP per capita variables both control for macroeconomic conditions (Triki et al., 2017). Depth of financial system denotes domestic credit to private sector as percent of GDP whereas population growth represents the annual population growth rate measured in percent.

Table 4: Control variable

Variable	Description	Source
GDPGRWH	The variable gross domestic product growth accounts for economic cycle in a specific country	(Li, 2019)
GDPPC	The variable gross domestic product per capita accounts for a country's income	(Li, 2019)
INFCPI	The inflation variable accounts for macroeconomic condition in a specific country	(Li, 2019)
DCPGDP	The variable domestic credit to private sector as percent of GDP measures financial development	(Li, 2019)
IQ	The variable institutional quality accounts for the institutional environment present in a specific country	(Li, 2019)
TO	The variable trade openness account for trade in goods and services	(Li, 2019)
POPGRTH	Annual population growth rate	(Li, 2019)

Source: Author's construct(2023)

Data processing and data analytic procedure

After the data has been collected based on measurement criteria, a checklist was established for each variable. The Microsoft excel plays significant roles in this respect where the dataset was processed and stored in a panel data format. The estimation procedure deployed was multiple regression

estimation techniques for the analysis. Panel dynamic estimation usually known as the Generalized Method of Moments was used as the estimation technique for objectives 2, 3 and 4 of the study. Also, quantile regression, especially quantile regression of method of moment with fixed effect was used for objective 1 of the study. The relevant test, Breusch Pagan Lagrange Multiple (LM) test was carried out at the onset to establish as to whether to deploy panel data technique or ordinarily least squares technique. The GMM, credited to Arellano and Bond, (1991), Arellano and Bover (1995) and Blundell and Bond (1998), was deployed for the purposes of the current study owing to its rocognition as being superior and use extensively (see, Rahman et al., 2019).

As one of the econometric techniques, the generalized method of moment can help to estimate parameters in statistical models. The suitability of this estimating technique is rooted in its capability of being applied to instances where large parameters are involved in model or non-normal distribution of data is assumed. GMM uses moment conditions (where there is a linkage between observed data and parameter modelled) to ascertain estimators. This method, can flexibly and consistently deal with models that are characterized with issues of endogeneity (correlation between error term n independent variable) and heteroskedascility (where variance of error term is non-constant).

Notably, GMM is crafted for instances where: 1) time period (t) is usually less compared with cross-sectional observations (i); 2) there is a linear relationship; 3) the explained variable is dynamic (i.e., where previous period's dependent variable value informs current period dependent variable

value); 4) the variable used as a dependent variable is not in the strictest sense considered exogenous; in which case the correlation between current or error term and independent variables is possible; 5) there exits individual fixed effect, a fixed constant of individual units which can not be observed exits; 6) autocorrelation and heteroskedasticity concerns are present. In GMM, lag of dependent variables coupled with regressors are incorporated into the models to account for dynamic features. In veiw of Goodman(2006), GMM is designed to utilize panel data analysis and at the same time acknowledges that current period dependent variable value is influenced by the value of previous period's dependent variable.

Significantly, the GMM estimators minimize bias presence in a dynamic panel, and deal with endogeneity concerns of explanatory variables. Closely associated with GMM is instrument variables which is capable of addressing endogeneity problems, where endogeneous variable served as instruments. Both internal and external instruments are usually employed. Whereas internal instruments are not visible in a dataset, external instrument are visible. The use of instrumental variables technique brings to the fore the need for number of instruments to be at lest equal to the number of exogenous variables. In addition, it is required that when IV technique is deployed the number of instruments should be at most equal to the number of groups in the panel.

There are some advantages associated with the use of GMM technique. Firstly, the use of GMM has the tendency to speed up control of endogeneity of lagged variables presence in a dynamic panel data; Secondly, it controls for

omitted variable biases; Thirdly, it deals with unobserved paned heterogeneity; and finally, it addresses the possible presence of measurement errors.

Inspite of wide recognition and usage of GMM, it is also important to highlight some of the limitations that come with it. First and foremost, the use of GMM is complex and can present invalid estimates owing to poor model specification concerns. Also, since there are several choices that researcher can make when it comes to the use of GMM, this freedom of choice can breed possible instance for manipulation by researcher. Additionally, GMM is not designed to hnadle cross-sectional concerns, where relationship among the units therein in the panel cannot be controlled by GMM. Furthermore, for panels involving long period of time, suitability of GMM may appear questionable.

In the current thesis, a system GMM technique was employed. With reference to system GMM, a longitudinal study consisting dymanic variable like poverty gap and digital financial inclusion is permitted. Here, using system GMM, it is possible to treat for dynamic variables (i.e., dependent variable, for example poverty gap and digital financial inclusion as used in this study). Also, since the data used for this study spans from the period 2014 to 2020 of 25 countries in SSA region, the 7-year period is less than the number of cross-sectional countries observed, thus, the use of system GMM was deemed most appropriate. Notwithstanding the chanllenges in identifying a unique instrument that correlate with exogenous variable but not the errors, GMM uniquely addresses this challenge by confining forms within the panels rather than outside the dataset.

To be more specific, since there are gaps in the panel data of this study, the system GMM deployed is appropriate due to peculiar nature of panel data, which is unbalanced. With reference to difference GMM, system GMM does not suffer from data loss as it uses orthogonal deviations. With system GMM, previous data is not subtracted from the current data as it is case with difference GMM. In light of this, computation for data is possible notwithstanding the number of gaps in each each except for the last observation. To put differently, the study deployed system GMM to avoid inaccurate conslusion, deal with heteroskedascticity problesm and enhance validilty and robustness of rsults of the study.

The autocorrelation assumption in the dependent variable is addressed because of the use of GMM estimation. This is achieved by investigating correlation analysis in detail between dependent variables and associated lagged values to test for perseverance, this is done by folowing Asongu et al.(2021) and Asongu et al.(2020). For persistent GMM estimate, the coefficient of lagged variable, dependent variable, apart from not being significant statistically should as well fall within range 0 to 1. In view of this, the current study expects correlation coefficeient of 0.8 as a benchmark value to attain sufficient perssistent. This rigor per methodology is crictical to validate autoregressive conditions of the depedent variable and to ensure econometic precision.

Validity of results are key to relevance of the study. Thus, some diagnostic tests were performed to established validity of the results. Particularly, the Arellano-Bond test for auto-correlation AR(2), Hansen's (1982) J test for over-identification restrictions were carried out to establish

instruments' validity using the null hypothesis of exogenous instruments. In view of null hypothesis of Arellano-Bond test auto-correlation AR(2) the claim is that residuals of first difference equation are not serially correlated at second order. The Hansen's test however goes with a null hypothesis that instruments employed in the study models are valid. With the system–GMM and two-step framework, accurate results are usually guaranteed taking into account robustness, autocorrelation and heterodasticity presence in the panel units (Windmeijer, 2005). Statistical software used was STATA 15.0 for processing data.

Statistical technique and estimation approach

This section takes into account description of methodology used to investigate the relationship among digital financial inclusion, banking sector regulation, and poverty in 25 countries in SSA over the period 2014-2020. The statistical technique adopted encompasses descriptive statistics and correlation analysis as follows:

Descriptive Statistics, and Correlation

The design of the data analysis entails conducts of descriptive analysis to present distribution of variables. With the descriptive analysis, significant differences across the countries over time were revealed. This analytical process encompasses the statistics about the number of observations, the mean, standard deviation, minimum and maximum values of every continuous variable used based on the whole sample.

Further, with the correlation analysis, it was possible to investigate the bivariate association between one variable and another variable. Mostly the Pearson correlation coefficients ascertained help to present and define the

nature of influence between the variables. In addition, the correlation analysis and the multicollinearity tests aid to examine possible concerns regarding multicollinearity present among independent variables.

Justification for the use of estimation technique base on each objective

Econometric Model – Quantile method of moment with fixed effect

In an attempt to provide understanding on how digital financial inclusion impact poverty reduction in Sub-Saharan African countries, the study set the objective one. The first objective examines the effect of digital financial inclusion on poverty reduction using conditional quantile regression approach. The conditional quantile regression estimation technique was adopted because the study examined effects of digital financial inclusion via conditional distribution of poverty across entire poverty distribution. The study considers CQR approach suitable because it permits the researchers to examine the various quantiles of level of poverty. Consequently, the CQR approach was deemed suitable as it addresses issues the purpose of the study, inter alia, is to articulate various levels of poverty. In the backdrop of the selected technique is considered relevant as it establishes relationship among the variables throughout the conditional distribution of the outcome variables (Asongu et al., 2021; Asongu et al., 2017).

In comparison with other estimation techniques, for instance ordinary least squares, which makes assumption about the nature of distribution of error terms. Specifically, it assumes that error terms are normally distributed. With CQR assumption about the normal distribution of the error terms does not hold. The rational for not considering such an assumption is because it is possible to engender biases of coefficient when basing the estimation on such

assumption. Quantile regression (QR) offers a different approach compared with linear regression (LR), enabling the assessment of associations throughout the entire range of an outcome's distribution. Quantile regression is a robust methodological tool that empowers researchers to examine effects beyond the average and across the complete spectrum of a distribution (Rios-Avila & Maroto, 2022). According to Waldmann (2018), QR efficiently addresses issues with outlier and heteroskedasticity particularly with dataset that exhibits non-linear distribution as indicated by Skewness and leptokurtosis (Chipunza et al., 2020). Based on the proposal of Koenker and Bassett (1978), the population of the predictor variable, X, and explained variable, Y, is related in light of quantile regression model (QRM) as follows:

$$Y_i = X_i\beta + \varepsilon_{i\tau} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

In equation 1the subscript τ, $0 < \tau < 1$, represents a quantile of y. The QRM model the population regression for quantile τ of y conditional on x:

$$Q_\tau(Y_i\,|X_i) = X_i\,\beta_\tau \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Just as parameter of conditional mean function, E(Y|X) =Xβ, are estimated by choosing ordinary least squares (OLS) estimator$(\hat{\beta})$, that minimises the sum of squared residuals, $\sum_{i=1}^{n}\left(y_i - x_i\hat{\beta}\right)^2$ or simply $\sum_{i=1}^{n}(\hat{\varepsilon})^2$ which is seemingly straightforward extention (Koenker & Bassett, 1978). The parameters of the conditional quantile $Q_\tau(Y_i\,|X_i) = X_i\,\beta_\tau$ are estimated by QR estimator, $\hat{\beta}_\tau$, that minimises the sum of weighted absolute residuals, $\sum_{i=y_i>x_i\hat{\beta}_\tau}^{n}\tau\left|y_i - x_i\hat{\beta}_\tau\right| + \sum_{i=y_i<x_i\hat{\beta}_\tau}^{n}(1-\tau)\left|y_i - x_i\hat{\beta}_\tau\right|$.

Since the data collected for the purposes of this study is panel data, the general specification of panel conditional quantile regression employed is as follow:

$$Q_{pov}(\tau|X_{it}) = (\alpha_i + \delta_i q_i) + X_{it}{}'\beta + Z'_{it}\,\gamma q(\tau) \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The equation (3) above, based on assumption, is a linear model where $X_{it}{}'$ represents a vector of all explanatory variables employed in the study. $Q_{pov}(\tau|X_{it})$ also represents distribution of the dependent variable which is the conditional on the locational explanatory variables; $\alpha_i(\tau) = \alpha_i + \delta_i q(_\tau)$ is the scalar coefficient of the quantile τ. The fixed effect for the individual country i or the distributed effect at τ. Z' is a k-vector of known differentiable (with probability 1) transformation of the components of X with | where i = 1, , , , , k; $q(\tau)$ is the $\tau - th$ quantile obtained out of the effect function

$$\min \sum_i \sum_t p_\tau \left(\hat{R}_{it} - \left(\widehat{\delta_\iota} + \hat{Z}_t\right)q\right)$$

In which case; $P_\tau(\mathrm{A}) = (\tau - 1)\, A|\{\mathrm{A} \leq 0\} + \tau A \,|\, \{\mathrm{A} > 0\}$ represents the check-function.

For the purposes of this study, a quantile regression Method of Moment with fixed effect credited to Machado and Silva (2019) was employed in the study. The MM-QR is displayed in equation 4 below. It is a modification of equation 3 above. This estimation technique helps to examine whether digital financial inclusion affects poverty gaps or poverty levels differently across the conditional distribution of poverty gap. The quantiles range used extend to 90^{th} quantile from 75^{th}, 50^{th}, 25^{th} , and 10^{th} quantiles. This range is deemed to have provided suitable representation of poverty level across upper and lower halves of poverty distribution. In view of this, the distribution seems to have offerred broad assessment of both linear and non-

linear associations. Following the new growth theory of economic growth, and making some modification to the empirical model of Lemnge and Raphael(2023), the empirical model for this study is as follow:

$$POV_{i,t}(\tau|\beta_i, \varepsilon_{i,t}, DFI_{i,t}) = \beta_o + \beta_1 DFI_{i,t} + \gamma' Z_{i,t} + \delta_i + \varepsilon_{i,t} \text{----------(4)}$$

In equation 4, POV is a proxy variable, poverty gap, for poverty level. DFI is the proxy variable for digital financial inclusion, Z is a vector of explanatory variables deployed as control variables as discussed earlier in this chapter. τ is the quantile, i is the country observed time t. The expectation is the sign of coefficient of DFI across entire quantile distribution of poverty level should be negative.

Econometric Model – Two-step system GMM estimation technique

The second objective focus on the effect of banking sector regulations on digital financial inclusion; the third addresses issues regarding how institutional quality shapes effect of banking sector regulations on DFI. Finally, the study also examines how BSR moderates between digital financial inclusion and poverty reduction. With reference to these objectives, two-step GMM estimation method was employed to enhance not only efficiency but also robustness in treatment of complications of this analysis. Considering the new growth theoretical discussions in chapter 2, and the need to assess direct and indirect impact of digital financial inclusion on poverty reduction, the study modified earlier empirical model used by Inoue (2024) as follows:

$$POV_{i,t} = \alpha + \beta_1 POV_{i,t-1} + \sum_{j=2}^{6} \beta_j DFI_{it} + \sum_{j=23}^{28} \beta_j Z_{i,t} + \mu_i + \eta_t + \varepsilon_{i,t} \ldots (5)$$

$$DFI_{i,t} = \alpha + \beta_1 DFI_{i,t-1} + \sum_{j=2}^{6} \beta_j DFI_{it} + \sum_{j=7}^{14} \beta_j IQ_{it} + \sum_{j=15}^{22} \beta_j (IQ * BSR)_{it} + \sum_{j=23}^{28} \beta_j Z_{i,t} + \mu_i + \eta_t + \varepsilon_{i,t} \quad \ldots (6)$$

$$POV_{i,t} = \alpha + \beta_1 POV_{i,t-1} + \sum_{j=2}^{6} \beta_j DFI_{it} + \sum_{j=7}^{14} \beta_j BSR_{it} + \sum_{j=15}^{22} \beta_j (DFI * BSR)_{it} + \sum_{j=23}^{28} \beta_j Z_{i,t} + \mu_i + \eta_t + \varepsilon_{i,t} \quad \ldots (7)$$

Where POV is a proxy variable, poverty gap, for poverty level. DFI is the proxy variable for digital financial inclusion, Z is a vector of explanatory variables deployed as control variables as discussed earlier in this chapter. These control variables are inflation rate, trade openness, gross domestic growth rate per annum, population growth rate and credit to private sector as percentage of GDP. The μ_i represents the country specific effect which is unobserved. While η_t denotes time-specific effect, $\varepsilon_{i,t}$ stands for the error term. The lagged dependent variable, $POV_{i,t-1}$, in the right hand-side of equation 5 permits the study to model dynamic process underlying poverty level and incidence and to deal with initial effect of poverty level. Also, where t is time or temporal dimension of study starting 2014 to 2020, i is the individual country dimension of the panel.

In equation 5, the poverty level (POV) is measured using poverty gap. The poverty gap at $2.15 (2017 PPP) captures the ratio by which the mean income of the poor fall below the poverty line, which is at $2.15 a day at 2017 purchasing power parity (PPP) prices. The increase in poverty gap indicates that the poor are getting far away from reaching the poverty line, illustrating worsening condition of poverty level. Including lagged value of poverty level is to account for persistent of poverty, showing that last year's poverty level has the high tendency of affecting current year's poverty level.

Critical to equation 5 is the independent variable digital financial inclusion. The digital financial inclusion is a composite variable measured from number of mobile phones subscriptions per 100 people, number of registered mobile money agents, number of registered mobile money users and internet usage by following the earlier works of Chinoda and Kapingura (2024) and Khera etal.(2021). Since mobile phones has become a critical tool use by people with relatively low-income levels to carry out financial transactions through digital platforms, the formerly unbanked and underserved populace use mobile phones to access financial services, engage in more economic activities and productive economic ventures (Inoue, 2024). In digital age, digital financial platforms, tools and devices improve access to and usage of rudimentary formal financial services. In line with this, based on priori expectation the coefficient of digital financial inclusion in equation 5 is expected to be negative.

In equation 6, banking sector regulations are important independent variable in the study. BSR stands for banking sector regulations. This captures the regulatory mechanisms accounting for factors in financial environment incorporating legal requirements, which can accommodate innovations and competition in financial sector by adopting digital financial technologies to promote efficiency and confidence in the financial system. This can lead to increase in access to and usage of financial services through digital tools. In essence, the BSR is expected to enhance access to and usage of digital financial services. The coefficient of banking sector regulations is expected to be positive.

Again in equation 6, the interaction term, product of IQ and BSR, shows the combined impact of institutional quality(IQ) and banking sector regulations has digital financial inclusion enhancing effects. As noted by Sodokin et al.(2023), strong institutional structures can help in efficient, effective and robust enforcement of regulatory mechanisms. In view of this, it is expected that the coefficient of interaction between institutional quality and banking sector regulations should have a positive sign.

In equation 7, the interaction term, product of DFI and BSR, shows the combined impact of digital financial inclusion and banking sector regulations in reducing poverty. The interaction term is introduced because of the argument that impact of finance on economic growth, for that matter poverty reduction, may depend on behaviour of other factors, for instance regulatory mechanisms in the entire financial environment. Given that BSR and DFI inclusion have poverty reduction effect, expected negative coefficient of interaction of DFI and BSR has the tendency to suggest that digital financial inclusion can complement banking sector regulations. In the backdrop of this, digital financial inclusion and banking sector regulations can support each other and have synergistic effect on reducing poverty levels in emerging or developing countries.

Digital financial inclusion index construction

The principal component analysis (PCA) technique was utilized to construct composite index of digital financial inclusion. The PCA method is considered robust because it overcomes arbitrary assignment of weights to dimensions, as used by earlier scholars including (Anarfo et al., 2020; Tweneboah & Nsiah, 2024; Chinoda & Kapingura, 2024). Due to PCA's

approach use of parametric method, it is considered robust in assigning weights. The use of author's decretion in assigning weights may pose challenge, as minutest change may affect all the results, this therefore strengthens legitimacy of deploying PCA (Lockwood, 2004).

The detalis of PCA method used is appended as follow:

$$DFIINDEX_i = W_1 Y_i^a + W_2 Y_i^u + \mu_i \quad \text{---------- (8)}$$

In equation 8, i, W_1 , W_2, Y_i^a , Y_i^u and μ_i respectively represent country, weight of sub-index of access dimension, weight of sub-index of usage dimension, access sub-index, usage sub-index and error term. The dimensions of sub-indices are estimated as shown below.

$$Y_i^a = \alpha_1 NRMMA_i + \alpha_2 MOBC100_i + \varepsilon_i \quad \text{---------- (9)}$$

$$Y_i^u = \beta_1 NRMMU_i + \beta_2 INDINTER_i + \in_i \quad \text{---------- (10)}$$

The two equations 9 and 10 represent two dimensions estimated using principal components involving exploratory variables. Where α and β are unobserved endogenous parameter estimated jointed. These parameters of access sub-index and usage sub-index constitute DFIINDEX, which cover dimensions of availability/access and usage of digital financial services and products. These dimensions are used based on the assumption that inability of the poors to access financial services has supply and demand side (Tweneboah & Nsiah, 2024) implications. Further, it assumes that availability of each of the components prepares the ground for growth in digital financial services access, indicating digital financial inclusion.

Chapter Summary

This is the third chapter of the thesis. It presents discussion on the research methodology used. With the discussion certain key issues including

research philosophy, research approach, research design, sample, measures, statistical and econometric tools employed to analyse the data were reviewed. Additionally, the structure of the dataset used and methods adopted to examine the variables and their operational explanations were as well considered. Particularly, the econometric model and its estimation strategies were captured in this chapter.

CHAPTER FOUR

ASYMMETRIC RELATIONSHIP BETWEEN DIGITAL FINANCIAL INCLUSION AND POVERTY ALLEVIATION IN SSA

Abstract

This chapter of thesis assesses the effect of digital financial inclusion on poverty reduction in sub-Saharan Africa region. To attain this, the study draws evidence on a panel data of 25 SSA economies spanning the 2014 to 2020. Applying a dynamic model, the results of the study were estimated employing SGMM and conditional quantile regression. Broadly, the findings illustrate strong evidence that digital financial inclusion and its indicators contribute to reduce poverty levels. For quantile regression results, empirical findings suggest that enhancement in digital financial inclusion reduces poverty level across entire poverty distribution. The results are robust based on alternative SGMM estimator. Policy implication is digital financial inclusion agenda are more pronounced in reducing poverty provided the agenda concurrently deployed mobile money agency regime, mobile money usage and mobile cellular subscription, and internet usage.

Introduction

Theoretical and empirical discourses on the link between financial inclusion and poverty alleviation remains inconclusive in extant literature in the context of both economics and finance. In the light of theory of economic development, Schumpeter (1911) emphasized the essential role of finance by arguing that the financial sector provides the capital required for the growth and expansion of the real sector. Similarly, the supply-leading hypothesis credited to Patrick (1966) explains that the growth of the real sector is usually

preceded by the financial sector expansion. Despite these theoretical arguments, evidence provided by empirical findings suggest that relationship between finance and growth fall short of generalization

This is because the empirical discussions on the importance of finance to growth seem to have evolved from three main lines of arguments. First of them being that the relationship between finance and growth is contingent on the measurement of growth (see Easterly & Levine, 1997). Easterly and Levine (1997) argued that for developing economies such as that of Africa, gross domestic product per capita represents a poor measure of growth and advocates for economic growth measures that includes all. Corollary to the change to sustainable development goals (SDGs) from millennium development goals, the focus of growth research and polices have shifted to strategies that alleviates poverty and ensures prosperity for all (de Jong & Vijge, 2021). In this regard, poverty reduction has become increasingly relevant to developing countries (Wang & Fu, 2021).

The second line of arguments stems from the measurement of finance, with some advancing financial development measures that encapsulate both financial institutions and markets (Armas & Tuazon, 2020), whilst some argues in favour of inclusive finance measures (see; Li, 2018; Banerjee et al., 2019). Finally, there are corpus of studies that argue that finance-growth relationship depends on some other factors (Demetriades & Andrianova, 2004; Afzal et al., 2023). This study does not seek to clarify which school of thought presents an accurate picture of finance-growth nexus. By aligning itself with all, this study appends to finance-growth literature and examines how

technology contribute to the linkage between digital financial inclusion and poverty alleviation.

In recent times, advancements in digital technology leading to DFI have contributed to the reduction in inefficiencies associated with inclusive finance. DFI has enhanced effective allocation of financial resources and has brought customers closer to financial institutions (Demirguc-Kunt et al., 2018). Specifically, for some countries in Africa, the emergence of mobile money has lessened the banes of traditional models of finance that are usually characterized by low level of penetration in rural areas. This is because in rural areas where there are no physical presence of banks and/or banking infrastructure like ATMs, people can assess still assess financial services via mobile devices (Guo et al., 2016). DFI allows the low-income populace to access loan facilities without providing expensive collaterals (Hua & Huang, 2020). On the part of financial institutions, the data generated on the users of various digital financial platforms can be used in place of credit bureau information. This information can help to effectively reduce asymmetric information together with associated adverse selection problems (Philippon, 2019).

Despite the economic and social value associated with DFI, some studies have argued that the relevance of financial inclusion to poverty alleviation could depend on the level of income (see Ozili, 2018; Demirguç-Kunt & Klapper, 2013). Demirguç-Kunt and Klapper (2013) demonstrate that the heterogeneity in income levels across economies influences the efficacy of financial inclusion. This was premised on the intuition that the financial inclusion gains associated with higher income individuals tends to be higher

than those with lower income levels. Subsequently, Allen et al. (2016) argue that the poor and lower income groups usually do not benefit more from financial inclusion but financial inclusion rather widens the inequality gap. However, previous studies that examine the financial-inclusion poverty alleviation nexus in developing economies usually assume that there are average poverty alleviation gains from financial inclusion across the SSA economies. However, the case of SSA economies seems different as the economies in the region are characterized by heterogeneous levels of poverty.

Therefore, a research question that becomes apparent is whether or not digital financial inclusion affects poverty levels differently across the upper tails and lower tails of poverty distribution. In this backdrop, this study tested whether the digital financial inclusion influence different levels of poverty distribution differently by employing quantile method of moments with fixed effect regression technique. The quantile regression estimates succor us to assess whether the influence of DFI on poverty alleviation is more profound in richer countries than poorer countries, and thus reveals the asymmetric dimensions of poverty alleviation. This is quite essential for SSA economies.

Despite the foregoing arguments, there is paucity of literature regarding theoretical and empirical studies on relationship between digital financial inclusion and poverty in SSA. Hence, with insights from the foregoing arguments, it is relevant to analyse impact of digital financial inclusion on poverty reduction to address issues of limited studies in SSA. Accordingly, this study makes some relevant appendices. In the first place, to the greatest extent of knowledge, this empirical study is the first to provide empirical evidence on the relationship between digital financial inclusion and

poverty alleviation in SSA. Existing studies have only explored the relationship by employing financial inclusion while ignoring the digitalisation of financial inclusion. To fill this gap, we follow the studies of Chinoda and Kapingura (2024); and Khera et al. (2021) to construct an index for digital financial inclusion for SSA economies. Thus, this study differentiates itself from Kelikume (2020) that examines the moderating behaviour of technology between financial inclusion and poverty alleviation in Africa. Second, the study provides first-time evidence on the digital financial inclusion's impact on poverty alleviation across several quantiles, given the heterogeneity of income equality across the sub-region. Third, this study adds to the stock of the burgeoning literature on digital financial inclusion in emerging economies.

The reason for the concentration on SSA is emphasized as follows. First, for the reason that the region is the most financially excluded worldwide (World Bank, 2018; Chinoda & Kapingura, 2024). It may have dire consequences for poverty alleviation. Despite this, the momentum in the delivery of digitalized financial services in SSA have largely been underpinned by mobile money in recent years (Abeka et al., 2021). Thus, it will be worthwhile to explore the nexus between DFI and poverty alleviation in the region. Second, the poverty gap in most SSA economies is wide relative to other regions, and thus it has become increasingly blatant to assess factors than can mitigate the widening poverty gap.

Literature Review

Theoretical Literature

Since the scholarly discussions on income inequality or poverty is still fledging, studies in the area usually draw theoretical institutions from already

established growth theories (see, Adeosun et al., 2020; Whajah et al., 2019). Specifically, the new growth theories emphasize the role of innovation and technological progress in the growth process (see, Lucas, 1988; Romer, 1990). Despite the contributions of these new growth theorists, Schumpeter (1912) had earlier pointed out the relevance of financial innovation to growth. Indeed, finance is a very key aspect of the growth process because it determines the extent to which households can have and make use of economic opportunities. The supply-leading hypothesis thus argues that finance underscores activities that lead to growth (see Patrick, 1966).

However, empirical discussions that overlooked the essential role of innovations in the financial sector have taken only a limited view of the relevance of finance to growth outcomes, since the financial sector also experiences innovations (Laeven et al., 2015). Corollary to this, this thesis argues that digitalisation of financial services represents a key innovation in the finance process that can expand financial landscape to endemic proportion. In essence it may allow more economic agents to be included in the financial system and creates opportunities for them to increase their income levels. Thus, digital financial inclusion can be predicted to have a first order impact on poverty reduction.

Empirical Literature

Digital financial inclusion, a contemporary tool for achieving inclusive growth, can promote access to finance and allocate financial resources conveniently and affordably regardless of location, and socio- economic status. The concept of DFI entails the usage of digital financial services or technology to expand financial landscape to endemic level. In view of which

digital means are deployed to reach financial excluded and underserved populace with wide range of financial services and products conveniently and affordably as well as sustainably to services providers.

As noted by Kulkarni and Ghosh (2021), the goal of DFI is to remove barriers due to cost, distance and transparency in delivery of financial services to vulnerable populace and consequently, realizing the benefits of those services. Pazarbasioglu et al.(2020) aver that digital financial inclusion guarantees easier daily life and help to plan for long-term even under unexpected conditions and circumstances. Prior studies looked at how financial inclusion(FI) and poverty are connected. Large number of these studies, for example, Emara and Mohieldin (2020), Nsiah et al. (2021), Olaoye and Zerihun (2023), Aracil et al. (2022) and Shi and Qamruzzaman (2022), reveal that FI enhances economic growth and reduces poverty. Besides, some studies by Fernandes et al.(2021), Durai and Stella (2019), and Chu (2018) give credence to the notion that digital financial services and technology are essential for financial inclusion.

The specifics of the studies examining the nexus between FI and poverty reduction are detailed as follow. For instance, drawing on generalised method of moments which deal with issues relating to heterogeneity, Inoue (2020) investigated the impact of financial development on poverty reduction. Inoue (2020) used unbalanced panel dataset for states in India from 1973-2014. It emerged from the findings that financial inclusion negatively impact poverty ratio. Further, the findings reveal that interaction between financial inclusion and financial deepening positively impact on poverty reduction. In a related study, Emara and Mohieldin (2020) analyse the impact of financial

inclusion(FI) on extreme poverty by drawing on evidence from 34 countries of MENA region for 1990-2017. They employed system generalised method of moments and dynamic panel estimation approach. They find that financial access and extreme poverty are positively related. Further, with gap analysis their findings reveal that no MENA country and few emerging economies will be able to close poverty gap by 2030.

In a related development, using fixed effect models, pooled ordinary least squares(OLS) regression and GMM, Khan et al.(2022)'s study examines FI's impact on poverty, income inequality and financial stability with evidence from 69 developing countries from 2002 to 2020. Their findings reveal that FI lowers poverty level and closes inequality gap but enhances financial stability. What is more, Saha and Qin (2023) demonstrate, using GMM and evidence from 156 countries for the period 2004-2019, that FI reduces extreme poverty particularly for emerging economies but they added that this did not apply to high income countries. This may be because digital financial services have been extended to excluded areas and poor people where they can conveniently participate in savings, credit, and insurance services (Demirguc-Kunt et al., 2017). Consequently, this helps to smoothen consumption, increase efficiency, raise participation of many in labour force and thereby leading to poverty reduction. However, not much empirical studies have focused on poverty alleviation across different quantiles given that there is much evidence regarding heterogeneity of income inequality across the region of SSA.

Based on foregoing, literature makes it clear on financial inclusion's impact on lowering poverty levels. Nevertheless, limited studies explore DFI-poverty nexus in SSA's setting. For instance, Lee et al. (2023) examined the

link between DFI and poverty alleviation using provincial data of China spanning the period 2011-2019. Drawing on heterogeneous analysis coupled with quantile regression estimate, the study established that DFI have divergent effect on users with different levels of poverty. Likewise, Peng and Mao (2023) employed probit model to data set of China family panel studies and demonstrate that digital financial inclusion reduces the likelihood that urban populace will fall into relative poverty.

Some scholars argue that there exists threshold to which financial inclusion can alleviate poverty. For example, Nsiah et al. (2021)'s study explored threshold effect of FI using balanced panel dataset comprising 15 countries in SSA. Using differenced generalised method of moments, the study estimate thresholds at which financial inclusion reduces poverty. It was found that beyond 0.365 threshold FI lowered poverty and money supply was identified to be positively associated with poverty reduction. In similar vein, Cao (2022), use provincial level evidence for the period 2011-2018 and examine relationship between development in DFI and poverty reduction at rural areas. The findings demonstrate that DFI can reduce poverty up to certain level. The findings of Emara (2022) also reveal that at early stages improvement in financial technology (fintech) index decrease rate of extreme poverty but at a up to 37.18 threshold. The author further appends that further improvement in fintech index turn to decrease with increasing penetration leading to drop in rate of poverty.

From empirical perspective, digital financial inclusion may impact poverty alleviation either directly or through other mechanisms. Directly, DFI can improve asset appreciation through innovation means of payment, credit,

investment and savings. Moreover, with DFI operation cost can be minimised as financial technology are deployed (Lee et al., 2022). For example, Li et al. (2023) investigate DFI's effect on urban-rural income gap in China applying spatial economic models. They employed index for DFI constructed from variables that capture breadth, depth and degree of digitalisation and they identify direct negative influence of DFI on urban-rural income gap. Chen and Zhao (2021)'s study indicates that easing of credit and information constraints, improving social network, and endorsing entrepreneurial activities are mechanisms through which digital finance may affect incidence of poverty.

Chen *et al*. (2022) utilize a number of empirical models and evaluated DFI's impact on rural household vulnerability to poverty. The empirical models which Chen *et al.* (2022) used are namely: a three-stage feasible generalised least squares (FGLS) logistic regression, ordinary least squares (OLS) and two-way fixed-effect regression. The results show that DFI is negatively linked to rural household vulnerability to poverty. The deduction from this finding points out that DFI reduces poverty. Also, the findings demonstrate that entrepreneurial activities mediates between DFI and vulnerability to poverty. Based on income disparities, statistically significant differences exist between low-income household's DFI and high-income household DFI. In this regard, DFI has stronger effect on reducing vulnerability to poverty among the low-income household than among high-income households. Likewise, Wang and Fu (2022) found out that DFI (coverage of breadth and depth of use) positively mitigate against vulnerability. The study further notes improvement in productivity, spurring entrepreneurial activities and promoting non-agricultural activities are key

levers for mitigating against poverty vulnerability. Similarly, Wang and He (2020)'s findings demonstrate that enhancement in usage of digital financial services(DFS) lower farmers' vulnerability to poverty. According to the study, usage of DFS promotes huge level of lowering of farmer's vulnerability to poverty when the services were provided by information communication and technology companies than when delivered by traditional banks.

Digital financial technology have been established as pivotal solution for accelerating financial inclusion (Telukdarie & Mungar, 2023). Khera et al. (2022) find that though adoption of DFI drives financial inclusion, but cross-country and regional variations are wide, and are more evidenced in Asia and Africa. For example, with evidence from 43 countries in SSA for the period 2004-2019, Kouladoum et al. (2022) reveal that Digital technology positively affect financial inclusion using GMM approach and instrumental variables. Kelikume (2021) examined whether mobile phone, internet, informal economy and financial inclusion lead to poverty reduction by drawing evidence on panel dataset comprising 42 African countries for the period spanning 1995-2017. Based on estimates by employing the SGMM approach, increased FI was linked with higher rate of poverty reduction. Further, it was unfolded that mobile penetration and internet usage significantly influence poverty reduction positively.

Poverty reduction is dependent on many factors/initiatives including microcredit, microfinance, financial inclusion, financial development and digital financial inclusion (Tay et al., 2022). These factors can promote asset appreciation of the poor people (Lee et al., 2023), reduce operational cost, enhance household entrepreneurial activities (Ding et al., 2023), and

distribution of income among populace, and household's participation in financial market (Ye et al., 2022). Scholars have argued that digital financial inclusion serve as most efficient tool to help individuals get out of poverty (Duvendack & Mader, 2020). This is because digital finance does not only help expand financial inclusion but also promotes financial stability which ultimately lead to reduction in poverty (Siddik & Kabiraj, 2020).

Principally, the depth of coverage and use of digital financial services share linkage with dimension of poverty alleviation. For example, while coverage breadth significantly influences medical poverty, the use depth impact income poverty and digital inclusive finance index significantly reduce three dimensions poverty (medical, income and education) (Zhou & Wang, 2021). The study of Li et al. (2022) shows that digital financial inclusion is positively and significantly linked to household consumption. Similarly, using unbalanced panel data from 2004-2015, Omar and Inaba (2020) find that financial inclusion reduces poverty. These findings are consistent with findings of Lyons et al. (2020); and Polloni-Silva et al. (2021) who note pro-poor effects of digital or financial inclusion.

However, limited studies have investigated the impact of digital financial inclusion on poverty alleviation and underlying mechanism. Just as the prior studies aver that financial development related to inclusive growth, economic growth and poverty reduction (Kheir, 2018), the current study argues that development in digital financial inclusion plays essential role in reducing poverty owing to the assertion that digital financial inclusion is an integral part of financial development (Ozturk & Ullah, 2022). Prior studies that investigated the effect of DFI on poverty reduction have limitations

including limited counties' dataset, variables and data span and econometric approaches (Khan et al., 2022). Also, the earlier studies principally focused on developed and developing countries poverty issues, economic growth, financial development and financial literacy. Notwithstanding, limited study or no study pay attention to heterogeneity level of poverty that characterised economies in SSA in examining the impact of digital financial inclusion on poverty. In view of Khan et al. (2022), the use of dataset comprising developed and developing countries may lead to bias results emanating from heterogeneity biases. Indeed, due to differences among low-income, middle-income and upper income countries in their digital financial activities and in their investment in financial technology, it is possible to find differences in outcomes regarding impact of digital financial inclusion and poverty reduction. Further, Carril-caccia (2021) argues that context plays key role in cross-country studies. Moreover, the previous studies focused on average poverty alleviation gains from financial inclusion without recognizing heterogeneous poverty levels in SSA. Consequently, to address this gap, this study attempt to examine the impact of DFI on poverty alleviation in countries in SSA from the perspective of new growth theories by employing quantile regression approach. Based on the argument advanced above, this postulation is formulated:

Hypothesis 1: There is a negative effect of digital financial inclusion on poverty level in Sub-Saharan Africa

Number of Registered Mobile Agents and Poverty level

Mobile money services are critical developments in digital financial landscape in attempt to deal with constraints causing financial exclusion.

Studies such as Gosavi (2018) and Islam *et al.* (2022) gave empirical exposition on ability of mobile money usage to remove constraints regarding access to finance. Specifically, the findings of Islam et al.(2022) reveal that mobile money fosters poverty reduction initiatives. This is because increase in mobile money transaction was found to be associated with reduction in poverty rate. Further, mobile money penetration has also significantly addressed some problems including transaction costs, improve transparency as it helps to lessen issues of information asymmetry and formalized informal economy as monies that were formally kept under pillows and find their into the financial system (Islam et al., 2022).

Based on the supply-leading hypothesis, mobile money resurces are expected to enhance growth enhancing resources in the economy, thereby leading to engagement in more productive economic activities, improvement in asset appreciation and accumulation of financial resources for savings, payments and inventments. Some empirical have identified mobile money use as a predictor of individual socioeconomic characteristics (Blumenstock et al., 2015). For example, Abiona and Koppensteiner (2022) idenified that proliferation in mobile money agent networks was linked to consumption smoothening and maintenance of investment in human capital. Further, Adaba *et al.* (2019) claimed that mobile money use empower more individual to participate in the financial system, and enhance well-being outcomes regarding employnment, heath and education.

This study argues that underserved communties and individuals will be able to engage in growth enhancing resources to pursue economics gains capable of reducing poverty. Thus, this informed the hypotheses:

Hypothesis 2: Number of registered mobile agents has a negative effect on poverty level.

Hypothesis 3: Number of registered mobile money users have negative effect on poverty level

Internet Usage and Poverty Reduction

Internet usage tells the extent to which individual employed digital infrastructure in accessing digital financial services. In the economies where most people are excluded from formal financial services, internet serves as one of the significant means of providing access to markets, lowering transaction costs and increasing income of large segment of people in developing countries (Galperin & Viecens, 2017; Mushtaq & Bruneau, 2019). This is because internet connectivity is positively related to economic growth. In a study Garcia-Mora and Mora-Rivera (2023) find that internet access is strongly related to lower poverty levels. Similarly, the findings of Shen et al.(2023) demonstrate that internet usage is critical for poverty elleviation among farmers. Thus, poverty allevaition has been linked significantly with increase usage of technology (Afzal, et al., 2023). Thus, the thesis hypothesises that:

Hypotheis 4: Individual internet usage has significant negative impact on poverty level.

Mobile Cellular Subscription and Poverty Level

Prior empirical evidence on mobile phone subscription pointed that mobile phones serve as mechanism for information delivery. This is partly explained by explosive expansion in availability and affordability of services related to mobile phones (Bhavnani et al., 2008). Also, partly because the

adoption of financial technology such as mobile cellular subscription has implication for poverty reduction. In study a by Emara and Mohieldin (2022) the findings exbibilt negative relationship between mobile cellular subcription and headcount ratio. This signifies that increase in number of mobile cellular subscrpition brings about reduction in poverty headcount ratio of the population.

Another strand of literature has also touted contribution of mobile cellular subcription to financial development. This is likely to be the situation because in economies where there are physical constraints regarding access to financial system and services, finacial technology contributes to ease and bridge access gap to physical financial services (Aziz et al., 2023; Mushtaq & Bruneau, 2019). Specifically, Chien et al.(2019) aver that growth in mobile cellular subcription positively influence financial development in Africa. This is likely because mobile banking activities enhances economic conditions of people and deep financial inclusion. Thus, the current thesis hypothesises that:

Hypothesis 5: Mobile cellular subscription has negative effect on poverty level

Methodology

In view of the purpose of the study, we employed panel data analysis techniques, generalised methods of moments (GMM) and Quantile method of Moments with fixed effect (MM-QR), to estimate models stated below. Strategically, the models were estimated from two approaches by using aggregated analysis and disaggregated analysis.

For the purpose of this thesis, the quantile method of moments with fixed effect (MM-QR) was used by borrowing from Machado and Silva (2019). Machado and Silva (2019) were credited with development of

Quantile method of Moments with fixed effect. The authors deployed the MM-QR estimating technique to examine effect of digital financial inclusion on poverty along different conditional quantiles regarding distribution of poverty levels. Similarly, in a related study by Lemnge and Raphael (2023), MM-QR was deployed to explain financial development's effect on poverty level in SSA. These authors argue that MM-QR is suitable based on a number of reasons, namely: for dealing with outliers and endogeneity concerns (Ma & Wang, 2022; Machado & Silva, 2019); makes room for large variations presence in poverty and financial development data for countries in SSA coupled with instances of variation in policy (IMF, 2023; World Bank, 2023); in order to capture nonlinear relationship between variables (Cannon, 2018). This for instance is based on the empirical claim pointing to existence of non-linear connection between financial development and poverty level in SSA (Zahonogo, 2017); the method is less sensitive to assumption regarding distribution and employs assumption that captures entire distribution (Ma & Wang, 2022); and finally, it is application for instances where there are limited data available on poverty gap (Lemnge & Raphael, 2023).

Based on the objective of this thesis, the baseline panel quantile regression model used comes with a fixed effect and it is specified as follow:

$$P_{it} = \alpha_\tau + \beta_\tau X_{i,t} + \left(\delta_i + \theta_{i,t\gamma}\right) + \varepsilon_{i,t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

In equation 11, P_{it} represents the dependent variable (poverty level) of country i at time t; α_τ is the constant term linked with τ^{th} quantile which captures the location of the effect; $\left(\delta_i + \theta_{i,t\gamma}\right)$ constitutes the scale effect which also captures extra factors that impacting the conditional mean of the dependent variable with the component displaying individual-specific

effect(δ_i) and time-varying effect $(\theta/)$. Where the location and scale effects are taken into account, the conditional quantile regression model is specified as follow:

$$QP_{it}\left(\tau|X`_{it}\right) = \alpha_\tau + \beta_\tau X_{i,t} + \left(\delta_i + \theta_{i,t\gamma}\right) + \varepsilon_{i,t} \quad \ldots\ldots\ldots\ldots\ldots (12)$$

Where τ denotes the range of τ^{th} quantile.

Estimation technique

Following (Lemnge & Raphael, 2023; Machado & Silva, 2019), the thesis examined whether digital financial inclusion affects poverty levels differently along the conditional quantile of the distribution of poverty levels. The range of quantile selected are 10th, 25th, 50th, 75th and 90th quantiles to offer good representation of variable relationship across upper and lower halves of distribution. In view of this, the baseline model 1 and model 2 were estimated using the following model:

$$POV_{it}\left(\tau|X`_{it}\right) = \beta^\tau{}_{it} + \beta^\tau{}_1 DFIINDEX_{i,t} + \beta^\tau{}_2 PSAV_{i,t} + \beta^\tau{}_3 VA_{i,t} + \beta^\tau{}_4 GDPGRWTH_{i,t} + \beta^\tau{}_5 POPGRTH_{i,t} + \beta^\tau{}_6 InTO_{i,t} + \beta^\tau{}_7 InINCPI_{i,t} \quad \text{----} \quad (13a)$$

Where POV_{it} represents indicator for poverty considering country i at time t; τ denotes the τ^{th} quantile range; $\beta^\tau{}_{it}$ = intercept term which is non-additive fixed effects; $\beta^\tau{}_1 DFIINDEX_{i,t}$ = Digital financial inclusion index of country i at time t which is the main explanatory variable. Besides the main explanatory variable, control variable used are PSAV = political stability and voice of people; VA = voice and accountability, GDPGRWTH = GDP per capita growth rate, POPGRTH = Population growth rate, InTO = logarithm of trade openness and In INFCPI = logarithm of inflation rate. In equation 13a,

based on new growth theory, specifically supply-leading hypothesis, it expected that digital financial inclusion index should have negative relationship with poverty gap across entire distribution of poverty level across the quantiles.

Focusing on the key indicators of digital financial inclusion index deployed in this thesis, the following estimated models were used for number of mobile money agents per 1000 people.

$$POV_{it} \quad (\tau|X`_{it}) = \beta^{\tau}_{it} + \beta^{\tau}_{1} lnNRMMAper1000_{i,t} + \beta^{\tau}_{2} PSAV_{i,t} + \beta^{\tau}_{3} VA_{i,t} + \beta^{\tau}_{4} GDPGRWTH_{i,t} + \beta^{\tau}_{5} POPGRTH_{i,t} + \beta^{\tau}_{6} InTO_{i,t} + \beta^{\tau}_{7} InINCPI_{i,t}$$ ------(13b)

Where POV_{it} represents indicator for poverty considering country i at time t; τ denotes the τ^{th} quantile range; β^{τ}_{it} = intercept term which is non-additive fixed effects; lnNRMMAper1000= logarithm of number of mobile money agents per 1000 people of country i at time t which is the one of indicators of digital financial inclusion, the explanatory variable. Besides the main explanatory variable, control variable used are PSAV = political stability and absence of violence; VA = voice and accountability, GDPGRWTH = GDP per capita growth rate, POPGRTH = Population growth rate, InTO = logarithm of trade openness and InINFCPI = logarithm of CPI inflation

Focusing on the key indicators of digital financial inclusion index deployed in this thesis, the following estimated models were used for number of mobile money users per 1000 people.

$$POV_{it}(\tau|X`_{it}) =$$

$$\beta^{\tau}_{it}+\beta^{\tau}_{1}lnNRMMUper1000_{i,t}+\beta^{\tau}_{2}PSAV_{i,t}+\beta^{\tau}_{3}VA_{i,t}+ \beta^{\tau}_{4}GDPGRWTH_{i,t} + \beta^{\tau}_{5}POPGRTH_{i,t}+\beta^{\tau}_{6}InTO_{i,t}+ \beta^{\tau}_{7}InINCPI_{i,t}$$ ------ (13c)

Where POV_{it} represents indicator for poverty considering country i at time t; τ denotes the τ^{th} quantile range; β^{τ}_{it} = intercept term which is non-additive fixed effects; lnNRMMUper1000= logarithm of number of mobile money users per 1000 people of country i at time t which is the one of indicators of digital financial inclusion, the main explanatory variable. Besides the main explanatory variable, control variable used are PSAV = political stability and absence of violence; VA = voice and accountability, GDPGRWTH = GDP per capita growth rate, POPGRTH = Population growth rate, InTO = logarithm of trade openness and InINFCPI = logarithm of CPI inflation

Focusing on the key indicators of digital financial inclusion index deployed in this thesis, the following estimated models were used for individuals using individual internet usage as a percentage of total population.

$$POV_{it}\ (\tau|X`_{it}) = \beta^{\tau}_{it}+ \beta^{\tau}_{1}INDINTER_{i,t} + \beta^{\tau}_{2}PSAV_{i,t} + \beta^{\tau}_{3}VA_{i,t} + \beta^{\tau}_{4}GDPGRWTH_{i,t} + \beta^{\tau}_{5}POPGRTH_{i,t} + \beta^{\tau}_{6}InTO_{i,t} + \beta^{\tau}_{7}InINCPI_{i,t}$$ ---- (13d)

Where POV_{it} represents indicator for poverty considering country i at time t; τ denotes the τ^{th} quantile range; β^{τ}_{it} = intercept term which is non-additive fixed effects; INDINTER = Individuals using internet as a percentage of total population of country i at time t which is the one of indicators of digital financial inclusion, the main explanatory variable. Besides the main

explanatory variable, control variable used are PSAV=political stability and absence of violence; VA=voice and accountability, GDPGRWTH = GDP per capita growth rate, POPGRTH = Population growth rate, InTO = logarithm of trade openness and InINFCPI = logarithm of CPI inflation.

Focusing on the key indicators of digital financial inclusion index deployed in this thesis, the following estimated models were used for individuals using internet as a percentage of total population.

$$POV_{it}\left(\tau|X`_{it}\right) = \beta^{\tau}{}_{it} + \beta^{\tau}{}_{1}MOBC100_{i,t} + \beta^{\tau}{}_{2}PSAV_{i,t} + \beta^{\tau}{}_{3}VA_{i,t} + \beta^{\tau}{}_{4}GDPGRWTH_{i,t} + \beta^{\tau}{}_{5}POPGRTH_{i,t} + \beta^{\tau}{}_{6}InTO_{i,t} + \beta^{\tau}{}_{7}InINCPI_{i,t} \quad \text{----(13e)}$$

Where POV_{it} represents the indicator for poverty considering country i at time t; τ denotes the τ^{th} quantile range; $\beta^{\tau}{}_{it}$ = intercept term which is non-additive fixed effects; MOBC100 = mobile cellular subscriptions per 100 of country i at time t which is the one of indicators of digital financial inclusion, the main explanatory variable. Besides the main explanatory variable, control variable used are PSAV=political stability and absence of violence; VA=voice and accountability, GDPGRWTH = GDP per capita growth rate, POPGRTH = Population growth rate, InTO = logarithm of trade openness and InINFCPI = logarithm of CPI inflation. Thus, it expected that the coefficients of the indicators of digital financial inclusion index used in equations 13b to 13e should have negative sign.

Further, in the current thesis two-step system GMM, serving as robustness alternate model, was deployed to analyse how digital financial inclusion and poverty related in SSA countries. Though in the finance-poverty literature some scholars used fixed and random effects models for panel data.

For instance, Akhter et al. (2010); Mallela et al. (2023); Ahmed et al. (2021) used fixed and random effects. These techniques have suffered from the criticism that they fail to address concerns regarding heteroscedasticity and endogeneity, and could not guarantee reliable and robust results using panel data techniques in some instances (Kim et al., 2018). However, it has been established that previous year poverty level may affect current year's poverty level. More so, issues of endogeneity, unobserved heterogeneity and correlation between regressors and lag-dependent variable render fixed or random effect models unsuitable for robust empirical analysis. Meanwhile, Arellano and Bond (1991) developed dynamic General Method of Moments for differencing all regressors and utilising (Hansen, 1982)'s GMM which are capable of addressing the issues aforementioned regarding the use of fixed or random effect models. The current study chooses system GMM estimating techniques as it permits the use of lags of endogenous regressors regarded as internal instruments to deal with possible challenges that may arise because lag dependent variables that form part of the regressors (Asante et al., 2023). In essence, the current thesis employed two-step system GMM estimation technique to investigate the determinants of poverty reduction in SSA region. Specifically, the system-GMM(SYS-GMM) based on Arellano and Bover (1995) which favors the use of dynamic model with small period (T) and large panel unit (N) was employed. In case of the current study, our sample involves 25 countries (N= 25) from 2014 to 2020(T=7). Following (Chinoda & Kapingura, 2024; Kelikume, 2021), the poverty model is estimated employing generalized method of moments panel estimation techniques examine how digital financial inclusion variables impact poverty reduction.

$$Y_{it} = \alpha + \rho Y_{it-1} + \theta_0 X_{it} + \sum_{i=1}^{n} Z_{it}\beta + \mu_{it} \quad \text{---------- (14)}$$

Y_{it} is Poverty gap at \$2.15 per day, $Y_{it-1}$is the Poverty level of previous year or the initial level of Poverty, X_{it} is a vector of explanatory variables, Z_{it} represents the control variables, ε_{it} is the error term, *i* represents country, and *t* represents the period respectively.

With objective one of the thesis which seeks to examine the effect of digital financial inclusion on poverty level, Based on equation 14 above, this model econometric model was specified for the thesis as follows:

$$POV_{it}=\beta_0+ \beta_1 POV_{it-1} + \beta_2 DFIINDEX_{it}+ \beta_3 InNRMMAper1000_{it}+ \beta_4 InNRMMUper1000_{it} + \beta_5 INDINTER_{it}+ \beta_6 MOBC100_{it} + \beta_7 MOBC100_{it} + \beta_8 PSAV_{it}+ \beta_9 VA_{it} + \beta_{10} GDPGRWH_{it}+ \beta_{11} POPGRTH_{it} +\beta_{12} InTO_{it}+ \beta_{13} InINFCPI_{it} + \mu_{it} \text{----------(15)}$$

This equation 15 above is modified to reflect both aggregated and disaggregated effects of digital financial inclusion on poverty level. The model 15a below seeks to examine the aggregated effect, using digital financial inclusion index. Whereas the models 15b, 15c, 15d and 15e consider the disaggregated effect, where the variables of digital financial inclusion are examined individually.

$$POV_{it}=\beta_0+ \beta_1 POV_{it-1} + \beta_2 DFIINDEX_{it} + \beta_3 PSAV_{it} +\beta_4 VA_{it}+ \beta_5 GDPGRWH_{it}+\beta_6 POPGRTH_{it} +\beta_7 InTO_{it}+ \beta_8 InINFCPI_{it} + \mu_{it} \text{-------- (15a)}$$

$$POV_{it}=\beta_0+ \beta_1 POV_{it-1} + \beta_2 InNRMMAper1000_{it}+ \beta_3 PSAV_{it}+\beta_4 VA_{it}+\beta_5 GDPGRWH_{it}+ \beta_6 POPGRTH_{it} +\beta_7 InTO_{it}+ \beta_8 InINFCPI_{it} + \mu_{it} \text{-------- (15b)}$$

$$POV_{it}=\beta_0+\beta_1 POV_{it-1}+\beta_2 InNRMMUper1000_{it}+\beta_3 PSAV_{it}+\beta_4 VA_{it}+\beta_5 GDPGRWH_{it}+\beta_6 POPGRTH_{it}+\beta_7 InTO_{it}+\beta_8 InINFCPI_{it}+\mu_{it}$$ --------- (15c)

$$POV_{it}=\beta_0+\beta_1 POV_{it-1}+\beta_2 INDINTER_{it}+\beta_3 PSAV_{it}+\beta_4 VA_{it}+\beta_5 GDPGRWH_{it}+\beta_6 POPGRTH_{it}+\beta_7 InTO_{it}+\beta_8 InINFCPI_{it}+\mu_{it}$$ --------- (15d)

$$POV_{it}=\beta_0+\beta_1 POV_{it-1}+\beta_2 MOBC100_{it}+\beta_3 PSAV_{it}+\beta_4 VA_{it}+\beta_5 GDPGRWH_{it}+\beta_6 POPGRTH_{it}+\beta_7 InTO_{it}+\beta_8 InINFCPI_{it}+\mu_{it}$$ ---------- (15e)

In all the models: 15, 5a, 5b, 15c, 15d and 15e, the dependent variable is POV, which is poverty level which is proxy by poverty gap. The main explanatory variable of interest is digital financial inclusion and its indicators. The coefficients of these variables are expected to show a negative sign.

Description of variables and data

Data used for this thesis has been sourced from World Devlepment Indicators (WDI) and World Governance Indicators (WGI) and International Monetary Fund (IMF) databases. The data collected cover 25 countries across the SSA regime and span the period 2014 to 2020. The dataset and the period for the study was selected based on data availability. The countries for which analysis was conducted are based on geographical regions comprises: four countries, namely: Cameroon, Democratic Republic of Congo, the Republic of Congo and Equatorial Guinea which are central African counties. Five of them, namely: Botswana, Eswantini, Lesotho, Namibia and South Africa, are southern African countries. There are nine of them, namely: Ethiopia, Kenya, Madagascar, Malawi, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe are

Eastern African countries. The rest which are seven: Burkina Faso, Cote d'lvoire, Ghana, Guinea, Mali, Nigeria and Senegal are West African countries..

With this paper, poverty gap and DFI are the main variables. Gross domestic product per capita growth, population growth, institutional quality (political stability and absence of violence, and voice and accountability), trade openness, and CPI inflation were included as control variables. Borrowing from Chinoda and Kapingura (2024); and Khera et al. (2021) an index, DFIINDEX, is constructed for digital financial inclusion. The index is constructed from a number of variables namely: number of registered mobile money agents, number of registered mobile money users, individual internet usage and mobile cellular subscription. These variables are selected from empirical studies of earlier researchers including (Chinoda & Kapingura, 2024). Just like most scholars using traditional financial inclusion index, the current thesis follows (Khera et al., 2021) to construct digital financial inclusion index (DFIINDEX). The DFIINDEX incorporates measures that reflect access of, penetration of and usage of digital financial services provided by financial technology companies, operators of mobile money services and some financial sector new entrants. These variables are sourced from World Bank WDI. Moreover, the variables are suggested and considered by upgraded G20 financial inclusion indicators system as critical for construction of comprehensive digital financial inclusion index. The construction of the DFIINDEX variable is made possible by using principal component analysis (PCA) which considered as a modern multivariate tool for data analysis (Chinoda & Kapingura, 2024). With the PCA technique, all

variations of variables used in the index is retained. Further, the PCA approach guarantees that data dimensionality is reduced coupled with resolving possible multicollinearity issues associated with variables (Nizam et al., 2020). As PCA is used, indicators of each dimension is normalized resulting in the indicators having values between zero (0) and one (1), thereby rendering immaterial the scales that were used to measure the variables (Chinoda & Kapingura, 2024). Additionally, the PCA helps to extract key components of the dimensions that encapsulate various characteristics of inclusive financial sector.

Results

Descriptive statistics

Prior to analyzing the results, descriptive analysis was performed to illustrate the movements as well as distribution patterns underlying the variables overtime/across countries utilising descriptive statistics. Further, descriptive statistics was used based on the reason that descriptive analysis helps to establish whether variables used are normally distributed or not. For the purposes of establishing normality, generalised methods of moments was adopted to figure out irregularly distributed panel data in the dataset used. Table 5 shows the results of descriptive analysis conducted.

Table 5: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
NRMMAper1000	175	44.838	73.616	.055	423.892
NRMMUper1000	175	7116.011	10627.248	.893	66005.789
MOBC100	173	88.893	36.965	31.363	185.559
INDINTER	171	26.552	18.694	1.249	75.469
DFIINDEX	170	0.42	0.11	0.03	0.546
POV	175	1.631	1.534	.02	6.74
PSAV	175	-.405	.723	-2.13	1.095
VA	175	-.386	.662	-1.465	.94
INFCPI	172	11.004	46.361	-2.49	557.202
POPGRTH	175	2.294	.885	.002	3.867
GDPGRWH	175	2.173	4.127	-14.597	10.821
TO	161	77.456	39.083	16.352	216.237

Source: Author estimate from research data; POV represents poverty level, DFIINDEX represents the digital finance index, NRMMAper1000 represents the number of mobile money agents per 1000 people, NRMMUper1000 represents the number of mobile money users per 1000 people, INDINTER represents Individuals using internet as a percentage of total population, MOBC100 mobile cellular subscriptions per 100, GDPGRWH represents GDP growth, POPGRTH represents population growth, TO represents Trade openness, INFCPI represents CPI inflation. PSAV represents political stability and absence of violence, VA represents voice and accountability

From table 5, the mean values of the variables used are positive. With emphasis on poverty level, the average value obtained for poverty level was 1.631 with a standard deviation of 1.53% and the mean value of digital financial inclusion index was 0.42 with standard deviation of 0.11. The difference between the minimum value of digital financial inclusion index of 0.03 and the maximum value of 0.546 appear significant. This is because DFIINDEX is ascertained by computing the coefficient of variation and it ranges from 0 to 1. Digital financial inclusion by digital infrastructure (internet usage and mobile subscription) have mean values of 26.552 and 88.893 respectively. Further, by usage digital financial inclusion measured using NRMMAper1000 people and NRMMUper1000 people are 44.838 and 7116.011 respectively. This signals increasing tendency of number of mobile

money agents and number of mobile money users for the sampling period across the SSA countries.

For the control variables, trade openness ranges from a minimum of 16.352 to a maximum of 216.237 with an average value of 77.456. Whereas annual GDP growth rate has a mean value of 2.173 with a standard deviation of 4.127 and ranges from -14.597 to 10.821; the population growth ranges from 0.002 to 3.867 with respective mean and standard deviation values of 2.294 and 0.885. Political right and voice to political institutions like central banks and stakeholders of financial institutions were measured with the proxies: political stability and absence of violence (PSAV) and voice and accountability (VA) respectively. Political stability and absence of violence has a mean value of -0.405 and ranges from -2.13 to 1.095 with a standard deviation of 0.723, suggesting that political stability appears weak in SSA region. This is because the established estimated scores of institutional quality index ranges from -2.5 to 2.5, with the higher score indicating strong institutional structures.

Correlation analysis

Focusing on the nature of relationship between the variables, a pairwise correlation analysis was conducted to explore the nature of the relationship. Table 6 provides the details of pairwise correlation results which measures the relative association among the explanatory variables and poverty level with their level of significant for the sample of 24 SSA for the period spanning 2010 -2022.

The second column of table 6 displays the relationship between poverty level (POV) and independent variables. The results indicate that there

are significant negative associations between all variables of digital financial inclusion, namely digital financial inclusion index, log of number of registered mobile money agents, log of number of mobile money users, internet usage, mobile cellular subscription and poverty level (POV) at the 10% significant level. Thus, it emerged from the findings that digital financial inclusion index, log of number of registered mobile money agents, log of number of mobile money users, internet usage and mobile cellular subscription are negatively and significantly correlated with poverty level. The significant negative correlation coefficient between digital financial inclusion and poverty level are higher for the variables: digital financial inclusion index (-0.620), mobile cellular subscription (-0.359), internet usage (-0.307), log of number of registered mobile money agents (-0.192) and log of number of mobile money users (-0.146) accordingly.

For the control variables used, the results show significant positive, significant negative and no significant relation between the control variables and poverty level. Specifically, the results show that GDP growth rate is negatively (-0.043) but not significantly correlated with poverty level. To put differently, though annual GDP growth rate appear to reduce poverty level, relationship is not statistically significant. In light of population growth and consumer price index inflation, the results illustrate a significant positive relationship with poverty level. The correlation coefficient of population growth / consumer price index and poverty level is higher for population growth (0.399) than consumer price index inflation (0.290) all significant at 90% confidence level. The findings suggest that plausible increases in population growth and consumer price index may lead to increasing poverty

levels. However, the results of log of trade openness shown otherwise. The correlation coefficient between log of trade openness and poverty level (-0.195) is negative and statistically significant. This indicate that a percent increase trade openness lead to 0.195 units reduction in poverty level.

On a whole, except the lagged of poverty level, the correlation coefficients of all independent variables with poverty level are less than 0.8. Further, the findings reveal that there are both positive and negative correlations between the independent variables and poverty level established using the correlation analysis. Correlation coefficients established fell short of the 0.80 threshold for multicollinearity. Therefore, there is no issue regarding the multicollinearity problem in the models used. The findings discussed above are consistent to the cases established in previous studies by Hair et al. (1995); and Apergis and Garcia (2019).

Table 6: Pairwise correlation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) POV	1.000												
(2) L.POV	0.948*	1.000											
(3) DFIINDEX	-0.640*	-0.061	1.000										
(4) lnNRMMAper1000	0.194*	0.193*	0.659*	1.000									
(5) lnNRMMUper1000	-0.146	-0.144	0.607*	0.842*	1.000								
(6) INDINTER	-0.307*	-0.306*	0.130	-0.409*	-0.304*	1.000							
(7) MOBC100	-0.359*	-0.340*	0.011	-0.392*	-0.226*	0.813*	1.000						
(8) PSAV	-0.562*	-0.559*	-0.210*	-0.481*	-0.323*	0.470*	0.562*	1.000					
(9) VA	-0.453*	-0.433*	0.005	-0.234*	-0.015	0.494*	0.555*	0.577*	1.000				
(10) GDPGRWH	-0.043	-0.032	0.148	0.199*	0.113	-0.293*	-0.109	-0.080	-0.027	1.000			
(11) POPGRTH	0.399*	0.384*	0.176*	0.393*	0.234*	-0.691*	-0.686*	-0.532*	-0.461*	0.226*	1.000		
(12) lnTO	-0.495*	-0.498*	0.506*	-0.579*	-0.570*	0.293*	0.394*	0.623*	0.212*	-0.107	-0.424*	1.000	
(13) lnINFCPI	0.290*	0.287*	-0.111	0.194*	0.183*	-0.183*	-0.271*	-0.149	-0.010	-0.141	0.172*	-0.199*	1.000

**** p<0.01, ** p<0.05, * p<0.1*

Note : L.POV is a lag value of POV, that is the lag of Poverty level (POV-1).

Econometric Results

In this section, empirical findings, which address essential gap regarding poverty reduction effects of digital financial inclusion, were presented. The summary of results from two-step sys-GMM estimation technique for five models are displayed in table 7. First, using the baseline model (model 1), as observed from column 2 of table 7, the coefficient is statistically significant with a negative sign. This indicates that one per cent increase in digital financial inclusion index reduces poverty level by 0.57 per cent. This finding suggests that increasing digital financial inclusion index alleviate relative poverty.

When digital financial inclusion is measured using the number of registered mobile money agents, the results show that log of number of registered mobile money agents has a negative explanatory power in determining poverty level at $p< 0.01$. Similarly, the log of number of registered mobile money users and number of mobile cellular subscription have significant negative effect on poverty level at $p< 0.01$. However, individual users of internet has a positive effect on poverty level, which is not significant. Meanwhile, on a whole, digital financial inclusion index has a significant negative effect on poverty level at $p< 0.01$. The findings thus support the hypotheses: H1a, H1b and H1 and reveal predictive power regarding expectation of modern growth theory, confirming strong presence of digital financial resources (digital financial infrastructure and digital financial services usage) contributing to poverty alleviation. The findings, based on system GMM estimators, justify the assertion that digital financial inclusion is required to mitigate financial exclusion and to reduce poverty levels.

However, the internet usage was not significant. This may be attributed to the fact that most African countries have significant issues of internet connectivity, and unreliable electricity supply.

Regarding the control variables, three are significant in column 1: GDP growth rate; trade openness and CPI inflation. Particularly, the results of system GMM estimator show that economic growth measured using annual GDP growth rate has significant negative effect on poverty level at $p< 0.01$. These findings demonstrate that economic growth has poverty alleviation implications. Likewise, it emerges from findings that population growth positively impact poverty level and significant at $p< 0.1$, $p< 0.05$ and $p< 0.01$ for columns 2, 3 and 4 respectively of table 6. Meanwhile, for columns 1 and 5 it was not statistically significant. Similarly, log of trade openness has significant negative effect on poverty level at $p< 0.01$, $p< 0.05$ and $p< 0.01$ for columns 1, 2 and 5. For columns 3 and 4, though the findings reveal negative relationship between log of trade openness and poverty level, but it is not statistically significant. Thus, under economic growth and trade openness, poverty levels reduces.

Table 7: Relationship between digital financial inclusion and poverty level

	(1) POV	(2) POV	(3) POV	(4) POV	(5) POV
L.POV	0.894***	0.887***	0.877***	0.798***	0.877***
	(0.160)	(0.045)	(0.045)	(0.082)	(0.072)
DFIINDEX	-0.577***				
	(0.139)				
lnNRMMAper1000		-0.534***			
		(0.049)			
lnNRMMUper1000			-0.307***		
			(0.035)		
INDINTER				0.018	
				(0.012)	
MOBC100					-0.082***
					(0.028)
PSAV	-0.331***	-0.414***	-0.324***	-0.223***	-0.211***
	(0.051)	(0.088)	(0.072)	(0.034)	(0.065)
VA	-0.119***	-0.117*	-0.190***	-0.141**	0.109
	(0.043)	(0.071)	(0.051)	(0.064)	(0.092)
GDPGRWH	-0.199**	-0.0731***	-0.0467***	-0.0185	-0.0559**
	(0.0345)	(0.0116)	(0.0119)	(0.0166)	(0.0215)
POPGRTH	0.547	0.532*	0.639**	0.661	0.592
	(0.591)	(0.258)	(0.271)	(0.427)	(0.364)
lnTO	-0.563***	-0.315**	-0.376	-0.577	-0.545***
	(0.102)	(0.138)	(0.238)	(0.396)	(0.192)
lnINFCPI	0.1275***	0.874***	-0.154	0.319**	0.509***
	(0.027)	(0.105)	(0.103)	(0.138)	(0.159)
Constant	3.498	-2.173	2.390*	5.465**	-3.249
	(3.736)	(1.592)	(1.341)	(2.497)	(2.151)
Observations	124	128	128	124	127
No. of Groups	24	24	24	24	24
No. of instruments	18	22	22	22	22
AR1 (p-value)	0.069	0.015	0.017	0.075	0.019
AR2 (p-value)	0.349	0.156	0.118	0.127	0.142
Hansen-J (p-value)	0.621	0.863	0.818	0.724	0.577

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.010

POV represents poverty level, DFIINDEX represents the digital finance index, NRMMAper1000 represents the number of mobile money agents per 1000 people, NRMMUper1000 represents the number of mobile money users per 1000 people, INDINTER represents Individuals using internet as a percentage of total population, MOBC100 mobile cellular subscriptions per 100, GDPGRWH represents GDP growth, POPGRTH represents population growth, TO represents Trade openness, INFCPI represents CPI inflation.VA represents voice and accountability, PSAV represents political stability and absence of violence.

Related to consumer price index inflation, the log of consumer price index inflation was used. The results show that log of consumer price index inflation has significant positive effect on poverty level at $p< 0.01$, $p< 0.01$, $p< 0.05$ and $p< 0.01$ for columns 1, 2, 4 and 5 respectively. Meanwhile, with regard to column 3 the established positive relation between log of consumer price index inflation and poverty level was significant. Political stability and absence of violence(PSAV) suggests that sound political institutional quality is good for reduction in poverty level in SSA countries. Based on the five models, the coefficients for political stability and absence of violence yield -0.331, -0.414, -0.324, -0.223 and -0.211 respectively for columns 1 to 5, indicating that one percentage point strengthening of political system and absence of violence is likely to bring about at least 0.21% significant reduction in poverty level. This could have been attributed to relatively stable political systems experienced in SSA economies in the sampled period. Mostly, the voice and accountability.

For the diagnostic test conducted, Hansen's over-identification test, to check the suitable number of instruments used in each specification. The results displayed in table 6 indicate that there were no issues with the instruments used. Specifically, the p-value for the Hansen and Arellano-Bond autocorrelation, AR(2), for each of the models are reported in columns 1 to 5. The tests demonstrate that GMM equations are correctly specified. To this end, it could be concluded that the instruments deployed in the system GMM are strictly exogenous. Further, the absence of presence of second-order serial correlation ensures that the estimation models employed for the system GMM are consistent.

The empirical evidence in summary, suggest that digital financial inclusion index has negative influence on poverty level, which implies support for H1; Number of registered mobile money agents have a positive influence on poverty level, fails to support H1a; Number of registered mobile money users have a significant negative influence on poverty level, which confirms H1b; Number of mobile cellular subscription has a significant negative effect on poverty level, which support H1c; and finally, effect of individual users of internet on poverty level was not significant but exhibit a positive coefficient, which fails to support H1d.

Quantile regression

The effect of digital financial inclusion on distribution of poverty level across five quantiles ($\tau = 0.10, \tau = 0.25, \tau = 0.50,\ \tau = 0.75$ and $\tau = 0.90$) is investigated. Table 8 presents the summary of quantile regression estimation results obtained for digital financial inclusion index. The results displayed in column 1 – 5 corresponds to the 10^{th}- 90^{th} quantiles. Whiles the lower quantiles represent low level of poverty, higher quantiles signpost high poverty level. The results of index of digital financial inclusion with some control variables displayed the estimates of parameters related to the distribution of poverty level, together with standard errors shown in the parenthesis obtained with the aid of bootstrapping for resampling technique. It is assumed that the distribution is linear for the quantiles and permits comparison of estimates yield through the deployment of the conditional quantile regression technique. The poverty level of digitally financially included countries in the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantiles are -0.341, -0.390, -0.480, -0.570 and -0.686. This indicates that poverty reduction

increases with increasing levels of poverty. It emerges from the results that digital financial inclusion index significantly reduce poverty level, and significantly dispersed across the quantiles ($\tau = 0.10, \tau = 0.25, \tau = 0.50$, $\tau = 0.75$ and $\tau = 0.90$) at p< 0.05, p< 0.05, p< 0.01, p< 0.01 and p< 0.01 significant levels respectively. This implies that a varying distribution across the quantile of digital financial inclusion index. This results suggests that the impact of digital financial inclusion becomes stronger and higher at increasing levels of poverty.

Table 8: Quantile regression estimation of digital financial inclusion index

	0.10	0.25	0.50	0.75	0.90
DFIINDEX	-0.342**	-0.390**	-0.489***	-0.576***	-0.689***
	(0.136)	(0.188)	(0.134)	(0.152)	(0.190)
PSAV	-0.331***	-0.285***	-0.338**	-0.423***	-0.446***
	(0.104)	(0.102)	(0.167)	(0.126)	(0.110)
VA	-0.245*	-0.312***	-0.441***	-0.409***	-0.411***
	(0.142)	(0.119)	(0.102)	(0.116)	(0.111)
GDPGRWH	-0.623***	-0.829***	-0.121***	-0.159***	-0.261***
	(0.011)	(0.088)	(0.0110)	(0.0176)	(0.0283)
POPGRTH	0.352**	0.364***	0.376**	0.398***	0.426**
	(0.165)	(0.114)	(0.163)	(0.124)	(0.175)
lnTO	-0.855***	-0.605***	-0.655**	0.659	-0.686
	(0.275)	(0.260)	(0.267)	(0.617)	(0.453)
lnINCPI	0.636***	0.857***	0.107	0.179	0.225
	(0.081)	(0.071)	(0.088)	(0.141)	(0.225)
Observations	145	145	145	145	145

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table 9 displays the estimates for QR using number of registered mobile money agents per 1000 from 2010 to 2022 across 24 countries in SSA. Here, digital financial inclusion is measured using the log of the indicator, number of registered mobile money agents. The results, at 10th quantile, reveal that an increase in number of registered mobile money agents per 1000 persons is related to a significant increase in poverty level (0.123, p< 0.05). Similarly, at 25th quantile, number of registered mobile money agents has a

positive effect on poverty level (0.128, $p < 0.05$), at higher quantiles ($\tau = 0.50$, and $\tau = 0.90$), number of registered mobile money agents is consistently related to increase poverty levels (0.138, 0.147, all $p < 0.01$).

For the control variables used, particularly for economic growth (using GDP growth), it emerges from the estimates that higher GDP growth is associated with reduced poverty level across all the quantiles, with a strong effect observed at the 25th quantile (-0.722, $p < 0.01$). On the part of population growth, the estimates obtained demonstrate that population growth has a varied effect on poverty level. Specifically, at the 10th quantile, population growth significantly increases poverty level (0.584, $p < 0.01$), whiles, at the 25th quantile it significantly reduces poverty level (-0.775, $p < 0.01$). Meanwhile, at 50th, 75th and 90th quantiles it demonstrates positive effect but not significant. In term of trade openness, the results show that there is a negative effect of trade openness on poverty level across all the quantiles. This indicates that more opened economies are associated with lower poverty levels. Concerning consumer price index, at the 10th quantile, the findings reveal that an increase in the consumer price index increases poverty severity but not significant. At upper quantiles, it significantly increases poverty level, indicating that increase in consumer price index is associated with high levels of poverty.

Table 9: Quantile regression estimates using number of registered mobile money agents

	0.10	0.25	0.50	0.75	0.90
lnNRMMAper1000	0.123***	0.128**	0.138***	0.128	0.147***
	(0.045)	(0.060)	(0.020)	(0.088)	(0.027)
PSAV	-0.333***	-0.289***	-0.338**	-0.323**	-0.309***
	(0.107)	(0.092)	(0.107)	(0.126)	(0.110)
VA	-0.467***	-0.332***	-0.414***	-0.419***	-0.418***
	(0.102)	(0.117)	(0.102)	(0.106)	(0.110)
GDPGRWH	-0.470***	-0.621***	-0.106**	-0.149***	-0.188***
	(0.143)	(0.122)	(0.0584)	(0.023)	(0.073)
POPGRTH	0.328***	0.327***	0.344***	0.358***	0.376***
	(0.098)	(0.051)	(0.024)	(0.048)	(0.052)
lnTO	0.112	0.126**	0.169**	0.221***	0.252***
	(0.092)	(0.065)	(0.071)	(0.080)	(0.041)
lnINCPI	0.124	0.132	0.158**	0.181**	0.207***
	(0.097)	(0.093)	(0.044)	(0.076)	(0.059)
Observations	149	149	149	149	149

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

From table 10, across all quantiles (0.10,0.25, 0.50, 0.75, and 0.90), the estimates obtained reveal that number of registered mobile money users negatively influence poverty level, indicating that the higher the number of registered mobile money users, the lower the poverty level. The strongest and most significant effect is observed in the 90th quantile followed by strong and more significant effect in the 75th quantile, which in turn is followed rather smaller and less significant effect in 10th quantile. The implication thus is that the higher the number of registered mobile money users in a country, the lower the level of poverty across all distribution of poverty level.

Table 10: Quantile regression estimation of number of registered mobile money users

	0.10	0.25	0.50	0.75	0.90
lnNRMMUper1000	-0.221**	0.233**	-0.252**	-0.295***	-0.324***
	(0.103)	(0.107)	(0.102)	(0.098)	(0.072)
PSAV	-0.234***	-0.334***	-0.345***	-0.401***	-0.442***
	(0.052)	(0.091)	(0.081)	(0.072)	(0.014)
VA	-0.115***	-0.216***	-0.330***	-0.334***	-0.356***
	(0.032)	(0.017)	(0.092)	(0.099)	(0.098)
GDPGRWH	-0.124***	-0.722***	-0.380***	-0.108**	-0.155**
	(0.014)	(0.010)	(0.018)	(0.048)	(0.069)
POPGRTH	0.584***	0.775***	0.108	0.176**	0.222***
	(0.136)	(0.101)	(0.103)	(0.072)	(0.084)
lnTO	-0.260	-0.258	-0.254	-0.247	-0.242
	(0.472)	(0.350)	(0.600)	(0.640)	(0.375)
lnINCPI	0.290***	0.951***	0.199**	0.435*	0.593
	(0.077)	(0.057)	(0.098)	(0.264)	(0.388)
Observations	149	149	149	149	149

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

In the quantiles 0.10, 0.25 and 0.50, the estimates in table 11 reveal that though coefficients of individual internet usage are negative but are insignificant. However, at higher quantiles 0.75 and 0.90, the coefficients are negative and significant, indicating that number of individuals internet usage has poverty alleviation implication.

Table 11: Quantile regression estimation of individual internet usage

	0.10	0.25	0.50	0.75	0.90
INDINTER	-0.0501	-0.0199	-0.0429	-0.088*	-0.013***
	(0.038)	(0.003)	(0.037)	(0.050)	(0.005)
PSAV	-0.124	-0.126	-0.130	-0.139*	-0.144*
	(0.110)	(0.109)	(0.092)	(0.074)	(0.095)
VA	-0.166	-0.191**	-0.173*	-0.177*	-0.184**
	(0.109)	(0.076)	(0.087)	(0.089)	(0.091)
GDPGRWH	-0.405***	-0.089***	-0.122***	-0.156***	-0.221***
	(0.128)	(0.009)	(0.013)	(0.019)	(0.029)
POPGRTH	0.307*	0.321**	0.349**	0.367**	0.391**
	(0.157)	(0.122)	(0.166)	(0.184)	(0.170)
lnTO	-0.997*	-0.120	-0.169*	-0.193	-0.231**
	(0.602)	(0.102)	(0.101)	(0.106)	(0.105)
lnINCPI	0.106	0.129*	0.151	0.170*	0.196*
	(0.096)	(0.074)	(0.099)	(0.103)	(0.112)
Observations	145	145	145	145	145

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

As displayed in table 12, the estimates of mobile cellular subscription per 100 (MOBC100), demonstrate a negative impact on poverty level across all quantiles. This signifies that in SSA countries irrespective of how far a country has addressed issues of poverty levels, a higher level of mobile cellular subscription is essential for continued use of digital financial services or digital financial infrastructure and consequently leading to reduction in poverty level.

Table 12: Quantile regression estimation of mobile cellular subscription

	0.10	0.25	0.50	0.75	0.90
MOBC100	-0.055**	-0.055***	-0.056***	-0.056**	-0.057***
	(0.022)	(0.014)	(0.016)	(0.023)	(0.016)
PSAV	-0.119	-0.132*	-0.145**	-0.152**	-0.161**
	(0.077)	(0.067)	(0.061)	(0.066)	(0.074)
VA	-0.211***	-0.214**	-0.222***	-0.236***	-0.244***
	(0.061)	(0.088)	(0.071)	(0.062)	(0.072)
GDPGRWH	-0.873***	-0.098***	-0.012***	-0.018*	-0.019*
	(0.011)	(0.009)	(0.009)	(0.010)	(0.010)
POPGRTH	-0.386	-0.398*	-0.424*	-0.454	-0.475
	(0.293)	(0.241)	(0.255)	(0.441)	(0.602)
lnTO	0.136	0.172*	0.175*	0.179*	0.180*
	(0.107)	(0.104)	(0.106)	(0.106)	(0.101)
lnINCPI	-0.352***	-0.123*	0.395***	0.995***	0.171*
	(0.083)	(0.068)	(0.072)	(0.125)	(0.102)
Observations	148	148	148	148	148

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Focusing on the control variables in tables 8 to 12, the results mostly show that GDP growth is negative and significantly predict reduction in poverty level. For trade openness, the coefficient estimates across the quantiles is positive, implying trade openness enhances use of digitally driven financial innovation and digital financial infrastructure.

Discussion of the findings on digital financial inclusion-poverty relationship

This section provides discussion on the findings regarding digital financial inclusion effect on poverty level. The discussion is based on disaggregated effects of indicators of digital financial inclusion coupled with aggregated effect of digital financial inclusion, used in the study as digital financial inclusion index, on poverty level. It includes how the current findings relates with some of earlier findings from earlier researchers.

Regarding disaggregated analysis, the study based on QR shows that number of registered mobile money agents, number of registered mobile money users and mobile cellular subscription significantly predict significant decline in poverty level across all quantiles of poverty distribution of the sampled countries in SSA. These findings imply that additional increases in the indicators of digital financial inclusion has homogenous effect on poverty level for countries in SSA across all quantiles. These findings resonate with some of the earlier empirical evidence that claimed digital financial inclusion possess poverty alleviation characteristics. Specifically, results on number of registered mobile money users follow the findings of Djahini-Afawoubo et al. (2023) that demonstrate that mobile money usage reduces multidimensional poverty. Further, the outcome of effect of registered mobile money agents is consistent with report of Balasubramanian et al. (2023) that mobile money is associated with lowering of poverty. Regarding the findings on mobile cellular subscription, the results support the earlier study by Dzator et al. (2023) whose findings reveal that mobile phone penetration contribute to reduce poverty. These findings signify that enhancing digital infrastructure by encouraging

mobile money agency distribution across various communities, making mobile phones available and affordable and promoting use of mobile money help more people to have access to formal financial services, increase income distribution and facilitate trickle-down development thereby reducing poverty levels. Contrary to this, individual internet usage does not reduce poverty levels. This seems to articulate the fact that individual internet usage in SSA countries is characterised with high internet cost and network challenges. This finding contradicts the results of study by Garcia-Mora and Mora-Rivera (2023); as well as Kelikume (2021) who report that internet access contribute to reduce poverty levels.

The findings on number of mobile money agents exhibit positive relationship with poverty levels, it perhaps could be because of transient poverty (Dang et al., 2024) where slightest shock, like COVID-19 pandemic and the Russia-Ukraine War (Tweneboah & Nsiah, 2024), can easily push more people into poverty. In addition, this may be attributed to threshold effect of financial inclusion on poverty levels (Nsiah & Tweneboah, 2024), where not until a certain level financial inclusion may not reduce poverty levels. Possibly, issues of number household dependency (Yunanto et al., 2025) may also account for why increase in number of mobile money agents aggravate poverty level. The likely explanation may be, though mobile money agents earn income but when they have large number of people who depend on them, it may not reduce poverty.

Related to above development, using aggregated analysis based on estimates of QR shows that digital financial inclusion index significantly predicts decline in poverty level across all quantiles of poverty distribution of

the sampled countries in SSA. These findings imply that additional increases in digital financial inclusion has homogenous effect on poverty level for countries in SSA across all quantiles. Further, this result points out that economies with higher digital financial inclusion experienced higher level of reduction in poverty level. This finding confirms earlier empirical evidence by Peng and Mao (2023); Zhou and Wang (2021); and Omar and Inaba (2020) whose findings claimed that digital financial inclusion index possesses poverty alleviation characteristics.

Clearly based on the foregoing discussion, increases in digital financial inclusion index and its indicators could predict declines in the level of poverty in SSA countries sampled. This is because digital financial inclusion index and its indicators contribute significantly to lower poverty levels. Notwithstanding significant poverty reduction impact of digital financial inclusion, the use of these digital tools and platforms present some level of risks. More importantly are the issue of cybercrime, fraud and money laundering concerns that come with these digital platforms or tools. These concerns can perhaps lead to customer dissatisfaction with the use of these digital tools and platforms leading low level of customer confidence and trust, resulting in poor patronage of these digital means to deliver or access financial services.

Summary and Conclusion

The overarching purpose of this chapter was to investigate the effect of digital financial inclusion on poverty reduction in a sample of SSA countries. Drawing evidence from data set regarding digital financial inclusion from WDI, this study employed both aggregate and disaggregated measures to expands stock of empirical literature regarding the association between

financial sector development and poverty reduction in SSA. Further, the study holding all things constant and to the best of knowledge, is the first empirical study on how digital financial inclusion impact poverty in a selected SSA economies. The study, on the basis of index of digital financial inclusion, finds that enhancement in digital financial inclusion lower poverty levels in SSA. Further, the findings reveal that digital financial inclusion reduces poverty level across the entire quantile of poverty levels but more significant at higher quantile. Focusing on the individual variables of digital financial inclusion, we find that increasing number of registered mobile money agents, number of registered mobile money users and mobile cellular subscription will reduce poverty levels. However, improving individual internet usage rather increases poverty levels.

CHAPTER FIVE

BANKING SECTOR REGULATIONS AND DIGITAL FINANCIAL INCLUSION

Abstract

This chapter of the study examines the effect of banking sector regulations on digital financial inclusion in sub-Saharan African region. Focusing on the accomplishment of this, the study relies on evidence regarding a panel data of 25 SSA economies spanning the period 2014 to 2020. The results of the study were estimated employing SGMM whiles taking into consideration the dynamic nature of the model. Largely, it emerged that some dimensions of banking sector regulations contribute to enhance digital financial inclusion. For the institutional quality as moderator, empirical findings suggest stable political system with its attendant absence of violence coupled with voice and accountability moderate positively between banking sector regulation and digital financial inclusion. Policy implication is that banking sector regulation initiatives that are more pronounced in enhancing digital financial inclusion should be considered concurrently with strengthening political stability and voice and accountability.

Introduction

Despite the emergence of new technologies for improving financial inclusion, digital financial inclusion (DFI) may be confronted with myriad of challenges. These challenges may range from poor technological support, poor institutional architecture that hiders private investment, weak political, legal and economic conditions, to insufficient banking sector regulations (Ngwu et al., 2019). However, the issue of banking sector regulations seems to be at the

center of several financial sector outcomes in many policy discussions (*see*; Feridun, 2025; Lemma, et al.,2025; Syed, 2024). Banking sector regulations could be relevant to digital financial inclusion in two main ways. First, the regulatory architecture should be able to accommodate the innovations associated with financial inclusion landscape, encourage the provision and use of digital financial services, and ensure healthy competition among the providers. Second, since the core mandates of banking sector supervision and regulation includes maintaining banking sector integrity and stability, and eventually customer protection (Abugre et al., 2022), the advancement of DFI should align with these mandates.

The series of global financial crises as well as country-specific financial crises has triggered a number of regulatory reforms in the banking sector of several economies (Triki et al., 2017). Aside the financial crises, there have been calls made by academics and policy practitioners to economies in SSA to adopt and comply to a common set of banking regulations (*see* Ngwu et al., 2019), since cross-border banking continues to increase in the region. To the extent that cross-border banks are able to effectively perform their role of financial intermediation, they may also drive digital financial inclusion. If adoption of common set of regulations in a continent are able to ensure the sustainability of cross border banking (Ngwu et al., 2019), it may also exhibit positive relationship on digital financial inclusion. In a similar vein, Kodongo (2018) argues that banking sector regulations may harm or improve the ability of banks to provide inclusive financial services within an economy.

Despite the possible relevance of banking sector regulations to digital financial inclusion, the literature in the area is burgeoning. Nevertheless, providing a nuanced understanding on the impact of banking sector regulation for digital financial inclusion is particularly relevant, especially to developing countries like that of SSA that have witnessed a recent increase in digital financial products. Hitherto, empirical studies concerning the linkage between banking sector regulation and DFI have only provided a limited view of the phenomenon. For instance, Anarfo et al. (2020) find evidence that stringent capital regulations impede financial inclusion in SSA. Nonetheless, DFI may be affected by a myriad of banking sector regulations and thus examining the nexus between a number of banking sector regulations and digital financial inclusion could be relevant to policy.

The literature on banking sector regulations and digital financial inclusion is therefore limited, particularly concerning peculiar context of SSA. Partly, this could be ascribed to paucity of related cross-country information that measures banking sector regulations as well as digital financial inclusion. This study therefore fills this gap by employing banking sector regulations data from Triki et al. (2017). The scholar constructed indices that covers several dimensions of Basel committee's banking sector regulations. The dimensions of banking sector regulations are stringent capital requirement, activity restrictions, entry restrictions, exit restrictions, transparency requirements, supervision quality, diversification and liquidity restrictions, financial safety nets and price controls. With a cursory view, there may be a number of reasons to suspect that these banking sector regulation variables affects financial inclusion. For instance, capital stringency and activity

restrictions may limit banks' ability to innovate and create new financial products, thereby hampering financial inclusion (Anarfo et al., 2020; De Sousa, 2015). Based on the traditional view that competition reduces market power and low cost of financial services increase financial services availability (*see*; Carletti et al., 2024), stringent entry requirements could stifle competition and impede financial inclusion. Conversely, high exit restrictions could increase competition and improve financial inclusion. Financial safety nets provide guarantees to depositors about the safety of their deposits. To the extent that financial safety nets are able to instill confidence in the financial system, it could also bolster the degree to which people subscribe to digital financial products. Price controls limits the ability of banks to charge high costs on financial services and thus price controls could improve financial inclusion. These suggest that regulatory mechanisms have implication for financial inclusion (Singhe & Louche, 2020). Altogether, banking sector regulations could exhibit a first order effect on digital financial inclusion.

This study therefore makes two main contributions. First, unlike the studies of Abor et al. (2020) that examines how financial regulation relates with financial inclusion, the current study explores how several dimensions of banking sector regulations affect DFI. Second, the focus on DFI instead of FI is also a novelty, and this is because the SSA region has gained the momentum in the provision of digitalized financial services in recent times.

Theoretical Literature

The Law and finance theory(LTF) is credited to the works of La Porta *et al*.(1998). The LFT expounds how legal origin, protection of shareholders and creditors' interest and the robust enforcement of laws predict development

of the financial sector (La Porta et al., 1998). This helps with knowledge of several aspects of the institutional architecture of the financial sector which are particularly important to the development of the financial sector. Consequently, it will eventually improve financial inclusion. Amidst the institutional architecture of the financial sector, banking sector regulations seemed to have caught the interest of policy makers owing to the several episodes of financial crises. Based on the Law and Finance theory, this study argues that banking sector regulations could represent laws that could affect ability of the financial sector to develop digital financial products to include more economic agents in the financial system.

Empirical Literature

Despite significant positive intentions of banking sector regulations to maintain financial system stability, the impact of the regulations should be evaluated in the context of its dimensions on digital financial inclusion. In addition to the claim that the global financial crises in 2007-2009 do bring to memories how extending access to finance can concomitantly create opportunities and risks (Demirguc-Kunt & Servens, 2010). It also intensifies interest in improvement in regulations of financial markets (Anarfo et al., 2020). Regulations in the banking sector mainly emphasize importance of ensuring safety and soundness of financial institutions, consumer protection, maintaining financial stability and integrity which are driven by maintenance of quality assets, more capital and liquidity, and better risk management which are capable of mitigating against build-up of adverse externalities capable of fueling crises and contagion (Cecchetti et al., 2011). Focusing on the broader objective of economic growth and inclusive growth, the trend thus

requires that regulators go beyond traditional oversight responsibilities of safety and stability of financial system to focus on efforts directed at increasing financial inclusion (Yoshino & Morgan, 2016).

The overarching goal of DFI is to increase access to formal financial system and services through digital means by boosting access, availability and usage of financial services, particularly among the low-income and underserved populations, by removing barriers regarding physical access and convenient, high cost of transaction and information asymmetry. A number of empirical studies supported this goal of DFI. For example, a number of studies suggest that digital financial inclusion promotes access to credit and reduce transaction cost (Osei et al., 2021); increase financial resilience and well-being (Belayeth Hussain et al., 2019); and increase poverty reduction (Kelikume, 2021). Meanwhile, a study by Lenka and Barik (2018) noted that adoption of mobile phone and internet access is associated with increased financial inclusion and improved welfare of households especially among low-income and rural households. Likewise, with evidence from Vietnam, Son et al. (2020) identified that holding account and using mobile money services positively influence participation in non-cash transactions.

Focusing on the mechanism of operations of the financial system that widen access and use of financial services and products, dimensions of banking sector regulations play pivotal roles. There are two perspectives of banking sector regulations, private interest and public interest, that have implications for financial inclusion. In view of public interest, increased regulations in banking sector serve a means to safeguard public interest by curtailing bank risk-taking behaviour and reducing susceptibility to bank

failure. On the part of private interest view, some bank regulations are designed and enforced to provide privileged treatment to certain groups within society thereby leading to bank-risk taking (Barth et al., 2013). The various dimensions of banking sector regulations have implications for digital financial inclusion within the context of these two perspectives. However, the prediction of this thesis is that public interest view may engender enhancement in digital financial inclusion through well-structure banking regulations that are capable of enhancing efficiency (Barth et al., 2013). This efficiency may foster competition among banks thereby promoting innovations.

Entry and exit restrictions

Entry regulation that is stringent could limit growth and depth of financial services including digital-based financial services and products. Banking sector can be contestable making barriers to entry and exit weak (Dirmerguc-Kunt & Peria, 2010). Though this fosters competition among the existing banks and new entrants, yet it puts undue pressure on existing banks. A sizeable number of literature has emerged to augment prior studies, and this examines the real effects linked to regulatory restrictions on entry and exit in banking sector. For instance, Barth et al. (2004) find that higher barriers abate bank efficiency and thereby lead to increase in interest rate margin and personnel expenses, corroborating the empirical claim that entry restriction reduces bank competition. Also, Besong *et al.* (2022) find that putting entry into financial sector under serious surveillance, and availability of deposit insurance increase sustainable financial inclusion with evidence from six countries from Central African Economic and Monetary Community (CEMAC) region. Furthermore, Ali et al. (2024) evinced that entry of foreign

banks, apart from increasing growth in competitive reactions from incumbent banks, provides stable access to credit. Based on reactions from the incumbent lenders, this could reduce borrowing cost. The finding of Huynh (2024) also demonstrates that entry of foreign banks threaten the profit of incumbent domestic banks and intensifies competition which in turn may foster bank efficiency and stability. Budzinski and Stöhr (2024) reveal that high entry and exit barrier turn to limit contestability and competition in a banking system. Further, Triki et al. (2017) found that tighter restriction on exit negatively impact efficiency of bank. However, Triki et al. (2017) averred that stringent restrictions on entry lead to increase efficiency of larger banks whereas smaller banks suffered from reduction in efficiency. Thus, the based on the above arguments advance, the study tests the following hypotheses

Hypothesis 1: Stringent entry restriction has a positive effect on digital financial inclusion.

Hypothesis 4: Stringent exit restriction has a positive effect on digital financial inclusion.

Activity Restrictions

Bank activities entail permitted core and non-core activities undertaken by banks. Regulators may place restriction on bank's activities. Examples of restricted bank activities range from participating in securities trading, insurance, real estate activities to acquisition of other non-financial institutions (Berger et al, 2024). These restrictions are deemed indispensable to aid in monitoring size, complexities of bank activities and inherent information asymmetries that may pose challenge to bank supervision. Fundamentally, restriction on bank activities is measured by determining whether engagement

in securities, insurance and real estate activities and ownership of non-financial institution are permitted, unrestricted or prohibited (Saif-Alyousfi et al., 2020). Restriction on activities of banks is linked to bank efficiency, stability and competitiveness. The theoretical grounds for restricting bank activities argues that increased scope of activities breeds conflict of interest potentials for banking management, raise risk–taking, increase propensity to make financial institutions complex and 'too big to regulate' coupled with assertion that financial conglomerate reduces efficiency and competition (Barth et al., 2004). In sharp contrast, Claessens et al.(2005) are of the view that banks are beneficiaries of economic of scales and revenue streams when they broaden their scope of activities. More so, increasing scope of activities is a signpost of more growth, value from franchise and incentive to reduce risk. The pursuit of bank activities restrictions is to simultaneously support inclusive finance and promote bank resilience. Concurrently addressing financial inclusion and building bank resilience may call for the choice that should elect fine balance between bank efficiency and financial inclusion. Empirical evidence appear to be mixed. Bank activities restriction breed inefficient financial intermediation. For instance, Ahmad et al. (2021) and Barth et al. (2008) noted that strong bank activities restrictions lessen diversification opportunities of banks. Low diversification can bring about decline in income stream and franchise value, which in turn may lead to inefficient financial intermediation. Further, activity restrictions minimise risk-taking (Danisman & Demirel, 2019; Saif-Alyousfi et al., 2020). On the contrary, unfettered bank activities facilitates moral hazard issues and promote risk-taking behaviour (Noman et al., 2021). More restriction on bank activities

encourage accumulation of safe assets whiles expected returns of risk asset drop. The implication thus is higher restriction on bank activities is detrimental to usage (investment) of additional funds and reducing efficiency. Thus, bank activities restriction is negatively linked to digital financial inclusion. Thus the following hypothesis was tested:

Hypothesis 2: Stringent activity restriction has a positive effect on digital financial inclusion.

Transparency requirements

From the perspective of information asymmetry, asymmetric information in financial distribution mechanism accelerates financial exclusion mostly among the financially excluded and disadvantage population (Ekong & Ekong, 2022). Also, financial service providers are likely to be confronted with financial inclusion challenges pose by information asymmetry as ambiguous client's credit history may expose banks to loan default risk (Beck & De La Torre, 2007). Nevertheless, with transparency requirements, disclosure can become good solution to enhance transparency and thereby eliminate information asymmetry. Some prior studies demonstrate that market disclosure positively impact on bank stability (Saif-Ayousfi et al., 2020). Another study by Elkelish and Tucker (2016) posit that existence of compulsory audit regime enhances stock market stability. In related study, Bhattacharya (2023) examined whether public disclosure of bank complaint data would attract reaction from customers, banks and the stock market. It emerged that stock market reacted positively to complaint data disclosure, and this is driven by brand value and presence of extant internal governance mechanisms. Some earlier literature noted that transparency weakens the

effect of financial crises on market power financial (Kusi et al., 2022). Based on the arguments advanced, the following hypothesis was provided:

Hypothesis 3: Stringent transparency requirement has a positive effect on digital financial inclusion

Capital Stringency

Regulatory requirement requires that financial institutions maintain stable and robust financial system by holding certain amount of equity capital to mitigate against unexpected losses and reduce likelihood of banking failure (Laeven & Levine, 2009). Capital stringency refers to the soundness of bank's indicators, which facilitate participation in financial institutions by customers. Measure of capital requirement captures both the exact amount of capital (e.g., ratio of capital to total asset) and nature of capital (represented by policies that go beyond cash and government securities, verification of source of capital by regulatory authorities and definition and valuation of assets) (Barth et al., 2013). Capital stringency is inimical to financial inclusion as it restricts development of new financial products and services as well as innovative financial products. Related to this, Le (2020) carried out a study on changes experienced by Vietnamese bank based on minimum capital requirement, to examine impact of regulatory change on market discipline for the period 2006-2015. The study used dynamic system generalised method of moments technique. It emerged from the study that higher capital adequacy to maintain soundness in financial system leads to weakening market discipline. The study concluded that market requires lower interest rate when new capital requirement is implemented which could dampen access for finance. In a related study, Anarfo et al. (2020) examined how financial regulation impact

financial inclusion with financial stability as conditioning factor. The study employed mixed linear effect model. It emerged that stricter prudential regulation (capital adequacy) negatively impact access to finance. However, the study concluded that capital adequacy requirement abates bank's capacity to furnish financial services resulting into capital rationing and thereby lowering financial inclusion. In another study, Deli and Hasan (2017) acknowledged significant roles of capital in bank profitability and mitigating adverse effect of regulation. In a study interrogating country specific factors associated with financial inclusion, Sarma and Pais (2011) identified negative relationship between capital asset ratio and financial inclusion. Likewise, Kodongo (2018) report a detrimental impact of capital regulation on financial inclusion. The study concludes that at high level of capita asset ratio, banking systems tend to be more guarded in granting credit facilities to financially excluded. In view of the aforementioned arguments advanced, the study hypothesizes that:

Hypothesis 5: Stringent capital restriction has a positive effect on digital financial inclusion;

Diversification and liquidity restrictions

Diversification restriction entails regulations that impose limit on diversification in order to reduce risks and promote financial stability. Focusing on banking sector based-regulations, it takes different forms such as portfolio diversification requirements, lending limits and restrictions on concentration of exposure to specific sector or counterparties (Keister, 2019). A study in less developed economies suggest the capability of diversification to improve financial strength of banks (Doumpos et al., 2016). Diversification

and liquidity restrictions are essential dimension of banking sector regulations that have implications for financial stability, efficiency, performance and risk taking behaviour of banks that in turn can influence digital financial inclusion. This is buttressed by a study of Kim et al. (2020) which found that bank diversification decreases the variance of bank stability before 2008 financial crises but during the crises it increased the variance of bank stability. Likewise, in a related study Liang et al. (2020) observed that positive diversification-profitability relation before 2008 financial crises has reversed to negative afterwards. Also, Duho et al. (2020) show that banks that more diversified reported less profit, profit efficiency and financial stability. This brings about the hypothesis that:

Hypothesis 6: Stringent liquidity restriction has a positive effect on digital financial inclusion.

Price Controls

On the other hand, price controls are considered as information that encompass restrictions on prices and fees earned by banks (Triki et al., 2017). Apart from preventing efficient allocation of resources, price controls can stifle innovation and suffocate economics of mobile money and halt expansion of service across regions (Nikomborirak, 2017). Some scholars have noted that non-imposition of price control on mobile money transactions is linked to increased usage of mobile money; including allowing non-banks to issue mobile money alongside international money transfers (Bahia et al., 2020). In terms of size and risk levels, increased price control requirements do not favour smaller banks (Triki et al., 2017). Based on the argument advanced, the study tests the hypothesis that:

Hypothesis 7: Stringent price control has a positive effect on digital financial inclusion.

Financial safety nets

Within the context of modern financial architectures, financial safety nets permit granting of liquidity supports to a number of institutions to relieve the strains of qualified members in financial distress. Financial safety net and price controls are part of dimension of banking sector regulations. Alley (2024) notes that financial safety nets are significant tools use to promote financial stability and inclusion in the financial system. In a study by Chen and Divanbeigi (2019) and Jameaba (2018), it emerged that financial safety nets, such as deposit insurance or government guarantee when put in place, make individuals feel more secure in using digital financial services and are likely to participate in formal financial system. Price controls on the other hand, in the form of transaction fees or account maintenance fees, on digital financial can contribute significantly to rendering financial services affordable and accessible to low-income segments of society, thereby facilitating digital financial inclusion. Some empirical literature has acknowledge that financial safety nets promote access, confidence and innovation in financial services. For instance, in studies by Izaguirre et al. (2016) and Kim et al. (2024), it emerged that deposit insurance encourages innovation by reducing fear of failure for financial institutions. Likewise, Demirgüç-Kunt et al. (2019) find that deposit insurance increases availability of credit, particularly among women. Another study also noted claimed that deposit insurance facilitates that patronage of banking services, which in turn positively influence financial inclusion. Thus, the study hypothesized that:

Hypothesis 8: Stringent financial safety restriction has a positive effect on digital financial.

Quality of supervision

Banking supervision plays essential roles to safeguard global financial system. Basel III is as a result of number financial regulatory framework reforms including Basel committee regarding banking supervision reform packages (Basel Committee on Banking Supervision, 2010). Banking supervision appears to describe how banks are prevented from engaging in activities consider as undesirable, and taking excessive risks in spite of growing complexity of their activities. In attempt to foster stable and efficient banking system, better supervision is of greater importance (Triki et.al., 2017). Digital financial services require bespoke supervision and regulation to manage activities such competition, consumer protection and conduct in the market (Gibson et al., 2015). Empirical studies have established that there is link betwwen quality of supervision and financial inclusion. For example, Jayasekara (2021) demonstrates that level compliance of banking regulations significantly determine financial inclusion. In a related study, the findings of Chen and Divanbeigi (2019) reveal that adherence sizeable number of regulatory good practices enhance financial inclusion.

Hypothesis 9: Stringent supervisory quality has positive effect on digital financial inclusion.

The forgoing demonstrates there is potential implications regarding linkage between banking sector regulations and financial inclusion, particularly among the low-income groups. Specifically, the consequences of 2008 global financial crises illustrate that too much innovation could distress

financial system. The outturn of 2008 GFC leads to tightening of financial system which in turn makes it difficult for low-income people to easily access financial system (Hannig & Jansen, 2011). However, Shah and Ali (2022) note that easy financial regulations is linked to increase financial inclusion through provision of financial activities at large scale for developing countries. With reference to implications of banking sector regulations on digital financial inclusion, empirical literature appears quite new and scanty. For instance, limited studies that focused on the impact of banking sector regulation on financial inclusion employing regulatory index. For example, the study of Ikram and Hussain (2022) reveal that financial regulation negatively influence financial inclusion. In sharp contrast, Chen and Divanbeigi (2019)'s study reported that regulatory index score of a country is positively related to individual's having account with financial institution. Hence, the following hypothesis was tested:

Hypothesis 10: There is a positive relationship between banking sector regulations and digital financial inclusion in sub-Saharan

Moderating Roles of Institutional quality

Institutional climate is key force for robust enforcement of financial regulation standards and supervision, thereby amplifying efficacy of regulatory restrictions (Sodokin et al., 2023). Institutional climate entails nature of institutional qualities, which institutional qualities constitute the rules of the game as they shape human interactions and are key drivers of economic performance (North, 1990).

The predominance factors identified in earlier studies are attributed to World Bank's Governance Indicator. With these governance indicators,

country risk guide is developed to address political risk of a country. The risk guide is often times referred to as international country risk guide (ICRG). They constitute measures commonly used to proxy institutional quality. Details of these measures are namely, political stability, rule of law, and voice and accountability. The rest are regulatory quality, control of corruption and governance effectiveness (Sanga & Aziakpono, 2022).

Institutional theory, credited to North (1990), is underpinned by several assumptions. The theory assumes that efficient institutions are associated with costless transactions, bring about appropriate mental models that lead to making right decisions and are economically rewarding; and mobilises and shares information (North, 1990). Scholars who favour this theory characterised institutions as the rules of game in society or are humanly created constraints that shape human interactions. Good institutions seem to guarantee security of property right and competitive market, and are key drivers of several productive and non-productive economic activities(Vu, 2021). With quality of institutions, attentions are directed at investment into human and physical capital, and innovative events that in turn lead to differences in income per capita across the globe. However, poor quality of economic and institutions are linked to historical background of countries (Nikolaev & Salahodjaev, 2017; Nunn, 2020; Vu, 2021). Thus, the underdevelopment observe in countries are as result of slowly sprouting institutions (Olaniyi & Odhiambo, 2024; Nunn, 2020).

Empirical studies on institutional quality attempt to categorize issues from economic, social, political and environmental perspectives (Fakher, 2014). Empirical evidence thus points out that institutional quality has mixed

impact on economic growth. Particularly, Wang et al.(2022), using the VECM on data from African countries for the period 1999-2017, find that institutional quality promotes economic growth and facilitates environmental quality. Similarly, Grabowski and Self (2021) noted that increase in economic development is a consequence of improvement in institutional quality. Chong (2020) on the other hand reported an Inverted-U shape relation between institutional quality and economic growth. Specifically, whiles control of corruption negatively impact growth, regulatory quality enhances growth (Appiah et al., 2024). Vergil and Teyyare (2017), Ngo and Nguyen, (2020) and Singh and Pradhan (2022) conclude that institutional quality positively influence economic growth.

In view of banking sector regulations, (Sodokin et al., 2023) argue that favourable institutional climate helps facilitate enforcement of regulatory standards and supervision, which consequently promotes efficacy of regulatory mechanisms. Likewise, study of Ofoeda et al. (2022) noted that quality of institutions coupled with sound financial regulatory regimes spur economic growth in Africa.

With extant studies concerning moderating roles of quality of institutions, institutional quality serving as a moderator variable has been positioned within varying fields regarding contexts and concepts in literature. The current thesis performed moderation analysis where institutional quality was identified to have moderation effect between banking regulation and digital financial inclusion in SSA. The rationale for this moderating analysis is that: quality institutional climate is proven to have positive effect on financial regulatory standards and supervision (Odusola et al., 2017; Sodokin et al.,

2023). More so, the argument of these studies is that favorable institutional climate is an enabler of efficacy of enforcement of robust regulatory standards. Thus, if the institutional qualities are deemed sound or high, liquidity and activity restrictions restrained risk-taking behaviour of banks (Klomp & de Haan, 2014), then financial inclusion might be difficult to attain. However, the results of study conducted by EL-Moussawi et al. (2023) demonstrate that political stability and high regulatory quality positively influence credit growth.

Soundness of institutional quality serves as grounds for robust enforcement of banking sector regulations that may either facilitate or inhibit digital financial inclusion initiatives. On the bases of the foregoing argument advanced, the current thesis argues that adoption of digital financial infrastructure, digital platforms, mobile money services and digital innovation, is impacted by stringent banking sector regulations dimensions developed through institutional quality proxy by stable political system devoid of violence, and democratic accountability. This study further argues that high institutional quality influences banking sector regulations for facilitation of digital financial innovations leading to digital financial inclusion.

Finally, the quest regarding moderation analysis in the current thesis is obliged by the established relationship among institutional quality, banking sector regulations, and digital financial inclusion. Banking sector regulations are stringent, when institutional quality is sound and devoid of weaknesses. For example, political stability and absence of violence has been identified to be critical in minimising uncertainties in activities of banking sector (EL-Moussawi et al., 2023). This consequently enhances credit supply by banks

leading to possible increase in investment in innovative financial technologies. Further, political stability as noted by Ha and Nguyen (2023) positively influenced financial inclusion. Furthermore, in contemporary DFI inclusion literature, there is a growing interest on examination of institutional quality on penetration, accessibility, and usage of financial services, thereby promoting financial inclusion (Nasreen et al., 2023; Boukhatem & Ben-Moussa, 2023; Doku et al., 2023). Notwithstanding the growing research attention, there appears to be limited research attention regarding banking sector regulation with innovative DFS, digital financial infrastructure and platform for DFI through institutional quality.

In the backdrop of the above, the current thesis investigates how institutional quality moderates between banking sector regulations and digital financial inclusion in SSA. Though, institutional quality has been demonstrated to moderate between financial intermediation, financial regulation and financial inclusion, the current thesis appears to be one of the first studies to explore institutional quality between banking regulation and digital financial inclusion.

Empirically, evidence that support moderating role of institutional quality in financial inclusion literature has been amplified as follows: institutional quality between efficacy of policy and sustainable development (Zakari & Khan, 2022), institutional quality between financial regulation and financial inclusion (Kouadio & Gakpa, 2022); institutional quality between banking sector regulation and financial inclusiveness of economy (Hussain et al., 2021), and institutional quality between digital technology and financial inclusion (Doku et al., 2023). The conclusion from these studies points to

postulation that institutional quality plays critical role in the moderating the link between banking sector regulations and digital financial inclusion.

Thus, the following hypotheses have been developed and tested based on the arguments advance above regarding the objectives of the thesis.

Hypothesis 11: Political stability and absence of violence positively moderate between dimensions of banking sector regulations and digital financial inclusion.

Hypothesis12: Voice and accountability positively moderate between dimensions of banking sector regulations and digital financial inclusion.

Methodology

Prior studies that explored the relationship between banking sector regulations and financial inclusion have deployed multivariate logit regression (Momany, 2018), ordinary least squares (OLS) regression (Gutierrez & Singh, 2013; Besong et al., 2022), mixed-effect regression model (Anarfo et al., 2020) and probit regression and fixed effect regression (Kodongo, 2018). There have some criticism regarding inability of these techniques in addressing the challenges of heteroscedasticity and endogeneity (Chinoda & Kapingura, 2024). Further, Kim et al. (2018) assert that these techniques could not deliver reliable and robust results when using panel data approaches. Addressing these concerns and at the same time ensuring robustness of findings of the current study, a system GMM estimator by Arellano and Bover (1995) which bring to the fore robust panel data technique have been employed. This technique helps to examine the effect of banking sector regulations on digital financial inclusion in SSA. Following (Chinoda & Kapingura, 2024), the formulated base regression model is as follow:

$$Y_{it} = \alpha Y_{it-1} + \theta_0 X_{it} + \sum_{i=1}^{n} Z_{it}\beta + \mu_{it} \quad \text{---------- (16)}$$

Where Y_{it} is DFIINDEX, $Y_{it-1}$is the DFIINDEX of previous year or the initial level of digital financial inclusion, X_{it} denotes variables that are used as explanatory variables, Z_{it} denotes the control variables, ε_{it} represents the error term. Meanwhile, *i* represents country, and *t* represents the period. With emphasis on the specific objective of this paper, the equation 4 has be modified to reflect the context of the study and it stated as follow:

$$DFIINDEX_{it}=\beta_0+ \beta_1 DFIINDEX_{it-1} + \beta_2 ETW_{it}+ \beta_3 ACW_{it}+\beta_4 TRW_{it}+\beta_5 EXW_{it}+ \beta_6 CPW_{it} + \beta_7 LDW_{it} + \beta_8 PCW_{it}+ \beta_8 FSW_{it}+\beta_9 SCW_{it} + \beta_{10} PSAV_{it}+ \beta_{11} VA_{it} + \beta_{12} GDPGRWH_{it}+ \beta_{13} POPGRTH_{it} +\beta_{14} InTO_{it}+ \beta_{15} InINFCPI_{it} + \mu_{it} \text{----------(17)}$$

Where $DFIINDEX_{it}$ is the digital financial inclusion index which is the dependent variable; $DFIINDEX_{it-1}$is the lag value of digital financial inclusion index ($DFIINDEX_{it}$), ETW is entry restriction, ACW represents activity restrictions, TRW represents transparency requirement, EXW represents exit restrictions, CPW is the stringent capital requirement, LDW denotes liquidity diversification, PCW is price control, FSW stands for financial safety net, SCW represents supervision quality which variables are the main explanatory variables. The other variables used as control variables are PSAV which denotes stable political system where there is no violence, VA represents voice and accountability, GDPPC GDP per capita growth, POPGRTH represents population growth, TO represents Trade openness, INFCPI represents CPI inflation, DIR captures domestic credit to private sector (% GDP), and DIR represents deposit interest rate.

Based on regulatory-inclusion hypothesis and slight modification made to empirical model of Triki et al.(2017), the effect of various dimensions of banking sector regulations have been examined separately in nine models as indicated below.

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 ETW_{it} + \beta_3 PSAV_{it} + \beta_4 VA_{it} + \beta_5 InGDPPC_{it} + \beta_6 InDCPSGDP_{it} + \beta_7 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_{10} DIR_{it} + \mu_{it} \text{----------(17a)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 ACW_{it} + \beta_3 PSAV_{it} + \beta_4 VA_{it} + \beta_5 InGDPPC_{it} + \beta_6 InDCPSGDP_{it} + \beta_7 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_{10} DIR_{it} + \mu_{it} \text{----------(17b)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 TRW_{it} + \beta_3 PSAV_{it} + \beta_4 VA_{it} + \beta_5 InGDPPC_{it} + \beta_6 InDCPSGDP_{it} + \beta_7 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_{10} DIR_{it} + \mu_{it} \text{----------(17c)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 EXW_{it} + \beta_3 PSAV_{it} + \beta_4 VA_{it} + \beta_5 InGDPPC_{it} + \beta_6 InDCPSGDP_{it} + \beta_7 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_{10} DIR_{it} + \mu_{it} \text{----------(17d)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 CPW_{it} + \beta_3 PSAV_{it} + \beta_4 VA_{it} + \beta_5 InGDPPC_{it} + \beta_6 InDCPSGDP_{it} + \beta_7 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_{10} DIR_{it} + \mu_{it} \text{----------(17e)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 LDW_{it} + \beta_3 PSAV_{it} + \beta_4 VA_{it} + \beta_5 InGDPPC_{it} + \beta_6 InDCPSGDP_{it} + \beta_7 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_{10} DIR_{it} + \mu_{it} \text{----------(17f)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 PCW_{it} + \beta_3 PSAV_{it} + \beta_4 VA_{it} + \beta_5 InGDPPC_{it} + \beta_6 InDCPSGDP_{it} + \beta_7 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_{10} DIR_{it} + \mu_{it} \text{----------(17g)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 FSW_{it} + \beta_3 PSAV_{it} + \beta_4 VA_{it} + \beta_5 InGDPPC_{it} + \beta_6 InDCPSGDP_{it} + \beta_7 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_{10} DIR_{it} + \mu_{it}$$ ----------(17h)

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 SCW_{it} + \beta_3 PSAV_{it} + \beta_4 VA_{it} + \beta_5 InGDPPC_{it} + \beta_6 InDCPSGDP_{it} + \beta_7 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_{10} DIR_{it} + \mu_{it}$$ ----------(17i)

Since efficacy of enforcement of banking sector regulatory standards and supervision is guaranteed by favorable institutional climate, in the current thesis we also examine the influence of interaction between banking sector regulation and institutional quality on digital financial inclusion. In line with interaction term was introduced, the model 17a to 17i are slightly modified and specified using institutional quality measures: political stability and absence of violence(PSAV) as follow:

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 ETW_{it} + \beta_3 (ETW \times PSAV)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_9 InTO_{it} + \beta_{10} InINFCPI_{it} + \beta_9 DIR_{it} + \mu_{it}$$ ---------- (18a)

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 ACW_{it} + \beta_3 (ACW \times PSAV)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_9 DIR_{it} + \mu_{it}$$ ----------(18b)

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 TRW_{it} + \beta_3 (TRW \times PSAV)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_9 InTO_{it} + \beta_{10} InINFCPI_{it} + \beta_9 DIR_{it} + \mu_{it}$$ ----------(18c)

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 EXW_{it} + \beta_3 (EXW \times PSAV)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_8 InTO_{it} + \beta_9 InINFCPI_{it} + \beta_9 DIR_{it} + \mu_{it}$$ ----------(18d)

$$DFIINDEX_{it}=\beta_0+\beta_1 DFIINDEX_{it-1}+\beta_2 CPW_{it}+\beta_3(CPW\times PSAV)_{it}+\beta_4 PSAV_{it}+\beta_5 VA_{it}+\beta_6 InGDPPC_{it}+\beta_7 InDCPSGDP_{it}+\beta_8 POPGRTH_{it}+\beta_9 InTO_{it}+\beta_{10} InINFCPI_{it}+\beta_9 DIR_{it}+\mu_{it}\text{----------(18e)}$$

$$DFIINDEX_{it}=\beta_0+\beta_1 DFIINDEX_{it-1}+\beta_2 LDW_{it}+\beta_3(LDW\times PSAV)_{it}+\beta_4 PSAV_{it}+\beta_5 VA_{it}+\beta_6 InGDPPC_{it}+\beta_7 InDCPSGDP_{it}+\beta_8 POPGRTH_{it}+\beta_9 InTO_{it}+\beta_{10} InINFCPI_{it}+\beta_9 DIR_{it}+\mu_{it}\text{----------(18f)}$$

$$DFIINDEX_{it}=\beta_0+\beta_1 DFIINDEX_{it-1}+\beta_2 PCW_{it}+\beta_3(PCW\times PSAV)_{it}+\beta_4 PSAV_{it}+\beta_5 VA_{it}+\beta_6 InGDPPC_{it}+\beta_7 InDCPSGDP_{it}+\beta_8 POPGRTH_{it}+\beta_9 InTO_{it}+\beta_{10} InINFCPI_{it}+\beta_9 DIR_{it}+\mu_{it}\text{----------(18g)}$$

$$DFIINDEX_{it}=\beta_0+\beta_1 DFIINDEX_{it-1}+\beta_2 FSW_{it}+\beta_3(FSW\times PSAV)_{it}+\beta_4 PSAV_{it}+\beta_5 VA_{it}+\beta_6 InGDPPC_{it}+\beta_7 InDCPSGDP_{it}+\beta_8 POPGRTH_{it}+\beta_9 InTO_{it}+\beta_{10} InINFCPI_{it}+\beta_{11} DIR_{it}+\mu_{it}\text{----------(18h)}$$

$$DFIINDEX_{it}=\beta_0+\beta_1 DFIINDEX_{it-1}+\beta_2 SCW_{it}+\beta_3(SCW\times PSAV)_{it}+\beta_4 PSAV_{it}+\beta_5 VA_{it}+\beta_6 InGDPPC_{it}+\beta_7 InDCPSGDP_{it}+\beta_8 POPGRTH_{it}+\beta_9 InTO_{it}+\beta_{10} InINFCPI_{it}+\beta_9 DIR_{it}+\mu_{it}\text{----------(18i)}$$

Where $(ETW\times PSAV)_{it}$, $(ACW\times PSAV)_{it}$, $(TRW\times PSAV)_{it}$, $(EXW\times PSAV)_{it}$,$(CPW\times PSAV)_{it}$, $(LDW\times PSAV)_{it}$, $(PCW\times PSAV)_{it}$, $(FSW\times PSAV)_{it}$, $and\ (SCW\times PSAV)_{it}$ represent the interaction terms of entry restriction and stable political system with absence of violence, activity restrictions, transparency requirement and stable political system with absence of violence, exit restrictions and stable political system with absence of violence, capital stringency and stable political system with absence of violence, liquidity diversification and stable political system with absence of violence, price control and stable political system with absence of violence, financial safety net and stable political system with absence of violence,

supervision quality and stable political system with absence of violence respectively.

Where institutional quality measure used is voice and accountability(VA), the modified models are accordingly specified as follow:

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 ETW_{it} + \beta_3 (ETW \times VA)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_9 InTO_{it} + \beta_{10} InINFCPI_{it} + \beta_{11} DIR_{it} + \mu_{it} \text{---------- (19a)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 ACW_{it} + \beta_3 (ACW \times VA)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_9 InTO_{it} + \beta_{10} InINFCPI_{it} + \beta_{11} DIR_{it} + \mu_{it} \text{----------(19b)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 TRW_{it} + \beta_3 (TRW \times VA)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_9 InTO_{it} + \beta_{10} InINFCPI_{it} + \beta_{11} DIR_{it} + \mu_{it} \text{----------(19c)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 EXW_{it} + \beta_3 (EXW \times VA)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_9 InTO_{it} + \beta_{10} InINFCPI_{it} + \beta_{11} DIR_{it} + \mu_{it} \text{----------(19d)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 CPW_{it} + \beta_3 (CPW \times VA)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_9 InTO_{it} + \beta_{10} InINFCPI_{it} + \beta_{11} DIR_{it} + \mu_{it} \text{----------(19e)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 LDW_{it} + \beta_3 (LDW \times VA)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_9 InTO_{it} + \beta_{10} InINFCPI_{it} + \beta_{11} DIR_{it} + \mu_{it} \text{----------(19f)}$$

$$DFIINDEX_{it} = \beta_0 + \beta_1 DFIINDEX_{it-1} + \beta_2 PCW_{it} + \beta_3 (PCW \times VA)_{it} + \beta_4 PSAV_{it} + \beta_5 VA_{it} + \beta_6 InGDPPC_{it} + \beta_7 InDCPSGDP_{it} + \beta_8 POPGRTH_{it} + \beta_9 InTO_{it} + \beta_{10} InINFCPI_{it} + \beta_{11} DIR_{it} + \mu_{it} \text{----------(19g)}$$

$$DFIINDEX_{it}=\beta_0+\beta_1 DFIINDEX_{it-1}+\beta_2 FSW_{it}+\beta_3(FSW\times VA)_{it}+\beta_4 PSAV_{it}+\beta_5 VA_{it}+\beta_6 InGDPPC_{it}+\beta_7 InDCPSGDP_{it}+\beta_8 POPGRTH_{it}+\beta_9 InTO_{it}+\beta_{10} InINFCPI_{it}+\beta_{11} DIR_{it}+\mu_{it}$$ ----------(19h)

$$DFIINDEX_{it}=\beta_0+\beta_1 DFIINDEX_{it-1}+\beta_2 SCW_{it}+\beta_3(SCW\times VA)_{it}+\beta_4 PSAV_{it}+\beta_5 VA_{it}+\beta_6 InGDPPC_{it}+\beta_7 InDCPSGDP_{it}+\beta_8 POPGRTH_{it}+\beta_9 InTO_{it}+\beta_{10} InINFCPI_{it}+\beta_{11} DIR_{it}+\mu_{it}$$ ----------(19i)

Where $(ETW\times VA)_{it}$, $(ACW\times VA)_{it}$, $(TRW\times VA)_{it}$, $(EXW\times VA)_{it}$, $(CPW\times VA)_{it}$, $(LDW\times VA)_{it}$, $(PCW\times VA)_{it}, (FSW\times VA)_{it}, and\ (SCW\times VA)_{it}$ represent the interaction terms of entry restriction and voice and accountability, activity restrictions, transparency requirement and voice and accountability, exit restrictions and voice and accountability, capital stringency and voice and accountability, liquidity diversification and voice and accountability, price control and voice and accountability, financial safety net and voice and accountability, supervision quality and voice and accountability respectively.

Variable description and Data

Several databases, namely: World bank World Development Indicators (WDI), Worldwide Governance Indicators(WGI), Bankscope and GFD served as source of data for this study. Specifically, banking sector regulation variables are extracted from bankscope database, digital financial inclusion from WDI, institutional quality variables are taken from WGI and other variables are taken from WDI. Despite the fact that the study concentrates on countries in SSA, 25 countries have been sampled for the study due to availability of data spanning 2014-2020 period. For the dependent variable, a digital financial inclusion index(DFIINDEX) was constructed from four

variables of digital financial inclusion by following (Chinoda &Kapingura, 2024) using principal component analysis(PCA).

Principal Component Analysis

Focusing on index construction, a PCA was deployed to give rise to digital financial inclusion index by utilising four variables of DFI. With the PCA, the jth factor index can be generated using the under stated equation as:

$$DFIINDEX_j = W_{j1}X_1 + W_{j2}X_2 + W_{j3}X_3 + W_{j4}X_4 + \ldots + W_{jn}X_n \text{----(20)}$$

In this case, $DFIINDEX_j$ is the index of digital financial inclusion, the factor of parameter is represented by W_j, X denotes the corresponding initial value of the constituents; and n is the number of variables in the equation. In this analysis, two dimension of digital financial inclusion form the DFIINDEX with two variables for each dimension. The first dimension entails individual internet usage as percent of population and mobile cellular subscription. The second dimension has constituents of number of registered mobile money agents and number of registered mobile money users. Thus, four variables constitute the digital financial inclusion index, DFIINDEX. Hence, the index can be formulated as:

$$\text{DFIINDEX} = \int(INDINTER, MOBC100, NRMMA, NRMMU) \text{ -----(10)}$$

Table 13: Indicators of Variables

Variable	Notation	Description	Source
Digital financial inclusion index	DFIINDEX	An index from internet usage, mobile cellular subscription, number of registered mobile money agents, number of registered mobile money users	
Digital financial inclusion	INDINTER	Percentage of population with internet	WDI
Digital financial inclusion	MOBC100	Mobile subscription per 100 people	WDI
Digital financial inclusion	NRMMA	Number of registered mobile money agents per 1,000 adults	WDI
Digital financial inclusion	NRMMU	Number of registered mobile money users per 1000 adults	WDI
Entry restriction	ETW	Information restriction of foreign bank entry	Bankscope
Activity restrictions,	ACW	Captures information about non-banking activities	Bankscope
Transparency requirement	TRW	Captures Level of information disclosure	Bankscope
Exit restrictions	EXW	Bank solvency	Bankscope
Capital stringency	CPW	Capital requirements or capital adequacy ratio	Bankscope
Liquidity diversification	LDW	Liquidity of assets	Bankscope
Price control	PCW	Price and fees	Bankscope
Financial safety net	FSW	Availability of deposit insurance	Bankscope
Supervision quality	SCW	Supervisory resources	Bankscope
Interaction term	ETW*PSAV	BSR and Institutional quality interactive term	
Institutional quality	PSAV	Institutional aspect for selection and monitory	WGI
Institutional quality	VA	Institutional aspect for selection and monitory	WGI
Economic growth	GDPPC	GDP per capita growth	WDI
Population growth	POPGRTH		WDI
Economic cycle	TO	Trade openness	WDI
Economic cycle	INFCPI	Change in consumer price index	WDI
Economic development	DCPGDP	Domestic credit to private sector (% GDP),	IFS
Financial inclusion	DIR	Deposit interest rate	IFS

Source: Author's construct (2024)

Empirical results and discussion

Descriptive analysis

Table 14 provides summary statistics of the main and control variables for objective two of this thesis. Usually, digital financial inclusion in Sub-

Saharan Africa (SSA) is remarkably low, yielding 42%, with a range of 3% to 54.6%, indicating a spread from its own mean of 11%. This disparity points to significant digital financial inclusion gap across the countries in SSA region, consistent with Mehrotra and Yetman (2015), as well as Chinoda and Kapingura (2024) who reported significant digital financial inclusion gap within the SSA region. Notwithstanding digital financial inclusion gap, 88.89% adult population in SSA own mobile phones and 26.6% have access to the internet, signaling the increasing potential for inclusion of unbanked population into formal financial system through digital means. Concerning, financial regulation measures,

Table 14: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
NRMMAper1000	175	44.838	73.616	.055	423.892
NRMMUper1000	175	7116.011	10627.248	.893	66005.789
MOBC100	173	88.893	36.965	31.363	185.559
INDINTER	171	26.552	18.694	1.249	75.469
DFIINDEX	170	0.42	0.11	0.03	0.546
POV	175	1.631	1.534	.02	6.74
ETW	154	3.763	1.892	1.042	7.083
PAW	154	4.123	.999	2.143	6.429
TRW	154	8.512	.927	6.25	9.881
EXW	154	5.455	3.255	.833	10
CLW	154	6.237	1.517	2.778	8.889
LDW	154	5.379	1.118	2.708	7.083
PCW	154	1.098	1.584	0	5.278
FSW	154	1.97	3.321	0	9.286
SCW	154	4.567	.725	3.402	5.823
INCPI	172	11.004	46.361	-2.49	557.202
POPGRTH	175	2.294	.885	.002	3.867
GDPPC	175	2786.251	3453.845	433.838	16747.343
DCPSGDP	166	26.772	27.408	5.238	128.838
DIR	148	6.141	3.655	1.107	17.09
PSAV	175	-.405	.723	-2.13	1.095
VA	175	-.386	.662	-1.465	.94

POV represents poverty level, DFIINDEX represents the digital finance index, NRMMAper1000 represents the number of mobile money agents per 1000 people, NRMMUper1000 represents the number of mobile money users per 1000 people, INDINTER represents Individuals using internet as a percentage of total population, MOBC100 mobile cellular subscriptions per 100, GDPPC represents GDP per capita growth, POPGRTH represents population growth, INFCPI represents CPI inflation, DCPSGDP represents domestic credit to private sector (%GDP), DIR represents deposit interest rate, PSAV represents political stability and absence of violence, VA represents voice and accountability. Also, entry restrictions has been abbreviated as ETW, ACW stands for activity restrictions, TRW denotes transparency requirement, EXW represents exit restrictions, CPW capital stringency, LDW is liquidity diversification, PCW represents price control, FSW denotes financial safety net, SCW represents supervision quality. All the other variables are previously defined.

Entry restriction (ETW), a proxy of banking sector regulation, has a mean score of 3.76%, and vary from its mean by 1.89% with a range of 1.04–7.08 in Sub-Saharan Africa. Also, activity restrictions (PAW) has a mean of 4.12 with a range of 2.14 to 6.43 and vary from the mean by 0.99. Transparency requirement (TRW) has a mean of 8.51 with a range, 6.25 -9.88 and vary from the mean by 0.93. Exit restrictions (EXW) has a mean score of 5.45, which falls within the range of 0.83 to 10 but varies around the mean by 3.25. Capital stringency (CPW) which measures both the risk capital and buffer of the financial institutions has a mean score of 6.23 which falls within the range of scores of 2.78 to 8.88 but varies slightly around its own mean score by 1.52. Liquidity diversification (LDW) has a mean score of 6.23, which associated with the range of values of 2.71 to 7.08 but exhibited some level of variation from its own mean by 1.12. Price control (PCW) has a mean score of 1.08 and ranges from 0 to 5.28 but varies from its own mean score by 1.58. Financial safety net (FSW) recorded a mean score of 1.97 with range of scores from 0 to 9.29 and vary from its own mean score by 3.32 which indicate huge variation in financial safety net among countries in SSA. Finally, supervision quality (SCW) records a mean score of 4.57 and standard deviation of 0.73 with a range of 3.40 to 5.82.

Regarding political stability and absence of violence of economies of SSA, the political stability and absence of violence (PSAV), as well as voice and accountability (VA) recorded mean scores of -0.41 and -0.386 respectively. Their associated standard deviation values are 0.72 and 0.66. This signifies that the institutional quality (represented by PSAV and VA) in SSA appears delicate as reveal by political stability and absence of violence

(PSAV), as well as voice and accountability (VA) average scores. This implies that SSA economies have serious fragile institutional quality that is consistent with earlier findings of Chinoda and Kapingura (2024).

Correlation analysis

Table 15 presents the relationships between the variables explored in objective two of this thesis, shedding light on their nature, strength and possibility of issue of multicollinearity. It emerges from the results display that digital financial inclusion is positively and significantly associated with liquidity restriction, financial safety net restriction, supervision quality, deposit interest rate, GDP per capita growth, domestic credit to private sector and population growth, at a confidence level of 10%. Furthermore, digital financial inclusion has a significant negative correlation with entry restriction, activity restriction, political stability and absence of violence, also at 10% confidence level. All correlation coefficients established do not exceed 0.8, suggesting that the variables used for the estimation are not highly correlated with each other. Further, to validate the instrumental variables deployed, Sargan- Hansen test was conducted.

Table 15: Pairwise correlations

Variables	(1)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) DFIINDX	1.000																	
(2)L.DFIINDEX	0.946*	1.000																
(3) ETW	-0.161*	0.148	1.000															
(4) ACW	-0.343*	0.363*	-0.026	1.000														
(5) TRW	-0.023	-0.020	0.107	0.196*	1.000													
(6) EXW	0.043	0.043	-0.358*	-0.300*	0.098	1.000												
(7) CPW	-0.112	0.100	-0.100	-0.060	0.078	0.417*	1.000											
(8) LDW	0.268*	0.258*	-0.194*	0.219*	-0.134	-0.113	-0.024	1.000										
(9) PCW	0.111	-0.095	0.436*	-0.027	-0.011	-0.607*	-0.158	-0.395*	1.000									
(10) FSW	0.258*	0.267*	0.359*	0.013	0.322*	0.100	-0.137	0.057	0.162*	1.000								
(11) SCW	0.333*	0.337*	0.399*	0.054	0.459*	0.387*	0.339*	0.001	0.044	0.819*	1.000							
(12) PSAV	-0.210*	-0.217*	-0.303*	-0.068	0.026	0.208*	0.463*	0.036	-0.331*	-0.667*	-0.334*	1.000						
(13) VA	0.005	0.001	-0.080	-0.178*	0.132	0.091	0.187*	-0.280*	-0.123	-0.416*	-0.262*	0.577*	1.000					
(14) DIR	0.430*	0.394*	0.338*	0.340*	-0.090	-0.148	0.092	0.009	0.076	0.044	0.152	-0.208*	0.129	1.000				
(15)GDPPC	0.255*	-0.250*	-0.270*	-0.397*	0.081	0.517*	0.239*	-0.230*	-0.207*	-0.248*	-0.034	0.596*	0.491*	-0.329*	1.000			
(16) DCPSGDP	0.193*	-0.189*	-0.040	-0.232*	0.316*	0.136	0.116	-0.469*	0.096	-0.256*	-0.108	0.439*	0.612*	-0.094	0.635*	1.000		
(17) POPGRTH	0.176*	0.176*	0.271*	0.426*	0.102	-0.296*	-0.314*	0.227*	0.227*	0.330*	0.224*	-0.532*	-0.461*	0.353*	-0.611*	-0.595*	1.000	
(18) lnINFCPI	-0.111	0.085	0.084	-0.049	-0.262*	0.002	-0.002	0.253*	-0.271*	-0.179*	-0.150	-0.149	-0.010	0.295*	-0.256*	-0.239*	0.172*	1.000

**** p<0.01, ** p<0.05, * p<0.1*

POV represents poverty level, DFIINDEX represents the digital finance index, NRMMAper1000 represents the number of mobile money agents per 1000 people, NRMMUper1000 represents the number of mobile money users per 1000 people, INDINTER represents Individuals using internet as a percentage of total population, MOBC100 mobile cellular subscriptions per 100, GDPPC represents GDP per capita growth, POPGRTH represents population growth, INFCPI represents CPI inflation, DCPSGDP represents domestic credit to private sector (%GDP), DIR represents deposit interest rate, PSAV represents political stability and absence of violence, VA represents voice and accountability. ETW represents entry restrictions, ACW stands for activity restrictions, TRW denotes transparency requirement, EXW represents exit restrictions, CPW is stringent capital requirement, LDW denotes liquidity diversification, PCW represents price control, FSW denotes financial safety net, SCW represents supervision quality. All the other variables are previously defined.

Direct effect of banking sector regulations on digital financial inclusion

The system GMM estimates of DFI index (DFIINDEX) and banking sector regulation factors of the sampled economies in SSA are displayed in table 16. The table entails 9 models shown in columns 1 to 9. Consistently the system GMM estimates obtained across different model specifications (models 4, 6, 7, 8 and 9) yield positive and statistically significant coefficient of digital financial inclusion. This indicates that strengthening banking regulations (stringent exit restriction, stringent liquidity restriction, tighter price controls, stricter safety net restriction and tighter supervisory quality mechanisms respectively) correlate positively with digital financial inclusion. Specifically, in model 4, there is a corroboration that exit restriction positively predict digital financial inclusion. This finding implies that controlled exit may stimulate financial innovation without compromising stability, and thereby enhancing digital financial inclusion. This finding resonates with earlier study by Ahamed et al. (2021) that highlight that strong positive association exist between financial inclusion and bank efficiency. However, this finding does not corroborate Triki et al. (2017)'s findings that averred that stringent exit restriction negatively influence efficiency of banks. The explanation for this finding may be that most economies in Sub-Saharan African have not fully implemented all pillars of Basel III accord.

One of the essential financial regulation mechanisms is stringent liquidity restriction in financial system in SSA. It appears that liquidity restriction plays a beneficiary role in fostering stable, efficient and trustworthy environment within the digital financial service sector. On the contribution of liquidity restriction to digital financial inclusion, the coefficient of liquidity

restriction (shown in model 6 of table 16) is positive and significant, indicating stringent liquidity restrictions do not hinder enhancement in digital financial inclusion. This finding suggests that after financial institutions implemented stringent liquidity regulations and having a sufficient buffer of liquid assets to a point (Pavón-Cuéllar, 2019), they may feel confidence and secure to extent credit to borrowers. However, it contradicts the assertion by Pavón Cuéllar (2019) that liquidity restrictions make vulnerable individuals and companies across the globe financially excluded. One explanation for the contradictory result is that mandatory maintenance of liquid assets by financial institutions contributes to heightened financial stability, potentially attracting users who may have been hesitant due to concerns about the reliability of digital financial services. Additionally, the positive relationship may be rooted in the prevention of liquidity crisis and disruption, making digital financial services more appealing and reliable to a broader user base. Despite theoretical expectation, this result suggests that, in the specific context, more liquidity restrictions are associated with increased trust, regulatory compliance and innovation, ultimately contributing to digital financial inclusion.

Focusing on effect of stringent price control on digital financial inclusion, results displayed in model 7 reveal a positive relationship between price control restriction and digital financial inclusion. Thus, finding implies that control of transaction fees and account maintenance fees serving as stringent price control (Triki et al., 2017) may render digital financial services affordable and accessible, which may lead to increase digital financial inclusion. This finding contradicts the works of earlier studies by di Castri et al. (2014) who find that price control stifles innovation, suffocate economics

of mobile money and limits efficient allocation of resources. A possible explanation for inconsistency in the findings with that of di Castri et al. (2014) may highlight the possibility that there is digital financial inclusion gap in countries in SSA.

Contrary to positive coefficients of digital financial inclusion for models 4, 6, 7, 8 and 9 in table 16, the coefficients of digital financial inclusion in models 1, 2, 3 and 5 are negative. The negative and significant coefficients of digital financial inclusion indicate that reducing entry, activity, transparency and capital restrictions positively impact digital financial inclusion. In particular, in model 1, stringent entry restriction, reduces essentially the extent to which new financial institutions enter the financial system thereby negatively impact digital financial inclusion. The findings indicate that stringent entry restriction may hinder the growth of digital financial services and products. This finding aligns with earlier studies by Triki et al. (2017) that highlight the importance of stringent entry restrictions for increase efficiency of banks. Increased efficiency of banks may be as a result of adoption of financial innovations, which in turn stir digital financial inclusion.

Another important driver of financial exclusion in SSA is information asymmetry. Asymmetric information could be eliminated through stringent activity restriction, which reduces diversification. In model 2, negative coefficient of activity restriction also demonstrates that reducing activity restrictions will lead to increased digital financial inclusion. This result is consistent with empirical claim that tighter activity restrictions encourage a reduction in incentives of depositors to monitor banks and the ability of

managers to engage in risky investments (Fonseca & González, 2010), thereby curtailing investment in digital financial infrastructure and consequently reducing digital financial inclusion. Further, activity restrictions may reduce product innovation and outreach (Bebczuk, 2008), which may stifle investment digital financial infrastructure, leading to decline in usage and access of digital financial services.

Stronger transparency is an important part of banking sector regulation structure that limit information asymmetry. Elimination of asymmetric information in financial distribution channels accelerates financial inclusion among financially excluded and disadvantage populace. As shown in model 3 of table 16, the results indicate that the impact of strong transparent restriction on digital financial inclusion is negative and significant at 5% level. The finding suggests that improving disclosure practices and compulsory audit regime facilitate transparency and reduces information asymmetry. The result is similar to the work of Song et al. (2020) who find that absence of transparency is detrimental to financial development.

Another critical driver of DFI is efficient allocation of financial resources or greater flow of low-cost funds for high return investments. Efficient allocation of resources is associated with stringent capital restrictions. In model 5, the findings show that stringent capital regulation is negatively related to the digital financial inclusion, implying that more stringent capital restriction is a hindrance to digital financial inclusion. It is imperative to note that a more stringent capital regulation restricts development of new financial products and services coupled with innovative financial products, thereby it is inimical to financial inclusion. This finding

confirms the earlier studies of Anarfo et al. (2020), Shama and Pais (2011) and Kondogo (2018) that report that stricter capital regulation reduces financial inclusion.

Increased liquidity and diversification requirements coupled with availability of financial safety nets exhibit efficiency enhancing effect in financial system. In the model 6 of table 16 the results exhibit that more stringent liquidity restriction recorded a positive coefficient of 0.332. This result suggests that digital financial inclusion in SSA economies is high when stringent liquidity restriction mechanisms are put in place, even when other factors that drive digital financial inclusion are accounted for. The result signifies that tightening of liquidity regulations does not shrink ability of financial institutions to advance credit to more economic agents. This result supports the findings of Banerjee and Mio (2018) that illustrate that tightening of liquidity regulations does not cause banks to shrink volume of lending to non-financial sector.

Another driver of digital financial inclusion is trust and reliability of digital financial services. Trust and reliability of financial services are consequences of financial consumer protection. Supervisory quality is critical for financial consumer protection. In model 9 of table 16, more supervisory quality has positive coefficient and is significant, indicating that more quality supervision on activities of financial institutions promote trust, reliable and protection of financial consumer, which in turn enhance digital financial inclusion. The findings signify that more stringent supervisory quality appears to be key factor for success of digital financial inclusion initiatives, as it is likely to permit critical innovation and deployment of mobile money services

and digital financial services. This result corroborates the earlier findings of Rojas-Suarez and Pacheco (2017) who report that supervisory quality is an enabler of financial inclusion.

Financial safety net function entails deposit insurance function. Deposit insurance plays important roles in promoting technology innovations and financial inclusion initiatives. In model 8 of table 16, availability of financial safety net has positive coefficient and is significant, meaning that more financial safety nets promote financial innovations, and technological innovation, thereby leading to enhancement in digital financial inclusion. This finding supports the earlier study by Izaguirre et al. (2016) who argue that deposit insurance promotes financial inclusion.

In model 7 of table 16 the result on relation between price control restriction and digital financial inclusion was reported. The system GMM estimation results reveal a positive coefficient and it is significant, indicating that statistical significant correlation between more stringent price control and digital financial inclusion. Plausible implication of the result is that tightening of price control mechanisms increase digital financial inclusion. This increase in digital financial inclusion is likely to be driven by reduction in transaction cost and processing fees associated with tightening of price controls restrictions. This result does not align with di Castri et al.(2014) who assert that apart from preventing efficient allocation of resources, price controls can stifle innovation and suffocate economics of mobile money and halt expansion of service across regions, thereby reducing digital financial inclusion.

Model 9 of table 16 reveals positive association between strengthening supervisory quality and digital financial inclusion. This is because result of

system GMM estimation reveal a positive coefficient and it is significant, indicating that statistical significant correlation between more quality supervisory restrictions and digital financial inclusion. This finding signifies that making supervision more independent and making more supervisory resources available drive investment in digital financial innovations. In essence, this has rippling effect on access, penetration and usage of digital financial infrastructure and digital financial services, and ultimately leading to enhancement in DFI. This finding corroborates the results of Beck et al. (2006), and Hague (2018) whose results assert that continuous supervision is key to effective implementation and enforcement discipline bank behaviour that can lead to better appreciation and fairness in pricing of bank risk by market participants, mitigating against market failure, leading to financial stability.

Table 16: Direct effect of banking sector regulation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
l.DFIINDEX	0.901***	0.819***	0.811***	0.907***	0.825***	0.910***	0.845***	0.851***	0.808***
	(0.084)	(0.139)	(0.066)	(0.215)	(0.086)	(0.072)	(0.160)	(0.075)	(0.057)
ETW	-0.116***								
	(0.027)								
ACW		-0.109***							
		(0.038)							
TRW			-0.160**						
			(0.069)						
EXW				0.280***					
				(0.036)					
CPW					-0.121*				
					(0.061)				
LDW						0.332***			
						(0.026)			
PCW							0.333***		
							(0.046)		
FSW								0.129*	
								(0.071)	
SCW									0.188***
									(0.038)
PSAV	-0.485***	-0.381***	-0.610*	-0.631***	-0.518**	-0.643**	-0.532**	-0.516**	-0.624**
	(0.105)	(0.118)	(0.343)	(0.222)	(0.215)	(0.235)	(0.217)	(0.205)	(0.282)
VA	0.848***	0.836**	0.579**	0.634*	0.896***	0.393**	0.449*	0.497*	0.706***
	(0.235)	(0.358)	(0.270)	(0.337)	(0.298)	(0.154)	(0.238)	(0.294)	(0.255)
lnGDPPC	0.357***	0.551***	0.426*	0.637***	0.431*	0.412*	0.732***	0.527**	0.333**
	(0.126)	(0.180)	(0.259)	(0.217)	(0.241)	(0.213)	(0.143)	(0.220)	(0.151)
lnDCPSGDP	0.938***	0.336**	0.329*	0.202***	0.136***	0.545**	0.477*	0.347***	0.645***
	(0.173)	(0.160)	(0.198)	(0.046)	(0.014)	(0.234)	(0.257)	(0.131)	(0.142)
POPGRTH	0.991*	0.618	0.671*	0.992*	0.838*	0.667**	0.615**	0.631*	0.901*
	(0.510)	(0.504)	(0.351)	(0.510)	(0.469)	(0.309)	(0.303)	(0.332)	(0.501)
DIR	0.021	0.047	0.032	0.043	0.046	0.051*	0.089	0.042**	0.021
	(0.035)	(0.036)	(0.023)	(0.055)	(0.046)	(0.028)	(0.069)	(0.021)	(0.019)

lnINFCPI	-0.091***	-0.105	-0.081	-0.097***	-0.065***	-0.042	-0.014	-0.126*	-0.191**
	(0.018)	(0.101)	(0.054)	(0.016)	(0.024)	(0.028)	(0.010)	(0.064)	(0.082)
Constant	0.278	-3.527	-1.307	-3.660	-2.243	2.436	-0.811	0.904	6.235
	(2.682)	(17.14)	(6.560)	(4.407)	(6.077)	(9.083)	(2.976)	(4.828)	(8.038)
Observations	116	116	116	116	116	116	116	116	116
No. of instruments	19	19	19	19	19	19	19	19	19
AR1 (p-value)	0.213	0.223	0.235	0.148	0.245	0.229	0.202	0.240	0.232
AR2 (p-value)	0.302	0.299	0.314	0.283	0.319	0.328	0.273	0.352	0.360
Hansen-J (p-value)	0.860	0.891	0.789	0.985	0.847	0.807	0.842	0.780	0.826

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.010

POV represents poverty level, DFIINDEX represents the digital finance index, NRMMAper1000 represents the number of mobile money agents per 1000 people, NRMMUper1000 represents the number of mobile money users per 1000 people, INDINTER represents Individuals using internet as a percentage of total population, MOBC100 mobile cellular subscriptions per 100, GDPPC represents GDP per capita growth, POPGRTH represents population growth, INFCPI represents CPI inflation, DCPSGDP represents domestic credit to private sector (%GDP), DIR represents deposit interest rate, PSAV represents political stability and absence of violence, VA represents voice and accountability. ETW denotes entry restrictions, ACW denotes activity restrictions, TRW denotes transparency requirement, EXW denotes exit restrictions, CPW capital stringency, LDW denotes liquidity diversification, PCW denotes price control, FSW denotes financial safety net, SCW denotes supervision quality. All the other variables are previously defined.

Concerning the control variables, the coefficient of PSAV is mostly negative and significant in all the models displayed in table 16. The result suggests that sound political system is related to greater digital financial inclusion that is consistent with the claim that stable political system and absence of violence ensure soundness, stability and safety of financial system. Also, economic growth (InGDPPC) positively and significantly predict digital financial inclusion. Mostly the domestic credit to private sector (%GDP) (DCPSGDP) has a positive coefficient and significant at 1%, indicating that the more credit is made available in the economy the more digital financial become inclusive. Another control variable included in the thesis is CPI inflation, which proxies' macroeconomic stability. Normally, it is expected that rise in inflation should hinder participation in financial systems, as a result of high interest rate, leading to fall in demand for new credit and credit volumes. Results in table 16 mostly show that the CPI inflation is negatively related to digital financial inclusion. This means that increasing inflation appears not to be favourable for investment in digitally driven financial innovation (mobile money, delivery channels and products), thus negative effect on digital financial inclusion.

Moderating effect of political stability and absence of violence

In this section an interaction term was introduced to examine the indirect effects of banking sector regulation factors on digital financial inclusion in the presence of conditioning factor, political stability and absence of violence. In this case, banking sector regulations mechanisms are interacted with political stability and absence of violence (PSAV) to form a new variable (for example, ETW*PSAV). The purpose of deploying interaction terms was to examine whether political governance could enhance and strengthen effects of banking

sector regulations on digital financial inclusion. The expectation therefore is that when political systems are sound, stable and safe, stringent banking sector regulations will not hinder digital financial inclusion activities of financial systems. Table 17 shows the regression results of the interaction terms. In model 1, the interaction result of stringent exit restriction and political stability and absence of violence maintains a positive relation with digital financial inclusion for the sampled economies in SSA, suggesting an inter-dependence between rules and regulatory mechanisms of entry into financial system and political stability mechanisms. This result supports the hypothesis that positive effect of more stringent entry restriction on digital financial inclusion is conditioned on sound political stability and absence of violence. The findings support the empirical evidence that institutional structures promotes effective enforcement of banking regulations (Sodokin et al., 2023).

The interaction result for activity restriction is interesting. The findings in model 2 of table 17 reveal that interaction of activity restriction and political stability and absence of violence has a positive effect on digital financial inclusion.

With the interaction of stringent transparent restriction and political stability and absence of violence, the thesis intents to establish the impact of stringent transparent restriction on DFI in the presence of a nation's political stability. The result shown in model 3 of table 17 discloses a positive interaction term which is significant and has a coefficient of 0.866. The result suggests enhancement in digital financial inclusion dynamics in SSA his heighten when transparency restriction is tighter and political stability is of high quality. This implies that the combination of transparency restriction and political stability

significantly enhance digital financial inclusion condition in SSA.

In view of the interaction of stringent exit restriction and political stability and absence of violence, the thesis further examines whether impact of stringent exit restrictions on digital financial inclusion is moderated by stable political system of a nation. The result displayed in model 3 of table 17 pointed out that DFI dynamics in SSA is enhanced when exit restrictions is tighter and political stability is of high quality. However, result was not significant. This implies that combined effect of stringent exit restriction and political stability is insignificantly in digital financial inclusion condition in the context of SSA.

The result of coefficient of interaction term of stringent liquidity restriction and stable political system is positive and significant, demonstrating that more stringent liquidity restriction enhances digital financial inclusion in the presence of stable political system. This signifies that stable political system enhances the effects of stringent liquidity restriction in promoting digital financial inclusion. In all the coefficients of the interaction terms of dimensions of banking sector regulation in exception exit and capital requirement restriction and political stability and absence of violence are significantly positive. It appears that unit increase in each of the interaction terms bring about between 6.1% to 86.6% increase in digital financial inclusion. This suggests that stable institutional structures are deployed to facilitate the process to select, monitor and replace governments in SSA enhances access, penetration and usage of digital financial services and infrastructure. This finding corroborates the results of (EL-Moussawi et al., 2023; Sodokin et al., 2023).

Table 17: Moderating effect of political stability and absence of violence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
l.DFIINDEX	0.807***	0.831***	0.811***	0.815***	0.822***	0.808***	0.881***	0.807***	0.808***
	(0.123)	(0.190)	(0.081)	(0.245)	(0.418)	(0.094)	(0.198)	(0.071)	(0.058)
ETW	-0.109***								
	(0.037)								
ETW*PSAV	0.061**								
	(0.032)								
ACW		-0.083							
		(0.073)							
ACW*PSAV		0.130**							
		(0.061)							
TRW			0.141						
			(0.094)						
TRW*PSAV			0.866***						
			(0.218)						
EXW				0.314***					
				(0.073)					
EXW*PSAV				0.052					
				(0.048)					
CPW					-0.106*				
					(0.062)				
CPW*PSAV					0.614				
					(0.415)				
LDW						0.455***			
						(0.056)			
LDW*PSAV						0.523***			
						(0.154)			
PCW							0.490***		
							(0.021)		
PCW*PSAV							0.725***		
							(0.117)		

FSW								0.177*	
								(0.105)	
FSW*PSAV								0.529*	
								(0.297)	
SCW									0.195***
									(0.056)
SCW*PSAV									0.625***
									(0.234)
PSAV	-0.246	-0.965***	-0.808***	-0.653***	-0.921***	-0.553***	-0.278	-0.467**	-0.230
	(0.188)	(0.089)	(0.081)	(0.242)	(0.343)	(0.139)	(0.217)	(0.216)	(0.224)
VA	0.162	0.810	0.620***	0.836*	0.805*	0.326*	0.611***	0.565**	0.812**
	(0.110)	(0.544)	(0.191)	(0.463)	(0.472)	(0.195)	(0.223)	(0.241)	(0.401)
lnGDPPC	0.400**	0.654***	0.794	0.647	0.335*	0.564**	0.937***	0.585***	0.465***
	(0.166)	(0.246)	(0.538)	(0.491)	(0.202)	(0.282)	(0.145)	(0.221)	(0.107)
lnDCPSGDP	1.186***	1.300***	0.965***	2.373***	1.664*	1.132***	1.004*	0.715	0.880***
	(0.363)	(0.367)	(0.253)	(0.540)	(0.931)	(0.330)	(0.569)	(0.435)	(0.211)
POPGRTH	0.107	0.283	0.184*	0.176*	0.177*	0.190*	0.147	0.399	0.192
	(0.338)	(0.183)	(0.108)	(0.103)	(0.101)	(0.097)	(0.110)	(0.292)	(0.130)
DIR	0.065	0.043	0.044	0.049	0.017	0.018	0.018	0.044***	0.034
	(0.069)	(0.043)	(0.043)	(0.062)	(0.035)	(0.022)	(0.019)	(0.012)	(0.025)
lnINFCPI	-0.099***	-0.109	-0.091**	-0.078***	-0.065***	-0.051*	-0.019*	-0.145*	-0.197**
	(0.014)	(0.104)	(0.044)	(0.014)	(0.024)	(0.029)	(0.011)	(0.082)	(0.092)
Constant	0.428	-3.804	-10.20	-2.892	-5.519	3.863	-4.151	1.299	7.138
	(4.049)	(21.00)	(13.80)	(6.421)	(18.80)	(12.06)	(5.364)	(5.425)	(9.194)
Observations	116	116	116	116	116	116	116	116	116
No. of instruments	19	19	19	19	19	19	19	19	19
AR1 (p-value)	0.198	0.228	0.216	0.140	0.382	0.225	0.216	0.223	0.203
AR2 (p-value)	0.312	0.323	0.313	0.313	0.945	0.302	0.283	0.384	0.358
Hansen-J (p-value)	0.763	0.834	0.843	0.965	0.998	0.702	0.895	0.682	0.797

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Based on interaction of stringent capital restriction and stable political system without violence, the result exhibited in the 4th model of table of 17 shows a positive coefficient of the interaction term, indicating that stable political system and stringent capital requirement are conducive for enhancing digital financial inclusion in SSA.

Moderation effect of voice and accountability

This section captures interaction term introduced to examine the indirect effects of banking sector regulation factors on digital financial inclusion in the presence of conditioning factor, voice and accountability. In this case, banking sector regulations mechanisms are interacted with voice and accountability (VA) to form a new variable (for example, ETW_VA). The purpose for which interaction term was introduced is to examine whether voice and accountability could enhance and strengthen effects of banking sector regulations on digital financial inclusion. The expectation therefore is that when citizen can freely participate in governance system, stringent banking sector regulations will not hinder digital financial inclusion activities of financial systems.

Given the widespread implementation of banking sector regulation in literature, the thesis considers the interaction between financial regulation and institutional quality. The expectation is that interaction effect of banking regulation factors and institutional quality should promote adoption and usage of digital financial infrastructure and platforms. From model 1 of table 18, the coefficient of the interaction between stringent entry restriction and institutional quality (voice and accountability) is positive and significant, suggesting that strong institutional quality complement tighter entry restriction

in financial system to enhance digital financial inclusion. This signifies that more participation of citizens in governance systems enhances the positive effect of stringent entry regulation on digital financial inclusion.

The results indicate that interaction terms ETW_VA, ACW_VA, TRW_VA, EXW_VA, CPW_VA, LDW_VA, PCW_VA, FSW_VA and SCW_VA have significant positive effects on digital financial inclusion. A unit increase in interaction terms of dimensions of banking sector regulations and institutional quality (voice and accountability) causes between 21.1% to 73.4% increase in digital financial inclusion, all things being equal. Higher institutional quality (voice and accountability) combined with stringent banking sector regulations to increase adoption of digital financial infrastructure and investment in digital platform, leading to higher digital financial inclusion. These findings signify that strong institutional structures for selecting, monitoring and replacing governments in SSA countries sampled enhance effectiveness and robustness of enforcement of banking sector regulations, thereby leading to improvement access, penetration and usage of digital financial services and digital financial infrastructure. This confirms the prediction of the study and lends credence to the results of Sodokin et al. (2023); EL-Moussawi et al. (2023); and (Maduka, Ogwu, & Ekesiobi, 2022).

Table 18: Moderation effect of voice and accountability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
l.DFIINDEX	0.880***	0.836***	0.870***	0.976***	0.857***	0.931***	0.920*	0.982***	0.809***
	(0.105)	(0.231)	(0.175)	(0.293)	(0.147)	(0.104)	(0.491)	(0.139)	(0.320)
ETW	-0.094								
	(0.261)								
ETW_VA	0.603**								
	(0.281)								
ACW		-0.102*							
		(0.052)							
ACW_VA		0.677***							
		(0.179)							
TRW			-0.155***						
			(0.026)						
TRW_VA			0.719***						
			(0.154)						
EXW				0.319***					
				(0.076)					
EXW_VA				0.734**					
				(0.288)					
CPW					-0.104*				
					(0.056)				
CPW_VA					0.479**				
					(0.209)				
LDW						0.571***			
						(0.052)			
LDW_VA						0.211**			
						(0.104)			
PCW							0.933***		
							(0.117)		
PCW_VA							0.701**		
							(0.348)		

FSW								0.578	
								(0.562)	
FSW_VA								0.324**	
								(0.159)	
SCW									0.189***
									(0.054)
SCW_VA									0.570**
									(0.278)
PSAV	-0.917***	-0.309	-0.181***	-0.935***	0.547***	1.649***	-0.815	-0.807***	-0.619*
	(0.233)	(0.216)	(0.022)	(0.265)	(0.156)	(0.154)	(0.788)	(0.240)	(0.340)
VA	0.859***	0.499***	0.607***	1.364*	3.168***	5.668***	0.235	0.483***	0.401*
	(0.209)	(0.031)	(0.145)	(0.873)	(0.108)	(0.702)	(0.156)	(0.137)	(0.222)
lnGDPPC	0.758*	0.397***	0.658**	0.678***	0.849***	-0.453***	0.344**	0.421**	0.644***
	(0.391)	(0.176)	(0.281)	(0.144)	(0.232)	(0.102)	(0.135)	(0.199)	(0.210)
lnDCPSGDP	0.324*	0.229***	0.591**	0.409***	0.743***	0.999***	0.353*	0.494***	0.510***
	(0.179)	(0.017)	(0.256)	(0.144)	(0.187)	(0.254)	(0.188)	(0.161)	(0.142)
POPGRTH	0.629***	0.441**	0.429***	0.494***	0.851***	0.611***	0.407***	0.809**	0.645***
	(0.226)	(0.194)	(0.125)	(0.167)	(0.273)	(0.223)	(0.152)	(0.360)	(0.164)
DIR	0.0241	0.0374***	0.0486***	0.0390***	0.0404***	0.556***	0.0354*	0.0945**	0.0607**
	(0.035)	(0.0119)	(0.0171)	(0.0102)	(0.0142)	(0.133)	(0.019)	(0.0384)	(0.0212)
lnINFCPI	-0.207***	-0.102	-0.169*	-0.223**	-0.121	0.454**	-0.873***	-0.248*	-0.255**
	(0.039)	(0.101)	(0.098)	(0.104)	(0.092)	(0.189)	(0.335)	(0.131)	(0.112)
Constant	-3.054	-1.025	2.541	-2.976	-3.870	-62.86	0.529	1.229	3.452
	(9.002)	(22.34)	(17.31)	(6.191)	(8.207)	(743.2)	(9.664)	(4.082)	(16.51)
Observations	116	116	116	116	116	116	116	116	116
No. of instruments	19	19	19	19	19	19	19	19	19
AR1 (p-value)	0.262	0.191	0.181	0.121	0.205	0.918	0.122	0.216	0.212
AR2 (p-value)	0.404	0.254	0.227	0.279	0.313	0.936	0.518	0.320	0.384
Hansen-J (p-value)	0.717	0.759	0.783	0.765	0.860	0.843	0.886	0.760	0.795

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Discussion of banking sector regulations and digital financial inclusion relationship

This section provides discussion on the findings regarding effect of banking sector regulation on digital financial inclusion. In addition, the moderating effect of institutional quality was examined. The discussion is based on direct effects of dimensions of banking sector regulations on digital financial inclusion coupled with interaction effect of institutional quality. It includes how the current findings relates with theoretical argument within context.

The findings displayed in table 16 reveal that there is no consistency in the direction of the relationship between dimensions of banking sector regulations and digital financial inclusion. This is because entry restrictions, activity restrictions, transparency requirements, and capital stringency exhibit a negative influence on digital financial inclusion. The sign and magnitude reported show that these dimensions of banking sector regulation decrease digital financial inclusion. Nonetheless, exit restrictions, liquidity restrictions, price controls, and supervision quality exhibit positive influence on digital financial inclusion. The implication of the sign and magnitude of these dimensions of banking sector regulation is that they increase digital financial inclusion. This inconsistent direction can be attributed to some enforcement gaps, contextual challenges and weak institutional structures that relate to banking sector regulations in financial sector of the sampled SSA region. This enforcement gaps and contextual issues are likely to fuel dissatisfaction among households and firms, which can scare them away, perhaps, from participating in the financial system. Further, the findings support the theoretical argument

that weak legal systems drive poor enforcement (La Porta et al., 1998) which in turn can hinder participation in the financial system due to lack of confidence in the system, contextual challenges and enforcement gaps.

The introduction of the interaction terms as displayed in tables 17 and 18 reveal that institutional quality positively moderates the relationship between dimensions of banking sector regulations and digital financial inclusion. The findings indicate that presence of stable political system and voice and accountability to the people strengthen enforceability, robustness and effectiveness of banking sector regulations in accomodating innovation and effcicency, thereby promoting digital financial inclusion. This finding strengthens the neo-institutional theory (La Porta et al., 1998) which posits that high quality institutional strctures supports financial sector development through effective and efficient enforcement of regulations and proctection of credit rights against exploration. Similarly, the evdience of the findings seem to support regulatory-inclusion hypothesis by illustrating that some dimensions of banking sector regulation can accommodate innovation and competitions that leverage digital financial technologies to enhance access to finance, mobilisation of capital , savings and investment leading to enhancement in digital financial inclusion. Furthermore, the findings have the tendency to extend law and finance theory which argue that quality institutional structures can trigger effective enforcement of regulations (Duru et al., 2020), illustrating that quality insitutional structure is a likely condition to enhance digital financial inclusiton. In addition, acknowledging that impact of robust regulations on financial stability differs, public interest view contends that market failures necessitate establishment of formal regulations

to address stablity issues and improve efficiency(Bace et al., 2020). These ultimately drive adoption of digital financial technologies to improve access to finance, accumulate capital and promote participation of financially excluded and underserved communities in the formal financial system.

Summary and Conclusion

The major objective of this chapter was to analyse the effect of banking sector regulations on DFI in a sample of SSA countries. Drawing evidence from data set on Africa development banks from (Triki et al.,2017), this study adds to stock of literature on the relationship between law and finance literature in SSA. Further, the study exhibits originality to the best of knowledge as it is first study regarding how dimensions of banking sector regulations impact poverty in a selected SSA economies. The study, on the basis of dimensions of banking sector regulations, finds that strengthening exit restriction, enhancing price control, improving availability of financial safety net, and improving quality of supervision will enhance digital financial inclusion. On the contrary, tighter entry restriction, strengthening restriction on bank activities, enhancing transparency requirement and stricter liquidity restriction will be detrimental to digital financial inclusion. Focusing on the moderating effects of institutional quality, we find that promoting stable political systems positively enhance digital financial inclusion characteristics of banking sector regulations.

CHAPTER SIX

DIGITAL FINANCIAL INCLUSION AND POVERTY ALLEVIATION: MODERATING ROLES OF BANKING SECTOR REGULATIONS

Abstract

This chapter of the study examines how banking sector regulations moderate between digital financial inclusion and poverty reduction in 25 sub-Saharan Africa countries for the period 2014 to 2022. The study employs the system generalized method of moments SGMM due to endogeneity and robustness concerns. Based on estimated results, it emerges that digital financial inclusion contribute to reduce poverty levels. Also, empirical findings suggest stringent banking sector regulations reduces poverty level. Additional, some dimensions of banking sector regulations play significant roles in poverty reduction effect of digital financial inclusion. Thus, policy implication is that digital financial inclusion agenda that are more pronounced in reducing poverty should be concurrently deployed with banking sector regulations.

Introduction

Finance and economics literature acknowledge financial development as a key determinant of economic operation (Lee et al., 2023). Prior studies have linked development in finance to economic growth where finance has been associated with economic growth, particularly contribution of gross domestic product (Al-Yousif, 2022; Wang, 1999; Demetriades & Hussein, 1996). Yet, the effect of finance on the poor and marginalized segment of societies remain controversial (Lee et al., 2023). For instance, studies have illustrated that influence of financial development and economic growth on

poverty reduction is few (Uddin et al., 2014). Further, theoretical evidence claims that financial sector is strongly related to real economy through such channels as provision of financial resources to factor of production, stimulating production of real output, creating avenues for more jobs and alleviating poverty levels (Dewi et al., 2018). However, there are many instances where countries that experience advancement in financial development exhibit high level of income inequality. Besides, instances of long-term instability of financial sector has been considered as detriment to the poor Akhter and Daly(2009) and may possibly lead to increase level of income inequality (de Haan et al., 2022). The foregoing signifies that effort made to reduce poverty might not have been realized (Dewi et al., 2018). This is further aggravated by less access, availability and penetration of formal financial services among the poor (Lee et al., 2023).

The current study thus argues that emergence of new technologies for improving financial inclusion, for that matter digital financial inclusion, may impact access, availability and usage of digital financial services leading to some influence on poverty reduction countries. Also, technological progress in financial industry has created new avenues for marginalized communities (Fu et al., 2023) by providing access to finance (Liu et al., 2020), enhancing entrepreneurial activities of poor people (Fu et al., 2023) and offering digital means to capital formation, savings, and investment avenues for businesses (Ozili, 2018). Further, combination of traditional finance and emerging financial technologies such as artificial intelligence, block-chain, cloud computing and big data (Cheng & Qu, 2020) support advancements in financial technology which can contribute to enhancement of operational

efficiency (Bu et al., 2022); facilitation of financing, payments, investment and information in technology services.

Digital financial inclusion does not only support economic growth (Ozturk & Ullah, 2022), and thereby influence indirectly living standards of the poor. It also contributes to inclusive finance which is crucial to enhance income of underserved segments of societies (Chen et al., 2022). Many studies have established a link between income and welfare of poor people and their accessibility to a range of appropriate and affordable digital financial services (Demirgüç-Kunt & Singer, 2017; Kim et al., 2018; Ozili, 2018). The view expressed by Demirquc-kunt (2008) shows that equitable access to financial resources is characterised with pro-growth and pro-poor which notable for reducing income inequality and alleviating poverty.

Despite relevance of DFI to the poor, more attention has to be paid to regulation of financial system that increase DFI. This is because the issue of banking sector regulations seem to be at the center of several financial sector outcomes in many policy discussions (see, Lumpkin, 2010). Banking sector regulations could be relevant to digital financial inclusion in four main ways. First, the regulatory architecture should be able to accommodate the innovations in financial inclusion, encourage the provision and use of digital financial services, and ensure healthy competition among the providers. Second, since the core mandates of banking sector supervision and regulation includes maintaining banking sector integrity and stability, and eventually customer protection (Barth et al., 2004), the advancement of digital financial inclusion should align with these mandates. Third, policy objectives of banking sector regulations highlighting mitigating of systemic risks, bring to

the fore proper market conduct and adequate protection of borrowers, investors and end-users of financial services that could have implications for distribution of resources efficiently, financial productivity and economic growth (Lumpkin, 2010). This therefore creates the competitive environment for stimulating higher levels of financial innovations and digital financial inclusion. Fourth, Sinha (2012) conceived financial stability as a necessary but not sufficient condition to attain other financial sector policy objectives. In line with this, Sinha (2012) argued that though prudential policies can deliver financial stability and facilitate growth, it needs to complement other growth imperatives, channel credit to disadvantage and preferred sectors, protect consumers and spur financial inclusion.

Juxtaposing literature on banking sector regulations and digital financial inclusion especially in SSA context, we observed that cross-country data that measure poverty alleviation effects of banking sector regulations as well as digital financial inclusion did so individually. We argue that poverty alleviation of digital financial inclusion can be established through interaction between banking sector regulations and digital financial inclusion. Banking sector regulations consist of financial system regulation, regulatory architecture, regulatory culture, intra-agency coordination and regulatory philosophy (Schmulow, 2015). The success of financial system may be attributed to functioning prudential regulations and regulatory enforcement. For instance, capital stringency and activity restrictions may limit banks' ability to innovate and create new financial products, thereby hampering financial inclusion (Anarfo et al., 2020; De Sousa, 2015). Focusing on the traditional view that competition reduces market power and cost of financial

services but increases financial services availability (see Berger & Hannan, 1998), stringent entry requirements could stifle competition and impede financial inclusion. Conversely, high exit restrictions could increase competition and improve financial inclusion. Financial safety nets coupled with the use of monetary and fiscal policies as noted by (Greenspan, 2001) contribute to eliminate bank runs, assuage financial crises and reduce the number and amplitude of economic contractions, thereby provide depository institutions and participants in financial markets with safety, liquidity and solvency. Inasmuch as financial safety nets are able to drill confidence in the financial system, it could also bolster the degree to which people subscribe to digital financial products. Price controls confine the ability of banks to charge high costs on financial services and thus price controls could advance financial inclusion. Altogether, banking sector regulations could exhibit a first order effect on DFI.

Notwithstanding the possible relevance of banking sector regulations to DFI, the literature in the area is burgeoning. Nevertheless, providing a nuanced understanding on moderating effect of banking sector regulation for digital financial inclusion-poverty alleviation relation is particularly relevant, especially to developing countries like that of SSA that have witnessed a recent increase in digital financial products (Podolski, 2020; Emara & Zhang, 2021). Hitherto, prior literature regarding impact of banking sector regulations have only provided a limited view of the phenomenon. For instance, Anarfo et al. (2020) find evidence that stringent capital regulations impede financial inclusion in SSA. Nonetheless, DFI may be affected by a myriad of banking sector regulations, and thus examining interaction effects of number of

banking sector regulations and digital financial inclusion on poverty alleviation could be relevant to policy.

Several studies examined how banking sector regulations contribute to financial sector development, influence economic stability and economic growth and promote stable and sound financial system. In contrast, the current study to the best our knowledge represents the foremost study on interaction effects of dimensions of banking sector regulations and digital financial inclusion on poverty alleviation specifically in Sub-Saharan Africa. In backdrop of this, this study is therefore justified by the fact that, unlike the studies of Abor et al. (2020) that examined the link between financial regulation and financial inclusion, this study explores how interaction of banking sector regulations and digital financial inclusion affect poverty alleviation. Further, the focus on digital financial inclusion instead of financial inclusion is also a novelty, and this is because the SSA region has gained the momentum in the delivery of digitalized financial services in recent times. The rest of the study is organized as follows:

Theoretical Literature

Two theories were used to espouse the relationship among digital financial inclusion, banking sector regulations and poverty reduction. The supply-leading hypothesis was deployed to espouse the relationship between digital financial inclusion and poverty alleviation. Supply-leading hypothesis, credited to Robinson (1952) and Patrick (1966), argues that financial development enhances economic growth by supplying growth enabling resources (Hsueh et al., 2013). In view of this, Lee et al. (2023) pinpoints two channels through which financial digital financial inclusion influence poverty

reduction. Firstly, just like financial institutions, digital financial inclusion is capable of facilitating capital accumulation by offering innovative and effective saving, transaction and investment platforms for savings, investment and credit. These encourage individuals in the economy to save, invest and work to bring about economic growth and poverty alleviation. Secondly, digital financial inclusion is capable of reducing operation cost of digital financial services and product operators effectively through the use of digital technology. Further, mobile money agents as well as some financial institutions or non-financial institutions offer financial intermediation functions that help various asset holders to effectively transfer e-money by changing ownership and composition. These channels create financial inclusion.

Related to finance-poverty relationship is the role play by institutions. In view of this, it has been argued in the current paper that banking sector regulations play essential role in explaining finance-poverty linkage and this is grounded in the law and finance theory. The law and finance theory avers that legal traditions differ regarding priority attached to the right of private property ownership and protection given to outsider investors which fundamentally form the basis of financial development. The law and finance theory pivots essentially on the contributions of institutions to dealing with challenges in financial sector in order to enhance financial development. The view of pioneers Easterly and Levine (1997) and Porta et al. (1998) of law and finance theory lay emphasis on a country's laws that seek to protect private property right. Private property right assigns exclusive rights to use to individual or firms or countries to their own resources. In the backdrop of this,

good institutions guarantee security of property right and competitive market, and are key drivers of several productive and non-productive economic activities (Vu, 2021). Undeniably, institutions play overarching roles in guiding contract enforcement and information sharing in human interactions intended to lower transaction cost associated with financial intermediaries' processes in expanding or extending access of finance to underserved populace or the poor. With this, the knowledge of several aspects of the institutional architecture of the financial sector is particularly important to the development of the financial sector, which eventually improves financial inclusion. Amidst the institutional architecture of the financial sector, banking sector regulations seemed to have caught the interest of policy makers owing to the several episodes of financial crises. Drawing on the law and finance theory, this study argues that banking sector regulations could represent laws that could affect ability of the financial sector to develop digital financial products to include more economic agents in the financial system. Thus, the use of dimensions of banking sector regulations: formal constraints, normative and enforceability characteristics as moderators between digital financial inclusion and poverty alleviation may promote information sharing, reduce transaction cost, and thereby improve the scope of digital financial inclusion, especially among the underserved populace and the poor in countries in SSA.

Empirical Literature

Banking sector regulations and supervision remain crucial for ensuring a stable and healthy banking system. Advancement in financial technologies across the globe in banking industry are facilitating regulatory and supervisory vicissitudes intended at enhancing stability, health and general performance of

the sector in the world, including Sub-Saharan Africa. This section examines how banking sector regulations facilitates or inhibit the effects of digital financial inclusion on poverty alleviation.

Digital financial inclusion and poverty alleviation

Poverty alleviation can be impacted by digital financial inclusion through myriad of potential pathways. Digital financial inclusion is capable of enhancing asset value of the poor through innovative channels such as innovative payments, credit, investment and savings. Also, increasing access to digital financial services and technologies can have significant positive effect on poverty reduction and improve well-being of individuals, households and community. In a study using evidence from China based on methods of mechanism analysis, Ding et al. (2023) observed that digital financial inclusion tends to reduce asset poverty and income poverty because of its capability of promoting entrepreneurship. With evidence from 42 countries of one belt and road initiative (OBRI) region and using ordinary least square, two-stage least squares and generalised methods of moments approaches, (Ozturk & Ullah, 2022) demonstrated that digital financial inclusion increased economic growth. On the issue of household financial participation, (Du et al., 2023), adduced evidence from China and used mechanism analysis, pointed out that increased DFI facilitates household financial participation, and thereby enhanced household well-being propensity. Additionally, there is evidence that digital financial inclusion policies have an economic impact because they contribute to pro-poor growth and accelerated economic growth. Further, they provide financial institutional infrastructure that reduces transaction costs and financial information asymmetry, thereby reducing

poverty and increasing economic growth. Many studies have established a link between income and welfare of poor people and their accessibility to a range of appropriate and affordable digital financial services (Demirgüç-Kunt & Singer, 2017; Kim et al., 2018; Ozili, 2018). According to Demirquc-kunt (2008), equitable access to finance is not only pro-growth, but also pro-poor, as it reduces income inequality and alleviates poverty. The study of Li et al. (2022) shows that digital financial inclusion is positively and significantly linked to household consumption (Hsueh et al., 2013) consumption. Similarly, using unbalanced panel data from 2004-2015, Omar and Inaba (2020) found out that financial inclusion reduced poverty. These findings are consistent with findings of Lyons et al. (2020); and Polloni-Silva et al. (2021) who noted pro-poor effects of digital or financial inclusion. Based on the assumption that supply-leading hypothesis fundamentally enhanced growth by facilitating growth enhancing resources (Hsueh et al., 2013). Thus, predicated on theoretical argument and empirical claim advanced, the following hypothesis was formulated and tested.

H1: Digital financial inclusion significantly relates with poverty alleviation in SSA countries.

Banking Sector regulations and poverty alleviation

The aftermath of 2007-2009 global financial crises has led to introduction of banking sector reforms which consider institutional structures of financial regulations, and has continued to attract significant research and practical attention (Huang & Schoenmaker, 2015). Banking sector regulation encapsulates various conventional and non-conventional monetary policies; legal framework and enforcement channels (Srbinoski et al., 2023) capable of

promoting bank performance, banking sector stability (Danisman & Demirel, 2019); and risk-taking behaviour (Bartholdy & Justesena, 2021). The rise of banking sector regulation is predominantly intended to enhance financial stability. A stable banking system is not only integral to economic growth and sustainability, but also essential to stable economy and sustainable growth (Ntarmah et al., 2019). Focusing on institutional architecture of the financial sector, empirical literature acknowledged bank regulation and supervision for simultaneously lowering micro financial institutions' social financial efficiency and increase financial efficiency indicating loss of mission for poverty eradication (Zainal et al., 2021). In case of increasing capital adequacy ratio, the higher cost incurred in transiting to higher capital ratio may cause banks to raise lending rate and reduce lending. Higher lending rates and lower bank lending as observed by Ghosh et al. (2012) may respectively lead to low economic activity in advance countries and lower trade volumes in emerging markets through low consumption, investment and expenditure. Indeed, these may have implication for financial inclusion and poverty alleviation.

Banking sector regulations and poverty reduction demonstrate some mechanisms through which financial system impact poverty reduction initiatives. Banking sector regulations seems to have impact on poverty reduction through social value of their products or services (Zainal et al., 2021). Banking as well as financial institutions offering financial services are regulated in one form or the other. These regulations are stringent. Scanty empirical studies exit on the effect of banking sector regulation on poverty reduction.

In the banking sector regulatory domain, studies on banking regulations examined the effect of regulations on stability, efficiency and performance (Djalilov & Piesse, 2019; Triki, et al., 2017). In a related development, Sodokin *et al*. (2023) draw evidence from 63 banks in West African Economic and Monetary Union and reveal that stringent banking regulations and supervisory bodies facilitate stability of banks. Specifically, the authors demonstrate that capital stringency, activity restrictions, and supervisory authorities lessen the risk of insolvency of banks. Further, effect of macroprudential policies on credit growth has been examined by Mirzaei and Samet (2022). Additionally, empirical studies of Kim and Katchova (2020), Brester and Watts(2019) and Murungi *et al.* (2023) examine effects of regulations on agric sector lending. On interest rate ceilings and portfolio balance of new microcredit and loan to small and medium enterprises(SMEs), Roa *et al.* (2022) aver that negative outcome of interest rate ceilings may drive customers to embrace less regulated forms of credit outside formal financial system. Largely, the results of these studies suggest that stringent capital requirements, banking activity restriction, legal origin, macroprudential policies and supervisory authorities have implications for poverty alleviation.

Based on the foregoing literature, the following research gaps emerge. Firstly, majority of the studies emphasized performance of financial institutions regarding efficiency, and financial sustainability. Secondly, in view of this limited studies that explored social efficiency as a measure of poverty reduction by the financial institutions. There is evidence of paucity of studies regarding dimensions of banking sector regulations on poverty reduction in SSA. Thirdly, in spite of the fact that some empirical studies

examined effect of baking sector regulations on poverty, the emphasis is completely nonexistence within the context of poverty reduction. Observations point out that empirical evidence is missing on impact of dimensions of banking sector regulation on poverty. In light of the arguments advanced and theoretical expectation, the present study formulates and test the following hypotheses.

H2: Dimensions of banking sector regulations have significant impact on poverty reduction of SSA region.

Dimensions of Banking sector regulation: Moderator between DFI and Poverty alleviation

Banks constitute an integral part of financial system across the globe. Based on the financial intermediation theory, banks play essential role in mobilizing and redistributing of social capital, financing illiquid assets with liquid liabilities, which in turn make available liquidity to the financial market. However, due to the presence of limited liability and government guarantees, banks engage in too much credit transformation, liquidity transformation, and maturity transformation. These have led to banks holding assets that are characterised as too illiquid, too risky and too long-term oriented comparable to what would have socially been considered optimal. Thus, addressing too much credit and maturity transformation bring to the fore prudential regulations and supervisory mechanisms that aim at building financial institutions that are financially healthy and capable of expanding availability of financial services and improve the flow of funds (Musau et al., 2018). In the backdrop of foregoing, regulators' actions are key for minimising risk-taking

and facilitate improvement of financial sector development (Michaels & Homer, 2018).

Related to financial inclusion is access to financial resources. Access to credit plays overarching roles for: firm growth, particularly small firms (Beck et al., 2005); creating new businesses (Klapper et al., 2006) and increase enterprise investment, especially among female entrepreneurs (Dupas & Robinson, 2013). Banking sector regulation plays crucial role in expanding access to finance. For example, focusing on entry of foreign banks, Leon and Zins (2020) drew on development of Pan-African banks to examine whether they influence financial inclusion of households and firms. The findings pointed out that presence of Pan-African banks increase firm's access to credit (Ahamed et al., 2021). However, in view of capital stringency and activity restrictions, evidence suggest that they may limit banks' ability to innovate and create new financial products, thereby hampering financial inclusion (Anarfo et al., 2015).

Research has demonstrated banking sector regulation as one of the factors behind both the proliferation and otherwise of digital financial services. In a study by Besong et al. (2022), the findings demonstrate that regulatory mechanism that tightens or monitors entry into the financial sector, requires external reporting and makes deposit insurance available increase sustainable financial inclusion with evidence from six countries from Central African Economic and Monetary Community (CEMAC) region. Consequently, digital financial inclusion, apart from promoting urban household entrepreneurship, increases households' participation in financial

markets (Peng & Mao, 2023). Conversely, restrictions in banking sector can facilitate or inhibit digital financial inclusion.

Bank's capitalisation ratio provides information on ratio of capital to banks assets. A higher level of capital-to-asset ratio represents a more restrictive banking system regarding lending. In view of this, Craig and Koepke (2012) stated that capital regulation plays essential roles in enhancing stability of financial system. Sarma and Pais (2011) identified negative relationship between capital asset ratio and financial inclusion. Likewise, Kodongo (2018) report a detrimental impact of capital regulation on financial inclusion. The study concludes that at high level of capital asset ratio, banking systems tend to be more guarded in granting credit facilities to the financially excluded.

Empirical evidence appear to be mixed. Bank activities restriction breed inefficient financial intermediation. For instance, Ahmad et al. (2021) and Barth et al. (2008) noted that strong bank activities restrictions lessen diversification opportunities of banks. Low diversification can bring about decline in income stream and franchise value, which in turn may lead to inefficient financial intermediation. Further, activity restrictions minimise risk-taking (Danisman & Demirel, 2019; Saif-Alyousfi et al., 2020). On the contrary, unfettered bank activities facilitates moral hazard issues and promote risk-taking behaviour (Noman et al., 2021). More restriction on bank activities encourage accumulation of safe assets whiles expected returns of risk asset drop. The implication thus is higher restriction on bank activities is detrimental to usage (investment) of additional funds and reducing efficiency.

Thus, bank activities restriction is negatively linked to digital financial inclusion.

Price controls on the other hand, in the form of transaction fees or account maintenance fees, on digital financial services can contribute significantly to rendering financial services affordable and accessible to low-income segments of society, thereby facilitating digital financial inclusion. Some empirical literature has acknowledged that financial safety nets promote access, confidence and innovation in financial services. For instance, in studies by Izaguirre et al. (2016) and Claessens et al. (2010), it emerged that deposit insurance encourages financial product innovation by reducing fear of failure for financial institutions. Likewise, Demirgüç-Kunt et al. (2019) found that deposit insurance increases availability of credit, particularly among women. Another study also claimed that deposit insurance facilitates that patronage of banking services which in turn positively influence financial inclusion.

Developing countries need to leverage banking sector regulations to pursue inclusive economic growth and poverty reduction. Research efforts have highlighted demonstrable evidence pointing to positive effects of digital financial inclusion on income and well-being of low-income populace of developing countries. For example, focusing on benefits such as wide coverage, high availability, low cost and sustainability, it emerged that digital financial inclusion enhances sustainable growth of small-scale enterprises (Yang & Zhang, 2020); impacts economic growth (Ahmad et al., 2021); relieves small and micro enterprises from financing constraints (He & Shen, 2021); promotes economic growth through moderating effects of monetary

policy (Jiang et al., 2022);expand coverage of financial services via product innovation and information technology (Liu et al., 2021); and promotes positive effects of technological progress on green growth as well as mitigate against negative effect of green growth on floating population (Cao et al., 2022). Further, it presents opportunity for capital formation, savings mobilisation and offers investment avenues for enterprises (Ozili, 2018). Notwithstanding these benefits, some scholars suggest that broadening access to finance is not panacea in itself (Banerjee et al., 2013). Thus, stringent and rigid implementation of banking sector regulations has been identified as being capable of jeopardizing well-crafted digital financial policies (GPFI, 2011). This claim is consistent with suggestion of Yoshino and Morgan (2016) who observed that focusing on the broader objective of economic growth and inclusive growth requires that regulators go beyond traditional oversight responsibilities of safety and stability of financial system to focus on efforts directed at increasing financial inclusion. This is because exclusive focus on financial stability has been identified as being detrimental to other policy objectives such as financial inclusion (Jones & Knoack, 2019). Further, drawing on evidence of Nigeria with data spanning from 1980 to 2018 using nonlinear autogressive distributed lag estimator, (Olaniyi et al., 2023) suggest that policies that are notable for expansion and contraction of financial sector are critical catalyst that spur poverty reduction in a long-run.

The foregoing demonstrates most prior studies in the literature on poverty reduction whether highlight on the impact of digital financial inclusion or banking sector regulations, hardly consider the effects of the interaction between the digital financial inclusion and banking sector

regulation. Leveraging prospects and significance of DFI, and banking sector regulations based on cross-border banks' influence on financial globalisation especially in developing countries (Claessens, 2017), it appears countries in SSA have implemented and continue to implement digital financial services in full-fledge. With the view that digital financial inclusion help guarantee banks to attain financial advancement (Demirguc-Kunt et al., 2018), stability (Ahamed & Mallick, 2019), and a well-oiled global financial sector.

The forgoing demonstrates there is a potential implication regarding conditioning effect of banking sector regulation on the relation between financial inclusion, particularly among the low-income groups. Specifically, the consequences of 2007-2009 global financial crises illustrate that too much innovation could distress financial system. The outturn of 2008 GFC leads to tightening of financial system which in turn makes it difficult for low-income people to easily access financial system (Hannig & Jansen, 2011). However, Shah and Ali (2022) note that relaxed financial regulations are linked to increase financial inclusion through provision of financial activities at large scale for developing countries. With reference to implications of banking sector regulations on digital financial inclusion, empirical literature appears quite new and scanty. For instance, limited studies that focused on the impact of interaction effect of banking sector regulation and FI on poverty alleviation. Also, the study of Ikram and Hussain (2022) reveal that financial regulation negatively influence financial inclusion. In sharp contrast, Chen and Divanbeigi (2019)'s study reported that regulatory index score of a country is positively related to individual's having account with financial institution. In a related study, Anarfo et al. (2020) examined how financial regulation impact

financial inclusion with financial stability as conditioning factor. Based on these considerations, the impact of banking sector regulation on digital financial inclusion may have different effects on poverty reduction.

H3: Banking sector regulations significantly moderate between digital financial inclusion and poverty alleviation of countries in SSA.

Methodology

For the purpose of the thesis, a panel model which is system GMM technique was used. This means that the study did not consider the ordinary least square regression and fixed effect models for the analysis. It has been pointed out that ordinary least squares (OLS) regression, mixed-effect regression model and probit regression and fixed effect regression fail to address issues of heteroskedasticity and endogeneity (Chinoda & Kapingura, 2024). Further, Kim et al. (2018) assert that these techniques lack outcomes that are reliable and robust when using panel data approaches. Addressing these concerns and at the same time ensuring robustness of findings of the current study, a system GMM estimator by Arellano and Bover (1995) which bring to the fore robust panel data technique have been employed. This technique helps to examine the effect of banking sector regulations on digital financial inclusion in SSA. Following Chinoda and Kapingura (2024), the formulated base regression model is as follow:

$$Y_{it} = \alpha Y_{it-1} + \theta_0 X_{it} + \sum_{i=1}^{n} Z_{it}\beta + \mu_{it} \quad \text{---------- (21)}$$

Where Y_{it} is POV, $Y_{it-1}$is the POV of previous year or the initial level of POV, X_{it} is a vector of explanatory variables, Z_{it} denotes the control

variables, ε_{it} is the error term, i denotes country, and t denotes the period respectively. Where the matrix of X_{it} and Z_{it} are given below:

$$X_{it} = \begin{bmatrix} DFIINDEX_{it} \\ ETW_{it} \\ ACW_{it} \\ TRW_{it} \\ EXT_{it} \\ CPW_{it} \\ LDW_{it} \\ PCW_{it} \\ FSW_{it} \\ SCW_{it} \\ BSR \times DFIINDEX_{it} \end{bmatrix}, \quad Z_{it} = \begin{bmatrix} GDPGRWH_{it} \\ POPGRTH_{it} \\ TO_{it} \\ INFCPI_{it} \end{bmatrix}$$

Empirical model

This study used the following empirical model by making reference to the equation 21 stated above:

$$POV_{it}=\beta_0+\beta_1 POV_{it-1}+\beta_2 DFIINDEX_{it}+\beta_3 ETW_{it}+ \beta_4 ACW_{it}+\beta_5 TRW_{it}+\beta_6 EXW_{it}+\beta_7 CPW_{it}+\beta_8 LDW_{it}+\beta_9 PCW_{it}+\beta_{10} FSW_{it}+ \beta_{11} SCW_{it}+\beta_{12} BSR \times DFIINDEX_{it}+\beta_{13} GDPGRWH_{it}+\beta_{14} POPGRTH_{it} +\beta_{15} InTO_{it}+\beta_{16} InINFCPI_{it}+\mu_{it} \text{--------(22)}$$

From equation 22, it must be pointed out that β_0 through to β_{16} indicate constant term and unknown parameters that would be estimated. Also, μ_{it} represents the disturbance error term which is predicated on the assumption of normal distribution with zero mean and constant variance$[\mu_{it} \sim N(0,1)]$. Further, t and i respectively indicate time trend and the cross-sectional countries. Additionally, the equation 22 is estimated 9 times which are captured as model 1, 2, 3, 4, 5, 6, 7, 8 and 9. Model 1 estimates the effect of digital financial inclusion on poverty level whiles models 2 to 9 estimate the interaction effect of dimensions of banking sector regulation and

digital financial inclusion. The expectation, therefore based on supply-leading hypothesis and law and finance theory, is that coefficients of digital financial inclusion and interactions terms should show negative sign.

Data source and variable description

The study deploys an unbalanced panel data on twenty-three (25) countries in SSA spanning the period 2014 to 2020. The period and the countries used for this study are informed by availability of data for the period. Data for the study are sourced from a number of databases, namely: World Development Indicators, and Bankscope.

Table 19: Indicators of variables and source

Variable	Notation	Description	Source
Poverty level	POV	Poverty gap	WDI
Digital financial inclusion index	DFIINDEX	An index from internet usage, mobile cellular subscription, number of registered mobile money agents, number of registered mobile money users	
Digital financial inclusion	INDINTER	Percentage of population with internet	WDI
Digital financial inclusion	MOBC100	Mobile subscription per 100 people	WDI
Digital financial inclusion	NRMMA	Number of registered mobile money agents per 1,000 adults	WDI
Digital financial inclusion	NRMMU	Number of registered mobile money users per 1000 adults	WDI
Entry restriction	ETW	Information restriction of foreign bank entry	Bankscope
Activity restrictions,	ACW	Captures information about non-banking activities	Bankscope
Transparency requirement	TRW	Captures Level of information disclosure	Bankscope
Exit restrictions	EXW	Bank solvency	Bankscope
Capital stringency	CPW	Capital requirements or capital adequacy ratio	Bankscope
Liquidity diversification	LDW	Liquidity of assets	Bankscope
Price control	PCW	Price and fees	Bankscope
Financial safety net	FSW	Availability of deposit insurance	Bankscope
Supervision quality	SCW	Supervisory resources	Bankscope
Interaction term	BSR*PSAV	BSR and Institutional quality interactive term	
Economic growth	GDPGRWH	GDP per capita growth	WDI
Population growth	POPGRTH	Population growth	WDI
Economic cycle	TO	Trade openness	WDI
Economic cycle	INFCPI	Change in consumer price index	WDI

Note: WDI : World development indicator

Principal component analysis

For the composite variable construction, a principal component analysis was employed to generate digital financial inclusion index by using four variables of digital financial inclusion. With the PCA, the jth factor index can be generated using the equation stated as follow:

$$DFIINDEX_j = W_{j1}X_1 + W_{j2}X_2 + W_{j3}X_3 + W_{j4}X_4 + \ldots + W_{jn}X_n \text{----(23)}$$

Where, $DFIINDEX_j$ is the index of digital financial inclusion, the factor of parameter is denoted by W_j, X represents the corresponding initial value of the constituents; and **n** is the number of variables in the equation. With this analysis, two dimensions of digital financial inclusion constitute the DFIINDEX with two variables for each dimension. The first dimension entails individual internet usage as percent of population and mobile cellular subscription. The second dimension has constituents of number of registered mobile money agents and number of registered mobile money users. Thus, four variables constitute the digital financial inclusion index, DFIINDEX. Hence, the index can be formulated as:

$$\text{DFIINDEX} = \int(INDINTER, MOBC100, NRMMA, NRMMU) \text{ ----- (24)}$$

Empirical results and discussion

The descriptive statistics of indicators and index of digital financial inclusion, poverty level, banking sector regulation variables in addition to control variables used for this study are shown in table 20. The number of registered mobile money agents per 1000 has a mean value of 44.84, with a standard deviation of 73.61. The mean of number of registered mobile money users stands at 7116.01, with variation from its own mean of 10627.25. Mobile cellular subscription per 100 stands at 88.89 average value, with a standard

deviation of 36.97. Also, internet usage of individuals recorded average value of 26.55, with a variability of 18.69. The primary variable, digital financial inclusion index (DFIINDEX), has a mean score of 0.42, with a standard deviation of 0.11, suggesting that overall digital financial inclusion of economies in SSA are significantly different. Further, average values of banking sector regulation variables signifying different banking sector regulation among the countries in SSA. This is evident in the mean and its associated standard deviation values of regulation variables displayed in table 20. For example, the average value of exit restriction is 5.46 with a variability of 3.26 suggesting differences in stringent exit regulation in SSA countries. Also, the average of poverty level (POV) measured using poverty gap is 1.63 with a standard deviation of 1.53.

Table 20: Descriptive statistics

Variable	N	Mean	STD	Min	Max
NRMMAper1000	175	44.838	73.616	.055	423.892
NRMMUper1000	175	7116.011	10627.248	.893	66005.789
MOBC100	173	88.893	36.965	31.363	185.559
INDINTER	171	26.552	18.694	1.249	75.469
DFIINDEX	170	0.42	0.11	0.03	0.546
POV	175	1.631	1.534	.02	6.74
ETW	154	3.763	1.892	1.042	7.083
PAW	154	4.123	.999	2.143	6.429
TRW	154	8.512	.927	6.25	9.881
EXW	154	5.455	3.255	.833	10
CLW	154	6.237	1.517	2.778	8.889
LDW	154	5.379	1.118	2.708	7.083
PCW	154	1.098	1.584	0	5.278
FSW	154	1.97	3.321	0	9.286
SCW	154	4.567	.725	3.402	5.823
INCPI	172	11.004	46.361	-2.49	557.202
POPGRTH	175	2.294	.885	.002	3.867
GDPGRWH	175	2.173	4.127	-14.597	10.821
TO	161	77.456	39.083	16.352	216.237

Note: POV represents poverty level, DFIINDEX represents the digital finance index, NRMMAper1000 represents the number of mobile money agents per 1000 people, NRMMUper1000 represents the number of mobile money users per 1000 people, INDINTER represents Individuals using internet as a percentage of total population, MOBC100 mobile cellular subscriptions per 100, GDPGRWH represents GDP growth, POPGRTH represents population growth, TO represents Trade openness, INFCPI represents CPI inflation. ETW denotes entry restrictions, ACW denotes activity restrictions, TRW denotes Transparency requirement, EXW represents exit restrictions, CPW is stringent capital requirement, LDW denotes liquidity diversification, PCW denote price control, FSW denotes financial safety net, SCW represents supervision quality. All the other variables are previously defined.

Correlation matrix

Table 21 displays the results for the correlation among the variables employed for study. Results from table 21 reveal that the relationship among digital financial inclusion is positive but not significant. The dimensions of banking sector regulation exhibit complex structure in the sense that whereas entry restriction, activity restriction, transparency requirement and exit restrictions relate positively with poverty level but are not significant, capital stringency requirement relationship with poverty level is positive and

significant. Also, quality of supervision, financial safety net and price control load negatively with poverty level and are significant. The results further reveal that correlation between independent variables and control variables is low, indicating that multicollinearity is not an issue for the results.

Table 21: Pairwise correlations

Variables	(1)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) POV	1.000															
(2) L.POV	0.948*	1.000														
	(0.000)															
(3) DFIINDEX	0.042	0.042	1.000													
	(0.589)	(0.613)														
(4) ETW	0.127	-0.121	0.161*	1.000												
	(0.118)	(0.167)	(0.047)													
(5) ACW	0.044	-0.047	0.343*	-0.026	1.000											
	(0.590)	(0.591)	(0.000)	(0.752)												
(6) TRW	0.052	0.055	-0.023	0.107	0.196*	1.000										
	(0.523)	(0.534)	(0.780)	(0.188)	(0.015)											
(7) EXW	0.054	0.038	0.043	-0.358*	-0.300*	0.098	1.000									
	(0.502)	(0.666)	(0.598)	(0.000)	(0.000)	(0.228)										
(8) CPW	0.167*	-0.165	0.112	-0.100	-0.060	0.078	0.417*	1.000								
	(0.038)	(0.058)	(0.170)	(0.218)	(0.461)	(0.336)	(0.000)									
(9) LDW	-0.123	0.118	0.268*	-0.194*	0.219*	-0.134	-0.113	-0.024	1.000							
	(0.130)	(0.176)	(0.001)	(0.016)	(0.006)	(0.097)	(0.162)	(0.770)								
(10) PCW	-0.164*	0.180*	-0.111	0.436*	-0.027	-0.011	-0.607*	-0.158	-0.395*	1.000						
	(0.042)	(0.039)	(0.173)	(0.000)	(0.738)	(0.889)	(0.000)	(0.050)	(0.000)							
(11) FSW	-0.600*	0.612*	0.258*	0.359*	0.013	0.322*	0.100	-0.137	0.057	0.162*	1.000					
	(0.000)	(0.000)	(0.001)	(0.000)	(0.871)	(0.000)	(0.219)	(0.091)	(0.483)	(0.045)						
(12) SCW	-0.441*	0.441*	0.333*	0.399*	0.054	0.459*	0.387*	0.339*	0.001	0.044	0.819*	1.000				
	(0.000)	(0.000)	(0.000)	(0.000)	(0.508)	(0.000)	(0.000)	(0.000)	(0.993)	(0.592)	(0.000)					
(13) GDPGRWH	-0.043	0.032	0.158*	0.011	0.188*	-0.004	-0.166*	0.026	0.173*	0.110	0.050	0.041	1.000			
	(0.570)	(0.699)	(0.040)	(0.893)	(0.020)	(0.958)	(0.040)	(0.750)	(0.032)	(0.175)	(0.541)	(0.617)				
(14) POPGRTH	0.399*	0.384*	0.176*	0.271*	0.426*	0.102	-0.296*	-0.314*	0.227*	0.227*	0.330*	0.224*	0.227*	1.000		
	(0.000)	(0.000)	(0.022)	(0.001)	(0.000)	(0.207)	(0.000)	(0.000)	(0.005)	(0.005)	(0.000)	(0.005)	(0.003)			
(15) lnTO	-0.495*	0.498*	-0.445*	-0.413*	-0.198*	-0.237*	0.062	0.183*	0.181*	-0.215*	-0.562*	-0.487*	-0.107	-0.424*	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.016)	(0.004)	(0.455)	(0.026)	(0.028)	(0.009)	(0.000)	(0.000)	(0.178)	(0.000)		
(16) lnINFCPI	0.290*	0.287*	0.111	0.084	-0.049	-0.262*	0.002	-0.002	0.253*	-0.271*	-0.179*	-0.150	-0.141	0.172*	-0.199*	1.000
	(0.000)	(0.001)	(0.168)	(0.315)	(0.560)	(0.001)	(0.982)	(0.983)	(0.002)	(0.001)	(0.031)	(0.072)	(0.075)	(0.029)	(0.015)	

*** *p<0.01*, ** *p<0.05*, * *p<0.1*

Direct effect of digital financial inclusion and banking sector regulation

This section examines the stand-alone effects of digital financial inclusion and banking sector regulation together with control variables separately on poverty level. The results of the thesis' empirical findings on banking sector regulation and digital financial inclusion are displayed in table 22. The system GMM estimates obtained for effects of: restrictions place on entry, activity, and exit, transparency requirement, capital stringency, liquidity diversification, price control, financial safety net and supervision quality on poverty level respectively for columns 1 to 9. All models in columns 1 to 9 used poverty level lagged, DFIINDEX, and control variables (GDP growth, population growth, trade openness and CPI inflation). The only variable that differs across the models is the banking sector regulation variables. From the table, the lag of poverty level positively and significantly predicts poverty level across the columns 1 to 9, indicating that previous year poverty level is positively and strongly correlated with the current year poverty level. For digital financial inclusion index, in exception of column 6, the sign of all coefficient are negative and significantly predicted lowering poverty level. This indicates that an improvement in digital financial inclusion leads to decline in poverty level in SSA. The findings corroborate results of Ding et al. (2023); Demirgüç-Kunt and Singer (2017); Kim et al. (2018); and Ozili (2018) who report that digital financial inclusion tends to reduce poverty.

From the table, the lag of poverty positively and significantly predicts poverty level across the columns 1 to 9. This implies that higher previous year's poverty level in SSA predict high poverty level in the current year.

As regards stricter entry restriction, one of the proxies of banking sector regulation, has a significant positive coefficient of 0.054 in model 1, yielding a positive relationship between tighter restrictions on entry and poverty level. The indication is that 1% increase in stricter entry regulation is associated with 5.4 increase in poverty levels. The insight drawn from this result implies that tighter entry restriction in financial system increases poverty level. One rational behind this is that restricted entry may reduce essentially new entrants to the sector. This could limit competition and more participation of economic agents in productive economic activities. Hence, restrictions regarding entry of new banks tend to increase poverty level. The finding is consistent with the earlier findings of Zainal et al. (2021) whose findings conclude that banking regulations are detrimental to poverty reduction efforts of microfinance institutions.

Then again, the outcomes derived from system GMM estimation disclose a significant relationship between activity restriction and poverty levels. Table 22 displays a report that activity restriction is positively correlated with poverty level. This may mean that the tighter activities of the financial system are regulated the higher the poverty levels. This may be due to the fact that restriction of bank activities reduces bank efficiency and limit the commercial activities of banks (Barth et al., 2013), thereby discouraging engagement in social strategies to alleviate poverty, hence high level of poverty. The result supports findings of Zainal et al. (2021) who report that more restriction results in a limited activity of the banks to advance credit to the poor.

The coefficient of the more stringent restrictions on transparency from model 3 of table 22 presents a significant and positive linkage with poverty level. The results illustrate that more transparency of financial system leads to higher poverty levels of economies in SSA. The findings infer that higher level of poverty can be attained from inefficient financial system as stringent restriction on transparency reduces efficiency (Triki et al., 2017). Meanwhile, the results on tighter restrictions on exit in model 4 of table 22 is negatively significant to poverty level. This offers that highly controlled exit restriction from financial system encourages reduction in poverty levels. This signifies that controlled exit of respective financial sectors is strong enough to promote competition and engender digitally enabled financial innovation and efficiency to drive lowering level of poverty in SSA. This result affirms the findings of (Bauhr & Carlitz, 2021).

The thesis also documents that stringent capital requirements (CPX) significantly influences higher poverty levels. The positive coefficient stringent capital requirement, for that matter, positive effect, can be attributed to concentration on building higher buffers and reserves to the detriment of poverty alleviation initiatives, leading to higher levels of poverty. Comparing the findings of this study with the positions established in prior studies, the finding suitable aligns with outcomes of Zainal et al. (2021) that suggest that capital regulation tend to reduce social efficiency.

Turning to increased liquidity requirement, tighter liquidity restrictions has a negative significant impact on poverty level. This suggests that stricter liquidity restriction of different financial sectors in SSA is critical to drive poverty reduction initiatives. The result indicates that strengthening liquidity

restriction encourages social efficiency activities of banks. Thus, the finding is inconsistent with results of Sedaghat and Abdollahi (2021). However, the finding supports the results of earlier work by Rashid and Intartaglia (2017).

The system GMM estimates display in model 6 of table 22 represent effects of price control restrictions on poverty level. The coefficient of price control is negative and significant, meaning that increased price control requirements is conducive for lowering poverty level. This signifies that stricter price control, in the form of deposit insurance, encourages financial product innovation by reducing fear of failure for financial institutions, which tend to reduce poverty level. The finding is consistent with results of studies by Izaguirre et al. (2016) and Claessens et al. (2010).

The results concerning financial safety net displayed in model 8 of table 22 has a significant negative coefficient, indicating that availability of safety net reduces poverty levels. Specifically, availability of financial safety nets exhibits efficiency enhancing effect in financial sector which is associated with pro-poor initiatives of the financial institutions. The findings support the results of Chen and Divanbeigi (2019).

From the supervisory quality perspective, the result obtained in model 9 of table 22 has a negative coefficient and is significant, indicating that strengthening the quality of supervision mechanisms reduces poverty levels. A stronger supervisory quality is a good indicator of reduced risk-taking behavior, and stability of financial systems. Further, a stronger supervisory quality may mean deployment of such tools as private monitoring of banking activities and independent third party audit activities to provide detailed information regarding banking activities and risk management procedures.

These monitoring strategies and policies may increase the checks and balances within financial sector architecture geared to most likely promote commitment to lower poverty levels. The findings align with the outcome of Jayasekara (2021), Chen and Divanbeigi (2019) and Zainal etal. (2020).

For control variables, the results also demonstrated that four variables, economic growth, population growth, trade openness and CPI inflation mostly have significant effect on poverty level. Particularly, the coefficient of economic growth is observed to be negative and significant at least 10% across 7 models of table 22, except for model 5 where the coefficient is positive and significant. However, in model 7 the coefficient was negative but not significant. The negative coefficients indicate that the larger economic growth was, the lower the poverty levels observed across SSA economies. This signifies that economic growth supports and plays critical roles in poverty alleviation initiatives.

Table 22: Relation between BSR and Poverty

	(1) POV	(2) POV	(3) POV	(4) POV	(5) POV	(6) POV	(7) POV	(8) POV	(9) POV
L.POV	0.868***	0.823***	0.875***	0.806***	0.855***	0.862***	0.838***	0.810***	0.853***
	(0.0716)	(0.0683)	(0.0764)	(0.0823)	(0.0827)	(0.0926)	(0.0761)	(0.0645)	(0.0651)
DFIINDEX	-0.506***	-0.154**	-0.247***	-0.0908*	-0.208**	-0.140	-0.295***	-0.779***	-0.340***
	(0.061)	(0.0600)	(0.073)	(0.0507)	(0.086)	(0.124)	(0.057)	(0.150)	(0.062)
ETW	0.051**								
	(0.021)								
ACW		0.061***							
		(0.010)							
TRW			0.047***						
			(0.017)						
EXW				-0.0315**					
				(0.013)					
CPW					0.062**				
					(0.024)				
LDW						-0.022**			
						(0.009)			
PCW							-0.080**		
							(0.035)		
FSW								-0.034**	
								(0.016)	
SCW									-0.016**
									(0.008)
GDPGRWH	-0.036**	-0.043***	-0.084***	-0.016*	0.076***	-0.034***	-0.019	-0.025**	-0.018*
	(0.015)	(0.011)	(0.017)	(0.009)	(0.019)	(0.011)	(0.014)	(0.010)	(0.010)
POPGRTH	0.161*	0.189*	0.243*	0.339***	0.199*	0.189*	0.117**	0.157**	0.190**
	(0.087)	(0.101)	(0.122)	(0.109)	(0.104)	(0.104)	(0.047)	(0.067)	(0.083)
lnTO	-0.302**	0.338	-0.266**	-0.596	-0.340***	-0.249**	-0.340**	-0.380**	-0.224
	(0.127)	(0.254)	(0.114)	(0.983)	(0.116)	(0.104)	(0.170)	(0.155)	(0.183)
lnINFCPI	0.140**	0.144**	0.179***	0.193***	0.211**	-0.304	0.269*	0.149*	0.236**
	(0.055)	(0.058)	(0.054)	(0.053)	(0.093)	(0.236)	(0.163)	(0.090)	(0.109)
Constant	0.272	0.389	1.113	0.760	0.406	0.228	0.0723	0.896	-1.123*
	(1.188)	(1.077)	(2.098)	(0.689)	(1.152)	(1.461)	(1.354)	(0.787)	(0.580)

Observations	117	117	117	117	117	117	117	117	117
No. of inst.	23	23	23	23	23	23	23	23	23
AR1 (p-value)	0.303	0.307	0.291	0.320	0.309	0.297	0.302	0.313	0.305
AR2 (p-value)	0.460	0.512	0.591	0.674	0.580	0.550	0.390	0.657	0.421
Hansen-J (p-value)	0.591	0.642	0.698	0.498	0.512	0.721	0.771	0.651	0.449

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.010

ETW denotes entry restrictions, ACW denotes activity restrictions, TRW denotes transparency requirement, EXW denotes exit restrictions, CPW is stringent capital requirement, LDW denotes liquidity diversification, PCW denotes price control, FSW denotes financial safety net, SCW denotes supervision quality. All the other variables are previously defined

Indirect effect of digital financial inclusion and banking sector regulations

In this section interaction term is introduced to measure influence of digital financial inclusion on poverty level in presence of stricter banking sector regulations. Implementation of stricter banking sector regulations, for example tighter capital and liquidity restrictions, can contribute to the establishment of a more resilient banking system that is less susceptible to crises, which may have significant macroeconomic consequences in terms of loss of economic output or reduction of participation of more economic agents in productive economic activities. Stricter regulatory requirements may also result in smaller fluctuations in output, leading to improved overall welfare even in absence of banking crises. However, it is important to recognize that the capital and liquidity restrictions imposed by regulations can be costly for banking institutions, potentially affecting their ability to provide finance. This can manifest in the form of increased borrowing costs or reduced loan volumes, ultimately affecting access to finance. The contraction of credit can have detrimental effects on the economy, but the impact may appear particularly pronounced in emerging markets due to their less developed financial markets and higher levels of financial exclusion.

Table 23: Interaction term and poverty

	(1) POV	(2) POV	(3) POV	(4) POV	(5) POV	(6) POV	(7) POV	(8) POV	(9) POV
L.POV	0.830***	0.826***	0.830***	0.882***	0.866***	0.860***	0.829***	0.839***	0.853***
	(0.0717)	(0.0943)	(0.0813)	(0.103)	(0.0814)	(0.0970)	(0.0957)	(0.0727)	(0.0648)
DFIINDEX	-0.586***	-0.194**	-0.268***	-0.168***	-0.212**	-0.156**	-0.652***	-0.679***	-0.741***
	(0.100)	(0.082)	(0.089)	(0.052)	(0.092)	(0.071)	(0.096)	(0.066)	(0.144)
ETW	0.0128								
	(0.011)								
DFIINDEX*ETW	-0.035**								
	(0.014)								
ACW		0.091***							
		(0.019)							
DFIINDEX*ACW		0.086*							
		(0.045)							
TRW			0.059***						
			(0.010)						
DFIINDEX*TRW			-0.032**						
			(0.016)						
EXW				-0.073**					
				(0.025)					
DFIINDEX*EXW				-0.037***					
				(0.011)					
CPW					0.0217**				
					(0.009)				
DFIINDEX*CPW					-0.033**				
					(0.013)				
LDW						-0.0120			
						(0.048)			
DFIINDEX*LDW						-0.028**			
						(0.013)			
PCW							-0.042**		
							(0.021)		
DFIINDEX*PCW							-0.047***		
							(0.011)		

FSW								0.0337*	
								(0.0169)	
DFIINDEX*FSW								-0.0127	
								(0.0157)	
SCW									-0.018**
									(0.007)
DFIINDEX*SCW									-0.022***
									(0.006)
GDPGRWH	-0.065***	-0.040**	-0.042**	-0.074***	-0.022	-0.034	-0.071***	-0.018	-0.057***
	(0.015)	(0.017)	(0.018)	(0.019)	(0.018)	(0.031)	(0.022)	(0.011)	(0.013)
POPGRTH	0.176	-0.204	0.926***	0.133	0.151	-0.115	0.382**	0.711***	0.111
	(0.122)	(0.188)	(0.161)	(0.126)	(0.132)	(0.104)	(0.183)	(0.114)	(0.101)
lnTO	-0.329*	-0.505	-0.544**	-0.810**	0.358**	0.106	0.221**	0.626***	0.444**
	(0.196)	(0.378)	(0.216)	(0.288)	(0.180)	(0.154)	(0.131)	(0.185)	(0.186)
lnINFCPI	0.349***	0.123*	0.474***	0.152*	0.238***	0.297*	0.441***	0.615***	0.613***
	(0.091)	(0.074)	(0.081)	(0.091)	(0.058)	(0.157)	(0.111)	(0.083)	(0.074)
Constant	0.775	0.0919	0.166	0.0733	0.418	0.215	0.303	0.357	1.058*
	(1.566)	(1.589)	(3.585)	(1.254)	(1.562)	(1.498)	(1.662)	(0.911)	(0.592)
Observations	117	117	117	117	117	117	117	117	117
No. of instruments	22	22	22	22	22	22	22	22	22
AR1 (p-value)	0.305	0.314	0.311	0.305	0.305	0.296	0.325	0.297	0.308
AR2 (p-value)	0.394	0.335	0.376	0.537	0.569	0.620	0.554	0.386	0.441
Hansen-J (p-value)	0.562	0.478	0.443	0.499	0.732	0.655	0.655	0.444	0.461

In table 23, the system GMM estimation results of interaction terms for testing moderating effect of banking sector regulations on the relationship between digital financial inclusion and poverty level are presented. In model 1 of table 23 the result indicates that the interactive term of stringency of entry restriction and digital financial inclusion is statistically significant and positive. This finding is evidenced by positive coefficient of interaction term, indicating that tighter entry restrictions increases the effect of digital financial inclusion in lowering poverty level. Meanwhile, the interaction term between stringent activity restriction and digital financial inclusion demonstrates a significant positive effect on poverty level. This finding also indicates that stringent activity restriction increases digital financial inclusion's effect in increasing poverty level in model 2 of table 23. The meaning of the revealed insight implies that higher digital financial inclusion increases poverty level is conditioned on stricter activity restrictions. This because greater activity restriction is associated with higher capital buffer, which reduces efficiency of banks (Triki et al., 2017), possibly leading to increased poverty levels.

The interaction term of digital financial inclusion and stringent transparency requirements has a negative coefficient, indicating that an increased transparency requirements and a greater digital financial inclusion combined to reduce poverty level. Though increased transparency requirement is expected to reduce efficiency, thereby leading to lowering digital financial inclusion (Triki et al., 2017), it appears increased transparency might have enhanced confidence in digitally driven financial innovation, resulting in increased used of mobile-money platforms and mobile money services. The result implies that when transparency requirement is stricter, it promotes confidence and trust in digital financial

services, innovations and using digital financial services leading to lowering of poverty level. The finding supports the earlier result of Jiang et al. (2022).

The interaction term of digital financial inclusion and tighter restrictions on exit from financial system shown in model 4 of table 23 has a significant negative coefficient. The negative coefficient of interactive term indicates poverty reduction characteristics of greater digital financial inclusion is conditioned on tighter restrictions on exit from banking activities. This is consistent with Okello Candiya Bongomin et al. (2018).

In view of the interaction term between digital financial inclusion and stringent capital requirements, the estimates displayed in model 5 of table 23 has a significant negative coefficient. This coefficient demonstrates that effect of digital financial inclusion in alleviating poverty increases with stringent capital requirements. The result signifies that, holding all other things constant, strengthening stringent capital requirement of banks is likely to significantly enhance the effect of digital financial inclusion in reducing poverty level. Thus, banking sector regulation (capital requirement) moderates between digital financial inclusion-poverty linkage. The finding supports the results of Jungo et al. (2022).

On the contribution of greater liquidity restrictions to digital financial inclusion and poverty relationship, the coefficient of interaction terms displayed in model 6 of table 23 reveals increased liquidity requirements enhances negative effect of greater digital financial inclusion on poverty level. This finding implies that increased liquidity requirement improves poverty reduction effect of digital financial inclusion. In line with this finding, it imperative to note that banking sector regulation (liquidity requirement) moderate between digital financial

inclusion-poverty relation. This is consistent with results of Ikram (2022) which demonstrate that financial regulation strengthens digital financial inclusion effect.

The interaction of digital financial inclusion with price control mechanisms reveals an interesting outcome. It imperative to note that price controls capture financial repression which encourages restrictive regulations to financial products leading to availability of price restrictive barriers to financial inclusion. The expectation therefore is that price controls should slow digital financial inclusion. It emerges from the findings displayed in model 7 of table 23 that the interaction term has a significant negative coefficient, indicating that increased price controls enhance the effect of greater digital financial inclusion in lowering poverty level. These findings fail to corroborate the work of Wang and Luo (2022). However, the estimates regarding availability of financial safety net do not impact relationship between digital financial inclusion and poverty. Though the coefficient of interaction term is positive, it is not significant. This suggest that financial safety net does not moderate between digital financial inclusion-poverty nexus. This supports findings of Anarfo et al. (2020). From model 9 of table 23, the thesis draws on effect of digital financial inclusion on poverty level in the presence of supervisory quality. The result points out that the coefficient of the interaction term between digital financial inclusion and supervisory quality is negative and significant, indicating that increased quality of supervision enhances effect of digital financial inclusion to lower poverty level. Thus, thus suggest that quality of supervision moderates between digital financial inclusion-poverty relation. This poverty reduction effect of digital financial inclusion in presence of quality supervision of banks is consistent with established

relation between digital financial inclusion and financial regulation on poverty (Zainal et al., 2021).

Summary and Conclusion

Critical to this chapter is the objective that examine the moderating effect of banking sector regulations between digital financial inclusion and poverty reduction in a sample of SSA countries. Drawing evidence from data set on Africa development banks from (Triki et al.,2017), this study adds to the existing stock of knowledge on the relationship between finance-poverty literature in SSA. Further, the study is the first to the best our knowledge, on how dimensions of banking sector regulations impact relationship between digital financial inclusion and poverty reduction in a selected SSA economies. The study finds that strengthening exit restriction, tightening liquidity restriction, enhancing price control, improving availability of financial safety net, and improving quality of supervision will reduce poverty levels. Furthermore, digital financial inclusion reduces poverty levels. Association between digital financial inclusion and poverty reduction depends on some dimensions of banking sector regulations. Specifics of the findings demonstrate that strengthening entry restriction, improving transparency requirement, strong exit restriction, stringent capital requirement, high liquidity restriction, enhancing price control, and improving quality of supervision will improve poverty reduction gains of digital financial inclusion. However, the results further show that whiles availability of financial safety net will not condition the relationship between digital financial inclusion and poverty reduction, placing restriction on activities of banks will be detriment for digital financial inclusion and poverty reduction relationship.

CHAPTER SEVEN

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This thesis examined the relationship among digital financial inclusion, banking sector regulation and poverty in 25 economies in SSA for the period spanning from 2014 to 2020. Particularly, the study investigated the effect of digital financial inclusion, and banking sector regulation on poverty, as well as the moderating effects of institutional quality (political and stability and voice of the people) and banking sector regulation on the relation between digital financial inclusion and poverty. In essence, the study is motivated by the need to provide policy implications regarding sustainable development goals in the light of inclusive finance, zero poverty and institutional quality across SSA economies in line with the sustainable development goals of United Nations. The specific objectives of the thesis were first and foremost to assess the influence of digital financial inclusion on poverty reduction, secondly to explain the influence of banking sector regulations on digital financial inclusion. Thirdly, the thesis assessed the moderation effects of banking sector regulations between digital financial inclusion and poverty.

The thesis employed a quantitative research method utilizing secondary data collected from world development indicators for SSA economies within World Bank database and bankscope. The data analysis was conducted using STATA version 15, quantile regression technique and system GMM estimation approach.

This chapter constitutes the concluding chapter of the thesis report. The chapter encompasses four sections. With the first section, the summary of

findings regarding the research objectives were presented. Following this is conclusions drawn and contributions of the thesis in advancing knowledge. The recommendation section follows immediately after the conclusions section. Finally, the chapter ends with suggestions for possible further studies.

Summary of findings

The findings were written in light of the objectives and their corresponding stated hypotheses. The first objective looked at whether or not digital financial inclusion influences poverty level. With this objective, it emerges from the findings that number of registered mobile money agents, number of registered mobile money users and mobile cellular subscription significantly lower poverty levels, whereas individual internet usage does increase poverty levels. Besides, the findings of the digital financial inclusion index significantly reduce poverty level in SSA region. It is imperative to note that the coefficient of digital financial inclusion index was negative and significant across the entire quantile distribution of poverty level (poverty gap). For the four variables used to construct digital financial inclusion index, number of registered mobile money users was found to have a significant negative relationship with poverty level through all quantile distribution except for 25th quantile which was positive. Further, the result show that the coefficient of number of registered mobile money agents was positive and significant across all quantile distribution of poverty levels. Whiles mobile cellular subscription was found to have significant negative relationship with poverty level through the entire quantile distribution of poverty, individual internet usage has negative coefficient but significant for only 75th and 90th quantiles of poverty level.

The second objective was to examine the impact of dimensions of banking sector regulation on digital financial inclusion in 25 sub-Saharan African countries. The study examined nine (9) dimensions of banking sector regulation comprising entry restriction, activity restriction, transparency restriction, exit restriction, stringent capital requirement, liquidity restriction, stringent price control, availability of financial safety net, and quality of supervision. The results showed that stringent restrictions place on entry, activity, capital requirement and liquidity significantly reduce digital financial inclusion.

Increased availability of financial safety nets has digital financial inclusion enhancing effect for SSA region. Also, the results reveal that increased availability of quality supervision enhances digital financial inclusion. Additionally, increased price controls has significantly enhanced digital financial inclusion.

Further, the results demonstrate that effects of dimension of banking sector regulations on digital financial inclusion in SSA region depend highly on institution quality (political stability and absence of violence and voice and accountability). Specifically, it was observed that political stability and absence of violence significantly moderates between banking sector regulations (entry, activity, transparency, liquidity, price controls, financial safety nets, and supervision quality) and digital financial inclusion. Thus, building strong institutional structure (political stability and absence of violence) is likely to improve digital financial inclusion enhancing effect of some dimensions of banking sector regulations. However, for stringent exit and capital requirements, political stability and absence of violence does not

moderate between banking sector regulations and digital financial inclusion. With voice and accountability, institutional quality moderates between dimensions of banking sector regulations and digital financial inclusion. Thus, it was observed that institutional quality (voice and accountability) appear to have created enabling environment for enforcing robust banking regulation to enhance digital financial inclusion in SSA.

With the third objective, the study assessed the effects of banking sector regulations between digital financial inclusion and poverty reduction in selected countries in Sub-Saharan Africa. The findings demonstrate that digital financial inclusion lead to poverty reduction. In essence, increasing access, penetration and usage of digital infrastructure and digital financial services is likely to reduce poverty level in SSA. However, banking sector regulations have implication for building digital infrastructure and use of digital financial services since banking sector regulations tend to moderate the innovative, efficiency and digital finance technology adoption of financial institutions. Thus, it was found that when entry restrictions, transparency requirements, exit restrictions, stringent capital requirements, liquidity restrictions, price controls and quality supervision are robust and effectively enforced, negative effect of digital financial inclusion on poverty is enhanced. However, whereas availability of financial safety net does not moderate between digital financial inclusion and poverty levels, more restrictions on activities of banks tend to enhance positive effect of digital financial inclusion on poverty levels in Sub-Saharan Africa countries.

Conclusions

This thesis provides deeper and thoughtful insights into the link between digital financial inclusion and poverty, and the role of banking sector regulations. It follows a number of seminal papers documenting relevance of modern growth theories for poverty reduction. Just like those studies, the current thesis gives credence to suggestions that emerging and developing countries stand to reap the benefits of poverty reduction by focusing on modern growth conditions. Despite the fact that the findings of this thesis gives credence to the earlier studies, which are predominantly concentrated in China (Lee et al., 2023), the current study therefore differs based on the context in which it was undertaken. Digital financial infrastructure and digital financial services access, penetration and usage indicators which are key determinants of digital financial inclusion were considered.

This study concludes that digital financial inclusion is crucial for poverty reduction in countries in SSA. Key findings demonstrate that as poverty level proxied by poverty gap increases towards higher quantiles, its negative connection with digital financial inclusion increases and becomes more significant beyond the 50^{th} quantile. Further, whereas number of registered mobile money users and mobile cellular subscription lower poverty levels across the entire quantile distribution, number of registered mobile money agents increase poverty level. The possible implication is that poverty level (poverty gap) is associated with higher access, penetration and usage of digital infrastructure and digital financial services that support people who reap benefit of digital financial inclusion. Since the SSA region is

characterised by high extreme poverty, digital financial inclusion does guarantee a solution for poverty reduction in SSA.

The study highlights the relevance of dimensions of banking sector regulation to digital financial inclusion, and the role of institutional quality (political stability and absence of violence, and voice and accountability). The specificity of this points out that dimensions of banking sector regulations exhibit complex trend with digital financial inclusion. Further, the thesis highlights influence of digital financial inclusion through dimensions of banking sector regulations. More specifically, the effect of digital financial inclusion was conditioned on dimensions of banking sector regulations. In light of this, countries of Sub-Saharan Africa can reap maximum benefits from digital financial inclusion by lowering restriction on some banking sector regulations and tightening restrictions on others. Thus, dimensions of banking sector regulations were investigated to establish the dimensions that facilitate or inhibit digital financial inclusion among countries in SSA.

The study further concludes that banking sector regulations reverses the negative effect of digital financial inclusion on poverty reduction. This suggests that digital financial inclusion has impact on poverty reduction when some dimensions of banking sector regulations are stringent. The results of this thesis strongly link digital financial inclusion to dimensions of banking sector regulation in financial sector. This means that increases in restrictions on activities of banking sector leads to increases in adoption of innovative financial technology resulting in more access, penetration and usage digital infrastructure and digital financial services, which tend enhance digital financial inclusion. It is evidence that adoption of innovation technologies in

SSA facilitate penetration of mobile money usage, mobile subscription and internet usage, suggesting that more restriction on banking sector regulations increase digital financial inclusion in SSA.

Recommendations of the study

In SSA, poverty is one of the key challenges faced by emerging and developing economies. Cases of successes in relation to contribution of digital financial inclusion in promoting economic growth and enhancing social welfare in advanced economies has been highlighted. The 2030 United Nations Sustainable Development Goal 1 (No poverty everywhere), Goal 9 (inclusive growth) and Goal 8 (financial inclusion) have been instituted expecting all governments to direct their development programs towards ending poverty in all forms, everywhere. Focusing on achieving these targets, primarily, it is recommended that governments and policymakers in sampled SSA countries should engage in critical developmental programs that aim at expanding digital financial inclusion. There must be calculated steps to create enabling environment for granting mobile money agents licenses, reduce taxes on mobile handset and internet subscription and usage, and charges on mobile money usage.

Secondly, the empirical evidence indicates a significant negative impact of number of registered mobile money users and mobile cellular subscription on poverty levels, whereas number of registered mobile money agents positively increase poverty levels. It is recommended that mobile money operators should grant agency licence to people in the rural areas to increase accessible and available of mobile money agents across rural communities. Further, mobile money operators should build capacity of

mobile money agents so that they will be able to register people unto mobile money platforms. In addition, telecommunication companies should promote the use of mobile devices or handsets by offering packages at subsidised prices that will make it affordable for rural populace to acquire handsets or mobile devices. Governments across the SSA should also grant mobile money operators some tax reliefs regarding the operators' initiatives in offering mobile devices at discount prices as it will benefit governments in their poverty reduction strategies. Finally, access to internet is not used economically across the SSA economies. Therefore, government of SSA economies should institute awareness creation programs on economic use of internet. It is further recommended that governments in SSA economies should learn from M-pesa business model, and where possible, improve on its operations to deepening digital financial inclusion.

Thirdly, from econometric results using conditional quantile regression, the results demonstrate that disaggregated effects of digital financial inclusion measures affect poverty level across different quantiles in the sampled SSA countries. As consequence of disaggregated effects of digital financial inclusion measures, poverty reduction requires public-private collaboration or reinforcement of public-private collaboration where they are already in existence, to help countries in upper quantiles of poverty levels. Central banks and policymakers in SSA countries sampled should implement digital financial inclusion policies that target and promote investment in digital financial infrastructure, product, services and platform aiming at advancing digital financial inclusion. Further, stringent measures like incentives or tax

advantages for the players in digitally enabled financial services sector to invest in key financial technologies and state of the ark internet facilities.

Fourthly, entities operating in digital financial landscape should recognize that digital financial services and products facilitate digital financial inclusion agenda. Thus, policymakers and central banks in SSA should formulate policies that engage investment in digital technology infrastructure. These digital technologies can facilitate poverty reduction effect of digital financial inclusion, including reducing transaction cost, reducing information asymmetry, increasing allocation of resources and enhancing provision of reliable, affordable and convenient formal financial services which occur in parallel with advancement in financial technologies. In similar vein, insights, experience and knowledge of effect of measures of digital financial inclusion on different quantiles of poverty distribution that emerged from quantile regression analysis is an opportunity for national economies in SSA to develop policies and programs that target people in different quantiles of poverty distribution. Thus, identification of differential effects of measures of digital financial inclusion across different quantiles of poverty level is informative for future poverty reduction policy impact and allocation of resources.

Furthermore, in order to attain sustainable development goals regarding poverty reduction, it is recommended that governments, development partners and policymakers in Sub-Saharan Africa pay particular attention to poverty distribution and promote specific digital financial inclusion package for people in specific quantile of poverty distribution.

It also recommended that central banks and policymakers undertake institutional policy reforms. This can be done by building stable political

system devoid of violence, and promote accountability and mass participation in governance systems through building quality institutional structures. These favorable institutional environment climate factors can enforce financial regulations in building confidence and trust of consumers and protecting consumers leading to more confidence in the use digital financial services. Furthermore, as banking sector regulations are within the remit of central banks, they should continue to maintain their independence of political meddling in order to ensure stable and consistent policy directions.

Finally, dimensions of banking sector regulations have been observed to have significant inconsistent influence on digital financial inclusion. The findings have demonstrated that availability of financial safety net and price controls impact positively on digital financial institutions. In the backdrop of this, it is recommended that central governments, financial institutions and policymakers in sampled SSA region should introduce more deposit insurance schemes, put in place more safety nets and reduce fees and charges on digital financial transactions. Apart from the need for stringent banking sector regulations for digital financial inclusion to ensure finance is more essential in reducing poverty, improving institutional structures is also helpful to lessen the hardship of the poor pose by financial exclusion. Thus, policy that ensure digital financial inclusion to reduce poverty and promote financial inclusion is crucial.

Governments should establish or strengthen institutional agencies in order to monitor how underserved or marginalized segments of societies register for mobile money accounts, acquire license for mobile money agency

business, and access mobile money accounts to use financial services, especially in the rural segments of societies.

It is also important for policymakers, regulators and central banks in the sampled SSA region to put in place measures to reduce risks, cybersecurity threats, and fraud and trust concerns posing huge digital financial technology adoption challenge for digital finance. Thus, regulators and central banks in the sampled SSA region while putting in place effective regulatory systems for financial technology companies and financial institutions to enhance credit growth such as credit information registry and collateral regimes should also enforce law that will help address potential risks associated with digital finance including fraud and cybersecurity threats.

Finally, it is recommended with reference to the findings of the study that governments across SSA improve upon their banking regulatory frameworks. This could be done by integrating regulation-based poverty alleviation approach into their banking regulatory framework where they blend policies, digital financial innovations, regulations and institutional structures with the aim to foster inclusive finance and reduce poverty.

Limitations and Suggested Further Research

To the extent that this study could not address everything there is about finance-poverty nexus, the following research areas are suggested for future researchers in order to advance knowledge in the area of finance and poverty literature: It is recommended for future researchers in the area of finance and poverty to consider the following.

First, the used of quantile regression provides comprehensive insights regarding global relationship between digital financial inclusion and poverty

level in the sampled SSA region. However, country-level study could be relevant within the context of corresponding country-specific panel empirical strategies that could offer policymakers the opportunity to device more country-specific policy on effect of digital financial inclusion across various poverty distributions. Thus, future study should deploy country-level analysis regarding digital financial inclusion and poverty relations.

Second, number of observations. Although the use of system GMM estimation procedure is suitable for cases where small observations are used, future research could consider to increase the number of observations, particularly the panel dataset over a long-term period which could help offer reliable estimates in the long-run considering the dynamics of digital financial technology and poverty.

Third, the assessment of digital financial inclusion through mobile money technology channels accounts for recent momentum in delivery of digitalized financial services in SSA region through mobile money services and digital platforms. This measure fails to account for multidimensionality of digital financial inclusion. Thus, future research capturing other indicators like, online banking, number of ATMs to mention just a few would enrich knowledge in the field of study.

Moreover, as clarified elsewhere in the report where number of mobile money agents were found to have increased poverty level, a threshold analysis and consideration of household dependency could help explain this effect. Thus, theoretical implications of a study where threshold effect of number of mobile money agents are considered could be assessed in future study to provide deeper insights in the poverty reduction implications of number of

mobile money agents. Further studies could as well consider other mechanisms and policy variables that could help address poverty concerns by enhancing conditions for attainment of sustainable development goals regarding reduction in extreme poverty.

Further studies should be conducted to investigate how banking sector regulations index influence poverty reduction. In spite of the fact that the current study found moderating roles of dimensions of banking sector regulations, more studies are required to give credence to these findings.

Finally, additional studies can be conducted to examine micro-level impacts of banking sector regulations and digital financial inclusion, especially in rural and underserved communities. This will improve or provide first-time evidence on financial regulations and digital financial inclusion at micro-level. Moreso, additional future research may also consider using mixed research approach or triangulation studies to enhance understanding of poverty from multiple perspectives.

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