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FINTECH, FINANCIAL INCLUSION AND ECONOMIC DEVELOPMENT NEXUS IN SUB-SAHARAN AFRICA

A Research Report submitted in partial fulfilment of the Degree of Master of Commerce (Applied Development Economics)
in the School of Economics and Finance,
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by

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ABSTRACT

Fintech is proven as an enabler for financial inclusion in the Sub-Saharan African (SSA) economies. This is achieved mainly through the utilisation mobile money accounts in the region. The link between Fintech and financial inclusion and their impact on economic development has not been widely explored. This paper investigates the Fintech, financial inclusion, and economic development nexus in SSA for 33 countries using for the period 2011 to 2021.

The study utilised multiple models of pooled ordinary least square (POLS), the two-stage least square (2SLS), Fixed Effects (FE), Random Effects (RE), Fully Dynamic Ordinary Least Squares (FMOLS), and Dynamic Ordinary Least Squares (DOLS) to estimate the relationship between the variables. We found that Fintech is a facilitator of financial inclusion and the relationship between these variables is significant. We further find that financial inclusion positively correlates with economic development, however the relationship is found to be insignificant. We also found that Fintech does not have positively correlates with economic development. Investing on Fintech by economies will assist in enhancing the level of financial inclusion in the region.

Keywords: Fintech; financial inclusion; economic development; Sub-Saharan Africa; Index of Financial Inclusion (IFI).

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CHARPTER 1: INTRODUCTION

Financial technology (Fintech)[1] has surfaced as an evolutionary power in the intercontinental financial environment, revolutionizing the provision and accessibility of financial services. According to Beck (2020), innovation in finance through unorthodox delivery channels, providers, and products has aided pushing out the borderline of access to finance and resulted in a rise on the bankable and banked population. In the context of SSA region, where orthodox banking facilities are often limited, Fintech holds the capability to play a pivotal role in promoting financial inclusion and driving economic development.

SSA is a domain characterized by weighty challenges in financial inclusion, with a sizeable portion of the individuals without accessibility to formal financial services[2]. The region lags behind at 55 percent account ownership with a mobile money or financial institution compared to 71 percent average for developing countries (Findex, 2021). Inclusion of the population to financial services is viewed as fundamental to economic growth and therefore strategic to the policy agenda of most developing economies (Ulwodi and Muriu, 2017). Limited physical infrastructure, low banking penetration, high costs, and geographical barriers have traditionally hindered the availability provision of financial services to underprivileged individuals. However, the swift multiplication of mobile phones and connectivity to internet across the region has paved the way for innovative Fintech solutions that can bridge the financial inclusion gap.

Financial inclusion, which related to accessibility and usage of financial services that are affordable, is popularly acknowledged as a main factor of economic development and reduction in poverty. However, this concept is multidimensional and thus attracted several but similar definitions, such

[1] Innovative technologies and digital platforms that enable the delivery of financial services, (Ramlall, 2018).
[2] Findex 2021

as Sarma (2008) view financial inclusion as a process to ensure availability of formal financial systems, its accessibility and its easy use by all participants of the economy, while Singh and Singh Kondan, (2011) defines financial inclusion as an initiative to ensure that household (and individuals) and community businesses can adequately access formal financial system (products and services). This includes ability to transact, own credit cards, make payments, save, and take up insurance, and these are made in a way that is sustainable.

By enabling Individuals (and households) and entrepreneurs' access to and utilize financial tools, like payment systems, credit, and savings accounts, inclusion in financial services can enhance economic opportunities, promote entrepreneurship, and foster income generation. Fintech, with its disruptive technologies and digital platforms, has the potential to significantly advance financial inclusion by offering accessible, convenient, and not too costly financial services to previously unbanked or underserved populations. The region is the world frontrunner in mobile money (a Fintech platform) usage, adoption, and innovation, (Perez-Saiz, and Sharma ,2019).

Understanding the nexus between Fintech, financial inclusion, and economic development in sub-Saharan Africa is important for policymakers, regulators, financial institutions, and development practitioners. By harnessing the capability of Fintech to drive financial inclusion, countries in the region can unlock new avenues for economic growth, job creation, and decrease in poverty. This research report aims to examine the complex interplay in Fintech, financial inclusion, and economic development in sub-Saharan Africa.

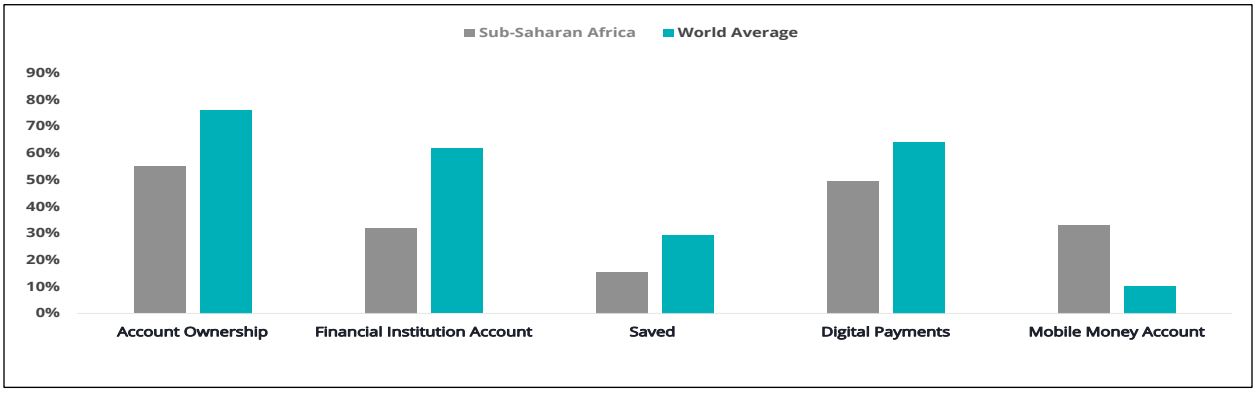
1.1 Background of the Study

Notwithstanding the efforts made, according to Demirgüç-Kunt, Singer and Ansar (2018), financial inclusion remains one of challenges in the African economies in which outcomes of the digital

innovations are not being shared in an equally manner and pivotal accessibility gaps continue between households that are poorer and those that are richer, between women and men, , and urban and rural populations.

Sub-Saharan Africa is a region characterized by significant challenges in financial inclusion and economic development[3]. Limited accessibility to formal financial services, coupled with high poverty levels and inequality, has hindered the region's progress towards sustainable economic growth and poverty reduction. According to the latest by the World Bank, the region has a poverty headcount ratio of 35.4 percent, compared to 9 percent world ratio. Individuals that use internet in the region account for only 36 percent of the total population, while the percentage for the world of double at 63 percent. However, the rapid advancement of Fintech offers a unique opportunity to address these challenges and transform the financial landscape in sub-Saharan Africa. Figure 1 illustrate how that the region has higher mobile money accounts compared to the world average, cementing the result of the Findex 2021 that increase on account ownership in Sub-Saharan Africa has been mainly attributable to mobile money accounts.

Figure 1: Regional overview of the state financial inclusion



Source: Global Findex Database (2021).

[3]The World Bank in Africa.

However, notwithstanding the growing interest and adoption of Fintech in the region, there exist a need for empirical research to scruitinise the actual impact of Fintech on financial inclusion and its subsequent effects on economic development. According to McKinsey and Company 2022 report on fintech trends, the number of tech-startups in Africa tripled between 2020 and 2021. The developing space of Fintech presents innovators with an opportunity to improve elements along the financial services value chain well beyond mobile money. This has presented different levels of maturity in the digital space across the economies in the region, with more opportunities for economies that have the most matured banking system like South Africa. The report anticipate growth in Fintech to be concentrated in 11 economies in the region namely: South Africa, Tanzania, Uganda, Senegal, Nigeria, Morocco, Kenya, Ghana, Egypt, Cameroon, Cote d'Ivoire.

Existing studies have provided valuable insights, but they often lack a broad understanding of the nuanced dynamics and contextual factors specific to SSA. This research aims to bridge this gap by conducting an in-depth analysis of the nexus between Fintech, financial inclusion, and economic development in sub-Saharan Africa. It seeks to investigate the extent to which Fintech innovations adds to improving financial inclusion levels in SSA and the subsequent implications for economic development indicators like GDP growth, investment, employment, and poverty reduction.

The outcomes of this research will not only contribute to the existing literature on the subject but also provide valuable guidance for policymakers, financial institutions, and development organizations in formulating effective strategies and policies to leverage Fintech for promoting financial inclusion and driving sustainable economic growth in sub-Saharan Africa. By harnessing the potential of Fintech and enhancing financial inclusion, the region can unlock new avenues for economic empowerment, poverty reduction, and inclusive development.

1.2 Statement of Problem

The Global Findex for 2021 indicates that account ownership in developing countries have improved from 63 percents to 71 percent between 2017 and 2021, which is 8 percentage point increase. Notably, this increase in Sub-Sahara is mainly attributable to the adoption of Fintech, through mobile money accounts, which in turn can be attributable to availability of mobile money services. The region is leading globally in mobile money innovations, usage, and adoption, (Perez-Saiz, and Sharma, 2019). The Global Findex indicates that 33 percent of individuals (adult population) in the SSA have a mobile money account, compared with 10 percent in the world.

Despite this improvement, the continent still has the highest number of the unbanked population globally. Over 50 percent of the world's unbanked individuals resides in seven regions, with Sub-Saharan Africa leading the pack. Other regions included are South Asia, East and Pacific, Middle East and North America, Latin America and the Caribbean, and Europe and Central Asia. According to Anarfo et al. (2019), financial inclusion is dependent on development levels of the financial industry in an economy. Inclusive finance is associated with sustainable development and empowerment of the disadvantaged population of the economy (Winful, Opoku-Asante, Mensah, and Quaye, 2022). Literature on inclusion finance and economic development has been well established, however a large gap remains on how fintech impact financial inclusion and subsequent impact on economic development.

1.3 Research question

The research report intends to address the following key questions on the link between Financial Technology, Financial Inclusion and Economic Development:

1. What is the link between financial inclusion and Fintech?

2. What is the impact of Fintech on financial inclusion and its subsequent effects on economic development in sub-Saharan Africa?

These research questions seek to examine the link between Fintech, financial inclusion, and economic development in the context of SSA. They aim to investigate the specific impact of Fintech innovations on improving financial inclusion levels in the region and the subsequent implications for economic development measures like growth in GDP, investments, employment, and poverty reduction. By addressing these research question, the study can provide valuable insights into the role of Fintech in facilitating inclusive economic growth and poverty reduction in sub-Saharan Africa.

1.4 Objectives of the study

The objective of the research report is to assess the relation between Fintech, financial inclusion, and economic development. Specifically, the study seeks to:

1. Investigate the pathways through which financial inclusion, facilitated by Fintech, influences economic development in Sub-Saharan Africa. This includes investigating the relationship between financial inclusion indicators (access and usage) and key economic development outcomes proxied by per capita GDP.
2. To identify the enabling factors and challenges in leveraging Fintech for financial inclusion and economic development in sub-Saharan Africa. This involves examining the role of regulatory frameworks, infrastructure development, public-private partnerships, and capacity building initiatives in facilitating the positive impact of Fintech on financial inclusion and economic development outcomes.

By addressing these objectives, the research will improve a better understanding of the how Fintech, financial inclusion, and economic development are related in sub-Saharan Africa, and provide valuable insights for policymakers and stakeholders to design effective strategies and policies for harnessing the potential of Fintech to facilitate inclusive economic growth and reduce poverty in the region.

1.5 Relevance of the study

While existing literature has explored the effects of Fintech and financial inclusion in various contexts, the specific dynamics and challenges in sub-Saharan Africa necessitate a focused examination of this nexus within the regional context. Many studies such as Demir, Pesqué-Cela, Altunbas, and Murinde (2022), Chinoda, and Mashamba (2021), Ashenafi, and Dong (2022) have focused on the relationship between Fintech, financial inclusion and income inequality or gender. This research report seeks to fill this gap by providing an in-depth analysis of the role of Fintech in promoting financial inclusion and its subsequent impact on economic development in sub-Saharan Africa.

Therefore, the study's relevance lies in its potential to close the identified gap, inform policy decisions, guide financial institutions and development organizations, impact socioeconomic outcomes, and contribute to academic knowledge. By shedding light on the Fintech, financial inclusion, and economic development nexus in sub-Saharan Africa, the research has the capacity to drive positive change, foster inclusive growth, and contribute to the body of literature that seeks to improve the lives of individuals and communities in the region. The study will also offer a comparative analysis of fintech adoption across different Sub-Saharan African countries, highlighting best practices and lessons that can be applied to other regions.

1.6 Contribution of the study

The study contributes to academic knowledge by adding to the body of research on fintech and financial inclusion. It may stimulate further inquiry into related topics, such as the role of regulatory frameworks, the impact of specific fintech applications (e.g., Crypto currencies, mobile money, and digital lending), and the dynamics of financial ecosystems in emerging markets. The contribution of this paper to knowledge lies in its empirical investigation of the topic being explored. The study offers insights into future research endeavours.

1.7 Study Outline

The outline of the study is such that chapter 1 is followed by Chapter 2 which provides an overview of the literature (theoretical and empirical) relevant to the study. Chapter 3 outlines the methodology and data sets employed in the study, leading to Chapter 4 which shows the empirical analysis and notes implications of the outcomes. The study is concluded by Chapter 5 which concludes the study findings, making policy recommendations, and identifying research gaps.

CHAPTER 2: LITERATURE REVIEW

This section details the analysis of related literature (theoretical and empirical) that forms the basis for the study and relating to the study variables.

2.1 Theoretical Review

There are many studies that have attempted to provide theoretical foundations of financial inclusion. The theoretical foundations relevant to this study are based on two approaches, (a) the technological innovation and diffusion approach which provides how technological innovations in Fintech are introduced and adopted, and considers factors such as mobile penetration, internet connectivity and regulatory environment influence the diffusion of Fintech solutions, (b) the financial

literacy approach which supports that awareness about accessibility of basic financial services should be established within the economy instead of investing public funds (Ozili, 2020) and (Ozili, 2021).

Through the influence of digitisation on financial systems, the offering of financial services has considerable introduced measure with adoption of mobile banking. The introduction of mobile banking has positively impacted the lives of many people, e.g., in the rurals (Kouladoum, Wirajing and Nchofoung, 2002). Almost all SSA economies have gone through substantial financial sector transformation in recent years, however, their financial industries are still less-developed, even compared to the levels of other developing economies particularly the Asian countries (Triki and Faye, 2013).

Growth in the technological availability and potential has come out as the most pivotal driver of digital financial inclusion. Financial inclusion is positively linked to financial technologies that enable efficient access to banking services, (Grohmann, Klühs, and Menkhoff, 2018). For example, accessibility of mobile connection in all parts of Africa region, South America and Asia has resulted in innovative Fintech solutions. A study by Suri and Jack (2016) shows that mobile money has contributed to a 2 percent of Kenyan households out of poverty and improvement in per capita consumption levels. The establishment of sizeable and subsisting agent networks also provides a significant role in pushing the far-reaching adoption of digital financial services. Efficacy may be molded by the scope these rural and urban agent networks can enable cash-in and cash-out. Evans (2018) opined financial access in developed economies is greater than in developing nations mainly as a result of technological advancement which contributes to a significant role to diminish financial exclusion.

Ozili (2020) present the theory of financial literacy which postulates that the eagerness of people to take up financial services available is mainly influenced by the levels of financial literacy. It elucidates that improving the understanding of finance people through learning is crucial for obtaining the financial inclusion agenda. With improvements in financial literacy, people are able to utilise more formal financial services and products available.

This theory further postulates that, financial literacy is considered as one of policy strategies to achieve financial inclusion. An improvement in financial literacy in population drives an improvement in account ownership, and the impact is significant in countries with low levels of financial depth (Grohmann, Klus and Menkhoff, 2018). It provides a way for populace to learn about financial management and the benefits of making use of formal financial services. This theory states that that financial literacy will enhance individuals' desire to take part in the formal sector (Ozili, 2020).

2.2 Empirical Review

2.2.1 Fintech and financial inclusion

According to existing literature there is a positive link between Fintech adoption and financial inclusion. Studies by Tchamyou, Erreyger, and Cassimon (2019) and Kouladoum, Wirajing, and Nchofoung, (2022) found that Fintech and ICT are pivotal drivers of financial inclusion. This indicates that financial technology has significant prospect for expending the spread of the formal banking system in nations where a large number of people is still financially excluded. While Kouladoum et al., (2022) assessed digital technology and financial inclusion relationship in 43 SSA countries for the 2004 and 2019 using Generalised Method of Moment technique and IV-Tobit regression method.

Ashenafi and Dong (2022) examined the association in financial inclusion, Fintech adoption, and income inequality in 39 African countries for the period 2011 to 2019 using POLS and 2SLS estimation methods. The study finds that Fintech can improve financial inclusion and reduce income disparities, shedding light on its potential to bridge gaps in accessibility of financial services in the African continent. Therefore, this highlights that Fintech has the ability to lift financial inclusion through provision of access to banking and financial services to previously unbanked or underbanked individuals.

Using a quantile regression approach to analyze data from 140 countries to assess the role of Fintech on income inequality across different income levels, Demir, Pesqué-Cela, Altunbas & Murinde (2022) observe that innovations in Fintech, like mobile banking and peer-to-peer lending, help promote financial inclusion by providing underserved populations with accessibility to financial services. This hints that Fintech can play a particularly pivotal role in enhancing financial inclusion and narrowing the income gap for those in vulnerable socioeconomic positions.

Anarfo (2018) finds digital technologies to supports the accessibility to more financial services by population who stay in marginalised and are unable afford having an account in a bank, making them financially excluded, while Asongu, Biekpe, and Cassimon, (2021) argues that digital technologies are valuable for the inclusion of the financial system and for obtaining sustainable development.

Kouladoum et al., (2022) explores the nexus between digital technologies and financial inclusion in Sub-Saharan Africa to examine how the widespread introduction of digital technologies, like mobile phones and mobile money services, has influenced financial inclusion in this region. The study reveals that digital technologies have played a significant role in enhancing financial inclusion in Sub-Saharan Africa. The authors find that the accessibility and availability of mobile phones and

related digital services have expanded financial access for previously underserved populations. This has resulted in increased usage of mobile money platforms and other digital financial services. The authors note that while digital technologies have had a desirable role on financial inclusion in SSA, challenges still remain. Issues such as low digital literacy, limited network coverage, and security concerns hinder the full realization of the potential benefits of digital financial services.

Similarly, Kanga, Oughton, Harris, and Murinde (2022) looks at the association between Fintech diffusion, financial inclusion, and income per capita for a wide range of countries and find that the diffusion of Fintech significantly contributes to improved financial inclusion. Fintech innovations, such as mobile banking and digital payment systems, enhance access to financial services, particularly for underserved and unbanked populations. This increased financial inclusion correlates with positive impacts on economic development and stability. Furthermore, the research reveals a positive association between Fintech diffusion and income per capita. The authors suggest that as Fintech services expand and become more accessible, they can stimulate economic growth and raise the overall income levels of individuals and communities. This relationship applies to both developed and developing countries.

Gurung (2020) examined how Fintech has emerged as a powerful tool in advancing financial inclusion and discusses how digital financial services provided by Fintech companies can eliminate the gap in formal financial systems and people who previously lacked access to financial services. The author heighted the positive impact of Fintech on underserved populations, including women, low-income individuals, and people in isolated areas. Fintech innovations can improve financial access, reduce transaction costs, and empower these populations economically.

Telukdarie and Mungar (2023) assessed how the adoption and integration of Fintech solutions contribute to expanding access to financial services for marginalised populations in developing

countries, thereby promoting financial inclusion. The study shows how Fintech adoption positively impacts financial inclusion in developing economies and opine that integration of digital financial solutions has the potential to provide previously underserved populations with convenient accessibility to different financial services, including banking, payments, and savings. The studies looking at the link between Fintech and financial inclusion mainly focused on the impact of these variables on gender inequality and to some extent economic growth, leaving their impact on economic growth less examined.

2.2.2 Mobile Money and Financial Inclusion

Examining the diffusion of mobile phone innovations and their relationship with financial inclusion, Asongu et al., (2021) discovered that the widespread usage of mobile phone technology significantly contributes to expanding financial inclusion. Mobile phones provide individuals with access to digital financial services, like mobile banking and mobile money, allowing them to take part in financial transactions and access formal financial services. Similarly, Makina (2019) documented that mobile money is the outcome of Fintech in Africa and is assisting to alleviate the challenges to financial inclusion in in the region.

In understanding the foundational elements that contribute to financial inclusion, particularly the ownership and effective use of formal financial accounts, in both developed and developing countries, Allen, Demirgüç-Kunt, Klapper, and Peria (2016) highlights the importance of demographics, regulatory environment, and access to technology in enhancing financial inclusion. In particular, the authors found that access to digital and mobile technologies positively influences the ownership and usage of formal financial accounts, particularly in developing countries where mobile banking and digital payments have gained traction. These studies mainly focus on mobile

money as the measure of fintech and have not explored other factors such as access to internet, mobile subscription which might be a challenge to people having mobile money accounts.

2.2.3 Financial Literacy and Financial Inclusion

Khan, Siddiqui, and Imtiaz, (2022) examined cruciality of financial literacy in promoting financial inclusion and identified the linkages between financial literacy and financial inclusion. They highlight that improved financial literacy can lead to increased usage of formal financial services, enhanced savings and investment behavior, reduced reliance on informal financial sources, and better financial decision-making. This implies that literacy in finance plays a pivotal role in enhancing financial inclusion. Therefore, individuals must possess adequate financial literacy to make informed decisions, access formal financial services, and effectively manage their financial lives.

In exploring the connection in financial literacy and financial inclusion using cross-country data, Grohmann et al., (2018) finds that improved financial literacy is positively associated with an increment in account ownership. This is effect is found to be greater in economies with greater levels of financial depth. Therefore, this implies that increasing financial literacy is a beneficial option and financial education could be a pivotal instrument in financial development over and above more traditional policy of improving financial infrastructure.

2.2.4 Financial Inclusion and Development

Countries with stronger economic development, well-functioning financial institutions, and improved telecom infrastructure tend to observe higher levels of mobile phone adoption and subsequently higher levels of financial inclusion. Sarma and Pais (2011) examine how expanding access to formal financial services can contribute to economic growth and development in both

developed and developing nations and emphasise that financial inclusion is crucial for promoting economic development. Financial inclusion enhances the efficiency of resource allocation, encourages savings and investment, facilitates entrepreneurship and job creation, and helps vulnerable groups manage risks and build resilience. Therefore, financial inclusion is not only important for individual well-being but also for overall economic development.

In examining role of inclusive finance in promoting economic development in the least developed countries (LDCs) in Asia and Africa, Cicchiello, Kazemikhasragh, Monferrá, and Girón, (2021) the authors highlight that being included to financial services plays a pivotal role in promoting development in LDCs. Formal financial services access can facilitate savings, investments, and entrepreneurship, leading to job creation, income generation, and poverty reduction. The study further finds that digital financial technologies, example mobile banking and digital payment systems, have the capability to overcome traditional barriers to financial inclusion in LDCs. These technologies can provide affordable and accessible financial services to marginalised populations, enhance financial literacy, and drive inclusive economic development. Studies that explore the effect of financial inclusion in economic development specific to Sub-Saharan African remain scant.

2.3 Conclusion

While these studies explored the effect of Fintech and financial inclusion in various contexts, with specific dynamics and challenges in SSA, the relationship between Fintech, financial inclusion and their subsequent implication on economic development remain less examined. The literature shows that financial technologies have a positive impact on financial inclusion in both developed and less developed economies. The impact of financial technologies in the form of mobile money is more prevalent in the African countries help reduce barriers to financial inclusion, (Makina, 2019) and (Asongu et al., 2021). With a number of studies focused on the relationship between Fintech,

financial inclusion and income inequality, economic growth, or gender; it is clear that there is a gap in the literature on the link between financial technology, financial inclusion, and economic development. With regards to Fintech measured the studied mainly focused on mobile money as a measure, ignoring measures such as mobile phone subscription and access to internet.

CHAPTER 3: RESEARCH METHODOLOGY AND DATA

This section of the study provides the methodology followed, the data sets, as well as sources of data. The section further presents the details of the research design used, model specification and the estimation thereof. It is classified into six different yet systemic sections. The second section provides description of the data employed and how a sample size was chosen, and the period. The third section talks to the variables used, while the fourth provides the analytical framework. The fifth and sixth sections outlines the regression equation and the variables thereof.

3.1 Data

The study employed secondary data from the World Bank's Global Financial Inclusion Database (Global Findex), World Development Indicators, and the G20 Financial Inclusion Database for the period 2011 to 2021. Dictated by availability of data and considering missing data, a sample of 33 countries that are included in this study are Angola, Botswana, Burkina Faso, Cameroon, Comoros, Congo Republic, Cote d'Ivoire, Eswatini, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia, and Zimbabwe.

3.2 Variables

The variables for this research report are financial technology, financial inclusion, and economic development. The access dimension variables include the proportion of population with an, mobile

money account, debit card, and a credit card. The usage dimension variables include are proportion of population that has borrowed money, saved money at financial institution, has made a withdrawal from a financial institution, and has deposited money at a financial institution. The Fintech infrastructure dimension is proxied by proportion of population that made or received digital payment and population that has mobile cellular subscription, while the variables for economic development are GDP per capita, human development index, and per capita consumption.

The study controlled other variables with a potential to influence financial inclusion in SSA as GDP growth rate, rural population, literacy rate as a proxy for financial literacy, and labour force. The variables are generally used in various literature studies as determinants of financial inclusion such as Park and Nercado (2021), Demir et al (2022), and Ashenaf and Dong (2022). The variables and their sources of data used in the empirical analysis of the study are described in table 1.

The study constructs an index of financial inclusion to investigate the impact of financial inclusion and its dimensions on economic development using the Principal Component Analysis (PCA). Aside from the traditional usage and access dimensions of financial inclusion, the index includes a new dimension of Fintech infrastructure (to account for the growing use of digital payments) to incorporate technological advances. Using the PCA technique, a two-stage approach is followed to develop the index, the data series is normalised with a min-max approach using the equation below.

$$F_{i,t} = \frac{K_{i,t} - Min_{i,t}}{Max_{i,t} - Min_{i,t}} \quad \ldots\ldots\ldots\

computed the Eigenvalues for the indicators and developed our composite index. In this case, this study used the equation stated below to construct the composite index to proxy financial inclusion.

$FI_i = W_{i1}Z_1 + W_{i2}Z_2 + W_{i3}Z_3 + \ldots + W_{in}Z_n$ ..... (2)

Where where FI_i = estimate of the ith factor of financial inclusion; W_i = weight of the score coefficient; Z_i = individual variables of interest (Account, Credit_Card, Debit_Card, Mobile_Money, Borrowed, Saved, Deposit, Withdrawal, Digital_Payment, Mobile_Subscription); and n = number of variables.

Table 1: Variable Description

Variable	Description	Data Source
	Financial Access	
Account	Respondents (%) who are 15 years and older who have a bank account.	World Bank Global Findex Database (accessed January 2024).
Credit Card Ownership	Respondents (%) who are 15 years and older who owns a credit card	World Bank Global Findex Database (accessed January 2024).
Debit card Ownership	Respondents (%) who are 15 years and older who owns a debit card	World Bank Global Findex Database (accessed January 2024).
Mobile Money Account	Respondents (%) who are 15 years and older who owns and use a mobile money account	World Bank Global Findex Database (accessed January 2024).
	Financial Usage	
Borrowed	Respondents (%) who are 15 years and older who borrowed money	World Bank Global Findex Database (accessed January 2024).

Saved	Respondents (%) who are 15 years and older who have saved	World Bank Global Findex Database (accessed January 2024).
Deposit	Respondents (%) who are 15 years and older who have made a deposited	World Bank Global Findex Database (accessed January 2024).
Withdrawal	Respondents (%) who are 15 years and older who have made a withdrawal	World Bank Global Findex Database (accessed January 2024).
	Fintech Infrastructure	
Digital Payments	Respondents (%) who are 15 years and older who have made or received digital payment	World Bank Global Findex Database (accessed January 2024).
Mobile Cellular Subscription	Respondents (%) who are 15 years and older who have a mobile subscription	World Bank World Development (accessed February 2024).
	Economics Development	
Per Capita GDP	Growth rate of GDP per capita (annual percentage)	World Bank World Development (accessed February 2024).
Per Capita Consumption	Growth of household final consumption expenditure per capita (annual percentage)	World Bank World Development (accessed February 2024)
Human Development Index	The HDI measures (annual) three basic dimensions of human development.	UNDP, Human Development Report (2021-22) (2022) – with minor processing by Our World in Data (accessed February 2024)
	Control Variables	
GDP Growth Rate	The annual percentage growth rate of the GDP at market prices based on constant local currency.	World Bank World Development (accessed November February 2024).
Rural Population	People who reside in rural areas (% of total population).	World Bank World Development (accessed February 2024).

Financial Literacy (Proxied by Literacy Rate)	Literacy rate is the adult total literacy rate (percentage of people ages 15 and above).	World Bank (2023); Various sources (2018) – processed by Our World in Data (accessed March 2024)
Labour Force	The proportion of the population aged that is economically active: all the people who supply labor to produce goods and services during a specified period	World Bank World Development (accessed February 2024).

Source: Author's own compilation.

3.3 Model Specification and empirical approach

The report employed pooled OLS and (2SLS) estimation methods to study the relationship between variables. To address potential endogeneity concerns and incorporating instrumental variables, the study will rely on 2SLS approach to enhance the credibility and robustness of the estimated relationships between Fintech adoption, financial inclusion, and economic development in SSA, while the Pooled OLS analysis allows the study to obtain an initial overview of the overall relationship between the variables in the region.

The study further used fixed effects (FE), random effects (RE), fully dynamic ordinary least squares (FMOLS), and dynamic ordinary least squares (DOLS). The Hausman test (see appendices) was used to determine whether the data is fit for fixed or random- effects model. This means operating on the null hypothesis that the data follows the random-effects model. The test results led to null hypothesis being rejected, and we used the fixed-effect model. The Breusch-Pegan (see appendices) was also used to test for heteroskedasticity. Following the sensitivity tests conducted, the results suggested that FMOLS and DOLS estimation would provide reliable and consistent estimates for the study models. As such the study opted for utilisation of multiple models. According

to Othman & Masih, (2015) and Tugcu (2018), these methods estimate long run equilibrium parameters of variables that are cointegrated, account for endogeneity and serial correlation, thereby producing consistent and efficient parameters.

To investigate and find the association between financial technology, financial inclusion, and economic development in SSA, the study will apply the following models: Equation (3) looks at the role of Fintech on financial inclusion, and Equation (4) estimates the impact of Fintech and financial inclusion on economic development.

$FI_{it} = \alpha + \beta_1 * Fintech_{it} + \beta_2 * CV_{it} + \varepsilon_{it}$…….. (3)

Per capita $GDP_{it} = \alpha + \beta_1 * FI_{it} + \beta_n * CV_{it} + \varepsilon_{it}$……..... (4)

Per capita GDPit = α + β1 * Fintechit + βn*CVit + εit……..... (5)

where FI represents financial inclusion indicators while Fintech is the Fintech adoption and ε is the error term. Per capita GDP is the measure for economic development. CV represents control variables that will account for additional factors that may influence financial inclusion and economic development. The subscripts i, t and n indexes country, time, and the number of control variables.

To determine the level of incongruity in the data, the table 2 summarises the results of the descriptive statistical analysis for the variables of the study. In comparison with the 2021 Global Findex report, table 2 shows that the percentage of adults who have an account with a financial institution is 37.7 percent, which is lower than the global average of 76 percent. The percentage of adults who have made or received a digital payment is 36.2 percent which is 27.8 percent less than the global average. The region shows a global leadership in mobile money account ownership of 26.7% compared the only 10 percent of adults globally. The availability of mobile money accounts and services in Sub-Saharan Africa has contributed to an increased account ownership, (Findex,

2021). The descriptive statistics table depicts prominent features of the nature of financial inclusion in Sub-Saharan Africa. As portrayed by the minimum and maximum values, the account ownership in the region ranges between 1.5 percent and 90.5 percent, while digital payments range between 5.4 percent and 80.8 percent.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Account	117	.377	.217	.015	.905
Credit_Card	117	.038	.044	0	.241
Debit_Card	117	.161	.162	.005	.805
Mobile_Money	85	.239	.186	.0	.729
Borrowed	117	.079	.051	.013	.252
Saved	117	.131	.086	.011	.372
Deposit	82	.553	.156	.264	.885
Withdrawal	82	.547	.153	.225	.866
Digital_Payment	88	.362	.204	.054	.808
Mobile_Subscription	117	.925	.342	.274	1.740
PerCapitaGDP	117	.026	.030	-.078	.130
PerCapitaConsump	105	.131	.825	-.268	6
Human Deve Index	117	.540	.093	.346	.805
LiteracyRate	117	.666	.194	.191	.950
GDPGrowthRate	117	.051	.029	-.056	.146
RuralPopulation	117	.590	.177	.096	.843
LabourForce	117	.636	.109	.404	.870

Source: Author's own computation using STATA

The correlation matrix in table 3 presents the relationship between the variables in the study. This provides insights into type of relationship and probability of multicollinearity between the variables. The table shows a positive and strong correlation between digital payments as a measure of

fintech and most financial inclusion variables, namely: account, credit card, debit card, mobile money, borrowed, and saved, while the relationship with deposit and withdrawals is weaker. The associated relationship between digital payment and variables of strong positive association is statistically significant, while the weaker relationships are found to be insignificant. For mobile subscription we only observe a strong positive association with account, credit card and debit card, while with other variables of financial inclusion there is a weak positive association.

With the exception of deposit and withdrawal, the relationship between mobile subscription and the financial inclusion variables is statistically significant. The positive association in the Fintech measures and the financial inclusion variables shows that mobile subscription enhances people ability to use digital banking and subsequently enables them to perform digital payments. The study utilised the instrumental variable approach and relied on the 2SLS to estimate the relationship among the variables to deal with issues of endogeneity and multicollinearity. We have also curbed the number of control variables to avoid multicollinearity in the variables.

Table 3: Correlation Analysis

	Account	Credit_C	Debit_C	Mobile_M	Borrowed	Saved	Deposit	Withdrawal	Digital_P	Mobile_Sub	PerCapitaGDP	PerCapitaCon	HDI	Literacy	GDPGrwthR	RuralP	Labour
Account	1.000																
Credit_Card	0.6672	1.000															
Debit_Card	0.7969	0.9154	1.000														
Mobile_Money	0.6216	-0.0094	0.1518	1.000													
Borrowed	0.7418	0.7841	0.7879	0.2363	1.000												
Saved	0.6914	0.6714	0.7718	0.0910	0.7987	1.000											
Deposit	0.2503	0.3548	0.4710	-0.1224	0.3487	0.5896	1.000										
Withdrawal	0.2410	0.4048	0.5042	-0.1570	0.3667	0.5517	0.9550	1.000									
Digital_Payment	**0.9591**	**0.5746**	**0.7161**	**0.7645**	**0.6620**	**0.5511**	0.1698	0.1644	1.000								
Mobile_Subscription	**0.4366**	**0.5601**	**0.5101**	0.1380	0.2999	0.2807	0.1400	0.1946	0.4656	1.000							
PerCapitaGDP	0.0843	-0.0019	0.0548	-0.0370	0.0201	0.1573	0.3136	0.2663	0.0178	0.0375	1.000						
PerCapitaConsump	-0.0463	-0.1462	-0.1030	-0.2131	-0.0528	0.1920	0.0618	0.0027	-0.1957	-0.3270	0.2606	1.000					
Human Dev Index	0.6640	0.7150	0.7624	0.1093	0.5344	0.5813	0.4041	0.4365	0.5932	0.5984	-0.0215	-0.1593	1.000				
LiteracyRate	0.6587	0.4385	0.6055	0.3668	0.4263	0.4630	0.2960	0.2702	0.6365	0.3138	-0.0855	-0.1753	0.7900	1.0000			
GDPGrowthRate	0.6587	0.4385	0.6055	0.3668	0.4263	0.4630	0.2960	0.2702	0.6365	0.3138	-0.0855	-0.1753	-0.1867	-0.3030	1.0000		
RuralPopulation	0.0467	-0.2190	-0.0975	0.1882	-0.0476	-0.0036	-0.0239	-0.1212	0.0170	-0.4333	0.0694	0.2856	-0.5229	-0.2009	0.2216	1.0000	
LabourForce	0.0467	-0.2190	-0.0975	0.1882	-0.0476	-0.0036	-0.0239	-0.1212	0.0170	-0.4333	0.0694	0.2856	-0.2459	0.0798	0.1709	0.3614	1.0000

Source: Author's own computation using STATA

3.4 Conclusion

Mobile money is the driver of account ownership in Sub-Saharan region, and therefore an enabler of financial inclusion. Through mobile subscriptions, which serves as a prerequisite to access mobile money services, the region is a global leader in mobile money account. Moreover, these allow individual to perform digital payment services, hence the positive correlation we observe in these variables and measures of financial inclusion.

CHAPTER 4: DISCUSSIONS OF RESULTS

The results are provided and discussed in this section. The section that follows discusses the results of the PCA analysis performed, while the third section provides the results of the financial inclusion index. The fourth section presents the results, and we conclude in the last section.

4.1 Estimation of the Financial Inclusion Index

Table 2 (found in chapter 3) provides a summary of statistics about the variables used in this study. The first 10 variables in the table represent the indicators used to estimate the financial inclusion index. Access, Usage, and Fintech infrastructure are three indices estimated by principal components.

In the first stage of the PCA, eigenvalues are calculated for each for each variable or sub-index of the three dimensions of financial inclusion. The highest eigenvalue of the components retains more standardized variance among others, and as a rule of thumb and based on the Keiser rule, an eigenvalue greater than 1 is retained and considered for the analysis. Table 4 shows the results of the first stage principal component analysis. As depicted in the table, only the first two components have eigenvalues greater than 1. The first 2 components explain the maximum variance (78.78 percent), with an eigenvalue above 1. Therefore, we only consider the first 2 components (5.63 and 2.23) for our analysis.

Table 4: Principal Component analysis – eigenvalues

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	5.63872	3.39901	0.5639	0.5639
Comp2	2.23971	1.27615	0.2240	0.7878
Comp3	.96356	.27028	0.0964	0.8842
Comp4	.69328	.497769	0.0693	0.9535
Comp5	.195512	.0258786	0.0196	0.9731
Comp6	.169633	.120554	0.0170	0.9900
Comp7	.0490789	.0236491	0.0049	0.9949
Comp8	.0254298	.00980339	0.0025	0.9975
Comp9	.0156265	.00617619	0.0016	0.9991
Comp10	.00945026	.	0.0009	1.0000

Source: Author's own computation using STATA

In the second stage of the PCA, the same process like the first stage is followed. Based on table 5, presenting the eigenvector loadings, the first two components are used to construct the index of financial inclusion for the selected countries in our sample. Subsequently, the following equations expanded from equation 2 above is used to construct the composite financial inclusion index.

FI = ((0.3742*Account) + (0.3629*Credit_Card) + (0.3960*Debit_Card) + (0.0969*Mobile_Money) + (0.3633*Borrowed) + (0.3824*Saved) + (0.2447*Deposit) + (0.2399*Withdrawal) + (0.3404*Digital_Payment) +(0.2248*Mobile_Subscription)) +((0.2776*Account) + (-0.0554*Credit_Card) + (-0.1110*Debit_Card) + (0.5512*Mobile_Money) + (0.0995*Borrowed) + (-0.1070*Saved) + (-0.4609*Deposit) + (-0.4833*Withdrawal) + (0.3612*Digital_Payment) + (0.0770*Mobile_Subscription) …….(5)

Where FI depicts the financial inclusion index, the rest of the variables are as already explained in variable description in table 1(see the table in chapter 3).

Table 5: Principal component analysis – Eigenvectors

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Comp9	Comp10
Account	0.3742	0.27760	0.0851	0.0404	-0.2124	-01558	-0.3783	-0.5164	0.1077	0.5322
Credit_Card	0.3629	-0.0554	-0.3918	-0.2451	-0.3586	0.3237	0.5743	-0.2690	0.1074	-0.0680
Debit_Card	0.3960	-0.1110	-0.0875	-0.1529	-0.3806	-0.3783	-0.0428	0.6628	-0.1836	0.1923
Mobile_Money	0.0696	0.5512	0.4496	0.2663	0.0450	0.2305	0.4634	0.2906	0.0609	0.2366
Borrowed	0.3633	0.0995	0.0048	-0.4515	0.4072	0.5556	-0.3553	0.1838	-0.1401	0.0054
Saved	0.3824	-0.1070	0.0799	-0.1478	06269	-0.5170	0.3269	-0.1248	0.1724	-0.0394
Deposit	0.2447	-0.4607	0.3310	0.3149	0.0075	0.1456	0.1152	-0.2098	-0.6618	0.0494

Withdrawal	0.2399	-0.4833	0.3125	0.2357	-0.1091	0.2266	-0.1508	0.1346	0.6679	-0.0734
Digital_Payment	0.3404	0.3612	0.1578	0.1335	-0.1965	-0.1348	-0.1813	-0.0878	-0.0771	-0.7795
Mobile_Subscription	0.2248	0.0770	-0.6253	0.6677	0.2645	0.0892	-0.0935	0.1340	0.0018	0.0460

Source: Author's own computation using STATA

Table 6 indicates that the KMO value of 0.7136 satisfies KMO > 0.5. Therefore, the analysis factor is consistent with the data and the use of PCA is justified.

Table 6: KMO

Variable	KMO
Account	0.8590
Credit_Card	0.7201
Debit_Card	0.7468
Mobile_Money	0.5128
Borrowed	0.7249
Saved	0.7791
Deposit	0.6452
Withdrawal	0.6498
Digital_Payment	0.7088
Mobile_Subscription	0.5485
Overall	0.7136

Source: Author's own computation using STATA

4.2 Regression analysis

Using POLS technique, table 7 shows the impact of Fintech on financial inclusion, indicating a significant positive association between the two variables. This indicate that Fintech development in Sub-Saharan Africa is an enabler of financial inclusion amongst the population. Moreover, literacy rate as a proxy of financial Literacy has a positive association with financial inclusion, this association is also statistically significant. Except labour force other variable also show a positive association with financial inclusion, however this relationship is not statistically significant. The positive relationship of literacy rate implies that as more people become financial literate, they have an increased demand for financial services. With high rate of literacy, people are better equipped to understand various financial products and benefits, as well as associated risks of those financial products, (Bashiru, Bunyaminu,

Yakubu, and Al-Faryan, 2023). Improving access to financial services in rural areas enables rural population to not only access finances, but also manage their finances better. Abramova, Nedilska, Kurovska, and Martynyuk, (2021) asserts that experience of developed economies indicates financial inclusion in the rural enhances the welfare of rural population and reduce its inequality relative to urban population.

Table 7: Impact of Fintech on Financial Inclusion

Financial Inclusion	Coefficient	Std. Err	t-statistic	Prob
Fintech	3.869374	.4430104	8.73	0.000
LiteracyRate	6.018619	.9485251	6.35	0.000
GDPGrowthRate	2.233437	5.289473	0.42	0.674
RuralPopulation	2.771935	.8912004	3.11	0.003
LabourForce	-1.618647	1.535023	-1.05	0.296
Constant	-9.884692	1.20804	-8.18	0.000
Diagnostics				
Observations	70			
R^2	0.8207			
Year FE	YES			

Source: Author's own computation using STATA

The regression results in table 8 indicates a positive and significant link between Fintech and financial inclusion. A positive relationship is also observed between but also with GDP growth rate and Fintech, however this relationship is insignificant. The growth in GDP provides an opportunity for an economy to invest in Fintech infrastructures. The relationship with other variables is negative, however with the exception of rural population the associated relationships are not statistically significant. The significant negative relationship between rural population and Fintech implies indicates that rural areas often lack the necessary infrastructure, such as reliable internet connectivity and electricity, which are pivotal for fintech adoption. Limited access to these basic amenities impedes the uptake of digital financial services in the rural.

Table 8: Impact of Financial Inclusion on Fintech

Fintech	Coefficient	Std. Err	t-statistic	Prob
Financial Inclusion	.143609	.016442	8.73	0.000
LiteracyRate	-.3407404	.2313613	-1.47	0.146
GDPGrowthRate	.6573853	1.017032	0.65	0.520
RuralPopulation	-.6415548	.1655449	-3.88	0.000
LabourForce	-.2737481	.2963407	-0.92	0.359
Constant	2.041334	.2128356	9.59	0.000
Diagnostics				
Observations	70			
R^2	0.7792			
Prob. (F-statistic)	0.0000			
Year FE	YES			

Source: Author's own computation using STATA

Economic development is associated positively and significantly to financial inclusion as depicted by the p-value in the table below. This is in tune with the findings of Singh and Stakic (2021) that development improves the extent of financial services and the financial system. Financial inclusion provides avenues for individuals to save money securely. Increased savings can result to increased levels of investment, both at the individual and national levels, contributing to economic development. By providing financial services to a broader segment of the population, financial inclusion has the potential to reduce economic inequality. This, in turn, can contribute to more inclusive and sustainable economic growth. Sarma (2012) to illustrate the significant and positive correlation between financial inclusion and development.

The table also shows a positive link between GDP growth rate and economic development, and between labour force and economic development. A positive GDP growth rate is generally associated with an increase in per capita GDP, reflecting economic development and improvements in living standards. Similarly high number of people in the labour force means people have access to income, which can be associated with improved economic conditions and standard of living. However, the relationship between economic development and labour force is insignificant. Cicchiello et al (2021)

found that GDP growth increase the level of financial inclusion. We can see the association between economic development and GDP growth rate is significant.

Table 9: Fintech, Financial Inclusion, and Economic Development

Economic Dev	Coefficient	Std. Err	t-statistic	Prob
Financial Inclusion	.2987326	.0948246	3.15	0.003
Fintech	-1.76201	.4922099	-3.58	0.001
LiteracyRate	-1.295594	.9050927	-1.43	0.157
GDPGrowthRate	10.28928	3.923123	2.62	0.011
RuralPopulation	-1.040473	.7104388	-1.46	0.148
LabourForce	1.915861	1.147158	1.67	0.100
Constant	2.581503	1.295764	1.99	0.051
Diagnostics				
Observations	70			
R^2	0.3572			
Prob. (F-statistic)	0.0010			
Year FE	YES			

Source: Author's own computations STATA

Tables 10, 11, and 12 display the two-stage least square regression model results. Our study outcomes show that through the easing of access for financial services, fintech has a prodigious role in achieving financial inclusion. This means the digital transformation approach employed by a few African countries has the capacity to achieve financial inclusion, (Ashenafi and Dong, 2022). This is also in line with finding by (Demir et al, 2022) that financial inclusion is enabled financial technology. We observe a positive link between financial inclusion and other variables, except labour force. However, the observed relationship is not statistically significant, but considered overall, the observed relationships are significant values of the f statistic diagnostic. Rural population is positively correlated to financial inclusion, indicating expanding access formal financial services to rural areas plays a pivotal role in promoting overall social inclusion. Moreover, Access to bank accounts and other financial services enhances a person's sense of belonging and inclusion, facilitating their integration into broader economic and social networks. Using FMOLS, table 14 also shows that Fintech and Literacy rate have

a significant positive relationship with financial inclusion. Fintech stimulates economic development by enhancing financial inclusion, reducing transaction costs, increasing access to credit, and promoting entrepreneurship. Additionally, it promotes competition in the financial sector, facilitates remittances, and empowers marginalized communities. Through these mechanisms, fintech contributes to inclusive and sustainable economic growth, particularly in developing regions like Sub-Saharan Africa, where traditional banking infrastructure is often lacking.

Table 10: The impact of Fintech on financial inclusion

Financial Inclusion	OLS		2SLS	
	Coefficient	Prob	Coefficient	Prob
Fintech	3.527952	0.000	8.288674	0.000
LiteracyRate	6.258493	0.000	-1.389076	0.611
GDPGrowthRate	4.202517	0.447	3.472351	0.704
RuralPopulation	2.505013	0.009	5.660292	0.006
LabourForce	-1.728438	0.284	4.472098	0.185
Constant	-10.02444	0.000	-18.02279	0.000
Diagnostics				
Observations	70		26	
R^2	0.7921		0.8120	
Prob. (F-statistic)	0.0000		0.0000	

Source: Author's own computation STATA

The results from both tables 11 indicates that rural population is negative associated with Fintech. This indicates that people who resides outside the urban areas have less access to financial institutions and financial services, and also to technology, and this relationship is significant. We also observe a positive link between Fintech and GDP growth rate. However, this relationship is insignificant. Fintech innovations have the potential to stimulate economic growth by enhancing efficiency, productivity, and innovation across various sectors. By streamlining financial transactions, improving access to credit, reducing transaction costs, and fostering entrepreneurship, fintech can contribute to higher GDP growth rates. The results of table 11 are similar to results displayed in table 15 for FMOLS.

Table 11: Impact of Financial Inclusion on Fintech

Fintech		OLS		2SLS
	Coefficient	Prob	Coefficient	Prob
Financial Inclusion	.1437838	0.000	.2382731	0.000
LiteracyRate	-.2987629	0.239	-1.048314	0.049
GDPGrowthRate	.3250726	0.771	-1.844675	0.237
RuralPopulation	-.6465571	0.001	-.6220415	0.020
LabourForce	-.3177519	0.329	.2521211	0.624
Constant	2.214801	0.000	2.575091	0.000
Diagnostics				
Observations	70		30	
R^2	0.7189		0.7991	
Prob. (F-statistic)	0.0000		0.0000	

Source: Author's own computation using STATA

In Table 12 we are testing the association between Fintech, financial inclusion, and economic development. The result shows that financial inclusion and GDP growth rate are positively correlated to economic development, while the relationship with the rest of the variables is negative. However, the relationship between all variables in the table is insignificant. On the contrary the FMOLS results in table 16 show a significant relationship. The level of significance Sarma and Pais (2011) emphasise an important role of financial inclusion in promoting economic development, and that access to financial services is seen as a key element for poverty alleviation, economic growth, and improved living standards. This indicates that financial inclusion, enabled by Fintech is linked to inclusive growth, where the benefits of economic development are more equitably distributed.

Table 12: Fintech, Financial Inclusion, and Economic Development

Economic Dev		OLS		2SLS
	Coefficient	Prob	Coefficient	Prob
Financial Inclusion	.1792927	0.063	.3257356	0.280
Fintech	-1.1076	0.021	-2.524251	0.168
LiteracyRate	-.7108119	0.459	-.9828278	0.639
GDPGrowthRate	9.028464	0.035	13.66461	0.096
RuralPopulation	-.4762973	0.525	-.2678295	0.869
LabourForce	1.707721	0.168	1.403081	0.566
Constant	1.622612	0.233	4.171252	0.326

Diagnostics		
Observations	70	26
R^2	0.2180	0.3567
Prob. (F-statistic)	0.0139	0.1858

Source: Author's own computation using STATA

In figure 13 below we regressed human development index and found that financial literacy and Fintech are positively associated to Human development index, and the relationship is significant. For rural population and labour force we found the relationship to be negative. Financial literacy is closely intertwined with human development, as it influences economic outcomes, access to financial services, and empowerment. The negative correlation between rural population and the human development Index underscores the challenges faced by rural areas in accessing essential services, economic opportunities, and education.

Table 13: Human Development Index

HDI	Coefficient	Std. err	t-statistic	Prob
RuralPopu	-.1343291	.0282877	-4.75	0.000
Financial Literacy	.0029377	.0002672	10.99	0.000
Fintech	.0421232	.0124171	3.39	0.001
LabourForce	-.0974256	.0462117	-2.11	0.038
PerCapitaGDP	.1877242	.1463035	1.28	0.203
Constant	.4283799	.0376892	11.37	0.000
Diagnostics				
Observations	88			
R^2	0.8295			
Prob. (F-statistic)	0.0000			

Source: Author's own computation using STATA

The results of the models used in the analysis are summarised in tables 14 to 16. The results of table 14 below shows that in all models Fintech has a significant positive relationship with financial inclusion. With the exception of 2SLS model, Literacy rate is also found to be positively linked to financial inclusion in all other models, and the relationship is significant.

Table 14:Summary of all Models: Regression of Financial Inclusion

Financial Inclusion	OLS		2SLS		FMOLS		DOLS	
	Coef.	Prob	Coef.	Prob	Coef.	Prob	Coef.	Prob
Fintech	3.527952	0.000	8.288674	0.000	3.540074	0.000	3.428453	0.000
LiteracyRate	6.258493	0.000	-1.389076	0.611	6.002983	0.000	7.551066	0.000
GDPGrowthRate	4.202517	0.447	3.472351	0.704	2.966574	0.552	26.49819	0.000
RuralPopulation	2.505013	0.009	5.660292	0.006	2.683627	0.002	2.625939	0.000
LabourForce	-1.728438	0.284	4.472098	0.185	-1.738634	0.229	-6.327348	0.000
Constant	-10.02444	0.000	-18.02279	0.000	-9.929658	0.000	-9.009384	0.000
Diagnostics								
Observations	70		26		69		67	
R^2	0.7921		0.8120		0.5581		0.8440	
Prob. (F-statistic)	0.0000		0.0000					

Source: Author's own computation using STATA

The result of the table below confirms earlier indication that rural population is negative associated with Fintech, this negative relationship is negative across all models. As one would expect, a positive relationship would like to occur between urban population and Fintech instead of rural population.

Table 15: Summary of all Models: Regression of Fintech

Fintech	OLS		2SLS		FMOLS		DOLS	
	Coef.	Prob	Coef.	Prob	Coef.	Prob	Coef.	Prob
Financial Inclusion	.1437838	0.000	.2382731	0.000	.1432102	0.000	.1642545	0.000
LiteracyRate	-.2987629	0.239	-1.048314	0.049	-.3073034	0.050	-.8516369	0.000
GDPGrowthRate	.3250726	0.771	-1.844675	0.237	.2356008	0.736	-4.019314	0.000
RuralPopulation	-.6465571	0.001	-.6220415	0.020	-.6608555	0.000	-.6499429	0.000
LabourForce	-.3177519	0.329	.2521211	0.624	-.3100963	0126	.6546203	0.000
Constant	2.214801	0.000	2.575091	0.000	2.233429	0.000	2.191706	0.000
Diagnostics								
Observations	70		30		69		67	
R^2	0.7189		0.7991		0.4023		0.7781	
Prob. (F-statistic)	0.0000		0.0000					

Source: Author's own computation using STATA

Table 16 shows that financial inclusion has a positive relationship wit economic development, however this relationship is only significant for FMOLS model. Similarly for GDP growth rate and Labour force have a positive relationship with economic development, and again the relationship is found significant for the results of the FMOLS model.

Table 16: Summary of all models: Regression of Economic Development

Economic Develop	OLS		2SLS		FMOLS		DOLS	
	Coef.	Prob	Coef.	Prob	Coef.	Prob	Coef.	Prob
Financial Inclusion	.1792927	0.063	.3257356	0.280	.1840986	0.000	.2502795	0.290
Fintech	-1.1076	0.021	-2.524251	0.168	-1.116989	0.000	-1.693392	0.113
LiteracyRate	-.7108119	0.459	-.9828278	0.639	-.7359557	0.034	-.4901164	0.845
GDPGrowthRate	9.028464	0.035	13.66461	0.096	9.095363	0.000	26.16543	0.036
RuralPopulation	-.4762973	0.525	-.2678295	0.869	-.524722	0.056	-1.939885	0.177
LabourForce	1.707721	0.168	1.403081	0.566	1.733563	0.000	2.272386	0.421
Constant	1.622612	0.233	4.171252	0.326	1.665977	0.001	1.980938	0.501
Diagnostics								
Observations	70		26		69		67	
R^2	0.2180		0.3567		0.1650		0.5162	
Prob. (F-statistic)	0.0139		0.1858					

Source: Author's own computation using STATA

4.3 Conclusion

Unlike conversional methods, the study included measurement of fintech infrastructure to construct the index of financial inclusion, apart from the traditional measures. Financial inclusion is enabled by fintech adoption, measured by digital payments and mobile subscription. Financial inclusion initiatives ensures that rural populations have access to formal financial services and enable pursuing of livelihood opportunities and promote economic development.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

This last section of the study provides the summary and the conclusions of the study. The section also puts forward key policy recommendations and suggest necessary further studies. The objective of this study was to assess the pathways through which financial inclusion, facilitated by Fintech, influences economic development, and to identify the enabling factors and challenges in leveraging Fintech for financial inclusion and economic development in sub-Saharan Africa. To perform this analysis, the constructed the indices of financial inclusion for the periods 2011 to 2021 using the principal component analysis. Furthermore, we employed regression analysis to study the link between Fintech and financial inclusion, and their nexus with economic development.

5.1 Summary and conclusions

Governments in Sub-Saharan have developed strategies to enhance financial inclusion, this includes active monitoring of the status of financial inclusion through surveys that assess the progress made and identifying related gaps. Studies in financial inclusion have attracted interest from policy makers and researchers in recent years. Using a POLS and 2SLS approach, this study examines the link between Fintech and financial inclusion and the subsequent impact on economic development. The empirical results reveal a strong and positive link between Fintech and financial inclusion. The results also show that financial literacy measured by literacy rate as strongly associated with financial inclusion. We further find that rural population growth has a strong negative association with Fintech, indicating the challenges associated with Fintech infrastructures in rural areas compared to urban areas.

The 2SLS regression results clearly shows that only financial inclusion has a positive association with economic development. However, this relationship is not so significant. The impact of Fintech on economic development is only through it impact on financial inclusion. To conclude, this study has provided empirical evidence that in line with other studies quoted in the literature financial inclusion is correlated to economic development. However, in our study we do find this relationship to be significant. Moreover, Fintech is evidently strongly correlated to financial inclusion, resonating with studies cited in the literature review.

5.2 Policy Recommendations

The study findings contribute to the existing literature on Fintech, financial inclusion, and economic development, particularly in the context of developing regions. Given the scant research on the subject matter, specifically in Sub-Saharan Africa, the proposed research holds significant implications for policymakers, financial institutions, Fintech entrepreneurs, and development practitioners.

Comprehensive knowledge of financial inclusion, and the need for it, specifically the of methodologies and strategies to promote financial in a constant changing world, specifically due to digital technologies.

The study provides evidence to policy makers that to enhance financial inclusion, Fintech development should be supported and that regulatory frameworks should not create a red tape and discourage competition for fintech start-ups and discourage innovation in digital financial services. For Fintech to successfully facilitate financial inclusion it is necessary that the cost of transacting on digital platforms are affordable and not neglect the poor (Ozili, 2018). By understanding the impact of Fintech on financial inclusion and the financial inclusion drive to economic development, the study provides actionable insights that can inform evidence-based policies and strategies to create a more inclusive and prosperous future for sub-Saharan Africa.

Governments and regulatory authorities should develop clear and enabling regulatory frameworks for fintech innovation that balance promoting innovation and consumer protection. Specifically, policy actions should include establishing regulatory sandboxes that allow for fintech startups and financial institutions to test new products and services in a controlled environment. Government should consider mobile data subsidies or offer low-cost digital devices to facilitate access to mobile financial services for low income and rural populations and encourage public-private partnerships to expand mobile coverage and broadband internet in rural and remote areas to reduce digital divide.

5.3 Areas Further Studies

The study recommends further studies to understand to explain financial inclusion impact on economic development, particularly focusing more on non-traditional measures of financial inclusion, with specific consideration of fintech infrastructure. We further recommend that other variables which measure fintech be considered to understand other factors that may influence fintech. This is also relevant to

innovators and poly makers who have vested interest in the impact of fintech on financial inclusion and subsequent impact on economic development. Lastly due to diverse nature of the economies in the region, considerations should be made to investigate factors that are specific to specific economies.

5.4 Limitations of the study

Similar to any research, this study is not free from limitations. The main impediment of the study was limitations in data across countries in SSA region, especially data that relates financial inclusion dimension variables.

APPENDICES

Hausman fixed random tests:

Test: Ho: difference in coefficients not systematic
chi2(**5**) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= **60.31**
Prob>chi2 = **0.0000**
(V_b-V_B is not positive definite)

Breusch-Pagan LM test for random effects versus OLS:

chibar2(01) = **19.32**
Prob > chibar2 = **0.0000**

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