UNIVERSITY OF CAPE COAST

FINANCIAL OUTREACH, FINANCIAL INNOVATION AND SUSTAINABLE DEVELOPMENT IN AFRICA

CHRISTINA ARCHER

2023

UNIVERSITY OF CAPE COAST

FINANCIAL OUTREACH, FINANCIAL INNOVATION AND SUSTAINABLE DEVELOPMENT IN AFRICA

BY

CHRISTINA ARCHER

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 requirements for the award of Master of Commerce degree in Finance

JULY 2023

DECLARATION

Candidate's Declarations

I hereby declare that this thesis is the result of my own original research and no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature…… Date……

Name: Christina Archer

Supervisor's Declaration

I hereby declare that the preparation and presentation of this thesis was supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's Signature…… Date……

Name: Dr. Anthony Adu-Asare Idun

ABSTRACT

There has been a call on policy makers in the African continent to formulate and implement initiatives that help to realise some of the SDGs. This is due to the low performance of the continent in terms meeting the targets of the SDGs. In view of this, the study sought to investigate the relationship between financial outreach, innovation and sustainable development in Africa. Data was collected on 34 African economies for a period of 10 years spanning from 2011 to 2020. The study employed the Two-step System Generalised Method of Moments technique to estimate the results. It was discovered that, depending on the indicator used to measure outreach, financial outreach has significant positive and negative relationship with sustainable development. On the various dimensions, financial outreach had negative influence on carbon dioxide emissions, positive impact on economic sustainability and inverse relationship with social sustainability. It was also revealed that financial innovation has a significant negative link with sustainable development in Africa. Additionally, the findings revealed that both financial outreach and innovation serve as moderating variables in the finance/development nexus. The study recommends that governments and policy makers in various African countries work together with financial service providers to ensure fair, flexible, and alluring interest rates on loans to the underprivileged, disadvantaged ones in the society, and vulnerable businesses in order to smooth their consumption and boost their businesses.

KEYWORDS

Africa

Economic sustainability

Environmental sustainability

Financial innovation

Financial outreach

Social sustainability

Sustainable development

ACKNOWLEDGEMENT

I would like to respectfully appreciate my supervisor, Dr. Anthony Adu-Asare Idun for his professional guidance and assistance towards the successful completion of this work.

I would be forever grateful and thankful to Mr. Ransford Elliot Ghartey, Mr. Seth Manful and Mr. Gordon Klutsey for their motivation, support and contribution toward my postgraduate study.

Again, a special thanks to my family members, friends and all persons who contributed in diverse ways to ensure the successful completion of this research work. I really appreciate your tremendous efforts.

DEDICATION

To my family

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ANS	Adjusted Net Savings
ATMs	Automated Teller Machines
CSR	Corporate Social Responsibility
GDP	Gross Domestic Product
IPA	Innovation for Poverty Action
IUCN	International Union for Conservation of Nature and Natural Resources
MSMEs	Micro, Small and Medium Enterprises
SDGs	Sustainable Development Goals
SD	Sustainable Development
SMEs	Small and Medium-scale Enterprises
UN	United Nations

CHAPTER ONE

INTRODUCTION

The adoption of UN 2030 Agenda and Sustainable Development Goals (SDGs) has necessitated the incorporation of sustainable development strategies by majority of economies across the world, particularly African countries into their policymaking process. The idea of the agenda was to help solve some pressing challenges (poverty, hunger, unemployment, continuous reduction of some countries' economic growth, among others) that befall the world at large (Strezov, Evans & Evans, 2017). The idea behind the study is to assess how the financial system contributes to sustainable development in Africa. This is achieved when banks reach out to more unbanked population and offer them with innovative products, thereby making them more capable of improving on their wellbeing.

Background to the Study

Economists have argued that trade off exists among present and future consumption across generations and this has repercussions on the standard of living of both generations. Therefore, attention has shifted from achieving enhanced economic growth to a more sustainable means of not compromising the standard of living of the future generation (Koirala & Pradhan, 2020). Sustainable development is defined by Brundtland Commission (1987, p. 43) as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs". This implies that in meeting the consumption needs of the present generation, efforts must be made in conserving resources for future purposes.

A report by International Monetary Fund (2017) reveals that, the economic growth of the African continent since the adoption of the SDG has been much lower than both the long-term historical average and the SDG target of 7% annually. Again, it was discovered from the report that, an African child today runs the risk of not receiving a comprehensive, top-notch education or dependable medical care. As compared to other continents, the status of Africa's sustainable development is not encouraging with countries in the North America and Europe having high sustainable development performance (Li, He, Jin & Tsai, 2021). Figure 1 shows the pictorial view of the status of SD based on the findings of Li *et al*. (2021).

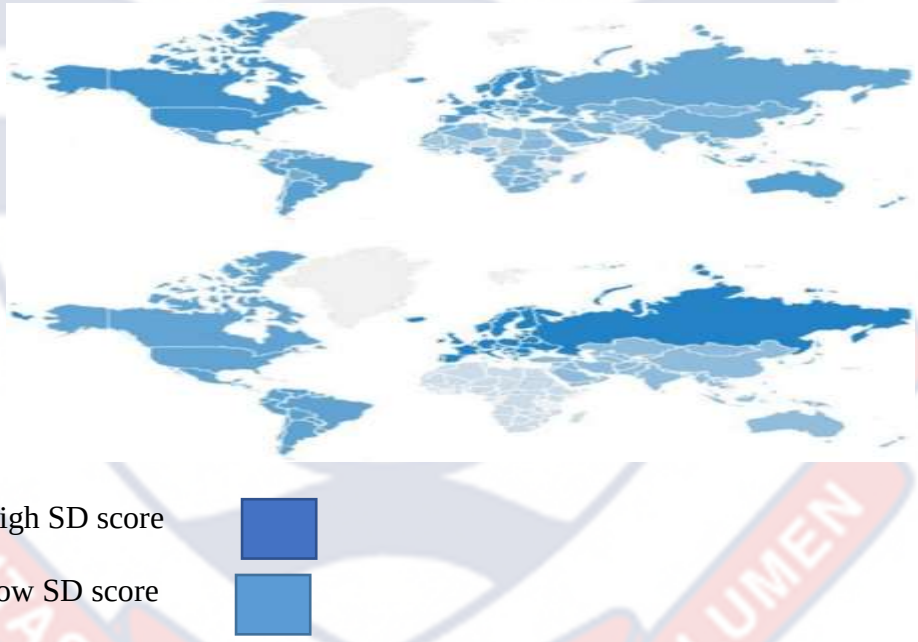

Figure 1: Geographical distribution of SD score among African and other continents.

SD score for each country (upper) and continent (lower). The darker the blue, the higher the mean SD score. Dark blue areas are North America and Europe continents and light blue is Africa.

Source: Li et al. (2021)

Economists have argued that, per capita GDP cannot be used as an indicator to decide whether an economy's development is sustained or not. Corollary to this, international bodies as well as researchers have developed indicators that are appropriate in measuring how a particular economy is sustained and the well-being of people enhanced. Sustainable development in this study is measured as the adjusted net savings (ANS) of a country. The indicator as defined by the World Bank (2016) "is the gross national savings subjected to some adjustment for the annual changes in the volume of all forms of capital". ANS is a broad means of measuring savings which involves the monetary value of physical capital, human capital, knowledge stock, natural capital and social capital (Gnègnè, 2008).

A thorough examination of Figure 2 shows that, the adjusted net savings of selected African nations shows an upward trend depicting a sustainable path. However, there was a tremendous decrease from 2019 to 2020. This recent decline suggests that the continent is on an unsustainable path in expanding its physical and human capital. The physical and human capital serve as the conduit for the welfare of future generations since majority of the economies in the continent are having a declined adjusted net savings. This is because Koirala and Pradhan (2020) opined that a country is said to be on an unsustainable path when it has a declining adjusted net savings rate.

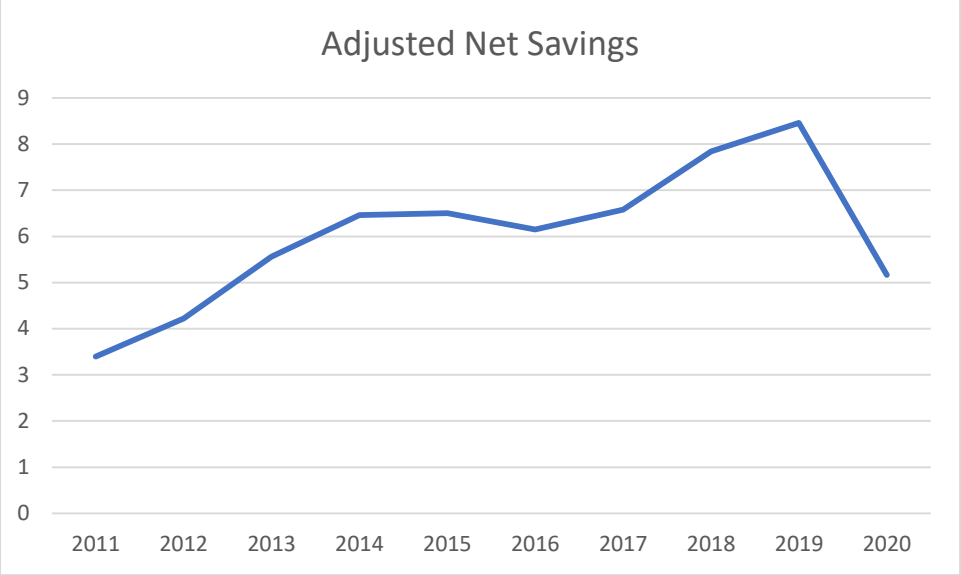

Figure 2: Adjusted Net Savings for the Sampled Countries

Source: Data from Sustainable Development Goals database (2011-2020)

In the attempt to create a sound and more sustainable economy for both the present and future generation, the contribution of the financial system cannot be overlooked. The relevance of finance in promoting growth and development was championed by Schumpeter (1911) in his growth model that, the financial sector which is dominated by banks ensures efficient allocation of savings and financing of innovations for productive activities. It has also been described as the backbone of every nation's economy since it acts as a catalyst for long-term economic growth by facilitating effective monetary intermediation (Jha & Hui, 2012).

Banks play essential role in giving households and individuals access to affordable and fundamental financial services and assist in creating new jobs for the unemployed, which helps improve the socio-economic development of citizens (Buys & van Niekerk, 2014). The activities of the banks result in entrepreneurial projects, promote sustainable investment in the private sector and improve the living condition of people since unemployment

rate would be reduced (Kargbo & Adamu, 2009). Notwithstanding, this would not be achieved if people do not have access to the formal financial system. This is because, being a part of the financial system and gaining access to financing is a significant step toward economic development and SDGs achievement (Sethi & Acharya, 2018; Ozili, 2020).

Access to finance has been a major issue of concern in Africa among governments, researchers and policymakers, and efforts are being made to ensure that low-income earners gain access to diversified financial products (Demirgüç-Kunt, Klapper, Singer & Ansar, 2022). This could probably be due to the immense contributions of financial outreach to the financial system and the economy at large. Outreach is a term that has been used in several disciplines like religion, marketing, among others. In marketing, it is termed as market penetration, which is a strategy that businesses use in their quest to enter a new market. In the finance discipline, the concept is termed as financial outreach (Beck, Demirguc-kunt & Peria, 2007). Financial outreach is the process of reaching out to more potential customers who are unbanked and underserved and providing them with financial products to improve their livelihood (Beck et al., 2007).

Financial outreach and financial inclusion have often been used interchangeably; however, these terms mean differently. Financial outreach is the effort of a particular financial institution to reach out to more people and introduce them into the financial system. Financial inclusion on the other hand, is an ongoing initiative which involves several stakeholders (government, financial institutions, policy makers, etc) to ensure that everyone has access to the financial system (Demirgüç-Kunt, Klapper, Singer & Ansar,

2022). This implies that through financial outreach, people from all social strata would have the chance to use financial services like payments, savings, loans, and investments and assist Small and Medium-scale Enterprises (SMEs) as well as small entrepreneurs to grow their businesses and generate income for the less privileged. This would enable them to get the needed funds to cater for their wards' education, get proper health care and smooth their consumption. If this is accomplished, there would be the likelihood of achieving some of the 17 Sustainable Development Goals—no poverty, zero hunger, good health and wellbeing, quality education, and access to decent work and economic growth.

Granting businesses and people access into the formal financial sector through increment in the number of bank branches and sharing of borrowers' credit information can either enhance or retard environmental sustainability (Abbasi & Riaz, 2016; Ehigiamusoe & Lean, 2019; Odhiambo, 2020). In the positive sense, researchers have opined that permitting the already excluded populace into the financial system offers them the access to cheap and valuable financial packages that help them to invest in green technology that do not emit more carbon dioxide (Yahaya & Ahmad, 2018; Salehnia, Alavijeh & Salehnia, 2020).

For instance, report by Innovation for Poverty Action (IPA) (2017) reveals that through financial access, farmers are able to acquire affordable solar energy microgrid that emit low carbon dioxide as compared to coal-burning plants. On the other perspective, it is argued that increased access to finance enhances industrialisation that boost economic growth but result in the emission of more carbon dioxide which retard environmental sustainability

(Acheampong, 2019). In the same vein, financial outreach enables people to purchase products such as refrigerators, air conditioners and other automobiles that consume more energy and emit more carbon dioxide which tamper with environmental sustainability (Maji, Habibullah & Saari, 2017).

Again, deepening the financial system through the activities of banks promote social sustainability because denying people access to the formal financial system is the originator of poverty, which leads to high illiteracy, improper healthcare facilities and lack of nutritious meals (Huang, Gu, Lin, Alharthi & Usman, 2022). Poverty has also been determined to be the significant factor contributing to poor mental health conditions among the less privileged (Cole & Tembo, 2011). This is due to their susceptibility to unhealthy living conditions, stressful events and poor health (Baird, Hoop & Ozler, 2013; Miller & Rasmussen, 2017; Adhvaryu, Fenske & Nyshadham, 2019).

Financial outreach through credit information sharing increases competition among financial intermediaries which lowers intermediation cost thereby enlarging the credit access bracket to potential entrepreneurs who previously lack access to the formal financial system (Liu, Zhang, Hafeez & Ullah, 2022). This would result in the establishment of new businesses by these new entrepreneurs and the expansion of existing business thereby creating more jobs which ultimately enhance economic development (Mushtaq & Bruneau, 2019; Singh & Padhi, 2019).

Financial outreach ensures that, the unbanked populace get access into the formal financial system through the rendering of varied financial services and offering of innovative opportunities. Innovation in the financial sector

helps to reach more people by making financial services more accessible and affordable. These innovations can be in the form of Automated Teller Machines (ATMs) and mobile money usage, accounts creation, agency banking, credit scoring techniques, new forms of mortgage lending and many others. As stated by Tufano (2003, p. 308**), "**financial innovation is the process of emergence, diffusion, and popularization of new financial instruments, financial institutions, financial technologies, and financial markets in the economy."

Innovation in the financial sector is not just limited to the development of new financial products (Michalopoulos Laeven & Levine, 2009). Financial innovation also includes more conventional financial advancements like the adoption and modernization of private credit departments as well as advancements in data processing and credit scoring that have improved the ability of various financial institutions to evaluate borrowers (Nazir, Tan & Nazir, 2021). Moreover, it involves the use of advanced technology to screen borrowers so as to reduce the number of defaults (Laeven, Levine & Michalopoulos, 2015).

Green innovation is very essential in achieving ecological sustainability through the reduction of carbon emissions and the spike in the efficiency of energy utilisation (Zhu, Niu, Ruth, & Shi, 2018; Zeng, Li & Huang, 2021). Through financial innovation banks are capable of screening out low-quality green innovation from high-quality green innovation projects and offer loans to finance the latter which helps promote environmental sustainability (Yuan, Ye & Sun, 2021). Financial intermediaries benefit from

this practice by reaping higher profits through their interest margin and maintain competitive advantage since they are able to reduce credit liability.

Branch networking as a traditional approach to banking has been heavily relied on by banks in most economies (Qamruzzaman & Wei, 2019). This approach could to some extent limit the number of people who may have access to banking services (Inoue & Hamori, 2016). Studies have argued that innovation in the financial sector speeds up the financial process in terms of increasing access to formal financial services and making financial products easier and more affordable (Andrianaivo & Kpodar, 2012; Raffaelli & Glynn, 2013). More so, based on the diffusion of innovation theory, it is argued that, the economy would exclusively benefit from innovation when such innovation is adopted and used by large range of people (Domeher, Konadu-Yiadom & Aawaar, 2022).

This would be materialised when more unbanked people are being reach out and brought into the financial system. The prevalence of new and improved financial services introduced by most financial institutions are all aimed at reducing transaction cost, meeting customers diverse demands and making financial services more accessible to all. It therefore, stands to reason that if these innovations are tailored towards the financially excluded adult population, massive depository funds will be generated for lending which in turn augments the wellbeing of both present and future generations.

Statement of the Problem

There has been a major concern by policy makers in Africa on how to achieve some socio-economic goals like poverty reduction, increasing employment, access to healthy food and water, improved economic growth

and many others. In addition to the achievement of these goals, it also become necessary for nations in the continent to reduce the amount of carbon dioxide emissions so as to solve the issue of global warming (Jin, Qian, Chin & Zhang, 2020). Due to this, African countries have joined hands with other neighbouring continents to adopt SDGs which integrate economic, social and environmental concerns to ensure that all persons have value for human development in order to end poverty, safeguard the environment and guarantee that everyone lives in peace and prosperity (Emas, 2015).

Despite the continent's tremendous economic expansion, inequality, poverty and unemployment rates are still high (African Development Bank, 2018). The high unemployment rates may be linked to poor levels of human development brought on by a lack of access to high-quality education and medical facilities, which has left a huge portion of the people unemployed (African Development Bank, 2018). Moreover, in assessing the performance of sustainable development across continents, it was observed that the African continent is at least of performance globally (Bilbao-Ubillos, 2013; Li, Liu & Song, 2014; Hickel, 2019) and as such much attention should be channeled towards the continent (Jin *et al*., 2020). Several reasons have been given by researchers on the low SD performance of developing nations. Thus, the economy and citizens' income levels are both quite low and also inadequate supply of public goods and services, such as public health, education and ecological protection due to the ineffective governments or insufficient fiscal income (Jin *et al*., 2020).

There has been an increase in worldwide and developing countries account ownership as the report by Demirgüç-Kunt *et al.* (2022) based on

Global Findex Database at the World Bank reveals that 76% of the global population while 71% of the population in developing economics own account. Notwithstanding the efforts in extending financial services to the vulnerable group of the society since access to formal financial system largely help achieve most of the SDGs (Klapper et al., 2016), 45% of adult population in the African continent do not have account with formal financial institution (Demirgüç-Kunt et al., 2022). Though the number has reduced from 77% in 2011, the report further revealed that the region is still among the bottom three regions globally in terms of account ownership. Considering the claim by Klapper et al. (2016) that access to the financial system aid in achieving most of the SDGs, these statistics above are disconcerting.

The use of GDP growth as an indicator for sustainable development has been criticised by scholars since it does not exhibit all the dimensions of sustainable development (Khan, 2015). Instead, it measures only the monetary value of total output without considering the enjoyment of shared prosperity by the people and the damage caused to the economy through natural resource depletion. In view of this, the study utilised the adjusted net savings as an indicator for sustainable development that covers all the dimensions of SD. Additionally, the essence of finance in fostering sustainable development in the African context has received little attention. The studies focus on only one dimension of sustainable development (Datta & Singh, 2019; Makina & Walle, 2019; Matekenya, Moyo & Jeke, 2020; Amin, Song & Khan, 2021) which do not reflect the true status of the sustainable development of the continent and the world at large.

Furthermore, no study has examined the relationship among financial outreach, innovation and sustainable development with no study assessing the moderating role of both outreach and innovation in the finance/development nexus both in the developed and developing economies. With the dearth of studies on the relationship among the variables, the current study seeks to investigate whether the sustainable development of Africa can be augmented if banks offer affordable, diversified and innovative financial products and services to formerly unbanked segment of the population, by assessing whether financial innovation and outreach can act as moderating variables in the finance and growth/development nexus.

Purpose of the Study

This study seeks to evaluate the relationship between financial outreach, financial innovation and sustainable development in Africa.

Research Objectives

To achieve the purpose of the study, the specific objectives of the study are to:

1. assess the relationship between financial outreach and sustainable development in Africa.
2. examine the relationship between financial innovation and sustainable development in Africa.
3. investigate the moderating role of financial innovation in the relationship between financial outreach and sustainable development in Africa.
4. investigate the moderating role of financial outreach in the relationship between and financial innovation sustainable development in Africa.

Research Hypotheses

1. There is no significant relationship between outreach and sustainable development.
2. There is no significant relationship between financial innovation and sustainable development.
3. Financial innovation does not moderate the relationship between financial outreach and sustainable development in Africa.
4. Financial outreach does not moderate the relationship between financial innovation and sustainable development in Africa.

Significance of the Study

This work attempts to evaluate the relationship between financial outreach, financial innovation and sustainable development in Africa and as such, would have both empirical and social contributions. Empirically, the study would add to the extant works on the said topic by employing indicators that incorporate several facets of financial outreach and serve as a reference point for scholars, financial analyst and the general public as a whole for further research. In the social context, the study will inform policymakers on the need to introduce financial outreach campaigns in their plan of work and also encourage financial practitioners and institutions to deliver innovative instruments that would target the unbanked population. The findings would also inform government on the need to reduce the amount of taxes paid by these commercial banks so as to motivate them to continually embark on corporate social responsibility programmes that help improve the wellbeing of people.

Delimitation of the Study

The study concentrated on 34 African countries of which the data span from 2011 to 2020. The study measured sustainable development as adjusted net savings percentage of gross national income while financial innovation was measured as the growth in net interest margin. Financial outreach on the other hand was measured with two measurements; thus, bank branch penetration and credit information sharing. The study also resorted to five macroeconomic indicators as control variables; inflation, bank sector development, natural resource rent, bank return and bank competition.

Limitation of the Study

The study was constrained by the difficulty in getting data on the variables for other countries. Moreover, the unavailability of data for some countries to some extent narrowed the scope of the study. Notwithstanding, this would not affect the representativeness of the study since the countries used covers more than half of the population.

Definition of Terms

Sustainable Development

Sustainable development refers to socio-economic, human, and environmental development that promotes economic opportunity and social inclusion, gender equality and ecological conservation without abandoning any individual (UN Women, 2018).

Financial Outreach

Financial outreach refers to the process of providing a variety of financial services to larger population, regardless of their income or poverty status (Moyo, 2020).

Financial Innovation

Financial innovation has been conceptualised in this study as the introduction of new innovative products into the financial system and the use of advanced technologies to screen out good borrowers from bad ones thereby allocating resources efficiently.

Organisation of the Study

This study is organised into five separate chapters. Chapter one discussed the introduction of the research which was followed by the background to the study, purpose, objectives and hypotheses, significance, delimitation, limitation, definition of terms and lastly the organisation of the study. The second chapter deliberated on the theoretical perspective relevant to the work, concepts and evidence from previous works in the subject area. Chapter three which covers the research design, approach, population and sample, data collection procedures and sources, model specification, data processing tool and estimation strategy and measurement of variables were discussed. The fourth chapter presented the analysis and discussions of the results based on the objectives. The last chapter also discussed the summary and conclusions based on the findings. The necessary recommendations premised on the conclusions were provided to policy makers and financial institutions.

CHAPTER TWO

LITERATURE REVIEW

Introduction

The study examines the link between financial outreach, financial innovation and sustainable development. The chapter discusses theories and prior works that a related to this study. The earlier section of the chapter discusses the theoretical underpinnings, which is followed by the review on the various concepts applied. Previous works on the topic were discussed in the subsequent section and it was followed by conceptual framework, gaps in literature and lastly the chapter summary.

Theoretical Perspective

The use of Adjusted Net Savings (ANS) is supported by the theoretical considerations of Solow (1974) and Hartwick (1977). These theorists developed the Solow-Hartwick sustainability model which explains that for an economy to achieve intergenerational equity to be enjoyed by future generation in same or greater amount as experienced by current generation, or for a nation to be on the sustainable development path, all profits earned from the use on nonrenewable natural resources should be reinvested in renewable resources. In this way, a country will achieve sustainable development if the utility function determined by consumption, is non-diminishing for a long period of time (Gutés, 1996). Neoclassical theory deduced that non-diminishing utility function would be possible if capital stock is constant (Solow, 1974). This sustainability model is viewed as savings-investment rule in the sense that the non-declining or constant capital stock could be achieved if the savings rate of a country for a given period is more than or same as the

rate of depreciation on both natural and artificial capital (Pearce & Atkinson, 1993). If this condition is met then such a nation can be said to be sustainable on the path of development.

A cursory scrutiny of the model above seems to concentrate on only economic sustainability without focusing on the other dimensions. However, the indicator used to measure sustainable development in this study captures all the other dimensions of sustainability. ANS as an indicator for sustainable development describes the monetary value of the total production of an economy after accounting for the enjoyment of shared prosperity by the society as well as the depletion of natural resources that emerged in the production process (Gnegne, 2009). This indicator is a best measure for sustainable development because it captures all the dimensions of sustainable development (Pardi, Salleh & Nawi, 2015).

The theoretical discussions of this study are done on the basis of each objective.

Objective One

Environmental Kuznets Curve (EKC) Theory

The Environmental Kuznets Curve (EKC) theory was originated by Grossman and Krueger (1995) who argued that there is an inverted-U relationship between economic development and environmental degradation. The proponent of the EKC theory contend that in the early stage of development, pollution rises swiftly as people focus more on employment and income and how to increase productivity than environmental quality such as clean and fresh air and water. This causes more natural resources to be used and increase the emission of pollutants which is detrimental to the quality of

the environment (Dinda, 2004). As income increases in the later stage, people place a higher value on the environment and pollutants emission decrease.

The argument made from the theory from the supply side is that, as more people have access to the formal financial system to benefit from financial products, performance of banks increases. This leads to improvement in the economic performance of countries within which these banks operate, but comes with a cost (Aye & Edoja, 2017). This cost is that, as people are getting access to more funds and income, the economy will expand and it is likely that they will pollute the environment. This theory provides credence to the assertion that, as the economy expands, environmental sustainability is undermined to a point where people become more concern about the environment.

Credit Information Sharing Theory

The information sharing theory emanated from Freimer and Gordon's (1965) information asymmetry hypothesis, which was extended by Stiglitz and Weiss (1981). The theorists claim that as a result of lack of comprehensive, complete and trustworthy credit information on credit market participants, lenders are unable to distinguish between good and bad borrowers, resulting in the lender's allocation of credit to risky borrowers. Consequently, non-performing loans increase, leading to low profitability on the part of the banks (lenders). Notwithstanding, Stiglitz and Weiss (1981) suggest that banks should require collateral securities to safeguard any future eventualities. Bester (1985) argues however, that when banks or lenders disclose information about their customers, they can influence bank profitability through screening and incentive or motivation effects.

According to the incentive or motivation effect, information sharing acts as a disciplinary device, forcing borrowers to settle their credit obligations out of fear of future credit refusal, so a credit information recorded with one lender is shared with other lenders and this helps small firms and low-income earners get access to finance. The screening effect on the other hand explains that lenders or banks who share credit information have access to more accurate and complete customer information, allowing them to screen out risky borrowers and improve loan repayment. The argument is that as these banks get access to accurate information about their clients, they are able to reduce adverse selection and moral hazard thereby reducing the non-performing loans which results in the increment in the profitability of banks. When the performance of banks improves, they are able to perform their intermediation function easily, which improves economic performance.

Moreover, building on the exposition of the information asymmetry theory, as banks get credit information on potential clients through Credit Referencing Bureaus (CRBs), they lessen the conditions that have to be met in terms of collateral requirement before a client can access loan which increases the level of loan extension to creditworthy customers with no collateral. These individuals would be in a better position to venture into industrial activities which would reduce the unemployment rate and increases the income level of the population.

Objective Two

Schumpeter's Theory of Innovation and Economic Development

The relevance of the financial system in promoting economic and sustainable development was championed by Schumpeter in most literature in

the early 20th century. According to Schumpeter (1911), the financial sector provides a wide range of functions, like mobilization of funds, risk management, monitoring of managers, project evaluation and technological innovation. Specifically, banks mobilized funds from the surplus unit and provide credit to private investors with which they financed investment in the adoption of new production technology, enabling economic development. Additionally, the theorist highlighted in Schumpeter (1912) that economic development is boosted by innovations in the financial intermediaries as banks support innovation by recognizing and supporting entrepreneurs as they develop and implement new innovations to replace old ones (creative destruction).

In furtherance, Schumpeter (1934) conceptualised innovation as a process that includes either of the following; introduction of new products; development of new method of production; opening of new markets, discovery of new source of raw materials or half-manufactured goods and implementation of a new form of organization. The financial sector, particularly banks come into the picture when they provide the entrepreneurs with the funds required for introducing new technologies which makes them more efficient to produce more new products (Schumpeter, 1939).

These financiers do not provide funds to all entrepreneurs since they screen out the less risky entrepreneurs from risky ones and grant credits so as to prevent defaults (Idun & Aboagye, 2014). By so doing, the financial sector ensures efficient allocation of savings for productive activities, thereby augmenting investment and subsequently promoting economic development. It is prudent to note that if this practice continues for a longer period, societal

welfare would be improved, thus, achieving sustainable development. Majority of seminal works (McKinnon,1973; Shaw,1973) support the hypothesis of Schumpeter that finance leads to growth and development. On the other hand, Robinson (1952) contended that the argument should be from the position that growth causes finance, in the sense that rising GDP leads to higher demand for financial services which cause the intermediary roles and innovation of the institutions to increase thereby resulting in a well-developed financial system.

Objective Three

The Dynamic Model of Financial Innovation and Endogenous Growth

The dynamic model of financial innovation and endogenous growth is employed in this study to support the argument that financial innovation enhances the relationship between financial outreach and sustainable development. The theory was developed by Michalopoulos et al. (2009) and revised by Laeven, Levine and Michalopoulo (2015). The model which is similar to the Schumpeterian endogenous growth model posits that entrepreneurs enjoy monopoly profit when they invent improved products. In addition to financiers screening entrepreneurs to avoid risk, the banks themselves tend to innovate to bring out new financial products and services to suit clients' desires and also develop more efficient screening procedures. Financial innovation speeds up the financial process by allowing the underserved population of society to enter the official financial system and benefit from formal financial services (Qamruzzaman & Wei, 2019). Through financial innovation, this segment of the population gets to be served with

improved financial securities and instruments which encourages them to save and invest more in new and less risky financial products (Chukwunulu, 2019).

Rousseau (1998) concur with this argument and surmised that innovations in the banking sector do not exclusively come from banks in their attempt to minimize credit risk through screening and monitoring but directly affect financial depth than growth. This is because as new products and services emerge, more people would be lured to enter into the financial system to enjoy these innovations. The author based his analysis in the United States and deduced that as banks innovate to reduce risk, they enjoy profit in the short run by reducing interest rates thereby encouraging more low-risk customers to apply for loans.

As more banks embrace the new technology to use for their screening and monitoring purposes, people tend to compete for loanable funds which increases the rate of deposit as per the loanable fund theory. This results in more deposits to be channeled to productive investment, thus improving growth and development. Based on this exposition, the current study espoused that innovation in the banking sector would attract more people into the financial umbrella leading to more funds for investment purposes.

Objective Four

Diffusion of Innovation Theory

The diffusion of innovation theory as originated by Rogers (1962) explains the patterns of how new products, ideas, services, or behavior spreads or diffuses through a particular social system or population over a period of time. The theory emanated from how a drop of dye diffuses through a glass of water. The diffusion process starts from the point where the dye is added to

the water which becomes concentrated at that particular moment. Over time, the dye diffuses gradually to a point where it spreads out completely. In the same manner, as an innovation emerges, it spreads from it source of invention to concentrated few adopters and finally gain widespread acceptance and usage.

In the financial sector, an innovation can be spread out when larger populace has access to the financial system. This can be achieved through financial outreach where banks expand their operations by opening more branches at locations that do not have one initially. The argument is that, as these banks expand in terms of branches, they tend to spread out the new products and services to their new clients for easy acceptance and adoption. This is supported by the assertion of Domeher, Konadu-Yiadom and Aawaar (2022) that, the ultimate result of the adaptation and diffusion of financial innovation is financial outreach or inclusion. As financial outreach makes it possible for less privileged to enjoy the innovative products, economic activities would be expanded and the poverty level among them would be reduced thereby making them able to smoothen their consumption.

It is indispensable to note that innovation can be embraced by several group of individuals in the society at different time periods (Marfo-Yiadom & Ansong, 2012). This indicates that the speed with which young people would accept and adopt a particular innovation would differ from other groups of users such as elderly retirees. In this regard, Shiffman and Kanuk (2009) opined that the educated group in the society usually adopt new ideas earlier than the less educated group. This implies that since financial outreach targets

the undeserving populace in the society who are normally less educated, they may be reluctant to adopt these innovations.

Linking Theory to the Study

The study relied on some theoretical underpinnings to assess the influence of the financial system on sustainable development.

The Environmental Kuznet Curve theory basically describes how improvement in economic growth and development results in the deterioration of the environment in the early stage of the economic development. The theory also suggests that as people continually enjoy the financial products, they tend to engage in practices that protect the environment. Additionally, the credit information theory provides insight on how banks are able to extend credit facilities to a large group of people who would have otherwise been denied due to strict loan conditions, when they get credit information on potential customers. Subsequently, the study argued that when people get access to formal financial system, it might influence their decisions regarding production and employment, enable them to spend their money in the formal economy, make them less susceptible to the negative effects of poverty and aid them to engage in ecologically friendly practices.

The Schumpeter's Theory of Innovation discusses how innovation in the financial sector influences growth and development. The theorist highlighted that financiers or financial intermediaries use advanced technologies to screen out entrepreneurs and provide funds for less risky ones to aid them come forth with new ideas and expand their operations. It is therefore argued that as firms are able to introduce innovative ideas and expand their businesses, employment and income level increase hence

allowing people the opportunity to save for children's education and attend to proper health care.

The Dynamic model of financial innovation espoused that banks do not only use advanced technology to screen and monitor entrepreneurs, instead they bring out new innovative products and services to meet the diverse needs of customers. This act tends to increase financial depth as more people would have access into the financial system through these innovations. More so, the idea of the proponent of the diffusion of innovation theory implies that innovation in the financial system would be embraced and accepted when it is spread out, which could be materialised when larger population have access to the financial system. It is on these expositions that the study argued that financial innovation and outreach can serve as moderating variables in the finance/development nexus.

Conceptual Review

Sustainable Development

The concept of sustainable development has been described as a cliche´ and as such has several definitions and interpretations (Kelly, Sirr & Ratcliffe, 2004). The concept as has been disclosed by Tomislav (2018) is to a larger extent grounded on the concept of development. Development is a process which aimed at improving people's quality of life and strengthens the self-sufficiency of more complex economies that rely on global integration (Pike, Rodríguez-Pose & Tomaney, 2016; Hopper, 2018). In the same vein, Tangi (2005) espoused that its fundamental goal is to create an interesting environment where individuals would continuously live a creative and active life. Development centres on three key items, thus, socio-economic

development in the presence of ecological restrictions, concept of needs (redistribution of resources to guarantee that everyone has a good quality of life) and concept of future generations (the possibility to use resources in the long run and ensure that future generations have the essential quality of life (Tomislav, 2018).

Sustainable development is defined by Brundtland Commission (1987, p. 43) as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs." According to UN Women (2018), sustainable development refers to socio-economic, human, and environmental development that promotes economic opportunity and social inclusion, gender equality and ecological conservation without abandoning any individual. The World Bank (2001) documented that sustainable development should be recognised as inclusive growth which includes putting in place environmentally sound measures to lessen poverty and establish shared prosperity for current population while also meeting the demands of future generations. Also, it is not only about how to maintain the environment but ways to alleviate poverty or improve material living standards while also preserving or improving important natural capital for future well-being (Polasky *et al*., 2019).

From the above definitions, it is prudent to note that, sustainable development is a multi-dimensional concept which encompasses many diverse elements of life, from environmental protection and natural capital preservation to achieving economic success and equality for present and future generations. The concept is derived from the Triple Bottom Line concept by Elkington (1997) which explains that there should be convergence of the three

dimensions of sustainability. Thus, environmental or ecological, social and economic or financial sustainability. However, in the quest to achieve overall sustainable development, Tomislav (2018) posits that ecological or environmental sustainability which is critical to total capability of development is mostly trampled on.

The environmental dimension basically deals with upholding the quality of the environment to enhance economic activities and improved life of individuals. The social pillar focuses on human rights and equality and respect for and protection of cultural diversity while the last dimension centres on sustaining the available capital (natural, human and social) needed for income and improvement in standard of living while firms make profit (Nadeem et al., 2020). It can therefore be deduced that sustainable development is concerned with safeguarding and sustaining society and the environment for future generations while attempting to achieve the goal of market capitalization maximization.

Financial Outreach

The concept of outreach has been described as vague since it includes both qualitative and quantitative aspect (Abdulai & Tewari, 2017a). The concept has been applied in several disciplines like natural sciences, religion, among others (Rao & Fitamo, 2014). In the field of finance, it is termed as financial outreach. Financial outreach refers to the process of providing a variety of financial services to larger population, regardless of their income or poverty status (Moyo, 2020). Ndlovu (2017) explained that due to the advancement in information and communication technologies, formerly financial excluded individuals are now able to access financial services.

Other researchers argue that outreach is concern with granting of loans to the poor who do not have access to formal financial system in order to alleviate poverty and assist them in starting their own enterprises (Conning, 1999; Hermes, Lensik & Meestres, 2011; Lopatta, Tchikov, Jaeschke, & Lodhia, 2017; Singh & Padhi, 2019). The definitions by these authors raise the concern as to whether the number of customers using financial services in general or only the number of impoverished people using financial services be considered when evaluating outreach. If the latter is considered how then can they be identified? As a result of this, this study defines outreach as the extent to which formal financial products and services are made accessible to all persons through bank branch penetration and credit information sharing.

Excluding people (mostly those with low income and vulnerable ones) from the formal financial system has ramifications on the growth and development of the economy. Shu and Oney (2014) explicate that, denial of people from getting access to financial markets is the primary cause of poverty, which has numerous repercussions such as a lack of education, adequate healthcare and nutrition. Several reasons have given for excluding people from the financial system. Among these are; inadequate capital to open account with commercial banks and lack of assets as collateral for credit (Meyer, 2019; Ratnawati, 2020).

Outreach has been discovered by Woller and Schreiner (2004) to have six dimensions and as such has been termed as a hybrid concept (Rao & Fitamo, 2014). These dimensions include length, worth, scope, cost, depth and breadth. Particularly for this study, much emphasis is laid on depth and breadth of outreach as earlier scholars have focused on them and information

on them are easily accessible (Bayai & Ikhide, 2016b; Abdulai & Tewari, 2017a).

Depth of Outreach

Basically, the depth of outreach deals with the qualitative aspect of the population which focus on both the economic and demographic status of the customers being served by the financial institutions (Moyo, 2020). According to Navajas, Schreiner, Meyer, Gonzalez-Vega and Rodriguez-Meza (2000, p.336), depth of outreach refers to "the value the society attaches to the net gain from the use of micro credit by a particular borrower". From the definition of Moyo, the economic aspect is concerned with providing financial products to economically inactive population or the economically active populations who work in Micro, Small and Medium Enterprises (MSMEs) as well as those who earn very low incomes.

The demographic perspective takes into account the delivery of financial services to more females than males as women are more vulnerable to poverty than men (Anh & Tam, 2013). Furthermore, outreach is deepened when the underserved populations including the disabled, aged and those living in rural or marginalised areas are served with financial products and services. This perspective to some extent is deficient in the sense that due to the recent women's independence, education and equal job opportunities, females are now becoming empowered and less poor. Likewise, living in a marginalized or rural area does not necessarily makes an individual poor. Some rich people can decide to reside in remote areas as a matter of lifestyle.

Extant works have utilised numerous indicators as proxies for outreach depth. Among these are; average loan size as a percentage of gross national

income (Hermes et al., 2011; Karanja, 2014; Heng, 2015; Abdulai & Tewari, 2017b) and average outstanding loan balance (Rosenberg, 2009). A smaller amount for the former indicator implies that more poor people have been served, thus greater outreach depth. Critics have contended that lower loan size does not accurately reflect outreach depth as poor clients with a good credit history are more likely to receive greater loans from banks (Churchill & Marr, 2017).

Moreso, others believe that as a result of market competition and the need to maximize profits, some banks and nonbank financial institutions have tended to reduce lending to poor clients in favour of relatively wealthy clientele who are willing to take on larger loans (Saxena, & Wagofya, 2018). In view this, the study adopts the measure for outreach depth by Beck, Lin and Ma (2014), thus, credit information sharing. This measure is essential because the credit information shared among potential lenders makes the request for collateral less important to these lenders as they have records, they can use to effectively monitor the activities of risky borrowers (low -income earners). Imperatively, these low- income earners do not have to worry much about collateral before assessing more finance.

Breadth of Outreach

The breadth of outreach which focus on the quantitative aspect of outreach refers to the number of users of formal financial products. Kaur (2014) argues that outreach breadth refers to the degree to which credits are provided by financial institutions to a wider range of individuals. It is also expressed as the numerical value, like the number of customers particularly those who formerly did not have access to the formal financial system to be

offered with financial services (Saxena, & Wagofya, 2018). Moyo (2020) posits that this aspect of outreach is achieved if a wide range of financial services and products is offered to as many clients as feasible in the right proportion mix and quantity.

It can be categorized as geographical or demographical breadth of outreach (access). Geographic access indicators represent the geographic distribution of a bank's physical outlets, such as branches and Automated Teller Machines (ATMs) (Le, Chuc, & Taghizadeh-Hesary, 2019). The demographic aspect deals with the number of clients who used these physical outlets. Some of the indicators used to measure breadth of outreach are as follows; the number of active borrowers, the number of new borrowers, number of bank branches per 1,000 km^2, number of bank ATMs per 1,000 square kilometers, percentage of female clients (Sarma, 2012; Abdulai & Tewari, 2017a; Saxena, & Wagofya, 2018; Bhandari & Mohite, 2020).

Financial Innovation

Financial innovation has been defined by earlier researchers as the development of new financial institutions, financial instruments, and payment mechanisms (Merton, 1992). It also refers to as the positive modifications or changes that occur in the financial markets and institutions' financial system or financial intermediation process (Qamruzzaman & Jianguo, 2018). According to Mention and Torkkeli (2012, p.8), financial innovation refers to "changes in the offerings of banks, insurance companies, investment funds and other financial service firms, as well as modifications to internal structures and processes, managerial practices, new ways of interacting with customers and distribution channels".

Abor (2016) posit that the ultimate goal of financial innovation is to ensure that financial system offers services such as deposits, loans, shares, debt instruments, among others that are cheap and easily available to customers. Moreover, Idun and Aboagye (2014) explained that, financial innovation is the application of new financial instruments, as well as technological and market information, to provide clients with a new product or service that are less expensive and/or have better features so that the innovating company makes a profit than before. Laeven, Levine, and Michalopoulos (2015) also documented that financial innovation involves the emergence of new firms and their corporate structures, financial mechanism and the expansion of recording methods.

Financial innovation contributes to the financial system from three main perspectives – process innovation, product innovation and institutional or organisational innovation (Tufano, 2003). Product innovation means the development of new financial products including derivatives, securitized assets, hedge funds, foreign currency mortgages, and modification of existing innovative financial securities to meet changes in market demand, while process innovation refers to the effective and competent delivery of financial services such as mobile banking, internet banking, among others to increase efficiency in operations (Nato, 2011). The institutional innovation on the other hand refers to the process of bringing in new kinds of financial institutions such as specialist credit card firms, discount broking firms and many others into the financial sector (Abubakar &Tasmin, 2012).

Merton (1992) revealed that innovation plays major roles in the financial system. Thus, pooling and movement of funds across time, risk

management, addressing moral hazard and asymmetric information problems, extracting information to support decision making and assisting the sale of goods and services through a payment system. Financial innovation improves the capital accumulation and allocation techniques (Uddin, Rahman, & Quaosar, 2014), value of financial products and services (McGuire & Conroy, 2013) and the effectiveness and efficiency of financial organization (Shaughnessy, 2015). Financial innovation also serves as a catalyst for transforming a static economic situation into a dynamic one by ensuring increased financial efficiency through accelerated capital formation, technological advancement for human capital development and long-term financial development (Johnson & Kwak, 2012; Mwinzi, 2014; Sood & Ranjan, 2015).

Other researchers argue that financial innovation also enhance the ability of financial intermediaries (banks) to efficiently allocate resources by giving them improved technology to screen information (King & Levine, 1993; Laeven *et al*., 2015). The authors documented that as a result of financial innovation, banks are able to screen out good projects from risky ones and grants loans for their financing. By so doing, these banks help alleviate the issue of agency problem and information asymmetry between owners and managers of companies. Yuan, Ye and Sun (2021) espoused that, financial intermediaries are able to make higher profits and maintain competitive advantage when they use advanced technology to screen out borrowers, thereby reducing credit liability. Aside the banks coming out with innovative technologies to screen borrowers, they also introduce new

innovative products into the financial system that aid in reducing the adverse impacts of some macroeconomic indicators on their clients (Rousseau, 1998).

Nevertheless, Arnaboldi and Rossignoli (2013) have described financial innovation as "double edge sword" since it has both good and bad side (Beck, Chen, Lin, & Song, 2012). It has been disclosed to be responsible for the recent global financial crisis of 2007/2008 (Llewellyn, 2012) and also results in the volatility of industry growth particularly for institutions that ignores securitization of investments (Beck *et al*., 2012; Adam & Guettler, 2015). Furthermore, Henderson and Pearson (2011) posit that financial innovation leads to increased risk of financial insolvency, institutional complexity and lessen interdependency among firms as new financial institutions arise to transact business in innovative ways. It also results in the spike of asset prices and credits (Boz & Mendoza, 2014).

Empirical Review

A strong, thriving and well-organized financial sector is the key to economic advancement in both the developing and developed worlds, according to the body of literature on the connection between finance and development.

Financial Outreach and Sustainable Development

In assessing the link between access to formal financial system and sustainable development, several authors have concentrated on only one dimension, thus, the economic perspective which is mostly viewed as economic growth. Also, in the literature, financial outreach, deepening and inclusion are not clearly distinguished as same indicators have been used as proxies for these terms. As a result of these afore stated issues, the review is

centred on these areas. Theoretically, Banerjee and Newman (1993) and Aghion and Bolton (1997) have contended that when the people, especially the vulnerable are provided with financial access, it contributes to reduction of poverty through employment.

Additionally, Sethi and Acharya (2018) posit that increased access to finance encourages self-employment which in turns helps lessens the unemployment difficulties in the economy. Other reviewers (Dupas & Robinson, 2013; Mehrotra & Yetman, 2015; Kumar et al., 2018) have also asserted that granting people access to formal financial sector enable the rural and semi-urban populace have the opportunity to keep their monies (savings) in these institutions which result in spike in investment opportunities.

The pooling of savings into the financial system improves the liquidity level of the institutions thereby encouraging more investment projects. Claessens and Perotti (2007) noted that consequential to this, income distributions and income available to the poor would be improved since more outputs are produced and employment on a higher rate. Financial outreach or financial inclusion has also been revealed to cause an improvement in the standard of living of people as the availability of banks or financial products and services at cheap and affordable price lessens the rate of vulnerability of the poor (Rajan, 2009). The rise in the living standard of people previously excluded would result in the amelioration of several human development (social perspective of sustainable development) indicators such as education, nutrition and health (Sethi & Acharya, 2018). Kumar *et al*. (2018) established that, financial outreach gives economically disadvantaged and excluded individuals access to one important factor of production, thus, finance/capital.

This leads to the efficient allocation of capital thereby bridging the wealth gap and makes the underprivileged ones undertake numerous productive activities (Demirgüç-Kunt & Levine, 2009).

Bruhn and Love (2014) conducted a study in Mexico using natural experiment and observed that, improvement in the rate at which informal businesses get access to formal financial services, makes them be in a better position to expand and employ more individuals as these low-income people get increment in their income. In line with this, Prasad (2010) pointed out that, excluding small and medium size entrepreneurs from the formal financial system through inadequate credit, hamper employment growth rate, economic growth and wellbeing of people, as these entrepreneurs tend to use more labour in their operations than the large-scale businesses.

Kumar *et al*. (2018) used banking outreach index calculated across countries and revealed that financial outreach has a significant positive relationship with growth of per capita income in India. Increased outreach measured as the number of customers served (breadth of outreach) result in a higher demand for financial services and financial system development (Hassan, Sanchez & Yu, 2011) and since financial development has been established to positively affect economic growth both theoretically and empirically (Bist, 2018; Guru & Yadav, 2019), then financial outreach supports growth and peoples' welfare (King & Levine,1993).

In Nigeria, Kamalu, Wan Ibrahim, Ahmad and Mustapha (2019) carried out research work over a period of 1970 to 2018 and concluded that for the economy of Nigeria to experience continuous growth, there is the need to make formal financial services more accessible to the vulnerable people of the

society. In line with this, Sahay, Čihák, N'Diaye and Barajas (2015) opine that increased access to the full range of banking services by businesses and consumers, as well as an increase in female users of these services, significantly and positively influence economic growth in emerging markets. Several researches related to the subject matter have revealed a strong positive relationship among financial outreach or inclusion or deepening on economic growth (Makina & Walle, 2019).

Away from the economic perspective to the environmental perspective of sustainable development, researchers have argued that, the impact of access to financial services and financial development on environmental sustainability is not conclusive as some authors discover positive and others negative impact in both developed and developing economies. A study conducted by Amin, Song and Khan (2021) in South Asia spanning from 1998 to 2019, using panel data analysis revealed that financial inclusion has a negative influence on environmental sustainability. In agreement, Zaidi, Hussain and Zaman (2021) found that financial inclusion has positive link with carbon dioxide emission in Organisation for Economic Co-operation and Development (OECD) countries. Ali *et al*. (2019) also conducted a study in Nigeria using autoregressive distributed lag and confirms that financial development positively influences carbon dioxide emissions.

Shahbaz, Shahzad, Ahmad and Alam (2016), Cetin, Ecevit and Yucel (2018), Lu (2018) and Acheampong (2019) are among the few researchers that are in agreement to the fact that financial development leads to carbon dioxide emissions. These scholars are of the view that, greater access to financial services gives the previously excluded segments the opportunity to acquire

high-energy products like air conditioners, automobiles, refrigerators, among others which pose a serious environmental danger due to increased emissions. Additionally, it may lead to increase in economic and manufacturing activities which may result in higher carbon emissions and, as a result, jeopardize environmental sustainability.

Contrary to this relation, Odhiambo (2020) carried out a study in 39 Sub-Saharan African (SSA) economies from 2004 to 2014 using generalised method of moments (GMM) and concluded that financial development positively affects environmental sustainability in the sense that financial development reduces carbon dioxide emissions in SSA economies. Usman, Makhdum and Kousar (2020) concur to the argument that financial development contributes to environmental sustainability such that it helps to overcome environmental degradation. Using Error Correction Model (ECM), Abbasi and Riaz (2016) revealed that financial development plays a vital role in mitigating CO_2 emissions in Pakistan. Series of research works also support the idea that financial access and development negatively affect CO_2 emissions, where Shahbaz, Tiwari and Nasir (2013) focused on South Africa and Omri, Daly, Rault and Chaibi (2015) focused on Middle East and North Africa (MENA) economies.

These researchers assert that, through financial outreach or financial inclusion, firms and households are able to obtain cheap financial products that aid in the investment of green technology that would help reduce environmental pollution. Moreover, Innovation for Poverty Action (IPA) (2017) documented that access to finance would be vital in poor communities since farmers do not have the required financial resources to invest in green

technology and as such if they are granted financial access, they would be able to purchase a cost-effective solar energy microgrid that is more environmentally benign than coal-burning plants.

Other groups of researchers believe that access to finance by the poor has contributing impact on human (social) development which is the third dimension of sustainable development. Arora and Kumar (2021) studied the relationship among human development and financial inclusion in India and confirms that access to financial services has a long run effect on human development. Similarly, Matekenya *et al*. (2020) employed GMM estimator and argued that, having access to and utilization of financial products and services enables people to invest in their health and education, engage in risk management and reduce to issues of financial shocks which ultimately results in human development in Sub-Saharan Africa. In a couple of developed and developing countries, Datta and Singh (2019) found that financial inclusion has positive influence on human development.

Financial Innovation and Sustainable Development

Financial innovation has been disclosed to connect the financial sector and sustainable development by both earlier and recent scholars (Laeven et al., 2015; Saqib, 2015; Ajide, 2016). The concept of sustainable development is focused on inclusive growth and not only growth. The concept takes into account ecologically all-encompassing strategy to enable poverty among the population to be lessened and also improve the wellbeing of the current and future generations. Nazir, Tan and Nazir (2021) concur that this can be effective if the strategy is well-organized, has sufficient financial resources, and is well planned to provide both immediate and long-term advantages to

people and the environment. Innovation is a necessary component of economic growth (Idun & Aboagye, 2014; Qamruzzaman, Jianguo, Jahan & Yingjun, 2021) since it introduces new concepts, procedures, and explanations for existing problems. Most importantly, it improves the organization's competitiveness and generates greater value.

Mention and Torkkeli (2012) contends that through financial innovation, financial development facilitates growth by allowing for the creation of diverse assets and services in the financial system, mobilizing savings for innovative and productive activities thereby increasing capital accumulation and marginal productivity of capital. Similarly, Chou and Chin (2011) posited that financial innovation not only accelerates financial development, but also supports capital growth, as well as industrial and technical innovation, all of which contribute to economic growth. Consequently, Laeven *et al*. (2015) developed a Schumpeterian model which predicts that unless financiers innovate, technological innovation and economic growth would eventually halt, and that policies that stifle financial innovation will have a long-term negative influence on economic growth. There have been a lot of literature that concur that innovation is a key engine that sustains long-term economic growth and national development (Anttila & Jussila, 2019; Pradhan, Arvin, Nair, Bennett, & Hall, 2019; Silvestre & Ţîrcă, 2019)

In some selected Asian economies (China, Pakistan and India), Nazir et al. (2021) used Autoregressive Distributed Lag (ARDL) estimator to examine the relationship between economic growth and financial innovation. The study revealed that a statistically significant positive short and long run

relationship exist between the variables. In the same vein, Qamruzzaman and Wei (2018) assessed the relationship between Bangladesh's economic growth, financial innovation and stock market development from 1980 to 2016 using autoregressive distributed lagged. The findings revealed that a long-run relationship exist between financial innovation and economic development. Mollaahmetoğlu and Akçal (2019) investigated the impact of financial development and innovation on economic growth in 15 high and upper-income countries ranging from a period of 2003 to 2016 and reported a significant direct relationship between financial innovation and economic growth. Analysing the influence of financial innovation on economic growth in a panel of 23 economies, Bernier and Plouffe (2019) debunked the existence of negative relationship among the variables. The authors used spending on Research and Development in the financial sector as proxy for financial innovation.

In the African context, Bara, Mugano and Le Roux (2016) studied the causal link among financial innovation and economic growth in Southern African Development Countries (SADC). The authors employed Autoregressive Distributed Lag (ARDL) and established that financial innovation positively affects and sustain long run economic growth. Ajide (2016) analysed the moderating role of bank competition on the relationship between financial innovation and sustainable development in West Africa using a 14-years period annual data (2000-2013). Using panel estimation, the author found that increased banking efficiency as a result of competition and financial innovation will augment economic growth and development. The results further discovered that the influence of innovation on development is

dependent on the type proxy used to measure financial innovation. In view of that, the growth of private credit was seen to have a positive and insignificant effect on sustainable development while ratio of Broad money to narrow money exhibited ad inverse relationship.

In agreement with the latter findings of Ajide (2016), Idun and Aboagye (2014) uncovered a long run negative connection among economic growth and financial innovation, in their study of assessing the nexus amidst financial innovation, bank competition and economic growth in Ghana. The authors utilised quarterly data spanning from 1990 to 2009 and ARDL co-integration technique. Financial innovation has also been reported to be a contributing factor to the increased economic development in Nigeria (Okafor, Chijindu & Chikezie, 2017; Chukwunulu, 2019). With financial time series data from 1980 to 2013, Bara and Mudzingiri (2016) explored a causal connection amidst financial innovation and economic growth in Zimbabwe and found that financial innovation has a relationship with economic growth. The authors further revealed that the nexus differs based on the proxy used employed to measure financial innovation and also a bi-directional causality between the variables.

Financial Outreach, Financial Innovation and Sustainable Development

Several researchers have documented that finance has an impact on the growth and development of every nation. In line with this, Chukwunulu (2019) noted that sustainable development, as well as social and financial outreach, rely heavily on financial innovation. Rousseau (1998) pointed out that as a result of innovation in the US's financial sector, financial intermediaries were able to screen loan applicants which lead to the reduction

in the credit spread. The author further revealed that since the credit spread was reduced, more borrowers subscribed for loans which led to the deepening of the sector. Judging from the point of view of these earlier scholars, it is imperative to assume that more people would be drawn into the financial system if financial institutions provide and render diversified products and services and investment opportunities, which can in turn boost the sustainable development of countries.

Qamruzzaman and Wei (2019) argued that financial innovation promotes economic activity by allowing the underserved population of society to enter the official financial system and benefit from it. By so doing, this segment of the population gets to be served with improved financial securities and instruments and encouraged to save and invest more in new and less risky financial products. This enables them to be able to acquire their basic necessities of life thereby improving their standard of living. In the same way, Raffaelli and Glynn (2013) contend that, financial innovation in the form of institutional innovation speeds up the financial process by increasing access to formal financial services such as internet and mobile banking which enhances the economy. Additionally, Andrianaivo and Kpodar (2012) pointed out that as a result of how convenient and affordable new technologies can be, many people tend to participate in the official financial system.

The institutional development form of financial innovation speeds up larger accessibility to financial services such as mobile banking (Raffaelli & Glynn, 2013). It has been asserted by Yawe and Prabhu (2015) that, with financial innovation such as the amelioration in financial services, instruments and technology, majority of individuals who would have otherwise been left

out from the formal financial system currently have access. The study of Lumsden (2018) discovered that instigating mobile-based transactions in the financial system results in a rise in the extent of financial inclusion particularly in emerging and developing countries. Doh (2020) revealed that financial innovation has a substantial impact on the rate of inclusion, with the number of mobile money transactions and agency banking having a positive and negative impact on financial inclusion respectively. Thus, financial innovation can be said to be crucial in curtailing the majority segment of the African populace unbanked currently.

Control Variables

Several factors have been identified to have influenced sustainable development. There have been numerous empirical works that have probe more into whether bank competition supports economic and sustainable development. Banking competition has been measured with Boone indicator, Lerner index, among others and uncovered a positive relationship with economic and sustainable development (Maudos & Guevara, 2006; Idun & Aboagye, 2014; Ajide & Aderemi, 2015; Ajide, 2016; Banya & Biekpe, 2017; Liyanagamage, 2018; Rakshit & Bardhan, 2019; Abuselidze, 2021). These authors concluded that effective and intense competition would propel development and growth. Ijaz, Hassan, Tarazi and Fraz (2020) on the other hand contend that lower banking competition promotes economic growth.

Other macroeconomic indicators have shown strong impact on sustainable development. Pardi, Salleh and Nawi (2015) conducted a study on the determinants of sustainable development and found that inflation has strong impact on sustainable development. This is supported Koirala and

Pradhan (2020). Again, Ajide (2016) revealed that banking sector development measured by credit provided to private sector and bank returns positively affect economic growth and development. Kaimuri and Kosimbei (2017) examined the determinants of sustainable development in Kenya and revealed that resource productivity has insignificant influence on sustainable development. Koirala and Pradhan (2020) also revealed that natural resource rents retard growth and development.

Conceptual Framework

In an attempt to add to literature on the relationship between finance and growth/development, conceptual and empirical reviews were carried out about the subject matter and as such the conceptual framework below represents a pictorial view of the link among the variables.

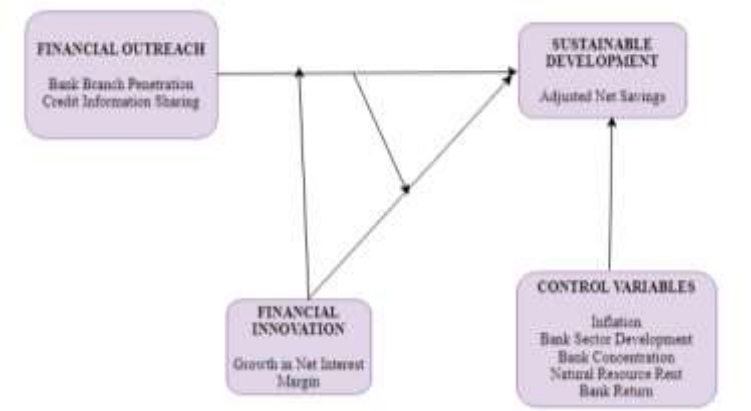

Figure 3: Conceptual Framework
Source: Archer (2023)

Gaps in Literature

Based on the literature reviewed above, it is realised that the findings on the finance and growth/development is inconclusive as part of the literature confirms a positive relationship, while the other part argued for an inverse connection. Moreover, the essence of finance in fostering sustainable development in the African context has received little attention. Specifically,

prior works either focused on how financial outreach or inclusion influence development or financial innovation affecting development, with the majority focusing on only one dimension of sustainable development. Furthermore, no earlier works have examined the trivariate relationship among the variables both in the developed and developing economies as well as assessing whether financial innovation and outreach can act as moderating variables. This study seeks to investigate whether the sustainable development of Africa can be augmented if banks offer affordable, diversified and innovative financial products and services to formerly unbanked segment of the population.

Chapter Summary

The chapter began with theoretical review which specifies the various theories that underpin the relationship that exists between the variables of concern. This was succeeded by the conceptual review where the various concepts related to the study were thoroughly discussed. The empirical review on the main variables as well as control variables followed which unearth further justifications on the relationships. Finally, the conceptual framework and the gaps in literature were indicated.

CHAPTER THREE

RESEARCH METHODS

Introduction

This chapter explains the procedures, methodologies and assumptions utilized in the data collection, processing, and analysis that led to the study's findings and conclusions. The research design, research approach and population and sample are all covered in this chapter, as well as estimation technique, sources and data collection methods. It also includes model specification, measurement of variables and chapter summary.

Research Design

A research design according to Zikmund, Babin, Carr and Griffin (2012, p.66) is "a master plan that specifies the methods and procedures for collecting and analysing the needed information." It establishes a framework or action plan for the study. For a design to be desirable, it should be adaptable, versatile, efficient, cost-effective and should contain probably few errors while minimizing bias and increasing the accuracy of the data collected (Cooper & Schindler, 2014). A research design can either be descriptive, exploratory or explanatory/causal design.

This study employs the explanatory or causal research design since it seeks to explain relationships between and among variables and as such the current study endeavours to evaluate the relationship between financial outreach, financial innovation and sustainable development**.** More so, explanatory research design seeks to provide the degree to which single or multiple variables influence another variable (Zikmund *et al*., 2012). According to Saunders, Lewis and Thornhill (2012), explanatory design gives

explanation to the cause and effect of one or several variables, thus, it detects how one variable affects the other. The design was relevant to the study since it plays emphasis on analysing a phenomenon to explain the series of relationships among variables.

Research Approach

The study uses the quantitative research approach which is aimed at achieving maximum level of the objective of the study, replicability and generalizing the results of the study as well (Creswell, 2014). It also aids in the usage and testing of hypothesis to attain the needed results and deductions can be made from the findings to make inferences about a particular population (Harwell, 2011). Additionally, Mbrokoh (2015) asserts that quantitative approach tries to quantify data and perform some statistical analyses which are mostly well-structured. Saunders et al. (2012) posit that quantitative approach is best when the study in question necessitates that an outcome should be predicted and the effects of variables on a particular phenomenon to be identified. The approach was appropriate to use since it creates room for the generalization of information about the sample to an entire population.

Population and Sample

The aim of the study is to assess the relationship between financial outreach, innovation and sustainable development in Africa. Premised on this, the population of the study comprises all African countries. The study later settled on 34 African economies due to the availability of data for the period of interest.

Data Collection Procedures and Sources

The nature of the study necessitates the use of secondary data. The study made use of secondary data with annual frequencies from credible sources for a period of 2011 to 2020. The sources include the World Development Indicators, Global financial development database and Sustainable Development Goals Indicators. These databases are exceptional in the sense that it brings together a wide range of variables for assessing the activity, size and efficiency of financial intermediaries and markets (Ajide, 2016). The choice of the sample period is dependent on the fact that all the countries used had complete information on their net interest margin.

Model Specification

The study adapted and modified the model used by Ajide (2016) who studied the relationship between financial innovation and sustainable development in some selected West African countries. The baseline models for this study are specified as follows;

$$SD_{it} = \beta_1 SD_{it-1} + \beta_2 FOUT1_{it} + \beta_3 FINN_{it} + \sum_{h=4}^{8} \beta_h Z_{it} + \mu_i + \varepsilon_{it} \quad \ldots. (1)$$

$$SD_{it} = \beta_1 SD_{it-1} + \beta_2 FOUT2_{it} + \beta_3 FINN_{it} + \sum_{h=4}^{8} \beta_h Z_{it} + \mu_i + \varepsilon_{it} \quad \ldots. (2)$$

In examining whether financial innovation or outreach can act as moderating variable an interaction term among outreach and innovation ($FINN * FOUT$) was included in the models as shown in model 3 and 4.

$$SD_{it} = \beta_1 SD_{it-1} + \beta_2 FOUT1_{it} + \beta_3 FINN_{it} + \beta_4 (FINN * FOUT1)_{it} + \sum_{h=5}^{9} \beta_h Z_{it} + \mu_i + \varepsilon_{it} \ldots.(3)$$

$$SD_{it} = \beta_1 SD_{it-1} + \beta_2 FOUT2_{it} + \beta_3 FINN_{it} + \beta_4 (FINN * FOUT2)_{it} + \sum_{h=5}^{9} \beta_h Z_{it} + \mu_i + \varepsilon_{it} \ldots.(4)$$

Where: i denotes the country level variable; t represents the time variable (years); μ denotes country-specific factors, SD represents sustainable development; $FOUT1\ and\ FOUT2$ represent the first and second measurement of financial outreach; $FINN$ denotes financial innovation; $(FINN * FOUT)$ is the interaction between innovation and outreach; Z represents the control variables; β denotes the coefficients; and ε represents the error term.

Based on the theoretical and empirical literature reviewed in Chapter 2, Table 1 displays the expected signs of the variables.

Table 1: Apriori Expected Signs of the Variables

Variables	Expected Sign
FOUT	+
FINN	+
FINN * FOUT	+

Source: Archer (2023)

Data Processing Tool and Estimation Strategy

The panel data used in the study was processed using Stata version 15.0 while the two-step System Generalised Methods of Moments by Roodman (2009a; 2009b) was employed to investigate the relationship among the variables. The two-step System GMM extends the approach used by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The approach by Arellano and Bond (1991) makes use of the lagged levels of the explanatory variables and the first difference of the variables to deal with issues of unobservable simultaneity bias and country-specific effects. Arellano and Bover (1995) later observed that Arellano and Bond's (1991) technique would result in erroneous conclusion when the series have

time-persistent problems. Additionally, Blundell and Bond (1998) contend that if the instruments utilised in the traditional first-difference GMM are not strong enough, then there is the possibility of the results of the within groups being biased. The System GMM was therefore originated as a remedy to the problems posed by the approaches of the earlier scholars.

The System GMM combines both the level of the residuals and the difference of the disturbance term as well as additional instruments in the levels equations (Odhiambo, 2020). It consists of one-step and two-step System GMM. The latter has been confirmed to be more efficient and robust to heteroscedasticity and autocorrelation (Obuobi *et al*., 2021). The choice of the two-step System GMM is motivated by the following justifications which have received massive support from earlier works (Fosu & Abass, 2019; Agyei, Marfo-Yiadom, Ansong, & Idun, 2020; Abeka, Andoh, Gatsi, & Kawor, 2021). The estimator is suitable to use when the cross-sectional data (the number of countries) is significantly more than the time series data (number of periods). The countries of interest for this current study are 34 while the time period is ten years.

Moreover, the technique deals with the proliferation of instrumental variables as well as controlling for the persistence in the dependent variables. The argument for persistence in the dependent variables is that, an economy's level of development and performance largely depends on its previous level of development. This agrees with Liu, Zhang, Hafeez and Ullah (2022) that past economic and environmental performance affect the current ones. Adding to this, Agyei et al. (2020) contend that if the correlation between the regressand and its lag exceeds 0.80, then the former is persistent. Pertaining to this study,

the correlation between sustainable development (SD) and its lag (L.SD) is 0.9246. Additionally, the technique tends to account for the possible endogeneity problem or bias resulting from the potential reverse causality between the explained and explanatory variables and time invariant omitted variables and account for it using instrumental variables (Tchamyou, 2020; Agyei *et al.*, 2021). Lastly, it controls for the problem of unobserved heterogeneity and reduces overidentification of instruments and cross-sectional dependence (Agyei *et al*., 2020). The general system GMM equation is specified as follows;

$$SD_{it} = \beta_0 + \beta_1 SD_{it-\tau} + \sum_{h=1}^{8} \beta_h Z_{it-\tau} + \mu_i + \delta_t + \varepsilon_{it} \quad \ldots\ldots (5)$$

$$SD_{it} - SD_{it-\tau} = \beta_1 (SD_{t-\tau} - SD_{t-2\tau}) + \sum_{h=1}^{7} \beta_h (Z_{it-\tau} - Z_{it-2\tau}) + (\delta_t - \delta_{t-\tau}) + \varepsilon_{it-\tau}$$

……. (6)

Where τ represents the autoregression coefficient, which is one in the models specified while λ, μ and δ represent country specific effects and time specific factors respectively.

Aside the GMM, the researcher could have equally employed other panel estimation techniques such as pooled ordinary least square (POLS), pooled mean group (PMG), two stage least square (2SLS) and fixed and random effect. However, GMM has be disclosed to have some advantages over these estimators. The POLS is not the best method because it does not account for heterogeneity among panels (Hill, Griffiths & Lim, 2012) and violates one of the assumptions of no autocorrelation in the traditional linear regression model. The PMG as a cointegration model estimates the long run relationship among variables. Though it uses lags of the variables because of its autoregressive nature (Pesaran, Shin & Smith, 1999), it requires panel

models with more time series observations than cross sectional which may not be appropriate for this study.

With regards to fixed and random effects, the assumption of current value of the dependent variable being completely independent of its past values is unrealistic which leads to leads to endogeneity arising from unobservable heterogeneity (Gujarati & Porter, 2009; Bell & Jones, 2015). The GMM technique is superior over 2SLS in the sense that the instrumental variable estimates are retrieved from lagged values which eliminates the need for external instrument as required in 2SLS (Roodman, 2006).

Diagnostic Tests

To test the potential over-identification problem, the technique utilises Sargan test of overidentifying restrictions with the null hypothesis as "overidentifying restrictions are valid". The implication of the null hypothesis of the test is that all instruments used are valid. It is expected that the null hypothesis should not be rejected. Obuobi et al. (2021) stipulated that in addition to the Sargan test, the system GMM demands the Arellano – Bond test for serial correlation to be carried out. The null hypothesis is "no serial correlation". It is expected that the null hypothesis of no first-order serial correlation in first differences (AR (1) test) be rejected but no rejection of the null hypothesis of no higher-order serial correlation in first differences (AR (2)). The Difference in Hansen Test (DHT) is also employed to test the exclusion restriction of the exogeneous variable.

Measurement of Variables

Generally, the measurement of the variables in this study is based on previous works. Sustainable development which is the explained variable was

measured as the Adjusted Net Savings (ANS) and was obtained from the Sustainable Development Goal Indicators. Adjusted Net Savings according to Pardi *et al.* (2015) measures sustainable development from the viewpoint that saving is seen as both capital investment and wealth accumulation. The metric incorporates all the three dimensions of sustainable development by ensuring that the monetary value of an economy's total production is adjusted to account for the enjoyment of prosperity by the society as well as the depletion of natural resources that arose in the cause of production.

The computation of ANS as a percentage of the Gross National Income (GNI) is based on the normal national income accounting where some adjustments are made to the Net National Savings (Gross national savings less the value of consumption of fixed capital, thus, economic dimension). Current operating expenditure on education is added to cater for human capital investment (social) while estimates of energy depletion, mineral depletion, net forest depletion, and carbon dioxide and particulate emissions damage are deducted to account for natural resources depletion and environmental degradation. After all these adjustments are made, the indicator is expressed as a percentage of GNI and has been extensively recognised as an inclusive indicator for sustainable development and utilised in numerous works by Gnegne (2009), Arrow, Dasgupta, Goulder, Mumford and Oleson (2012), Pardi *et al*. (2015) and Ajide (2016).

Financial outreach which is one of the independent variables was measured using bank branch penetration and credit information sharing, as have been used by earlier researchers such as Beck *et al.* (2014), Abdulai and Tewari (2017b) and Moyo (2020). Bank branch penetration used in this study

is conceptualised as the Commercial bank branches (per 100,000 adults) while credit information sharing is measured with Private credit bureau coverage (% of adults). This is because Tchamyou and Asongu (2017) argued that information sharing through credit bureaus and public registries enhance access to finance in the African continent. Private credit bureau coverage as per the World Bank, Doing Business project reports the number of individuals or firms listed by a private credit bureau with current information on repayment history, unpaid debts, or credit outstanding.

This as a measure of outreach indicates that as this information is shared among financiers, more people especially low -income earners would be able to access funds with limited collateral. Financial innovation as the other independent variable was measured with growth in net interest margin. This is due to the fact that as innovation revolves, banks use sophisticated technologies which make them more efficient in screening good borrowers out from bad ones and as this is done, banks are likely to experience growth in their net interest margin. This measure has been employed by Rousseau (1998).

The study also used bank sector development, inflation, bank concentration, bank return and natural resource rent as control variables. The indicators have been used because they are widely used and accepted in literature. The variables utilised in this study and their appropriate data sources are presented in the Table 2.

Table 2: Variables Definitions and Sources

Variable	Measurement	Source
Sustainable Development	Adjusted Net Savings	Sustainable Development Goals Indicators
Economic sustainability	Gross National Income per Capita	Sustainable Development Goals Indicators
Social sustainability	Government Expenditure on Education (% of total expenditure	Sustainable Development Goals Indicators
Environmental sustainability	Carbon dioxide emissions (kg per USD of GDP)	Sustainable Development Goals Indicators
Financial Innovation	Growth in Net Interest Margin	Global Financial Development Database
Financial Outreach	Bank Branch Penetration	Global Financial Development Database
	Credit Information Sharing	World Development Indicators
Bank Concentration	Assets of three largest commercial banks as a share of total commercial banking assets	Global Financial Development Database
Inflation rate	Annual CPI	World Development Indicators
Natural resource rent	Total natural resource rent	World Development Indicators
Banking sector development	Bank credit to private sector (% of GDP)	Global Financial Development Database
Bank return	Bank return on assets (%, after tax)	Global Financial Development Database

Source: Archer (2023)

Chapter Summary

This chapter generally discussed the methods carried out in conducting the study. The explanatory (causal) research design and the quantitative approach were adopted. The population and sample, data collection procedures as well as the estimation techniques were also discussed in the chapter. The chapter further dealt with how the variables used were measured and the various sources the data was obtained from.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter of the work presents the findings based on the objectives and hypotheses of the study. It also comes in addition with the discussion of the results. The findings were presented in tables for better view. The chapter started with the summary statistics of data used, correlation analysis, regression results based on the system GMM and lastly a summary of the chapter.

Descriptive Statistics

Before any empirical analysis and discussion can be conducted, Idrees (2018) advocated that the descriptive information of the various indicators employed in the study should be displayed for the researcher to know the distribution of the data. Specifically for this study, the mean, standard deviation, minimum and maximum values were presented in Table 4 below. Tests of stationarity and normality were not conducted in this study because Wooldridge (2001) has stipulated the GMM estimator does not require distributional assumptions such as normality.

The results from the table show that sustainable development which is measured as the adjusted net savings (ANS) depicted an average of 6.493 percentage of Gross National Income (GNI) within a minimum and maximum values of -31.523% and 30.289% respectively. The rate of volatility is 11.223 which is an indication that the level of development in the African continent is widely dispersed with some of the countries being more developed than others as some nations recorded negative ANS. This negative value implies that the

current generations themselves are not fully meeting their needs and as such cannot preserve any resource for the future generation.

On the various dimensions of sustainable development, it is seen from the table that the environmental dimension (ENV) which is measured with CO2 emissions (kg per US$ of GDP) had a mean value of 0.419kg with 0.265 standard deviations and a minimum and maximum values of 0.1kg and 1.427kg respectively. It is further observed that the economic sustainability (ECON) (GNI per capita (US$)) recorded an average value of $2851.864 lying within a range of $224.506 and $16416.179 with 3092.992 standard deviations. This is an indication that for the sampled countries, the per capita income is low and highly dispersed which could to some extent be due to the fact that most of countries are low-income nations with higher population growth rate.

The social dimension (SOC) which is mainly concern about investment in human capital averaged 16.367% of total expenditure which lies within a boundary of 5.131% to 37.521%. This implies that the expenditure the governments of the sampled economies incur on education is very low since the average value is even lesser than half of the maximum value. This means that as some of the nations within the continent are putting initiatives in place to advocate the need for formal education, others are still lagging behind and probably prioritizing on other sectors.

Table 3: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
SD	316	6.493	11.223	-31.523	30.289
ENV	270	0.419	0.265	0.1	1.427
ECON	340	2851.864	3092.992	224.506	16416.179
SOC	280	16.367	5.037	5.131	37.521
FOUT1	288	9.126	10.422	1.255	55.071
FOUT2	303	10.029	17.921	0	67.3
FINN	307	0.022	0.332	-0.74	4.313
INF	338	7.514	33.304	-3.233	557.202
BSD	336	27.962	20.227	5.801	106.26
BC	320	71.948	18.409	32.521	100
NRR	339	8.617	7.427	0.001	41.093
BR	321	1.742	1.025	-3.185	4.701

SD denotes sustainable development, ENV represents environmental dimension, ECON represents economic dimension, SOC denotes social dimension, FOUT1 and FOUT2 are the first and second measures of financial outreach respectively, FINN denotes financial innovation, INF is inflation, BSD denotes bank sector development, BC is bank concentration, NRR is the natural resource rent and BR is bank return

In respect of the independent variables, the first indicator for financial outreach (FOUT1) which is bank branch penetration averaged 9.126 which indicate that for every 100,000 adults in the sampled countries, there are only 9 commercial bank branches they can have access to. This would deter more adults to access these banks since there would be more queues which would distort the smooth running of their operations. This could also to some extent be attributed to the fact that the commercial banks do not get the needed incentive they presume they would be entitled to when they open more branches. The second indicator which is credit information sharing (measured as Private credit bureau coverage (% of adults)) recorded a mean value of 10.029% with a minimum value of 0 and highest value of 67.3%. The volatility level of 17.921 reveals that there is wide variation in the number of individuals or firms listed by a private credit bureau with current information on repayment history, unpaid debts, or credit outstanding across the sampled countries as in some countries, these credit bureaus recorded nothing.

Financial innovation (FINN) which is the last regressor had an average value of 0.022% with -0.74% and 4.313% as the lowest and highest values respectively. The measure for this indicator is growth in banks' net interest margin as employed by Rousseau (1998). A low mean value of 0.022% suggests that banks in these economies are not financially innovative enough. This is because the negative values in their growth prospect depict their inability to reap more profit probably as a result of the use of less sophisticated technology to screen out borrowers.

Relative to the control variables, the results revealed that the rate of inflation averaged 7.5% signifying that the inflation rate in some of the countries has relatively been on the decrease since some recorded a negative value while bank sector development had an average figure of 27.962% of GDP between a range of 5.8% and 106.26% of GDP. Bank concentration recorded an average of 71.948% with a wide range of 32.521% to 100% signifying that the banking industry in the sampled countries is fairly concentrated.

Natural resource rent to GDP had an average value of 8.617% with 7.427 standard deviations suggesting that there is high level of dispersion in the natural resource endowment in the sampled nations. Again, the results revealed that majority of the economies in the African continent are not rich in natural resources as some even have as low as 0.001% of GDP. Bank return (BR) which describe the efficiency and soundness of the banking industry averaged 1.742% with a lowest value being -3.185% and highest value being 4.701%.

Correlation Analysis

Correlation measures the strength (weak or strong) and direction (positive and negative) of the association between two or more variables. The association between the variables does not imply causality and as such cannot deduce that any change in one variable is a resulting from a change in another variable. The correlation matrix for the variables used in this study is presented in Table 4. A thorough examination of the table reveals that, there is a strong positive connection (0.925) between the dependent variable (SD) and its lag which is even more than the threshold of 0.80, making it suitable to employ the System GMM (Tchamyou, 2020). This high correlation coefficient suggests that the level of persistency in the dependent variable is very high.

The individual sustainability dimensions exhibited weak correlation with the composite sustainability measure. Albeit the weak correlation, they had positive connection excerpt the social dimension that had inverse association. Additionally, a cursory observation of the correlation matrix unveils that there is generally weak correlation among all the variables used in the study with the exception of bank sector development which exhibited moderate association with both the economic dimension and the first indicator for financial outreach, thus, 0.504 and 0.528 respectively. Moreover, the first indicator of financial outreach (bank branch penetration) exhibited a strong positive association (0.736) with the economic dimension of sustainable development. These associations among the variables do not pose any problem of multicollinearity since they are all lesser than the cut-off point of 0.90 as suggested by Adam (2016).

Table 4: Pairwise Correlation Analysis

	SD	L.SD	ENV	ECON	SOC	FOUT1	FOUT2	FINN	INF	BSD	BC	NRR	BR
SD	1.000												
L.SD	0.925***	1.000											
ENV	0.122**	0.144**	1.000										
ECON	0.183***	0.180***	0.255***	1.000									
SOC	-0.114*	-0.141**	0.156**	-0.154***	1.000								
FOUT1	0.214***	0.222***	0.089	0.736***	-0.139**	1.000							
FOUT2	0.058	0.066	0.382***	0.233***	0.256***	0.034	1.000						
FINN	-0.014	0.024	-0.019	-0.042	0.012	-0.057	-0.024	1.000					
INF	-0.121**	-0.108*	-0.096**	-0.054	-0.261***	-0.088	0.139**	-0.074	1.000				
BSD	0.175***	0.181***	0.339***	0.504***	0.209***	0.528***	0.299***	-0.054	-0.111**	1.000			
BC	0.025	0.039	0.244***	0.218***	-0.073	0.262***	0.171***	-0.039	-0.023	0.118**	1.000		
NRR	-0.101*	-0.101*	-0.116*	-0.182***	-0.232***	-0.207***	-0.339***	0.070	0.041	-0.318***	-0.041	1.000	
BR	-0.275***	-0.284***	-0.179***	-0.038	0.081	-0.124**	0.158***	-0.034	0.099*	-0.291***	-0.009	0.006	1.000

***, **,* represent 1%, 5% and 10% significant levels respectively

SD denotes sustainable development, ENV represents environmental dimension, ECON represents economic dimension, SOC denotes social dimension, FOUT1 and FOUT2 are the first and second measures of financial outreach respectively, FINN denotes financial innovation, INF is inflation, BSD denotes bank sector development, BC is bank concentration, NRR is the natural resource rent and BR is bank return

Regression Results

The research seeks to examine the contribution of the banking industry towards sustainable development in Africa through financial innovation and outreach. In view of this, four objectives were stipulated and the results are presented in Table 5 and Table 6. Table 5 presents the findings of objective one which seeks to assess the relationship between financial outreach and sustainable development and two which investigates the link amidst financial innovation and sustainable development. The findings of objectives three and four are presented in Table 6. Models 1, 3, 5 and 7 of Table 5 as well as Models 9, 11, 13 and 15 of Table 6 display the results when bank branch penetration (FOUT1) was utilised as the measure of financial outreach and credit information sharing was used as the second measure of financial outreach in the remaining models (Models 2, 4, 6, 8, 10, 12, 14 and 16) in their respective tables.

In addition, the study treated each dimension of sustainable development (environmental, economic and social) as dependent variables in separate models aside the main dependent variable (sustainable development). This was done to check the influence of the explanatory variables on the individual dimensions for appropriate recommendations. The results from the two tables revealed that the lags of the explained variables significantly influence their current values across all the models at 1% significance level. By intuition, it is worthwhile to espouse that an economy's level of development largely depends on its previous level of development. This agrees with Liu, Zhang, Hafeez and Ullah (2022) that past economic and environmental performance affect the current ones.

Table 5: Baseline Models

	Model 1 SD	Model 2 SD	Model 3 ENV	Model 4 ENV	Model 5 LECON	Model 6 LECON	Model 7 SOC	Model 8 SOC
L.SD	1.003 ***	0.958***						
	(0.059)	(0.076)						
L.ENV			0.9664***	0.9837***				
			(0.031)	(0.0319)				
L.LECON					0.7682***	0.9537***		
					(0.0304)	(0.0195)		
L.SOC							0.899***	0.937***
							(0.074)	(0.063)
FOUT1	0.216*		-0.0014*		0.0110		-0.038	
	(0.121)		(0.0008)		(0.0085)		(0.151)	
FOUT2		-0.124**		-0.0003		0.0030*		-0.065**
		(0.047)		(0.0003)		(0.0017)		(0.024)
FINN	-5.782**	-5.988***	-0.0093	-0.0114**	-0.0863***	-0.0335**	-0.786	-3.607*
	(2.681)	(1.987)	(0.0069)	(0.0053)	(0.0231)	(0.0128)	(1.308)	(1.853)
INF	0.033***	0.056***	0.0001	0.0005*	0.0004**	-0.0003	-0.104	0.006
	(0.009)	(0.011)	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.061)	(0.029)
BSD	-0.075*	0.021	0.0009**	0.0005*	0.0074***	0.0004	-0.008	0.072**
	(0.038)	(0.032)	(0.0003)	(0.0003)	(0.0023)	(0.0008)	(0.046)	(0.029)
BC	-0.026	0.022	-0.0003**	-0.0002*	-0.0005	-0.0009***	0.025	0.035**
	(0.018)	(0.019)	(0.0001)	(0.0001)	(0.0008)	(0.0003)	(0.024)	(0.014)
NRR	-0.155**	-0.149**	-0.0006	-0.0012***	0.0073***	0.0069***	0.013	-0.087
	(0.069)	(0.058)	(0.0005)	(0.0004)	(0.0016)	(0.0016)	(0.053)	(0.052)
BR	-0.293	-0.615*	0.0024	0.0046**	0.0459***	0.0169*	-0.592***	-0.260*
	(0.418)	(0.325)	(0.0019)	(0.0020)	(0.0089)	(0.0089)	(0.210)	(0.149)

_cons	4.197** (1.863)	2.249 (1.955)	0.0219 (0.0135)	-0.0107 (0.0158)	1.336*** (0.1854)	0.2961** (0.1154)	1.707 (2.756)	-1.614 (2.418)
Diagnostics								
AR1	0.001	0.000	0.031	0.028	0.014	0.006	0.028	0.003
AR2	0.848	0.976	0.084	0.115	0.397	0.620	0.120	0.732
Sargan OIR	0.866	0.304	0.866	0.608	0.562	0.687	0.279	0.927
Hansen OIR	0.876	0.239	0.475	0.209	0.332	0.324	0.191	0.712
DHT for instruments:								
(a) Instruments in levels								
Hansen test excluding group	0.695	0.566	0.664	0.743	0.261	0.305	0.832	0.365
Difference (null H = exogenous)	0.813	0.165	0.336	0.096	0.501	0.801	0.136	0.762
(b) iv(year, eq(diff))								
Hansen test excluding group	0.829	0.183	0.408	0.193	0.381	0.240	0.163	0.968
Difference (null H = exogenous)	0.805	0.931	0.817	0.385	0.385	0.675	0.419	0.094
Instruments	22	22	26	26	26	26	18	22
Countries	34	34	34	34	34	34	31	32
Observations	235	245	212	218	240	253	191	200

***, **,* represent 1%, 5% and 10% significant levels respectively and standard errors are in parentheses

SD denotes sustainable development, ENV represents environmental dimension, ECON represents economic dimension, SOC denotes social dimension, FOUT1 and FOUT2 are the first and second measures of financial outreach respectively, FINN denotes financial innovation, INF is inflation, BSD denotes bank sector development, BC is bank concentration, NRR is the natural resource rent and BR is bank return

Financial Outreach and Sustainable Development

In assessing the impact of financial outreach on sustainable development, two measures of financial outreach were utilised with each measuring a particular dimension of outreach. The results from columns 1 and 2 of Table 5 uncover that there is both positive and inverse relationship between the two variables depending on the indicator used to measure outreach. In column 1, it could be observed that a 1% rise in commercial bank branches would result in sustainable development increasing by 0.216%. The reason being that if more bank branches are opened, more people will get access to the financial system thereby providing them with the avenue to benefit from affordable financial products and services like credit facility and savings which help them smoothen their consumption patterns, and handle negative financial shocks. When these individuals patronize the products, they might be able to create microbusinesses which would make them be in a position to cater for the educational expenses of their wards and also attend to proper health care.

Moreover, when people get access to financial services it tends to minimize income disparity and poverty for both the present and future generations in the economy, hence improving the living condition of people. This is so because as access to formal financial system is said to increase competitiveness (Mushtag & Bruneau, 2019), it lowers the cost of intermediary services, hence enabling more potential entrepreneurs to obtain loans to create new jobs. Another possible explanation to be given to the direct relation is that, as in any other organization who wishes to enter into a new market come out with strategies such as performing corporate social

responsibilities for easy acceptance, banks also undertake CSR activities when expanding their branch operations. Thus, boosting the returns of the banks through larger customer base also helps improve the living condition of the society. The implication is that countries in the African continent ought to improve access to financial services in the quest to achieve SDGs of zero hunger, poverty reduction, higher economic growth, among others.

On the other hand, model 2 of the same table reveals that financial outreach measured with credit information sharing has a significant negative relationship with sustainable development at 5% significant level. This implies that an increase in the number of people or companies that credit bureaus report information on their outstanding loans and repayment history would lead to a 0.124% reduction in sustainable development. The idea behind this measure is that, it is expected that as these bureaus share credit information about individuals or firms, it gives them the opportunity to benefit from the financial system by accessing more credit from financial institutions for productive activities. As the people engage in productive activities, it increases their income levels and improve their quality of life. However, the result from model 2 proves otherwise and the reason could somewhat be due the fact that, as these individuals get access to financial services, they venture into unproductive activities that do not benefit the larger society in terms of employment in the long run.

From the perspective of the dimensions of sustainable development, the findings from models 3 and 4 show that financial outreach have significant and insignificant negative influence on carbon dioxide emission respectively. This indicates that as more people get access to the formal financial system,

they tend to emit less carbon dioxide through their various activities and hence promoting environmental sustainability. The significant negative connection suggests that a percentage increase in commercial bank branches leads to 0.0014% reduction in CO2 emission. This could possibly mean that as people and business organisations have access to funds through their bank accounts, they invest more in green technology which contributes to the improvement in environmental quality. More so, the availability and affordability of financial services can encourage the adoption and usage of clean energy production and consumption practices that lower the need to burn fossil fuels such as coal, oil and gas which produces heat-trapping gases and so reduce CO2 emissions. This is achieved since some credit facilities have terms and conditions that frown on the use of non-renewable sources of energy that cause global warming.

The finding is consistent with the notion of the Environmental Kuznet Curve theory and other researchers like Liu, Hong and Sohail, (2021), Qin *et al*. (2021) and Zaidi, Hussain and Zaman (2021) who argued that easy access to finance promote environmental sustainability through the reduction in carbon dioxide emissions. The result however contradicts with the argument of Liu *et al*. (2022) and Mehmood (2021) that easier access to financing promotes manufacturing operations and enhances households to be capable to acquire more energy-intensive commodities like air conditioners which have a tendency to produce more carbon emissions and cause environmental degradation.

The reason for the insignificant relationship between financial outreach through credit information sharing and environmental sustainability could be

that, majority of the African countries do not have CRBs and the few that have, report credit information on limited number of the population. This implies that, if lenders do not have access to this information, they may be hesitant in granting funds to individuals and firms to invest in green technology. Another possible explanation for the insignificant link between financial outreach and environmental sustainability is that, banks may hesitate to finance newer, perhaps cleaner technologies that could depreciate the value of the collateral supporting existing loans, which are mostly secured by older, potentially dirtier technologies since they have been generally disclosed to be technologically conservative (Minetti, 2011).

Additionally, banks may be unwilling to fund innovations that involve green technologies especially when they are human capital and intangible assets-related because of the difficulty in collateralizing such intangible assets due to their limited ability to be used elsewhere (Carpenter & Petersen, 2002; Hall & Lerner, 2010). This supports the assertion of Odhiambo (2020) that banks be might less suited to promote environmental sustainability.

The findings further reveal from columns 5 and 6 that financial outreach has positive influence on economic sustainability. This means that financial outreach stimulates economic growth in the sense that it eases lending restrictions on households and producers for economic activities in the society. This is because as lenders get complete information about borrowers, they would be willing to lend credit to individuals without constraints or requesting for collateral. Behr and Sonnekalb (2012) document that information sharing makes it easier to grant credit to low-income but

creditworthy borrowers without collateral since inaccurate information results in credit rationing and collateral requirements.

Moreover, poor individuals become less susceptible to the negative effects of poverty if they have greater access to financial services which will lead to a rise in their standard of living, hence enhancing the nation's per capita income and overall economic growth. The finding is supported by the theory of Aghion and Bolton (1997) that easy access to finance results in higher income level and low unemployment rate through the expansion of existing projects or setup of new industrial activities which enhance the economic growth of an economy. In the same vein the finding is in line with the results of Le, Chuc and Taghizadeh-Hesary (2019) and Chatterjee (2020) that access to the financial system spurs economic development by boosting investment in the manufacturing sector.

The relationship between financial outreach and social sustainability is captured in models 7 and 8 and the results show that financial outreach negatively influences social sustainability. This suggests that as people get access to financial services, the level of human development reduces. The intuition is that as vulnerable and low-income individuals within the society are expected to save and keep their wards in school for quite a long time due to access to inexpensive financial services, they tend to consume luxurious products which may be harmful to their health. The possible explanation that could be given based on the measure for social sustainability (government expenditure on education) is that when people get loans, they may use them as business start-ups or expand their business which increase the amount of taxes

the government gets from the organisations and the employees for developmental projects such as education.

However, the government may to some extent underinvest in human development. Since expenditure on education is essential to human capital development which is a major component of human development (Matekenya, Moyo & Jeke, 2020), governments of African countries have to invest more in education because it increases the number of skilled labours and enable people to be responsible about their health. The results disagree with the arguments of Namda and Kaur (2016), Raichoudhury (2016), Anderson, Hopkins and Valenzuela (2019) and Datta and Singh (2019) that access to finance has direct relationship with human development.

On the other hand, the result from model 7 unveil that bank branch penetration has insignificant impact on social dimension of sustainable development. This is consistent with the findings of Ahmed (2013) and Menyelim, Babajide, Omankhanlen, and Ehikioya (2021) that, as a result of the insufficient financial facilities in SSA economies, commercial bank branches per 100,000 adults insignificantly affects human capital development. This has become an issue of concern to policy makers because of the failure of the banking industry in the region to give appropriate assistance for the expansion of banking network (Taddese & Abebaw, 2021).

Financial Innovation and Sustainable Development

In addressing the second objective which assesses the influence of financial innovation on sustainability, the results from all the models reveal that financial innovation influences sustainable development and its dimensions negatively. This inverse relationship means that as banks' net

interest margin increases, the rate at which economic activities boost which result in economic growth declines and human development in terms of individuals' decision to stimulate quality education, healthy life, increased quality of life as well as political freedom would be trampled upon.

This, to some extent cause the wellbeing of present and future generations to be undermined since they might not have the opportunity to live their lives to the fullest as a result of income and gender inequalities and poverty. This may be ascribed to the fact that as innovation evolves, banks become more efficient in screening good borrowers out of the pool of borrowers due to the use of advanced technologies which could result in growth in net interest margin (Rousseau, 1998). The use of expensive screening tools may cause the banks to charge higher interest rates which could deter people from accessing credits for productive activities and investment in education and proper health care. This is not surprising as Africa is best known to be having higher interest rates on credits (Issaka, Anarfo & Aveh, 2022).

The negative relationship between financial innovation and carbon dioxide emissions (in models 3 and 4) implies that innovation in the financial sector leads to environmental sustainability. It could be explained that the use of the advanced technology lessens banks' monitoring cost which enables them to charge affordable interest rate. The ability of individuals to secure loans at such rates may cause them to be stop using fossil fuels that emit more carbon dioxide thereby reducing environmental degradation.

A closer look at the results unveils that the relationships in all the models are significant except models 3 and 7 which recorded insignificant

relationship. As African banks are not highly inclined in technological innovation as compared to developed nations, it is prudent to state that the level of development may not be depended on how innovative these financial institutions are. The result is not surprising as Ajide (2016) found that financial innovation has an insignificant connection with development.

Moderation results

The last two objectives were accomplished by interacting each of the proxies of financial outreach with financial innovation to get two additional interacting variables (FINNOUT1 and FINNOUT2). To experience the presence of a moderating effect in a given model, Jose (2013) proposed that the coefficient of the interaction term must be statistically significant. The results are presented in Table 6. The results indicate that the lags of the dependent variables consistently show significant positive influence across all models at 1% significance level.

Moreover, it is apparent that the coefficients of the interaction terms are significant in models 10, 11, 12, 14 and 15 at 5% significant level indicating that both financial outreach and financial innovation can be applied as moderators in the study. Thus, implying the rejection of the third and last hypotheses. It is also evident in the table that the interaction terms in the models mentioned above have positive coefficients which are consistent with the expectation of the researcher. The positive coefficients of the interaction terms mean that both outreach and innovation can complement each other in the relation. On the other hand, the negative coefficients of the interaction terms in models 9, 13 and 16 indicate that financial innovation and outreach

are substitutes. As such, decision cannot be made with them since they are all insignificant.

Financial Innovation serving as Moderating Variable in Outreach and Sustainable development nexus

The third objective of this study is to investigate whether financial innovation can act as moderating variable on the relationship between financial outreach and sustainable development in Africa. The results in Table 6 revealed that some of the coefficients of financial outreach indicators have reduced as compared to the ones in Table 5 in the presence of the interaction term. This could possibly suggest that even though financial outreach targets the vulnerable group of the society, the introduction of innovative products may not be their motive of getting access to formal financial system because of their little or no knowledge about such innovation. This means that the introduction of the interaction term divulges the actual impact of the financial system towards sustainable development.

In view of this, the researcher further determined the net effects of the explanatory variable on the explained variable. The formula employed by Abeka, Andoh, Gatsi and Kawor (2021) which determines the net effect by partially differentiating the dependent variable with respect to the independent variables was used. The formula is specified as;

$$\frac{\partial SDit}{\partial FOUTit} = \ldots\ldots\ldots (5)$$

Where FOUTit denotes each of the measures of financial outreach used in Table 6.

The partial differential of FOUT1 in model 10 is calculated as;

$$\frac{\partial SDit}{\partial FOUT2it} = -0.0245 + 0.0.3379 * 0.022 \ldots (6)$$

= -0.0171

The 0.022 is the mean of the moderating variable, thus FINN. This process was repeated to get the net effect for model 11, 12 and 15. However, since the dependent variable used in model 14 is in logarithmic form, the net effect was computed as;

$$\frac{\partial \text{LECONit}}{\partial \text{FOUT1it}} = (e^{0.0005} - 1) + (e^{0.0168*0.022} - 1) \ldots (7)$$

= 0.000869

The results explain that though the interaction term between FOUT2 and FINN was positive, it produced a negative net effect of -0.0171 as compared to -0.124. A further look at model 11 and 12 reveal that the unconditional effects of FOUT1 and FOUT2 on ENV are -0.0014 and -0.0003 as compared to the conditional effect of -0.0017 and -0.00035 respectively. Again, the marginal effect of FINNOUT1 and FINNOUT2 in model 14 was seen to be 0.000869 while the unconditional effect produced beta of 0.0030. Lastly, as compared to the unconditional effect of FOUT1 (-0.038) on SOC, the conditional effect produced an improved beta (-0.00247), albeit negative.

Table 6: Moderation Results

	Model 9 SD	Model 10 SD	Model 11 ENV	Model 12 ENV	Model 13 LECON	Model 14 LECON	Model 15 SOC	Model 16 SOC
L.SD	0.9743***	0.9652***						
	(0.0369)	(0.0724)						
L.ENV			1.0347***	0.9671***				
			(0.0371)	(0.0305)				
L.LECON					0.8654***	0.9371***		
					(0.0484)	(0.0476)		
L.SOC							0.8705***	0.8735***
							(0.0357)	(0.0299)
FOUT1	0.1471**		-0.0019		0.0087*		-0.0153	
	(0.0609)		(0.0015)		(0.0051)		(0.0775)	
FOUT2		-0.0245		-0.0004		0.0005		-0.0285***
		(0.0189)		(0.0004)		(0.0015)		(0.0101)
FINN	-0.0723	-4.3168***	-0.0572**	-0.0245***	-0.0465	-0.1666***	-3.0951**	0.2399
	(1.5194)	(1.5129)	(0.0278)	(0.0088)	(0.0903)	(0.0584)	(1.2982)	(0.8578)
FINNOUT1	-0.1637		0.0069**		-0.0122		0.5833**	
	(0.2640)		(0.0032)		(0.0122)		(0.2341)	
FINNOUT2		0.3379**		0.0025**		0.0168**		-0.0042
		(0.1309)		(0.0009)		(0.0076)		(0.0922)
Net Effect A		-0.0171	-0.0017	-0.00035		0.000869	-0.00247	
Net Effect B		-0.9280	0.0058	0.00057		9.0455	2.2281	
INF	0.0314***	0.0512***	0.0002	0.0011***	0.0010	0.0004	-0.0548*	-0.0644 ***
	(0.0039)	(0.0057)	(0.0005)	(0.0004)	(0.0016)	(0.0009)	(0.0315)	(0.0223)
BSD	-0.0579**	-0.0047	0.0004	0.0001	0.0009	-0.0025	-0.0003	0.0473***
	(0.0235)	(0.0249)	(0.0004)	(0.0005)	(0.0019)	(0.0016)	(0.0259)	(0.0135)
BC	-0.0205	-0.0074	-0.0003	-0.00003	-0.0005	0.0010	0.0193	0.0372***

	(0.0145)	(0.0108)	(0.0003)	(0.0002)	(0.0009)	(0.0009)	(0.0116)	(0.0108)
NRR	-0.1497***	-0.0700*	0.0001	-0.0008**	0.0009	0.0019	0.0079	-0.0528**
	(0.0405)	(0.0373)	(0.0009)	(0.0004)	(0.0019)	(0.0032)	(0.0309)	(0.0250)
BR	-0.2355	-0.3316	-0.0031	0.0051**	0.0532***	-0.0004	-0.5035***	-0.3532***
	(0.2014)	(0.2659)	(0.0048)	(0.0024)	(0.0107)	(0.0131)	(0.1463)	(0.1056)
_cons	3.9235**	2.9212*	0.0186	-0.0009	0.7964**	0.4609	1.9493	-0.3349
	(1.5373)	(1.7176)	(0.0168)	(0.0127)	(0.2953)	(0.3453)	(1.2241)	(0.9085)
Diagnostics								
AR1	0.001	0.000	0.035	0.036	0.005	0.008	0.005	0.008
AR2	0.689	0.408	0.763	0.234	0.078	0.168	0.589	0.774
Sargan OIR	0.464	0.090	0.626	0.223	0.164	0.176	0.956	0.931
Hansen OIR	0.688	0.216	0.884	0.829	0.164	0.266	0.475	0.713
DHT for instruments:								
(a) Instruments in levels								
Hansen test excluding group	0.362	0.753	0.502	0.875	0.061	0.282	0.801	0.716
Difference (null H = exogenous)	0.771	0.096	0.877	0.663	0.353	0.283	0.298	0.578
(b) iv(year, eq(diff))								
Hansen test excluding group	0.640	0.261	0.844	0.780	0.235	0.210	0.902	0.668
Difference (null H = exogenous)	0.656	0.142	0.687	0.797	0.102	0.731	0.086	0.632
Instruments	30	30	22	26	22	22	26	30
Countries	34	34	34	34	34	34	31	32
Observations	235	245	212	218	240	253	191	200

***, **,* represent 1%, 5% and 10% significant levels respectively and standard errors are in parentheses

SD denotes sustainable development, ENV represents environmental dimension, ECON represents economic dimension, SOC denotes social dimension, FOUT1 and FOUT2 are the first and second measures of financial outreach respectively, FINN denotes financial innovation, FINNOUT1 and FINNOUT2 are the interaction terms, INF is inflation, BSD denotes bank sector development, BC is bank concentration, NRR is the natural resource rent and BR is bank return. Net Effect A and B are the marginal effects when financial innovation and financial outreach were used as moderating variables respectively

The results indicate that presence of the interaction variable in each of the models produced a greater marginal effect as compared to the unconditional effects in the baseline models, with the exception of models 11, 12 and 14. Based on the claim made by Rousseau (1998) that innovation is the catalyst for financial depth to have a better impact on the economy, it was anticipated that innovation in the financial system would quicken the outreach process. However, the presence of the interaction term reduces the effect of financial outreach on sustainable development and its dimensions though the significant coefficients of the interaction terms are positive.

The intuition behind this is that since financial innovation is conceptualized in this study as the use of advanced technology to screen borrowers which would translate into growth in net interest margin of the financial institutions, as the banks charge high interest rate on credits because of how expensive the technology might be, people would be hesitant in accessing funds from them. As financial outreach targets the underserving group of the society mostly with limited income and no collateral (Meyer, 2019), higher rate of interest would deter them for assessing loans for economic activities.

Financial Outreach serving as Moderating Variable in Financial innovation and Sustainable development nexus

The last objective of this study is to investigate whether financial outreach can serve as moderating variable on the relationship between financial innovation and sustainable development in Africa. The approach in addressing this objective is similar to the one employed in objective 3. As compared to the results in Table 5, though financial innovation still has

unfavourable impact on sustainable development, the negative impact has reduced. Thus, financial innovation has been observed to have had an improvement at the introduction of the interaction term.

From the perspective of the proponents of the diffusion of innovation theory, it is implied that innovation would have impact on the economy if it is spread out from its point of creation to a widespread coverage. Financial outreach makes this possible by spreading innovation to the vulnerable group who were not previously part of the financial system. The results in Table 6 concerning the Net Effect B show that when financial outreach was treated as a moderating variable in model 10 the conditional effect of FINN is -0.9280 while the unconditional effect is -5.988 in model 2. In models 11 and 12, it is realised that the conditional effects of FINN are 0.0058 and 0.00057 respectively as compared to the original coefficients of -0.0093 and -0.0114 in Table 5.

Again, the conditional effect of financial innovation on economic sustainability is 9.0455 as could been seen in model 14 whereas the unconditional effect was -0.0335 in the baseline results. Finally, the marginal effect of FINN in model 15 is 2.2281 with its corresponding unconditional effects of -0.786. The findings indicate that the interaction in each of the models produced higher marginal effects of financial innovation than in the baseline regression results.

The results suggest that irrespective of the fact that the level of financial inclusiveness is low in Africa which could deter growth and development, it serves as a complementary factor to financial innovation to have an improved relationship with sustainable development and its

dimensions. This is seen in the reduction of the negative coefficients of financial innovation in Table 6 and the marginal effects outweighing the original betas in Table 5. Given the foregoing, it is obvious that promoting for an inclusive financial system will create an avenue for innovation introduced by the financial sector to be spread out to various sectors of the economy for its usage to bring about improvement in the living standard of people. This confirms the position of the diffusion of innovation theory.

Control Variables

In analysing the influence of the financial system on sustainable development, other macroeconomic indicators were used as control variables. Among these are inflation, banking sector development, bank concentration, natural resource rent and bank return. These indicators were employed on the basis that statistical data on them is easily accessible. The findings from Tables 5 and 6 reveal that inflation has positive influence on sustainable development at 1% significance level and a mixed relationship with the individual dimensions across the models. The positive nexus among inflation and sustainable development implies that as inflation rate increases, sustainable development (measured with adjusted net savings) rises. Higher inflation leads to inflation uncertainty (Lee, 1999) which makes people more uncertain about their future incomes and as such motivate them to save more for precautionary motives.

This relationship is also possible in instances where households wish to keep a certain amount of wealth in relation to their income levels which would lead to higher savings in the presence of inflation. The finding is in line with the uncertainty effect hypothesis and the findings of earlier researchers that

inflation has a positive effect on adjusted net savings (Shaw, 1973; Giovannini, 1985) and disagrees with Koirala and Pradhan (2020) who uncovered that inflation has a significant negative relationship with sustainable development.

Bank sector development from both Tables 5 and 6 has been observed to have a significant negative relationship with sustainable development. It is apparent from the submissions of earlier researchers and theorists that, financial development enhances the mobilization of funds by the financial institutions for lending activities through the reduction of transaction costs, and provides accurate information concerning the possible investment avenues which boost the income and savings level of individuals.

However, the results from this study reveal that, as the banking sector develop, sustainable development diminishes. This could be due to the inadequate regulation and inefficient allocation of limited resources which could be detrimental to the growth and development of the economy. Although the number of research works to compare with it is limited, the study contradicts with the findings of Pardi, Salleh and Nawi (2015) and Koirala and Pradhan (2020) that financial development influences sustainable development positively.

Bank concentration as one of the control variables has an inverse insignificant relationship with sustainable development indicating that the level of development of an economy is not dependent on how competitive its banking industry is. Shaffer (1998) argued that when the banking industry is competitive enough banks fail to screen borrowers efficiently which makes such credits less likely to be used for productive activities. This is because as

the number of new entrants increases, banks fail to perform their role effectively because of fear to lose potential clients to another competitive bank. This is in contrary to the findings of Ajide (2016) that effective competition in the banking sector boosts growth and development.

The fourth control variable is the natural resource rents and the study assessed how the natural resource endowment of a nation affects its sustainable development. The results from the tables show that natural resource rent has a significant negative connection with sustainable development. This means that as the natural resources that are meant to generate income for the economy rises, the development of the economy dwindles. This could be resulting from human actions that cause these endowments to be seen as doing more harm than good, as described by the natural resource curse hypothesis, which could be due to weak governance and corruption. Another possible explanation is that if the rents emanate from nonrenewable resources which are used for immediate consumption other than investment purposes, capital stock of the economy would decrease and future generation might have little or no share of the rents.

The final variable used as control variable is bank return. The results indicate that the level of banks' profitability and efficiency has a negative relation with sustainable development. To some extent, the results could mean that as banks become more profitable, they tend to limit their CSR activities because of the belief that they operate mainly for economic gains. This retards sustainable development since Siueia, Wang and Deladem (2019) opined that CSR activities contribute to the sustainability of the society and economy at large.

Model Diagnostics

The two-step system GMM necessitates some diagnostic tests to be conducted. This study conducted the Difference in Hansen Test (DHT), Sargan test of overidentification and Arellano – Bond test for serial correlation. It is expected that the null hypotheses of these test should not be rejected with the exception of first-order serial correlation in first differences (AR (1). The results from all the models revealed that all the diagnostic tests had p-values greater than 0.05 except (AR (1) which exhibited p-values less than 0.05.

The non-rejection of the Sargan test implies that the instruments are exogenous and valid. Moreover, the rejection of the AR (1) suggests that the error term is serially correlated. This is so because of the autoregressive nature of the dependent variable, thus, sustainable development. This suggests that the results for all the models are valid. The findings also show that the number of countries in each model is more that the number of instruments which solves the problem of instrument proliferation.

Chapter Summary

The chapter started by discussing the descriptive statistics of the variables used in the study and preceded with the correlation analysis to elucidate the level of association amidst the variables. The regression results were subsequently presented and discussed based on the objectives of the study.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

Introduction

The final chapter of the work provides a summarized form of the whole research work to get the most important information about the study. The chapter begins with a summary of research work and proceeded summary of the key findings. Afterwards, conclusions were deduced based on the key findings and appropriate recommendations were made as well. The chapter ended with suggestions for future researchers to explore.

Summary of the Study

Sustainable Development Goals assist in solving some tenacious challenges such as poverty, hunger, unemployment, continuous reduction of some countries' economic growth, among others that is being faced by countries in the world. In view of this, the study sought to investigate how the banks contribute in providing solutions to these challenges in Africa through their outreach initiatives and innovative products. The following research objectives were specified to help achieve the purpose of the study;

1. Assess the relationship between financial outreach and sustainable development.
2. Examine the relationship between financial innovation and sustainable development.
3. investigate the moderating role of financial innovation in the relationship between financial outreach and sustainable development in Africa.

4. investigate the moderating role of financial outreach in the relationship between and financial innovation sustainable development in Africa.

Aside the objectives, hypotheses were developed to support the objectives. The study relied on the Environmental Kuznet Curve theory, Credit information sharing theory, Schumpeter's theory of innovation, Dynamic model of financial innovation and Diffusion of innovation theory to assess the relationships among the variables. Explanatory research design and quantitative approach were employed while secondary data on all the variables were obtained from credible sources such as World Development Indicators, Global Financial Development database and Sustainable Development Goals Indicators website. The data was analysed using the two-step System GMM on 34 African countries from 2011 to 2020.

Summary of Key Findings

Upon the analysis of the data, some thrilling results were made. The results are summarized in the order in which they were discussed.

Regarding the first objective, the study revealed that financial outreach measured by bank branch penetration has significant positive relationship with sustainable development while outreach measured by credit information sharing has significant inverse relationship with sustainable development. Concerning the dimensions, the study further discovered that bank branch penetration and credit information sharing have significant and insignificant negative relation with carbon dioxide emissions respectively, implying that outreach promotes environmental sustainability. It was also discovered that financial outreach enhances economic sustainability whereas outreach inversely influences social sustainability.

With regards to the second objective, it was unveiled that financial innovation has a significant negative link with sustainable development in Africa. This implies that as banks innovate, the ability of realizing SDGs become difficult because of the increment in their charges that comes with the innovation. The study further found that financial innovation has a significant negative effect on the dimensions of sustainable development except for environmental sustainability that recorded positive relationship.

Furthermore, the findings revealed that both financial outreach and innovation serve as moderating variables in the finance/development nexus. The interaction terms recorded positive significant coefficients. It was found that, though financial innovation increases financial access, the introduction of innovation into the financial sector reduces the impact financial outreach has on environmental and economic sustainability in Africa. On the other hand, the study found that financial outreach enhances the connection between financial innovation and sustainable development in Africa.

Conclusion

Based on the findings of the study, it is concluded that financial outreach through bank branch penetration enhances sustainable development by giving the underserved segment the chance to utilise the mainstream banking services thereby making them able to participate fully in basic healthcare, education, industrial activities. It is also concluded that financial outreach promotes environmental and economic sustainability, in the sense that as people get access to the financial system, they get access to funds for industrial activities which enables them to invest in green technology that emit

less carbon dioxide. Financial outreach also limits human capacity which results in low human development in Africa.

Additionally, the study concluded that financial innovation deters development in the sense that due to the innovation, many people would be rendered unemployed thereby reducing the labour force of the continent. Unemployment cause people to be vulnerable as they are unable to get good medical care due to low or no income.

Moreover, it is concluded that since the poor who are the focus of financial outreach are not knowledgeable about technological advancement, the introduction of innovation into the financial system may not necessarily reduce the number of unbanked citizenries.

Finally, innovation in the financial sector would have impact on sustainable development when more underserved and marginalised have been reach out and provided with financial access. This suggest that the benefit of financial innovation would not be felt on the economy if more people are not reached out and brough into the financial system.

Recommendation

Relying on the results and conclusions drawn, the study made the following recommendations.

For African countries to realise appreciable number of the SDGs, governments should keep pushing for wider access to and usage of financial services by providing the excluded group with basic education, income and healthcare that mostly restrict them from assessing the services of these financial institutions.

Banks should collaborate with other stakeholders to make screening technologies less expensive. This to some extent would help guarantee reasonable, flexible and attractive interest rates on loans to the underprivileged, deprived segment of the society and vulnerable businesses so as to smooth their consumption and expand their business.

Since financial outreach serves as a conduit for innovation to influence development, policy makers should increase the level of awareness and literacy of the availability of new innovations in the financial system particularly to the marginalized for their usage.

Suggestion for Further Studies

Further studies can be conducted to examine how other non-banks financial institutions contribute to the realisation of the sustainable development goals target set up for African countries. in addition, other indicators of outreach should be employed to examine their impact on sustainable development. Moreover, the study can be extended to other developing and developed economies.

REFERENCES

Abbasi, F., & Riaz, K. (2016). CO2 emissions and financial development in an emerging economy: An augmented VAR approach. *Energy Policy*, *90*, 102-114.

Abdulai, A., & Tewari, D. D. (2017a). Determinants of microfinance outreach in Sub-Saharan Africa: A panel approach. *Acta Commercii*, *17*(1), 1-10.

Abdulai, A., & Tewari, D. D. (2017b). Trade-off between outreach and sustainability of microfinance institutions: Evidence from sub-Saharan Africa. *Enterprise Development & Microfinance*, *28*(3), 162-181.

Abeka, M. J., Andoh, E., Gatsi, J. G., & Kawor, S. (2021). Financial development and economic growth nexus in SSA economies: The moderating role of telecommunication development. *Cogent Economics & Finance*, *9*(1), 1862395.

Abor, J. Y. (2016). *Financial markets and institutions: A frontier market perspective.* Tema, Ghana: Digibooks.

Abubakar, A. A. & Tasmin, R. B. H. (2012). The impact of information and communication technology on banks' performance and customer service delivery in the banking industry. *International Journal of Latest Trends in Finance and Economic Sciences,2*(1), 80-90.

Abuselidze, G. (2021). The impact of banking competition on economic growth and financial stability: an empirical investigation. *European Journal of Sustainable Development*, *10*(1), 203-203.

Acheampong, A. O. (2019). Modelling for insight: Does financial development improve environmental quality*? Energy Economics, 83*, 156-179.

Adam, A. M. (2016). *Statistics for business research: A guide for non statistician*. Accra, Ghana: Global research publishers.

Adam, T., & Guettler, A. (2015). Pitfalls and perils of financial innovation: The use of CDS by corporate bond funds. *Journal of Banking & Finance*, *55*, 204-214.

Adhvaryu, A., Fenske, J., & Nyshadham, A. (2019). Early life circumstance and adult mental health. *Journal of Political Economy, 127*(4), 1516-1549.

African Development Bank (2018). African economic outlook. https://www.afdb.org.

Aghion, P., & Bolton, P. (1997). A theory of trickle-down growth and development. *The Review of Economic Studies*, *64*(2), 151-172.

Agyei, S. K., Isshaq, Z., Frimpong, S., Adam, A. M., Bossman, A., & Asiamah, O. (2021). COVID-19 and food prices in sub-Saharan Africa. *African Development Review*, *33*, S102-S113.

Agyei, S. K., Marfo-Yiadom, E., Ansong, A., & Idun, A. A. A. (2020). Corporate tax avoidance incentives of banks in Ghana. *Journal of African Business*, *21*(4), 544-559.

Ahmed, H. (2013). Financial inclusion and Islamic finance: Organizational formats, products, outreach, and sustainability. In Iqbal & Mirakhor (Eds), *Economic Development and Islamic Finance* (pp *203*-229). Washington DC, USA: The World Bank

Ajide, F. (2016). Financial innovation and sustainable development in selected countries in West Africa. *Journal of Entrepreneurship, Management and Innovation*, *12*(3), 85-112.

Ajide, F. M., & Aderemi, A. A. (2015). Market power of Nigerian deposit money market: Evidence from Bresnahan-Lau's approach. *American journal of Economics*, *5*(1), 21-28.

Ali, H. S., Law, S. H., Lin, W. L., Yusop, Z., Chin, L., & Bare, U. A. A. (2019). Financial development and carbon dioxide emissions in Nigeria: Evidence from the ARDL bounds approach. *Geo Journal*, *84*(3), 641-655.

Amin, N., Song, H., & Khan, Z. A. (2021). Dynamic linkages of financial inclusion, modernization, and environmental sustainability in South Asia: A panel data analysis. *Environmental Science and Pollution Research*, *29*(11), 16588-16596.

Anderson, J., Hopkins, D., & Valenzuela, M. (2019). *The role of financial services in youth education and employment*. Washington DC, USA: CGAP

Andrianaivo, M., & Kpodar, K. (2012). Mobile phones, financial inclusion, and growth. *Review of Economics and Institutions*, *3*(2), 30-43.

Anh, N.K. & Tam, P. L. T. (2013). The sustainability of microfinance institutions in Vietnam: Circumstances and implications. Vietnam Microfinance Working Group. Transport Publishing

Anttila, J., & Jussila, K. (2019). Striving for benefits of sustainability from the interactivity of quality and innovation. *Journal of Cleaner Production*, *212*, 409-419.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277-297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29-51.

Arnaboldi, F., & Rossignoli, B. (2013). Financial innovation in banking. In *Bank Risk, Governance and Regulation*. 127-162.

Arora, N., & Kumar, N. (2021). Does financial inclusion promote human development? Evidence from India. *Jindal Journal of Business Research*, *10*(2), 163-184.

Arrow, K. J., Dasgupta, P., Goulder, L. H., Mumford, K. J., & Oleson, K. (2012). Sustainability and the measurement of wealth. *Environment and Development Economics*, *17*(3), 317-353.

Aye, G. C., & Edoja, P. E. (2017). Effect of economic growth on CO2 emission in developing countries: Evidence from a dynamic panel threshold model. *Cogent Economics & Finance*, *5*(1), 1379239.

Baird, S., De Hoop, J., & Özler, B. (2013). Income shocks and adolescent mental health. *Journal of Human Resources*, *48*(2), 370-403.

Banerjee, A. V., & Newman, A. F. (1993). Occupational choice and the process of development. *Journal of political economy*, *101*(2), 274-298.

Banya, R. M., & Biekpe, N. (2017). Bank competition and economic growth: Empirical evidence from selected frontier African countries. *Journal of Economic Studies*. *51*(1), 69-95.

Bara, A., & Mudzingiri, C. (2016). Financial innovation and economic growth: evidence from Zimbabwe. *Investment Management and Financial Innovations*, 13(2), 65-75.

Bara, A., Mugano, G., & Le Roux, P. (2016). Financial innovation and economic growth in the SADC. *African Journal of Science, Technology, Innovation and Development*, *8*(5), 483-495.

Bayai, I., & Ikhide, S. (2016b). Financing and financial sustainability of microfinance institutions (MFIs): a conceptual view. *Banks and Bank Systems*, *11*(2), 21-32.

Beck, T., Chen, T., Lin, C., & Song, F. M. (2016). Financial innovation: The bright and the dark sides. *Journal of Banking & Finance*, *72*, 28-51.

Beck, T., Lin, C., & Ma, Y. (2014). Why do firms evade taxes? The role of information sharing and financial sector outreach. *The Journal of Finance*, *69*(2), 763-817.

Beck, T., Demirguc-Kunt, A., & Peria, M. S. M. (2007). Reaching out: Access to and use of banking services across countries. *Journal of Financial Economics*, *85*(1), 234-266.

Behr, P., & Sonnekalb, S. (2012). The effect of information sharing between lenders on access to credit, cost of credit, and loan performance–Evidence from a credit registry introduction. *Journal of Banking & Finance*, *36*(11), 3017-3032.

Bell, A., & Jones, K. (2015). Explaining fixed effects: Random effects modeling of time-series cross-sectional and panel data. *Political Science Research and Methods*, *3*(1), 133-153.

Bernier, M., & Plouffe, M. (2019). Financial innovation, economic growth, and the consequences of macroprudential policies. *Research in Economics*, *73*(2), 162-173.

Bester, H. (1985). The level of investment in credit markets with imperfect information. *Journal of Institutional and Theoretical Economics*, 503-515.

Bhandari, V., & Mohite, V. (2020). Banking Outreach: A geographic and demographic analysis for countries of the gulf cooperation council. *Emerging Economy Studies*, *6*(2), 214-222.

Bilbao-Ubillos, J. (2013). Another approach to measuring human development: The composite dynamic human development Index. *Social Indicators Research*, *111*(2), 473-484.

Bist, J. P. (2018). Financial development and economic growth: Evidence from a panel of 16 African and non-African low-income countries. *Cogent Economics & Finance*, *6*(1), 1449780.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115-143.

Boz, E., & Mendoza, E. G. (2014). Financial innovation, the discovery of risk, and the US credit crisis. *Journal of Monetary Economics*, *62*, 1-22.

Bruhn, M., & Love, I. (2014). The real impact of improved access to finance: Evidence from Mexico. *The Journal of Finance*, *69*(3), 1347-1376.

Brundtland Commission (1987), Our Common Future, World Commission on Environment and Development. University Press, Oxford.

Carpenter, R. E., & Petersen, B. C. (2002). Capital market imperfections, high-tech investment, and new equity financing. *The Economic Journal*, *112*(477), F54-F72.

Cetin, M., Ecevit, E., & Yucel, A. G. (2018). The impact of economic growth, energy consumption, trade openness, and financial development on carbon emissions: Empirical evidence from Turkey. *Environmental Science and Pollution Research*, *25*(36), 36589-36603.

Chatterjee, A. (2020). Financial inclusion, information and communication technology diffusion, and economic growth: a panel data analysis. *Information Technology for Development*, *26*(3), 607-635.

Chou Y.K, Chin M.S. (2011). Financial innovations and endogenous growth. *J Econ Manage 25*, 25-40.

Chukwunulu, J. I. (2019). Effect of financial innovation on the Nigerian economy. *World Journal of Innovative Research*, *6*(5), 15-21.

Churchill, S. A., & Marr, A. (2017). Sustainability and outreach: A comparative study of MFIs in South Asia and Latin America and the Caribbean. *Bulletin of Economic Research*, *69*(4), 19-41.

Claessens, S., & Perotti, E. (2007). Finance and inequality: Channels and evidence. *Journal of Comparative Economics*, *35*(4), 748-773.

Cole, S. M., & Tembo, G. (2011). The effect of food insecurity on mental health: Panel evidence from rural Zambia. *Social Science and Medicine*, 73(7), 1071-1079.

Conning, J. (1999). Outreach, sustainability and leverage in monitored and peer-monitored lending. *Journal of Development Economics*, *60*(1), 51-77.

Cooper, D. R., & Schindler, P. S. (2014). *Business research methods*. McGrawhill education.

Creswell, J. W. (2014). *A concise introduction to mixed methods research*. SAGE publications.

Datta, S. K., & Singh, K. (2019). Variation and determinants of financial inclusion and their association with human development: A cross-country analysis. *IIMB Management Review*, *31*(4), 336-349.

De Guevara, J. F., & Maudos, J. (2009). Regional financial development and bank competition: Effects on firms' growth. *Regional Studies*, *43*(2), 211-228.

Demirguc-Kunt, A., Klapper, L. & Singer, D. (2017). *Financial inclusion and inclusive growth: A review of recent empirical evidence*. Policy Research Working Paper;No. 8040. World Bank, Washington, DC. World Bank. https://openknowledge.worldbank.org/handle/10986/26479 License

Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2022). *The Global Findex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19*. World Bank Publications.

Dinda, S. (2004). Environmental Kuznets curve hypothesis: a survey. *Ecological Economics*, *49*(4), 431-455.

Domeher, D., Konadu-Yiadom, E., & Aawaar, G. (2022). Financial innovations and economic growth: Does financial inclusion play a mediating role? *Cogent Business & Management*, *9*(1), 2049670.

Dupas, P., & Robinson, J. (2013). Savings constraints and microenterprise development: Evidence from a field experiment in Kenya. *American Economic Journal: Applied Economics*, *5*(1), 163-92.

Ehigiamusoe, K. U., & Lean, H. H. (2019). Effects of energy consumption, economic growth, and financial development on carbon emissions: Evidence from heterogeneous income groups. *Environmental Science and Pollution Research*, *26*(22), 22611-22624.

Elkington, J. (1997), *Cannibals with Forks: The triple bottom line of 21st century business*, (1st ed.). *Proceedings from Oxford Centre for Innovation*. Oxford: Capstone Publishing Limited.

Emas, R. (2015). The concept of sustainable development: Definition and defining principles. *Brief for GSDR*, *10*, 131-140.

Fosu, A. K., & Abass, A. F. (2019). Domestic credit and export diversification: Africa from a global perspective. *Journal of African Business*, *20*(2), 160-179.

Freimer, M., & Gordon, M. J. (1965). Investment Behaviour with Utility a Concave Function of Wealth. In *Risk and uncertainty* (pp. 94-119). London: Palgrave Macmillan,

Giovannini, A. (1985). Saving and the real interest rate in LDCs. *Journal of Development Economics*, *18*(2-3), 197-217.

Gnegne, Y. (2009). Adjusted net saving and welfare change. *Ecological Economics*, *68*(4), 1127-1139.

Grossman, G. M., & Krueger, A. B. (1995). Economic growth and the environment. *The Quarterly Journal of Economics*, *110*(2), 353-377.

Gujarati, D.N. & Porter, D.C. (2009). *Basic econometrics*. (5th ed.). Singapore: McGraw-Hill.

Guru, B. K., & Yadav, I. S. (2019). Financial development and economic growth: panel evidence from BRICS. *Journal of Economics, Finance and Administrative Science*, *24*(47), 113-126.

Gutés, M. C. (1996). The concept of weak sustainability. *Ecological economics*, *17*(3), 147-156.

Hall, B. H., & Lerner, J. (2010). The financing of R&D and innovation. *In Handbook of the Economics of Innovation* , *1*, 609-639.

Hartwick, J. M. (2017). Intergenerational equity and the investing of rents from exhaustible resources. In *The Economics of Sustainability* (pp. 63-65). Routledge.

Harwell, M. R. (2011). Research design: Qualitative, quantitative, and mixed methods: Pursuing ideas as the keystone of exemplary inquiry. In *the Sage handbook for research in education*

Hassan, M. K., Sanchez, B., & Yu, J. S. (2011). Financial development and economic growth: New evidence from panel data. *The Quarterly Review of economics and finance*, *51*(1), 88-104.

Henderson, B. J., & Pearson, N. D. (2011). The dark side of financial innovation: A case study of the pricing of a retail financial product. *Journal of Financial Economics*, *100*(2), 227-247.

Heng, S. (2015). *Assessing outreach and sustainability of microfinance institutions in Cambodia*. Unpublished master's thesis, Ohio University.

Hermes, N., Lensik, R., & Meestres, A. (2011). Outreach and efficiency of microfinance institutions, *World Development, 39*(6), 938–948.

Hickel, J. (2019). The contradiction of the sustainable development goals: Growth versus ecology on a finite planet. *Sustainable Development, 27*(5), 873-884.

Hill, R. C., Griffiths, W. E., & Lim, G. C. (2012). *Principles of econometrics*. John Wiley & Sons.

Hopper, P. (2018). *Understanding development*. New Jersey, US: John Wiley & Sons.

Huang, W., Gu, X., Lin, L., Alharthi, M., & Usman, M. (2022). Do financial inclusion and income inequality matter for human capital? Evidence from sub-Saharan economies. *Borsa Istanbul Review*.*3*(8), 24-35.

Idrees, M. A. (2018). Foreign capital inflows and economic growth in SAARC. *Journal of Business, 5*(2), 81-107.

Idun, A. A. A., & Aboagye, A. Q. (2014). Bank competition, financial innovations and economic growth in Ghana. *African Journal of Economic and Management Studies*,*5*(1), 30-51.

Ijaz, S., Hassan, A., Tarazi, A., & Fraz, A. (2020). Linking bank competition, financial stability, and economic growth. *Journal of Business Economics and Management*, *21*(1), 200-221.

Inoue, T., & Hamori, S. (2016). Financial access and economic growth: Evidence from sub-Saharan Africa. *Emerging Markets Finance and Trade*, 52(3), 743–753.

International Monetary Fund (2017) Regional Economic Outlook: Restarting the Growth Engine. Retrieved from https://www.imf.org/en/Publications/REO/SSA/Issues/2017/05/03/sreo0517

IPA, 2017. Innovation for poverty action. In: Climate change and financial inclusion

Issaka, J. Y., Anarfo, E. B., & Aveh, F. K. (2022). Financial inclusion and bank profitability in Sub-Saharan Africa. *International Journal of Finance & Economics*, *27*(1), 32-44.

Jin, H., Qian, X., Chin, T., & Zhang, H. (2020). A global assessment of sustainable development based on modification of the human development index via the entropy method. *Sustainability*, *12*(8), 3251-3276.

Johnson, S., & Kwak, J. (2012). Is financial innovation good for the economy?. *Innovation Policy and the Economy*, *12*(1), 1-16.

Jose, P. E. (2013). Doing statistical mediation and moderation. Guilford Press.

Kaimuri, B., & Kosimbei, G. (2017). Determinants of sustainable development in Kenya. *Journal of Economics and Sustainable Development*, *8*(24), 17-36.

Kamalu, K., Wan Ibrahim, W. H., Ahmad, A. U., & Mustapha, U. A. (2019). Causal link between financial developments, financial inclusion and economic growth in Nigeria. *International Journal of Scientific and Technology Research*, *8*(12), 2757-2763.

Karanja, A. M. (2014). *Relationship between outreach and financial performance of deposit taking micro finance institutions in Kenya*. Unpublished master's dissertation, University of Nairobi, Kenya.

Kargbo, S. M., & Adamu, P. A. (2009). Financial development and economic growth in Sierra Leone. *Journal of Monetary and Economic Integration*, 9(2), 30-61.

Kaur, P. (2014). Outreach and sustainability of microfinance institutions in India in pre and post Andhra Pradesh microfinance crisis in context of South Asia. *Global Journal of Finance and Management*, *6*(6), 569-574.

Kelly, R., Sirr, L., & Ratcliffe, J. (2004). Futures thinking to achieve sustainable development at local level in Ireland. *Foresight*. 12-20.

Khan, M. A. (2015). Putting 'good society'ahead of growth and/or 'development': overcoming neoliberalism's growth trap and its costly consequences. *Sustainable Development*, *23*(2), 65-73.

King, R. G., & Levine, R. (1993). Finance and growth: Schumpeter might be right. *The Quarterly Journal of Economics*, *108*(3), 717-737.

Klapper, L., El-Zoghbi, M., & Hess, J. (2016). Achieving the sustainable development goals. The role of financial inclusion. Retrieved From: http://www. ccgap. org.

Koirala, B. S., & Pradhan, G. (2020). Determinants of sustainable development: Evidence from 12 Asian countries. *Sustainable Development*, *28*(1), 39-45.

Kumar, S., Kumar, P., Shrivastava, A., Acharya, A., & Chaudhari, D. (2018). Financial outreach and growth in India: Interactions at the sub-national level. *Reserve Bank of India Occasional Papers*, *39*(1-2), 105-128.

Laeven, L., Levine, R., & Michalopoulos, S. (2015). Financial innovation and endogenous growth. *Journal of Financial Intermediation*, 24(1), 1-24.

Le, T. H., Chuc, A. T., & Taghizadeh-Hesary, F. (2019). Financial inclusion and its impact on financial efficiency and sustainability: Empirical evidence from Asia. *Borsa Istanbul Review*, *19*(4), 310-322.

Lee, K. (1999). Unexpected inflation, inflation uncertainty, and stock returns. *Applied Financial Economics*, *9*(4), 315-328.

Li, D., He, G., Jin, H., & Tsai, F. S. (2021). Sustainable development of African countries: Minding the public life, education, and welfare. *Frontiers in Public Health*, 9, 1454-1465.

Li, X. X., Liu, Y. M., & Song, T. (2014). Calculation of the green development index. *Soc. Sci. China*, *6*, 69-95.

Liu, D., Zhang, Y., Hafeez, M., & Ullah, S. (2022). Financial inclusion and its influence on economic-environmental performance: demand and supply perspectives. *Environmental Science and Pollution Research*, 1-10.

Liu, N., Hong, C., & Sohail, M. T. (2021). Does financial inclusion and education limit CO2 emissions in China? A new perspective. *Environmental Science and Pollution Research*, *29*(13), 18452-18459.

Liyanagamage, H. D. D. (2018). Efficiency, stability and optimum level of bank competition for sustainable development: A study of Sri Lankan banking sector. *OIDA International Journal of Sustainable Development*, *11*(09), 69-80.

Llewellyn, D. T. (2012). The evolution of bank business models: Pre-and post-crisis. *Future Risks and Fragilities for Financial Stability*, *45*, 26-35.

Lopatta, K., Tchikov, M., Jaeschke, R., & Lodhia, S. (2017). Sustainable development and microfinance: The effect of outreach and profitability on microfinance institutions' development mission. *Sustainable Development*, *25*(5), 386-399.

Lu, W. C. (2018). The impacts of information and communication technology, energy consumption, financial development, and economic growth on carbon dioxide emissions in 12 Asian countries. *Mitigation and Adaptation Strategies for Global Change*, *23*(8), 1351-1365.

Lumsden, E. (2018). The Future Is Mobil: Financial Inclusion and Technological Innovation in the Emerging World. *Stan. JL Bus. & Fin.*, *23*, 1-18.

Maji, I. K., Habibullah, M. S., & Saari, M. Y. (2017). Financial development and sectoral CO2 emissions in Malaysia. *Environmental Science and Pollution Research*, *24*(8), 7160-7176.

Makina, D., & Walle, Y. M. (2019). Financial inclusion and economic growth: Evidence from a panel of selected African countries. In *Extending financial inclusion in Africa* (pp. 193-210). Academic Press.

Marfo-Yiadom, E., & Ansong, A. (2012). Customers' perception of innovative banking products in cape coast metropolis, Ghana. University of Cape Coast Institutional Repository. Retrieved From http://hdl.handle.net/123456789/4546

Matekenya, W., Moyo, C., & Jeke, L. (2020). Financial inclusion and human development: Evidence from Sub-Saharan Africa. *Development Southern Africa*, *38*(5), 683-700.

Mbrokoh, A. S. (2015). *Factors that influence internet banking adoption in Ghana*. Unpublished mater's dissertation, University of Ghana, Ghana.

McGuire, P. B., & Conroy, J. D. (2013). *Fostering financial innovation for the poor: The policy and regulatory environment*. *Proceedings from Foundation for Development Cooperation*. Brisbane, Australia.

Mehmood, U. (2021). Examining the role of financial inclusion towards CO2 emissions: Presenting the role of renewable energy and globalization in the context of EKC. *Environmental Science and Pollution Research*, *29*(11), 15946-15954.

Mehrotra, A. N., & Yetman, J. (2015). Financial inclusion-issues for central banks. *BIS Quarterly Review March*,*5*(3), 20-35.

Mention, A. L., & Torkkeli, M. (2012). Drivers, processes and consequences of financial innovation: a research agenda. *International Journal of Entrepreneurship and Innovation Management*, *16*(1-2), 5-29.

Menyelim, C. M., Babajide, A. A., Omankhanlen, A. E., & Ehikioya, B. I. (2021). Financial inclusion, income inequality and sustainable economic growth in sub-Saharan African countries. *Sustainability*, *13*(4), 1780-1800.

Merton, R. C. (1992). Financial innovation and economic performance. *Journal of Applied Corporate Finance*, *4*(4), 12-22.

Meyer, J. (2019). Outreach and performance of microfinance institutions: the importance of portfolio yield. *Applied Economics*, *51*(27), 2945-2962.

Michalopoulos, S., Laeven, L., & Levine, R. (2009). *Financial innovation and endogenous growth* (No. w15356). National Bureau of Economic Research.

Miller, K. E., & Rasmussen, A. (2017). The mental health of civilians displaced by armed conflict: An ecological model of refugee distress. *Epidemiology and Psychiatric Sciences*, 26(2), 129-138.

Minetti R. (2011) Informed finance and technological conservatism. *Review of Finance*, *15*, 633-692

Mollaahmetoğlu, E., & Akçalı, B. Y. (2019). The missing-link between financial development and economic growth: Financial innovation. *Procedia Computer Science*, *158*, 696-704.

Moyo, Z. (2020). *Financial sustainability, liquidity and outreach of deposit-taking microfinance institutions: evidence from low income Sub-Saharan Africa*. Unpublished Doctoral thesis, University of Kwazulu-Natal, South Africa.

Mushtag, R., & Bruneau, C. (2019). Microfinance, financial inclusion and ICT: Implications for poverty and inequality. *Technology in Society*, 59, 101154.

Mwinzi, D. M. (2014). *The effect of financial innovation on economic growth in Kenya*. Unpublished Doctoral dissertation, University of Nairobi.

Nadeem, M. A., Liu, Z., Ali, H. S., Younis, A., Bilal, M., & Xu, Y. (2020). Innovation and sustainable development: Does aid and political instability impede innovation?. *SAGE Open*, *10*(4), 2158244020973021.

Namda, K., & Kaur, M. (2016). Financial inclusion and human development: A cross-country evidence. *Management and Labour Studies*, *41*(2), 127-153.

Nato, J. W. (2011). *Financial innovations and financial inclusion: the case of mobile money transfer among the urban poor in Kenya*. Unpublished Doctoral dissertation, University of Nairobi.

Navajas, S., Schreiner, M., Meyer, R. L., Gonzalez-Vega, C., & Rodriguez-Meza, J. (2000). Microcredit and the poorest of the poor: Theory and evidence from Bolivia. *World Development*, *28*(2), 333-346.

Nazir, M. R., Tan, Y., & Nazir, M. I. (2021). Financial innovation and economic growth: Empirical evidence from China, India and Pakistan. *International Journal of Finance & Economics*, *26*(4), 6036-6059.

Ndlovu, G. 2017. *Access to financial services: towards an understanding of the role and impact of financial exclusion in Sub-Saharan Africa*. Unpublished doctoral thesis. University of Cape Town. Retrieved From https://open.uct.ac.za/handle/1142 7/28085

Obuobi, N. K., Gatsi, J. G., Appiah, M. O., Kawor, S., Amoah, E. K., & Abeka, M. J. (2022). Trade liberalization policies and foreign direct investment inflows in Africa: Evidence from new measures of trade liberalization. *The Journal of International Trade & Economic Development*, *31*(3), 394-409.

Odhiambo, N. M. (2020). Financial development, income inequality and carbon emissions in Sub-Saharan African countries: a panel data analysis. *Energy Exploration & Exploitation*, *38*(5), 1914-1931.

Okafor, I. G., Chijindu, E. H., & Chikezie, A. K. (2017). Does financial innovation drive growth? Empirical analysis of the Nigerian case. *British Journal of Economics, Management & Trade*, *16*(3), 1-10.

Omri, A., Daly, S., Rault, C., & Chaibi, A. (2015). Financial development, environmental quality, trade and economic growth: What causes what in MENA countries. *Energy Economics*, *48*, 242-252.

Ozili, P. K. (2020). Theories of financial inclusion. In Özen & Grima (Eds), *Uncertainty and challenges in contemporary economic behaviour* (*Emerald Studies in Finance, Insurance, and Risk Management*) (pp.89-115). Bingley: Emerald Publishing Limited. Retrieved from https://doi.org/10.1108/978-1-80043-095-220201008

Pardi, F., Salleh, A. M., & Nawi, A. S. (2015). Determinants of sustainable development in Malaysia: A VECM approach of short-run and long-run relationships. *American Journal of Economics*, *5*(2), 269-277.

Pearce, D. W., & Atkinson, G. D. (1993). Capital theory and the measurement of sustainable development: an indicator of "weak" sustainability. *Ecological Economics*, *8*(2), 103-108.

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American statistical Association*, *94*(446), 621-634.

Pike, A., Rodríguez-Pose, A., & Tomaney, J. (2016). *Local and regional development*. New York: Routledge.

Polasky, S., Kling, C. L., Levin, S. A., Carpenter, S. R., Daily, G. C., Ehrlich, P. R., ... & Lubchenco, J. (2019). Role of economics in analyzing the environment and sustainable development. *Proceedings of the National Academy of Sciences*, *116*(12), 5233-5238.

Pradhan, R. P., Arvin, M. B., Nair, M., Bennett, S. E., & Hall, J. H. (2019). The information revolution, innovation diffusion and economic growth: an examination of causal links in European countries. *Quality & Quantity*, *53*(3), 1529-1563.

Qamruzzaman, M., & Jianguo, W. (2018). Investigation of the asymmetric relationship between financial innovation, banking sector development, and economic growth. *Quantitative Finance and Economics*, *2*(4), 952-980.

Qamruzzaman, M., & Wei, J. (2018). Financial innovation, stock market development, and economic growth: An application of ARDL model. *International Journal of Financial Studies*, *6*(3), 69-93.

Qamruzzaman, M., & Wei, J. (2019). Financial innovation and financial inclusion nexus in South Asian countries: Evidence from symmetric and asymmetric panel investigation. *International Journal of Financial Studies*, *7*(4), 61-80.

Qamruzzaman, M., Jianguo, W., Jahan, S., & Yingjun, Z. (2021). Financial innovation, human capital development, and economic growth of selected South Asian countries: An application of ARDL approach. *International Journal of Finance & Economics*, *26*(3), 4032-4053.

Qin, L., Raheem, S., Murshed, M., Miao, X., Khan, Z., & Kirikkaleli, D. (2021). Does financial inclusion limit carbon dioxide emissions? Analyzing the role of globalization and renewable electricity output. *Sustainable Development*, *29*(6), 1138-1154.

Raffaelli, R., & Glynn, M. A. (2013). Institutional Innovation: Novel, Useful. *In: The Oxford Handbook of creativity, innovation, and entrepreneurship*, 407-420.

Raichoudhury, A. (2016). Financial inclusion & human development: A cross country analysis. *Journal of Business Research ISSN*, *6*(1), 1-20.

Rajan, R.G. (2009). "A Hundred Small Steps – Report of the Committee on Financial Sector Reforms", Planning Commission, Government of India, New Delhi

Rakshit, B., & Bardhan, S. (2019). Does bank competition promote economic growth? Empirical evidence from selected South Asian countries. *South Asian Journal of Business Studies*.

Rao, K. R. M., & Fitamo, T. L. (2014). Concepts and measures of outreach and sustainability in microfinance institutions: A comprehensive literature review. *International Journal of Science and Research (IJSR)*, *4*(2), 41-49.

Ratnawati, K. (2020). The impact of financial inclusion on economic growth, poverty, income inequality, and financial stability in Asia. *The Journal of Asian Finance, Economics, and Business*, *7*(10), 73-85.

Robinson, J. (1952). *The generalization of general theory in the rate of interest and other essays*. London: MacMillan

Rogers, E., (1962) *Diffusion of Innovations*, New York: Free Press

Roodman, D. (2006). How to do xtabond2: an introduction to 'Difference' and 'System' GMM. *Stata Center for Global Development Working Paper*, *103*.

Roodman, D. (2009b). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, *9*(1), 86-136.

Roodman, D. (2009a). A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics*, 71, 135– 158.

Rosenberg, R. (2009). *Measuring results of microfinance institutions: Minimum indicators that donors and investors should track-A technical guide*. The World Bank.

Rousseau, P. L. (1998). The permanent effects of innovation on financial depth: Theory and US historical evidence from unobservable components models. *Journal of Monetary Economics*, *42*(2), 387-425.

Sahay, R., Čihák, M., N'Diaye, P., & Barajas, A. (2015). Rethinking financial deepening: Stability and growth in emerging markets. *Revista de Economía Institucional*, *17*(33), 73-107.

Salehnia, N., Alavijeh, N., & Salehnia, N. (2020). Testing porter and pollution haven hypothesis via economic variables and CO2 emissions: A cross-country review with panel quantile regression method. *Environmental Science and Pollution Research*, 27(25), 31527-31542.

Saqib, N. (2015). Review of literature on finance-growth Nexus. *Journal of Applied Finance & Banking*, *5*(4), 1-15.

Sarma, M. (2012). Index of financial inclusion: A measure of financial sector inclusiveness. *Centre for International Trade and Development, School of International Studies Working Paper Jawaharlal Nehru University. Delhi, India*.

Saunders, M.N.K, Lewis, P., & Thornhill, A. (2012). *Research methods for business students* (6th ed.). New York: Pearson.

Saxena, K. K., & Wagofya, G. M. (2018). Statistical analysis of outreach and financial sustainability of kifanya Saccos limited in Njombe. *International Journal of Statistics and Applied Mathematics*, *3*(6), 119-123.

Schumpeter, J. A. (1912). *The theory of economic development*. New Brun swick, New Jersey: Transaction Publishers.

Schumpeter, J. (1934). *The theory of economic development*. Cambridge, MA: Harvard University Press

Schumpeter, J.A. (1939). *Business cycles: A theoretical, historical, and statistical analysis of the capitalist process*. New York: McGraw-Hill.

Schumpeter, J.A., (1911). *The theory of economic development: An inquiry into profits, capital, credit, interest and the business cycle*. New Brunswick (U.S.A) and London (U.K.): Transaction Publishers.

Sethi, D., & Acharya, D. (2018). Financial inclusion and economic growth linkage: Some cross country evidence. *Journal of Financial Economic Policy*, 10(3), 369-385.

Shaffer, S. (1998). The winner's curse in banking. *Journal of Financial Intermediation*, *7*(4), 359-392.

Shahbaz, M., Shahzad, S. J. H., Ahmad, N., & Alam, S. (2016). Financial development and environmental quality: The way forward. *Energy Policy*, *98*, 353-364.

Shahbaz, M., Tiwari, A. K., & Nasir, M. (2013). The effects of financial development, economic growth, coal consumption and trade openness on CO2 emissions in South Africa. *Energy Policy*, *61*, 1452-1459.

Shaughnessy, H. (2015). *Innovation in financial services: The elastic innovation index report.*La Hulpe: Innotribe

Shaw, E.S. (1973). *Financial deepening in economic development*. New York: Oxford University Press

Shiffman, L. G., & Kanuk, L. L. (2009). *Consumer behaviour* (9th Ed.). London, UK: Pearson Education International.

Shu, C. A., & Oney, B. (2014). Outreach and performance analysis of microfinance institutions in Cameroon. *Economic Research, 27*(1), 107-119.

Singh, V., & Padhi, P. (2019). Factors influencing outreach performance of microfinance sector in India. *Asia-Pacific Journal of Management Research and Innovation*, *15*(4), 162-176.

Siueia, T. T., Wang, J., & Deladem, T. G. (2019). Corporate Social Responsibility and financial performance: A comparative study in the Sub-Saharan Africa banking sector. *Journal of Cleaner Production, 226*, 658-668.

Solow, R. (1974). The economics of resources or the resources of economics. *American Economic Review, 64*(2), 1-14

Sood, V., & Ranjan, P. (2015). Financial innovation in India: An empirical study. *J Econ Bus Rev*, *10*(1), 1-20.

Strezov, V., Evans, A., & Evans, T. J. (2017). Assessment of the economic, social and environmental dimensions of the indicators for sustainable development. *Sustainable Development*, *25*(3), 242-253.

Stiglitz, J. E., & Weiss, A. (1981). Credit rationing in markets with imperfect information. *The American Economic Review, 71*(3), 393-410.

Taddese, B. D., & Abebaw, D. A. (2021). The effect of financial sector development on economic growth of selected sub-Saharan Africa countries. *International Journal of Finance & Economics*.*4*(1), 15-35.

Tangi, S. (2005). Introduction to development studies. Scientific network Academia.edu.

Tchamyou, V. S. (2020). Education, lifelong learning, inequality and financial access: Evidence from African countries. *Contemporary Social Science*, *15*(1), 7-25.

Tchamyou, V. S., & Asongu, S. A. (2017). Information sharing and financial sector development in Africa. *Journal of African Business*, *18*(1), 24-49.

Tomislav, K. (2018). The concept of sustainable development: From its beginning to the contemporary issues. *Zagreb International Review of Economics & Business*, *21*(1), 67-94.

Tufano, P. (2003). Financial innovation. *Handbook of the Economics of Finance*, *1*, 307-335.

Uddin, K. M. K., Rahman, M. M., & Quaosar, G. A. A. (2014). Causality between exchange rate and economic growth in Bangladesh. *European Scientific Journal*, *10*(31), 14-30

UN Women. (2018). Gender equality and the sustainable development goals in Asia and the Pacific baseline and pathways for transformative change by 2030.

Usman, M., Makhdum, M. S. A., & Kousar, R. (2020). Does financial inclusion, renewable and non-renewable energy utilization accelerate ecological footprints and economic growth? Fresh evidence from 15 highest emitting countries. *Sustainable Cities and Society*, *65*, 102590.

Woller, G., & Schreiner, M. (2004). "Measuring outreach: Conceptual workshop proceedings. In *Workshop Proceedings* 22, 23-30.

Wooldridge, J. M. (2001). Applications of generalized method of moments estimation. *Journal of Economic Perspectives*, *15*(4), 87-100.

World Bank (2001). World development indicators 2001. Washington: The World Bank. https://doi.org/10.1596/0-8213-4898-1

World Bank (2016). World development indicators. Washington: The World Bank.

Yahaya, M. H., & Ahmad, K. (2018). Financial inclusion through efficient zakat distribution for poverty alleviation in Malaysia: Using fintech & mobile banking. *In Proceeding of the 5th International Conference on Management and Muamalah* (pp. 15-31). Malaysia

Yawe, B., & Prabhu, J. (2015). Innovation and financial inclusion: A review of the literature. *Journal of Payments Strategy & Systems*, *9*(3), 215-228.

Yuan, G., Ye, Q., & Sun, Y. (2021). Financial innovation, information screening and industries' green innovation—Industry-level evidence from the OECD. *Technological Forecasting and Social Change*, *171*, 120998.

Zaidi, S. A. H., Hussain, M., & Zaman, Q. U. (2021). Dynamic linkages between financial inclusion and carbon emissions: Evidence from selected OECD countries. *Resources, Environment and Sustainability*, *4*, 100-122.

Zikmund, W., Babin, B.J., Carr, J.C., & Griffin, M. (2012). *Business Research Methods* (8th ed.). Victoria, Australia: South-Western, Cengage Learning

APPENDIX

List of countries used in the study

Algeria
Angola
Benin
Botswana
Burundi
Burkina Faso
Cabo Verde
Cameroon
Djibouti
Egypt, Arab Rep.
Gabon
Ghana
Guinea
Kenya
Lesotho
Madagascar
Mali
Mauritius
Mauritania
Morocco
Mozambique
Namibia
Niger
Nigeria
Rwanda
Senegal
Seychelles
South Africa
Tanzania
Togo
Tunisia
Uganda
Zambia
Zimbabwe