**UNIVERSITY OF EDUCATION, WINNEBA**

# SUSTAINABLE INVESTMENT AND COST EFFICIENCY OF BANKS IN SUB-SAHARAN AFRICAN COUNTRIES, THE ROLE OF BANK STABILITY




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**MASTER OF PHILOSOPHY**

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# SUSTAINABLE INVESTMENT AND COST EFFICIENCY OF BANKS IN SUB-SAHARAN AFRICAN COUNTRIES, THE ROLE OF BANK STABILITY

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# DECLARATION

## STUDENT'S DECLARATION

I, **Esther Arhin,** hereby declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

STUDENT'S SIGNATURE .....

……

DATE.....

## SUPERVISOR'S DECLARATION

We hereby declare that the preparation and presentation of this work weas supervised in accordance with the guidelines for supervision of thesis laid down by the University of Education, Winneba.

**Principal Supervisor**……

**Signature**.....

**Date**.....

**Co- Supervisor**…….

**Signature**..... …….

**Date.**.....

## DEDICATION

To my family and mentors

## ACKNOWLEDGEMENT

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**KEYWORDS**

Cost efficiency

Bank stability

Sustainable investment

Sub-Saharan Africa

Banks

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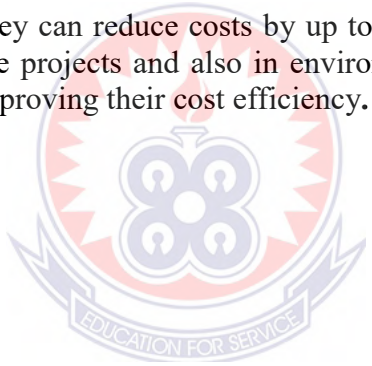
## LIST OF ACRONYMS

| | | |
|---|---|---|
| SSA | - | Sub-Saharan Africa |
| BC 92 | - | Battese and Coelli (1992) |
| BC 95 | - | Battese and Coelli (1995) |
| SFA | - | Stochastic Frontier Analysis |
| CE | - | Cost Efficiency |
| ESG | - | Environment, Social and Governance |
| DEA | - | Data Envelopment Analysis |
| UNE | - | Unemployment |
| NIM | - | Net Interest Margin |
| BCON | - | Bank Concentration |
| CAR | - | Capital Adequacy Ratio |
| BS | - | Bank Stability |
| MENA | - | Middle East and Northern Africa |
| GMM | - | Generalized Method Moment |
| CIR | - | Cost-to-Income Ratio |
| FBP | - | Foreign Bank Presence |
| PCA | - | Principal Component Analysis |

| | | |
|---|---|---|
| EG | - | Economic Growth |
| CO2 | - | Carbon Dioxide |
| MLE | - | Maximum Likelihood Estimation |
| UNEP | - | United Nations Environment Program |
| PRA | - | Prudential Regulation Authority |
| CSR | - | Corporate Social Responsibility |
| SDI | - | Sustainable Development Index |
| CSP | - | Corporate Social Performance |
| IMF | - | International Monetary Fund |
| GDP | - | Gross Domestic Product |

# ABSTRACT

Sustainable investment (ESG) factors are increasingly analyzed to identify the potential benefit of banks‘ cost efficiency. The banking sector influences the whole economy through the credit channel and balances its stability. The interplay of these elements motivated the main objective of the study to examine the effect of a bank‘s sustainable investment on the cost efficiency of banks and the role of banking sector stability in this relationship. Using panel data from 25 countries in sub-Saharan Africa over the period 2010 to 2017, the study used stochastic frontier analysis to estimate the cost efficiency scores, then the study used GMM to establish the effect sustainable investment has on cost efficiency and the influence of bank stability in this effect. The findings indicated that the cost efficiency of banks in sub-Saharan African countries is at least 70%. Environmental projects negatively impact cost efficiency in banks, while socially responsible banks have no impact. Governance factors improve efficiency in sub-Saharan African banks. Environmentally friendly banks are less risky and stable, enhancing efficiency. Socially responsible banks' cost efficiency is not influenced by bank stability, and governance factors positively impact cost efficiency but independent of bank stability. It was recommended that banks should improve their cost efficiency by identifying areas where they can reduce costs by up to 30%. Banks should invest more into social and governance projects and also in environment projects as it enhances the stability of banks while improving their cost efficiency.



# CHAPTER ONE

# INTRODUCTION

## 1.0 Overview

This chapter outlines the background of the study, the problem statement and the objectives of the study, the research questions, and the significance of the study. It goes on to discuss the scope, limitations, and chapter organization of the study.

## 1.1 Background to the Study

There have been wide discussions in the literature about the financial institutions‘ role in the world‘s sustainability and their contribution to the ongoing climate change and humanitarian crisis. Although financial institutions might not be as directly responsible for the excessive CO2 emissions into the atmosphere, or to produce military weapons or the use of child labor in manufacturing, they might indirectly contribute to these causes through their lending to firms.

The idea of banks‘ essential role in the sustainable environmental, social and governance activity was brought to attention in 1991 when a small group of commercial banks from all over the world joined forces with the United Nations Environment Program – UNEP, establishing the UNEP Finance Initiative. The goal of this program was to increase the recognition of banks‘ indirect impact into the environment, encourage them in the process of sustainable development and to catalyze the ―financial industry‘s awareness of the environmental agenda” (Thompson & Cowton 2004; UNEP FI, 2019).

Sustainable investment has gained increasing attention over the past few years, with investors becoming more aware of the long-term impact of their investments on the environment and society. This has led to a shift in investment strategies towards companies or projects that are environmentally and socially responsible. At the same time, banks have been under pressure to increase their stability and cost efficiency, particularly in the wake of the 2008 financial crisis.

Sustainable investment can help to reduce risks associated with environmental, social and governance (ESG) factors, which in turn can improve bank stability. A study by Hasan et al. (2019) found that sustainable finance practices can enhance the resilience of banks and reduce the probability of bank failures. The study showed that banks with higher sustainability scores had lower credit risk, lower default risk, and lower systemic risk. Similarly, a study by Clark and Feiner (2019) found that ESG (environmental, social, and governance) factors can have a positive impact on bank risk. The study analyzed European banks and found that those with higher ESG scores had lower volatility and lower default risk.

On the other hand, sustainable investment may also lead to higher costs for banks, which could negatively impact their financial stability. The study analyzed the costs associated with implementing sustainable finance practices in European banks and found that these costs can outweigh the benefits in the short run. However, the study also found that the long-term benefits of sustainable finance, such as improved customer satisfaction and reduced risks, can outweigh the short-term costs.

Bank stability means building a robust and resilient banking sector that is capable of withstanding global financial pressures, regulatory rigidities, economies pressures and

maintaining healthy competition in the guest to allocating financial and capital resources (Financial Stability Report, 2020).

According to Bozena (2013), a stable and resilient banking system can continue in the provision of financial services to meet the financial needs of households, firms and government in the face of adverse economic events. An unstable banking sector is more likely to be severely affected by shocks such as financial crises (Bozena, 2013). Furthermore, a weak banking system affects the process of credit creation, distribution of capital and employment which in the long run impacts negatively on the overall production and growth of economies (Chant, 2003).

In line with the World Bank Group (2019) report that bank stability across the globe remains a challenge, the global economic growth rate seems to follow the trend of stability in the banking sector. For example, the World Economic Outlook (2019) reported a weakened global growth in Europe and Asia with an estimated global growth rate of 3.7% in 2018 compared to 3.5% in 2019. The fall in the global growth rate could stem from the diminished optimism in the financial sector of advanced economies mainly arising out of fears of cycles of financial crises and increased monetary policy rates. The global banking sector is further described as having banking executives becoming more conservative to risk, together with declining feelings about growth prospects and central banks such as the likes of Germany, the United States of America, and United Kingdom are having shifts in policy expectations; these have contributed to drop in yields on sovereign securities. Furthermore, banks‘ spread in areas such as Italy and Europe have seen decline.

From the perspective of emerging economies and for that matter Sub-Saharan Africa, central bankers and financial regulators in Sub-Saharan Africa (SSA) have always faced major institutional challenges in striking the right balance in their policy design to achieve financial stability, growth and equity" (Grifith-Jones, Karwowski, & Dafe, 2014). During the last decade, Sub-Saharan Africa has encountered myriad of challenges in its banking and real sectors; these challenges include the rampant volatility of the exchange and interest rate and the problem of high cost of financial fragility (Akinsola, Foluso, Odhiambo & Nicholas, 2017).

According to Fowowe (2013), the problem of financial instability and by extension bank instability which is common in many SSA economies stems from the weak implementation of financial liberalization policies. It is thought that the banking sector of SSA economies is plagued with exchange rate exposures, large spread between lending and deposit rates, sharp decline in domestic credit access and the liquidity challenges which have led many banks to exit the banking industry (Ikhide, 2015). Misati and Nyamongo (2012) argues that bank instability is a major challenge confronting the SSA economies and add that weak banking system stifles capital formation and impedes on the efficient distribution and allocation of capital to the various sectors of the economy (Misati & Nyamongo, 2012) which by extension could have implication on the growth of the Africa sub-region; even though the growth rate of the SSA is projected to rise to a modest 2.6% in 2019 from 2.5% in 2018 (World Bank, 2019).

The banking sector in the Sub-Saharan Africa region has undergone significant changes in recent years. Advances in technology and increased competition have pushed banks to find ways to efficiently manage their costs, while still providing high quality

services to their customers. In order to remain competitive, many banks have focused on improving their cost efficiency, which is defined as the ability to minimize costs while maximizing output (Mester, 1991).

The pursuit of cost efficiency is particularly important in the sub-Saharan Africa region, where many banks have struggled to maintain profitability due to high operating costs, low revenues, and a challenging regulatory environment (Mlambo & Biekpe, 2017). In this context, improving cost efficiency has become a key strategic priority for many banks in the region, as it provides a means to improve profitability, enhance customer satisfaction, and meet regulatory requirements (Nkundabanyanga & Ovia, 2019).

Several studies have been conducted on cost efficiency in the banking sector, however, there is limited research that focuses specifically on the sub-Saharan Africa region. Past studies have shown that there are various factors that influence cost efficiency in banking including organizational structure, technology, and human capital (Berger & Humphrey, 1997; Rahman & Qureshi, 2017). With the recent trends in the banking sector and understand the factors that influence it.

The World Bank reports that sub-Saharan Africa's banking sector has experienced significant growth in recent years, with an increase in the number of banks and an expansion in the range of banking services offered (World Bank, 2019). This growth, however, has been accompanied by high operational costs, which have affected the profitability of banks in the region. According to a recent report by McKinsey & Company, banks in sub-Saharan Africa have an average cost-to-income ratio of 60%, compared to a global average of 50% (McKinsey & Company, 2018). This highlights the need for banks to improve their cost efficiency in order to remain competitive.

The relationship between sustainable investment and cost efficiency in the banking sector is also complex. Some studies have suggested that sustainable investment can improve cost efficiency, particularly in the long run, by reducing risks and improving customer satisfaction. Nguyen et al. (2019) analyzed European banks and found that those with higher sustainability scores had higher efficiency ratios, indicating that sustainable investment can improve cost efficiency. Similarly, Kraussl and Kraussl (2018) found that ESG performance can be a valuable indicator of credit risk, which can improve loan pricing and reduce credit losses.

However, other studies have found that the costs associated with sustainable investment can outweigh the benefits, particularly in the short term. Fontaine and Sylvestre (2017) found that the costs of implementing sustainable finance practices can be high, particularly in terms of data collection and analysis. The study also found that the costs of implementing sustainable finance practices can vary depending on the size of the bank, with larger banks being better able to absorb these costs.

The relationship between sustainable investment and cost efficiency is complex and requires further research. While sustainable investment can reduce risks associated with environmental and social factors, it can also lead to higher costs for banks, particularly in the short term. However, the long-term benefits of sustainable investment, such as improved customer satisfaction and reduced risks, may outweigh these costs. Overall, the findings suggest that sustainable investment can be a valuable tool for improving cost efficiency, but its implementation requires careful consideration of the costs and benefits.

## 1.2 Problem Statement

Banks play an important role in promoting ecological infrastructure financing such as; clean water, waste treatment plants, energy projects, and biofertilizer plants depending on the mode of investment (Islam & Das, 2013). Further, by creating funds such as the ―Climate Change Risk Fund" to assess environmental risks. This shows the greater importance of the bank's primary social responsibility. Failure may lead to devastating impacts on the overall society (Dikau & Volz, 2018).

Sustainable investment has been gaining momentum in recent years, as investors become more aware of the long-term impact of their investments on the environment and society. Banks have also been under pressure to increase their stability and be cost efficient, particularly in the wake of the 2008 global financial crisis. Therefore, there is the need to explore how sustainable investment impacts their efficiency in terms of cost management with the influence of the banks' stability. Some studies have suggested that sustainable investment can improve bank stability by reducing risks associated with environmental, governance and social factors. For example, Hasan et al. (2019) found that banks with higher sustainability scores had lower credit risk, lower default risk, and lower systemic risk. Similarly, Clark and Feiner (2019) found that ESG factors can have a positive impact on bank risk. However, other studies have found that sustainable investment can lead to higher costs for banks, which could negatively impact their financial stability. Fontaine and Sylvestre (2017) found that the costs associated with implementing sustainable finance practices in European banks can outweigh the benefits in the short run.

However, a report by McKinsey & Company (2019) highlights that the region's banking sector faces significant challenges, including low returns on equity and high operating costs. Moreover, the implementation of sustainable investment strategies often requires significant upfront costs, which may deter some investors from pursuing such opportunities. This is particularly true in Sub-Saharan Africa, where there is a lack of well-developed ESG regulatory frameworks and reporting standards.

As the concern about environmental and social issues grow, financial institutions are increasingly adopting sustainable investment strategies. This shift raises questions about the effect of these strategies on the cost efficiency of banks and most importantly, the role of bank stability in this relationship.

Previous research has explored sustainable investment and cost efficiency independently, but there is a notable empirical gap in understanding how the bank stability of banks interacts with the relationship between sustainable investment and cost efficiency of SSA banks. While there is some evidence suggesting a positive relationship between sustainable investment and bank performance in developed markets (Eccles & Serafeim, 2013), the extent to which this relationship holds in sub-Saharan African banks remains unclear and also with bank stability role in this relationship.

Therefore, there is a need to examine the effect of sustainable investments on cost efficiency in Sub-Saharan Africa by providing empirical evidence on this effect and how bank stability may influence this effect in the banks.

## 1.3 Purpose of the study

The purpose of this study is to investigate the effect of sustainable investment on cost efficiency in African banks. The study sought to provide empirical evidence on the effect of sustainable investment on cost efficiency and how bank stability may influence this effect in sub-Saharan African banks

## 1.4 Objectives of the Study

The main objective of the study is to examine how banks' sustainable investment influences the cost efficiency of banks in the SSA and the role of banking sector stability in this relationship. The specific objectives are to:

(i) estimate the cost efficiency level of banking activities in SSA countries.

(ii) analyze the effect of sustainable investment on cost efficiency level of banks in SSA countries

(iii) examine the moderating role of bank stability in the relationship between cost efficiency and sustainable investment in SSA countries.

## 1.5 Research Questions

1. What is the cost-efficient level of banking activities in SSA countries?
2. What is the effect of sustainable investment on the cost efficiency level of banks in SSA countries?
3. What is the moderating role of bank stability in the relationship between cost efficiency and sustainable investment in SSA countries?

## 1.6 Significance of the study

The study of sustainable investment, bank stability, and cost efficiency in African banks is significant for several reasons. Firstly, African banks play a crucial role in the continent's economic development by providing financial services to households and businesses. Secondly, sustainable investment practices are gaining importance globally due to their potential to promote long-term value creation, reduce risks, and enhance reputation. Thirdly, bank stability and cost efficiency are essential for the sustainability of banks and the financial system. Therefore, this study aims to investigate the impact of sustainable investment on bank stability and cost efficiency in African banks, which has significant implications for the African banking sector and its stakeholders. The study of sustainable investment, bank stability, and cost efficiency in African banks is significant for the African banking sector and its stakeholders. This study contributes to ongoing discussions about financial institutions' role in sustainability and climate change by shedding light on the importance of sustainable investment practices for promoting environmental and social responsibility in the banking sector. The study aims to investigate the effect of sustainable investment on cost efficiency and how this effect affects banks when they are stable or not, which has significant implications for the African banking sector and its stakeholders. The findings of this study may inform policymakers and financial institutions on how to promote sustainable investment practices in the banking sector, which can contribute to reducing environmental risks and promoting long-term value creation.

### 1.7 Delimitations of the study

The study focuses on sub-Saharan African banks, which have unique characteristics and challenges compared to banks in other regions. The findings may not be generalizable to banks in other regions. It focuses on the period from 2010 to 2017, which is a critical period for sustainable investment practices' adoption and implementation in the banking sector. The study focuses on the banking sector, and the findings may not be generalizable to other financial institutions such as insurance companies and pension funds.

### 1.8 Limitations of the study

The first limitation has to do with the number of sub-Saharan African countries used for the study. The target was to include all the 48 sub-Saharan African countries but unfortunately, the data on sustainable investment, 23 countries out of the 48 did not have a complete data covering the study‘s period. The data used to estimate the cost efficiency levels just ended in 2017 which limited the study‘s period to 2017. This study encountered an empirical review limitation as there was virtually nothing published to examine the role of bank stability on the relationship between sustainable investment and cost efficiency.

### 1.10 Organization of the Study

The entire study is organized into five distinct chapters to enhance clarity of presentation, facilitate reading and ensure understanding. The chapter one of this study enumerates the background to the study, the problem statement, the research objectives, the research questions, significance of the study, the scope of the study, the various

limitations of the study and finally, the organization of the study. The second chapter consists of review of related literature from books, articles, related research work and internet resources which helped the researcher in extracting relevant literature. It consists of both theoretical and empirical literature. The third chapter of the study focuses on the source of data and detailed methodology. It consists of the study design, the research instrument used, data analysis and ethical consideration of the study. Chapter four presents the analyzed data together with its interpretations and finally presents the research findings and thoroughly discusses them. Chapter five, which happens to be the final chapter of this study, features recommendations based on the findings, summarizes the study and draws useful conclusions.

### 1.11 Chapter Summary

Chapter One provides an overview of the entire research work. The chapter begins by outlining the background of the study, which is the role of bank stability in sustainable investment and cost efficiency of banks in Sub-Saharan African countries. The problem statement and objectives of the study are also presented, along with the research questions and the significance of the study. Furthermore, the chapter discusses the scope and limitations of the study, as well as the organization of the subsequent chapters. The scope of the study is limited to Sub-Saharan African countries, and the research focuses on banks. The limitations of the study include the availability of data and the reliability of the data sources. The chapter concludes by presenting the organization of the subsequent chapters, which includes a literature review, research methodology, data analysis, and conclusions and recommendations.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.0 Overview

This chapter reviews relevant studies on sustainable investment, cost efficiency and bank stability. It is organized to include; theoretical review, empirical analysis, and conceptual framework.

## 2.1 Theoretical Review

Physical and transition risk theory as well as stakeholder theory are covered in the study's theoretical review.

### *2.1.1 The Physical and Transition Theory*

The physical and transition theory is a framework that seeks to explain the impact of climate change on the banking industry. The theory posits that climate change will

have both physical and transitional impacts on the banking sector. Physical impacts refer to the direct effects of climate change such as natural disasters, while transitional impacts refer to the indirect effects such as changes in regulations and consumer behavior (Carney, 2015).

Proponents of this theory include scholars, central banks, and regulators who have been analyzing the effects of climate change issues from the perspective of financial stability and risk (Carney, 2015; Battiston et al., 2017; Volz, 2017; Kim et al., 2015). These proponents argue that there is a lack of regulatory and supervisory frameworks to address environmental problems brought about by banks in the banking sector.

To mitigate these risks, more central banks and regulators are becoming conscious of their position and possible role in addressing environmental problems brought about by banks in the banking sector. They are taking action by implementing policies that promote sustainable investment practices among banks (Volz, 2017).

There is no conclusive scientific data regarding how changes in climate will influence the banking industry, according to the Intergovernmental Panel on Climate Change report (2001). Scholars, central banks, and regulators, however, have been analyzing the effects of climate change issues from the perspective of financial stability and risk (Carney, 2015; Battiston et al., 2017; Volz, 2017; Kim et al., 2015). Because there is a lack of a regulatory and supervisory framework, more central banks and regulators are now becoming conscious of their position and possible role in mitigating environmental problems and climate change brought by banks in the banking sector.

The prudential regulation authority (PRA) of the Bank of England (PRA, 2018; Feridun & Güngör, 2020) has recognized the two main financial risk concerns linked to climate-

related changes. Physical risk occurs when a natural disaster, such as a flood, drought, or storm, or an increase in sea level, occurs. It also occurs when systems that affect people and the environment are vulnerable to these events (PRA 2015; PRA 2018; Batten et al., 2016). This leads to investors and depositors withdrawing their funds from the banking sector or increasing the demand for loans to undertake cover or protection against the disaster leading to insolvency risk or increasing the non-performing loan provision. Thus, this can lower asset prices, increasing credit risk and financial losses.

Transition risk occurs when moving towards less pollution, a greener economy, an eco-friendly environment or a low-carbon economy, which is usually conducted in an informal manner (Platinga & Scholtens, 2016; Carney, 2015). Such a transition could shift the banking sector‘s asset values or increase the costs of doing business. For example, when banks grant loans to illegal mining companies, the introduction of policies to curtail the activities of these illegal miners can increase the probability of default in the loan payment. This increases the non-performing loan provision due to impaired loan portfolio which affect the cost of the banks. Also, a shift from the use of non-renewable energy consumption to renewable implies an increase in the overhead costs of banks in the banking sector using non-renewable energy sources which reduces the banks‘ profitability and affects their stability.

### *2.1.2 The Stakeholder Theory*

Stakeholder theory is a management theory that emphasizes the importance of considering the interests of all stakeholders in an organization, not just shareholders. The theory was first introduced by Freeman (1984) in his book "Strategic Management: A

Stakeholder Approach" in 1984. According to Freeman (1984), stakeholders are individuals or groups who can affect or are affected by the actions of an organization.

The stakeholder theory proposes that organizations should not only focus on maximizing shareholder value but also consider the needs and interests of other stakeholders such as customers, employees, suppliers, communities, and the environment. This approach is based on the belief that by satisfying the needs of all stakeholders, organizations can create long-term value and sustainability.

The prosperity of every business is dependent on its stakeholders. The shareholders are key stakeholders of a company and their interests should be considered in addition to other stakeholders. Stakeholders are groups of persons who have an interest in the affairs of the firm. Stakeholder theory is a theory that promotes practical, effective, efficient, and ethical means of managing an organization in a highly complex and dynamic environment (Freeman, 1984; Freeman, Harrison & Wicks, 2007). According to the stakeholder theory, the management of firms should not only focus on shareholders‘ wealth maximization but should also consider the needs of other stakeholders such as customers, potential investors, employees, community, and government which increase the profitability of the firm in the long-term as a result of an increase in buying of firm‘s product (customers), hard work and loyalty to the firm (employees) and better financial terms (financier) (Harrison, Freeman & Abreu 2015).

Thus, according to the stakeholder theory, "management of stakeholders" entails, at least, addressing these stakeholders' well-being and interest (Harrison, Philips & Bosse, 2010) with fairness, honesty, and generosity. The demand of these stakeholders

has changed over the past few decades and now firms are required to satisfy their needs in an environmentally and socially responsible manner.

In recent years, there has been a growing interest in stakeholder theory as a way to promote sustainable business practices and corporate social responsibility (CSR). The demand for socially responsible investing has increased as investors seek to align their investments with their values and beliefs. Stakeholder theory emphasizes the importance of considering the interests of all stakeholders in an organization and has become increasingly relevant in today's business environment where sustainability and CSR are becoming more important considerations for organizations.

Therefore, the stakeholder theory has become a premise for debate on sustainable investment. Thus, it supports the inclusion of the issues of environmental, social and governance (ESG) in the operations of the firm as a way of improving the long-term returns of investors or shareholders while at the same time satisfying the needs of other stakeholders. For instance, studies have shown that firms that do not really adopt environmental policies can adversely affect shareholders' wealth (Marie-Louise & Juliane, 2017; Ming-Te, 2016). The firm's social activities have increased its social performance, which has improved the firm's financial performance, and the stakeholders are more concerned about these activities (Velte, 2017).

The stakeholder theory explains the dynamics of ESG and shareholder value (Freeman, 1984). Shareholders are the primary stakeholders in a firm; hence companies should perform business activities to maximize shareholder interests. Therefore, negative consumer attitudes toward a firm‘s products and services or non-compliance with government regulations and environmental practices may decrease shareholder value

(Eccles et al., 2014). CSR can be explained by the stakeholder theory (Freeman, 1984). The theory states that firms should service a multitude of stakeholders, including shareholders, customers, and employees, rather than shareholders only, so that firms may boost the popularity of products and financial performance (Freeman, 1984). Corporate governance refers to the proper management of a company. For instance, firms should follow good business ethics, as well as disclosure and accountability practices (Shakil et al., 2019). Sustainable business policies cover the areas such as disclosure of financial and operational information to increase stakeholders‘ confidence in the company, gender equality, board diversity to allow various opinions on the firm operations, and so on (Kaymak, 2017).

The stakeholder theory required firms to be ethical, transparent, and accountable to stakeholders (Lerach, 2002; Aboud & Diab, 2018) in respect of their operational activities. Given this, firms recently disclose both financial and non-financial information to stakeholders about their environmental, social responsibility, and governance issues to enhance stakeholders‘ confidence in the firm‘s operation as well as show stewardship (Kaymak & Bektas, 2017). This has led to companies producing voluntary reports including integrated reporting and sustainability reports.

## 2.2 Empirical Review

Below are the existing literatures on the study, sustainable investment and cost efficiency with a moderating role of bank stability. These helps identify the relevant methods, thesis, or dissertation for the study. An empirical review also critically analyzes

and synthesizes the sources, giving a clear picture of the state of knowledge on the subject.

### *2.2.1 Cost Efficiency*

Efficiency is related to the ability to produce a result with minimum effort or resources. It measures how close a production unit gets to its production possibility frontier, which is composed of sets of points that optimally combine inputs in order to produce one unit of output.

There is a volume of literature that has empirically studied the efficiency of banking institutions over the past decades. These studies have applied parametric and/or non-parametric approaches to estimate bank efficiency, most of which have been conducted on developed economies. However, the recent resurgence of economic and financial reforms across the developing countries has also raised the awareness of the importance of bank efficiency for which the current study seeks to explore.

#### *2.2.1.1 Efficiency assessment in the banking industry of developing economies (SSA)*

Ncube (2009) examined the South African banking sector efficiency with the main focus of the study being the cost and profit efficiency of banks in South Africa. Applying the SFA, the study examined cost and profit efficiency of small and large banks. The results indicated that, over the period of study 2000-2005, South African banks significantly improved their cost efficiencies but no significant gains in profitability fronts. The results also indicated that there was a weak positive correlation between the cost and profit efficiencies of South African banks. In addition, most cost-

efficient banks were also most profit efficient. A regression analysis of cost efficiency in bank size suggested a negative relationship, with cost efficiency declining with the increasing bank size. Sanya and Wolfe (2011) used a stochastic frontier analysis to measure the cost efficiency of 40 banks from eight SSA countries over the period 2005–2007. They found that the average cost efficiency score was 0.79, indicating that banks could reduce their costs by 21% on average. They also found that bank size, capital adequacy, asset quality, liquidity, diversification, ownership, and macroeconomic conditions had significant effects on cost efficiency.

Tecles and Tabak (2010) used both Bayesian stochastic frontier and DEA approaches and reported that large banks are the most efficient banks. Their finding shows a lower level of bank cost efficiency in Brazil, with an average cost efficiency score of 0.66. On the determinants of bank efficiency based on a static model, their results report a positive effect of bank capitalization on efficiency. The authors also find no significant relation between non-performing loans and
bank efficiency.

In China, a study by Matthew and Zhang, (2010) applying the non-parametric DEA found out that, on average, efficiency was constant in the Chinese banking industry for the period 1997-2007. The findings showed that the policy of opening up the banking industry was yet to accrue any benefit at the time of the study. However, in relation to bank ownership, comparing State-owned commercial banks, Joint-stock Banks and City Commercial Banks experience efficiency progressively, indicating possible benefits of the liberalization of the banking industry.

Turk-Ariss (2010) uses 821 commercial banks in 60 developing countries from five different regions, including Africa, East and South Asia and Pacific, Eastern Europe and Central Asia, Latin America and Caribbean, and the Middle East for the years 1999–2005. The author‘s aim is to assess the effect of a higher degree of market power on bank efficiency and stability using SFA among others to estimate bank efficiency. The author reports evidence of significant negative relationship between bank market power and cost efficiency and documents that market power is significant and positively associated with bank profit efficiency and overall stability.

In another study, Staub et al. (2010) estimated cost, technical and allocative efficiencies for Brazilian banks for the period 2000 – 2007. The authors applied the DEA approach and found that banks in Brazil are inefficient. The inefficiency in the Brazilian banks was assigned mostly to technical inefficiency rather than allocative inefficiency. The authors explain that the higher technical inefficiency is evidence that the Brazilian banks‘ managers selected the appropriate input mix given the prices. The authors, however, used fewer inputs which could be attributed, for some banks, to the large interest expenses or capital, personnel expenses and a low production. On the other hand, between the period 2003-2007 technical efficiency was greater than allocative efficiency. They conclude that non-performing loans have an effect on allocative efficiency. However, investigating the factors of bank efficiency by applying a dynamic system GMM estimator, the study indicates that non-performing loans have insignificant and negative relationship with bank technical and cost efficiency. Bank capitalization and size also have no significant effect on technical and cost efficiency. In addition, the coefficient of the lagged efficiency (the persistence effect) was positive and significant.

Kiyota (2011) examined whether foreign banks are more efficient than domestic banks using the SFA. The empirical results of the study indicated that foreign banks outperform domestic banks, which are consistent with the Agency Theory postulates, that is, banks with higher leverage or lower equity are associated with higher profit efficiency. In terms of bank size, smaller banks were more profit-efficient, whereas medium-size and larger banks are cost-efficient. On another hand, the findings of the study suggested that non-Sub Saharan African foreign banks were more cost-efficient than Sub-Saharan foreign as well as domestic banks, for the period of 2000-2003.

Kamau (2011), using the non-parametric DEA, investigated intermediation efficiency and productivity in Kenyan commercial banks during the post-liberalization period. The study showed that, though the banks were not fully efficient in all aspects, they performed fairly well during the period under study. Moreover, the commercial banks‘ efficiency score was not less than 40% at any point. In terms of ownership and size, foreign banks were found to be more efficient than local banks, and in the local category, local private banks were more efficient than local public banks, while large-size banks were more efficient than medium and small-size banks.

Gordo (2013) applied DEA to estimate technical efficiencies and productivity of Philippine banks for the period 1999-2009. The results showed a general decline in technical efficiency over the period of the study. The results also indicated that Philippine banks experienced decline in productivity, which was mainly due to declines in technical efficiency changes with weak technological progress over the study period. The study was however not conclusive as the differences in efficiencies and changes in total factor productivity are not supported statistically. Ghosh (2016) shows that banking

globalization may be a precondition for improved efficiency of banking firms, suggesting that greater foreign investment in the banking system of developing economies has an increasing effect on the financial consumer welfare possibly because of a significant reduction in both profit and cost inefficiency which were estimated using the DEA.

#### *2.2.1.2 Parametric versus non-parametric*

In the literature on efficiency studies, the ideas of non-parametric and parametric techniques are widely utilized to measure this frontier function. In a multi-input-output production system, the relative efficiency scores are calculated using the non-parametric methodology known as the DEA method. When compared to the created efficient frontier, it evaluates how well each decision-making unit performed. Best-practice banks, which build the DEA frontier, create certain output combinations with the lowest level of inputs or accomplish the maximum level of output with a given level of inputs, i.e., they function with an optimal input-output combination. Businesses that don't function on the ideal frontier lose some efficiency. Data Envelopment Analysis involves calculating the frontier using non-parametric mathematical linear programming. The approach has the benefit of being easy to apply, and restrictive functional form assumptions are not necessarily beforehand. The fundamental drawback of this method is that it is impossible to separate the inefficiency and random error components of some banks' departures from the efficient production frontier. Regardless of whether the deviation is from inefficient operation or external factors unrelated to management, the variance as a whole is seen as inefficiency. The method's disregard for costs is another issue. The method, which is focused on technology and not economic optimization, is more concerned with assessing technological efficiency.

The parametric methods are considered to be more sophisticated compared to non-parametric techniques, whereby the estimation of efficiency is based on economic optimization, given the underlying assumption of a stochastic optimal frontier. The parametric techniques most frequently used include the Stochastic Frontier Approach (SFA) that was independently developed by Aigner et al. (1977) and Meeusen and Van den Broeck (1977) and the Distribution Free Approach (DFA). Parametric methods allow for incorporating both input allocative and technical efficiencies. The SFA decomposes random error terms and the production unit inefficiency and takes into account the existence of exogenous shocks.

Given that in transition economies the quality of banking data is not perfect and measurement errors are quite widespread, Fries and Taci (2005) argue that parametric methods, which are more robust to data problems, would constitute more suitable empirical tools for analyzing banking efficiency.

#### *2.2.1.3 Which approach to apply?*

There is no agreement on the optimal estimate approach for efficiency measurement because both the parametric and non-parametric methods have advantages and shortcomings of their own. When assessing different aspects of a firm's efficiency, both parametric and non-parametric estimating methodologies perform well. However, parametric procedures are frequently used because they typically align well with principles of cost and profit efficiency. Since non-parametric methods typically neglect pricing, they can only account for technical inefficiency and not allocative inefficiency (Berger & Mester, 1997). The SFA presents the random disturbance factor independently from the one-sided inefficiency scores of the particular company, but the DEA reports

both the inefficiency scores and the random error term as one, which results in erroneous efficiency metrics. Therefore, a more reliable assessment of the bank's efficiency ratings is provided by the SFA technique. Based on this, this study used the SFA to determine the cost effectiveness of the sample banks.

### *2.2.2 Sustainable Investment and Cost Efficiency*

By converting funds from investors into investment opportunities with risks associated with desired returns, conventional investing creates value. To enhance long-term results, sustainable investing combines social, environmental and governance consideration with conventional investing. Sustainable investing can be seen as a part of the evolution of investing in a number of ways. Businesses and investors are becoming more aware that some ESG factors have an impact on the economy, particularly over the long term, and that it is crucial to include relevant ESG factors in decision-making. The sustainable investment aims to consider the interest of diverse stakeholders which is in line with how businesses are evolving. As interest in sustainable investing grows, so does the demand for investment organizations to shift to a sustainable investing model. Sustainable investors, ranging from global institutions to individuals, mix traditional investment strategies with ESG data to achieve their investment objectives. Sustainable investing seeks out companies that are well-positioned to grow while also doing good and pioneering innovative business practices. This technique blends a desire to serve others with a return-oriented mindset.

The goal of undertaking sustainable investment (ESG) is to boost the profitability by investing in well-managed, socially responsible businesses. Environmental challenges

include things like climate risk, carbon management, pollution, exposure to adverse weather and the exploitation of limited resources. Social challenges include things like diversity and inclusion, workplace safety, customer data protection, product safety, and human rights; governance issues involve matters like regulatory compliance, corporate accountability, and overall effective board control.

ESG investors assess and evaluate firms based on data and the impact of ESG risks and opportunities on the company's performance. This strategy typically encourages long-term investments while maintaining the same level of financial rewards as a standard investment strategy. While ESG investing promotes investment opportunities that benefit society and the environment, the primary focus is on portfolio performance. ESG measures help investors protect their investments from new sources of risk in the future.

The inclusion of ESG aspects is the rapidly growing and most prominent means of sustainable investment (Akhigbe & McNulty, 2005; Galbreath, 2013). Despite the increasing global popularity of sustainable and ESG-related investments, there is still a disparity in practice and concept across geographical locations (Bengtsson, 2008). Even though sustainable investment has grown rapidly in areas such as America, Australia, and Europe, it has been more sluggish in developing countries (Nair & Ladha, 2014) like Africa. ESG techniques have also resulted in variations in sustainable investment decisions due to a range of causes. When constructing portfolios, investors and asset managers commonly assign varying degrees of emphasis to each ESG component. Additionally, governance is not seen as a crucial component that integrates into ESG strategies but rather as a pillar that stands alongside the environment and society

(Hickman, Teets & Kohls, 1999; Cadman, 2011). Furthermore, Osthoff and Kempf (2008) reported that ESG-driven mutual funds investment process brings additional costs and charged higher fee ratios. Although ESG provides a suitable framework for long-term investing, such challenges cast doubt on the approach's legitimacy.

A more recent study has been conducted by Deloitte in 2017, on the Nigerian banks focusing on sustainable investing. Deloitte‘s latest sustainable banking research highlights important trends in the banking industry towards ESG conscious lending and investments, and some challenges faced by financial institutions in the process (Deloitte, 2017). In this survey of Nigerian Banks, the Deloitte Global Sustainability Services leader Eric Dugaley suggests that the traditional banking sector has changed over the years, in terms of their capital market decisions - in addition to just risk and return, the new banking sector adopts impacts into their capital decisions as well. In this article, Dugaley notes that the biggest difficulty with sustainable investing in modern times is the inability to determine the risk and return of the green projects. Despite the challenges of sustainable banking, studies have shown business benefits such as higher and more stable profits and stronger growth of responsible banks relative to the irresponsible ones.

Further in this study, it was also discussed the importance of sustainable banking. He adds that the benefits of sustainable banking can range from investor confidence to improved reputation for banks (Deloitte, 2017). According to this study, the Nigerian banks are increasingly shifting their focus from only managing their environmental and social risks to also looking for more sustainable investing opportunities by screening the companies by their green and sustainable actions. The Deloitte study on Nigerian Banks concluded that the banks were ―highly committed to sustainability” and saw potential

links between their sustainable investments and their business benefits, however, the study also revealed that the banks lacked the important data and the tools to integrate sustainable banking principles in their core company values and their goals (2017).

There are studies that have examined the relationship between sustainable investment and cost efficiency of SSA banks and also, other studies talk about how sustainable investment influences other factors. Some of the main findings are:

A study by Velte (2017) examined the effect of social, environmental, and governance performance on the financial performance by individual pillars and collectively. Data was obtained from 2010 to 2014 from a sample of listed companies on the German prime standard (TecDAX, MDAX and DAX30) and the Thomson Reuters' Assets4 database. The findings indicated that collectively social, environmental and governance performance boost profitability. However, individual governance performance has the highest effect on financial performance, followed by environmental and social performance.

Ahmed, Ahmed and Hasan (2018) support the ESG consideration in the lending decisions due to the positive relationship between ESG and financial performance of the companies. Ahmed et al. (2018) concluded that banks considering the environmental, social and governance factors in their decisions, perform better in the long term. The authors conduct the research using the data on separate E, S and G factors and use the Return on Assets variable as the dependent variable of the regressions. Their findings reveal that among the ESG factors, the environment was the least important whereas the governance factor was the most significant in influencing the ROA of banks.

Abdul-Majid et al. (2010) used a meta-frontier analysis to compare the cost efficiency of 162 banks from 22 SSA countries over the period 2000–2007. They found that the average cost efficiency score was 0.67, indicating that banks could reduce their costs by 33% on average. They also found that foreign-owned banks were more cost efficient than domestic-owned banks, and that macroeconomic stability, financial development, and institutional quality had positive effects on cost efficiency.

Shakil, Mahmood, Tasnia and Munim (2019) examined how financial performance of banks in developing economies is affected by environmental, social and governance performance. After collecting data on the ESG index and financial performance of 93 banks from the Asset4 database and Refinitiv Datastream database from 2015 to 2018 using the dynamic GMM model and as estimation technique. The social and environmental performance had a positive and significant impact on banks performance according to the findings. However, in the case of an emerging market, the study found no impact of corporate governance on bank performance. Some studies such as those of (Dincer, Celik, Yilmaz & Hacioglu, 2014; Miras-Rodrguez, Carrasco-Gallego & Escobar- Pérez, 2015; Esteban-Sanchez, Paredes-Gazquez & Cuesta-Gonzalez, 2017) all indicated a positive and significant relationship between financial performance and corporate governance.

A study by Buallay (2019) investigated the relationship between ESG and banks‘ operational, financial, and market performance. The study used return on assets, return on equity and Tobin‘s Q for banks‘ operational, financial and market performance respectively for the firm with bank-specific (total and financial leverage) and macroeconomic factor (GDP) as control variables. A sampled data from 235 listed banks

on the European Union countries stock exchange was obtained from the Bloomberg Database for a period of 10 years from 2007 to 2016. The study adopted path analysis, panel causality test, and random-effect model. The result of the study showed that ESG overall has a significant positive relationship with bank performance. However, considering the individual element of ESG, a positive correlation was found between environmental disclosure and Tobin‘s Q and ROA. Social responsibility negatively affects ROA, Tobin‘s Q and ROE whereas corporate governance positively affects Tobin‘s Q but negatively affects ROA and ROE. It was found that Tobin‘s Q granger caused ESG from the Granger causality test. This shows inconsistent evidence in literature with regards to governance aspects of ESG and financial performance.

According to (Popli, Ladkani, & Gaur, 2017; Popli, Akbar, Kumar, & Gaur, 2017), firms that plan their actions in accordance with the dynamic environment are best positioned to prevent profitability erosion. As a result, in order to profit, environmental awareness is required. Furthermore, social actions must be disseminated in both formal and informal ways so that investors and stakeholders understand the firm's social responsibilities (Hwang & Gaur, 2009).

Adu (2022) looks into how corporate governance disclosure affects sustainable banking initiatives from a broader perspective and then assesses how much corporate governance principles influence the sustainability for performance sensitivity metric. For country-level data over an 11-year period, data was gathered from the websites of the sampled 220 banks from 16 Sub-Saharan African countries, the World Bank, and the IMF (2007 to 2018). The study adopted the OLS model and GMM estimator. The results of the study showed that sustainable banking initiatives help banks in Sub-Saharan Africa

enhance their financial performance. Effective corporate governance has an impact on long-term decisions. This suggests that the sustainability for performance sensitivity metric is generally favorable and improves in banks with sufficient corporate governance systems.

The long-term viability of a bank's financial performance is dependent on its sound corporate governance systems.

A study on the empirical effects of social responsibility performance on the value relevance of financial data in the Polish banking industry was conducted by Bolibok (2021). The sample data from 17 Warsaw Stock Exchange-listed banks from 2009 to 2020 was collected for the study. The study uses multivariate regression analysis that discovers the structural breaks based on the Chow test and the Ohlson model. The findings indicate that financial disclosures of banks included in CSR indexes are more value relevant. Also, banks with a more commitment to social responsibility have market prices that are more (less) responsive to book value of equity (net earnings) than competitor banks which are less socially responsible.

Bernardelli, Korzeb, and Niedzióka (2022) evaluated the effect of financing fossil fuel on banks' ESG ratings and the application of this to their investment and actual credit risks. Consequently, to ascertain whether coal power finance has an effect on ESG ratings. The largest fossil fuel firms in the world are financed by a sample of 60 of the most prestigious banks in the world. Following the adoption of two logistic regression models, which were later integrated into a single final model, one was used to identify banks with less ESG risk and the other to predict banks with greater ESG risk. The study discovered that, in comparison to the low- or medium-risk ESG groupings, the likelihood

of being assigned to the high-risk ESG category lowers as the Sustainable Development Index (SDI) increases. Additionally, it was shown that while banks' exposure to the fossil fuel industry is growing, their environmental and social responsibility scores for the world‘s largest biggest banks have not yet reflected. The findings also demonstrated that actual risk of firms in the coal sector had an impact on ESG ratings, both low and high. However, none of the financial position evaluation categories (asset quality, profitability, liquidity, and solvency) had a statistically significant influence on their ESG ratings.

In order to reorient a regional and local bank's business toward sustainability, Hörnlein (2015) looked at sustainable banking principles and socially responsible investment. This study, which assumes a positive relationship between CSR and financial performance, concludes that expanding banking operations into the sustainability niche does produce positive financial returns and even better performance than conventional banks. Credibility and reputation are related to this, particularly in times of economic distress.

A study by Talan and Sharma (2019) systemically reviews the literature on sustainable investing with concentration on how effective ESG is as a sustainable investment strategy. In a study, 213 literature papers were reviewed and analyzed. They found that ESG integration was the world's second most popular sustainable investment approach, with the leading regions such Asia, Oceania and the United States. They also found it one of the most popular long-term investment ideas. In addition to ESG, the study identified positive screening, corporate contact and community investing as other important methods of achieving long-term success. However, ESG was a critical

approach to sustainable investment and that evidence suggests variations in how different firms and investors implement ESG strategy.

Crespi and Migliavacca (2020) looked at the determinants of ESG rating in the financial industry using global sample data from 727 financial firms, both banks and non-bank institutions, operating in 22 countries from 2006 to 2017, looking for firms, countries, and temporal factors that affect corporate social performance. The study employed the Pearson correlation and ordinary least square regression model to analyze the data. The findings from the study indicate that higher firm size leads to higher ESG scores. Return on equity was found to positively and significantly affect ESG scores of financial firms while a negative impact was found for leverage. Moreover, nations with a civil law system and developed economies seem to positively influence corporate social performance. The corporate social performance of financial firms was assessed using the MSCI-ESG scores, based on the three pillars: social, environmental and governance. The environmental pillar consists of indicators such as footprint, carbon emissions, as well as corporate climate change sensitivity. It also assesses a firm's dedication to ongoing research into environmentally friendly materials and techniques. Management's ability to implement cutting-edge corporate governance and behavior norms is measured by the corporate governance factor. It focuses on board diversity and unequal pay, as well as business ethics and transparency in general. The social pillar measures the company‘s effort to build loyalty and trust among its stakeholders such as enhancing job conditions, protecting human rights and safety and strengthening its reputation in the society. The study further identified that the size of the firm was an important variable indicator of the improvement in corporate social performance. Thus, the result showed that big financial

institutions are driving the overall improvement in CSP, while small businesses are struggling. This was because small financial institutions lack the necessary financial and organizational resources to implement certain external and internal sustainable practices.

The sustainable investment is measured using the three factors that are environment, social and governance. These are empirical explained as follows;

#### *2.2.2.1 Environmental Factor*

Climate change is a major world environmental concern. Literature suggests that human activities also contribute to this climatic change. Over time climatic changes have shifted from environmental threat to an economic risk (Zouabi, 2021). This economic risk influences the financial system at the macroeconomic level (Battiston et al., 2017). Multinational corporations are already devising strategies for utilizing renewable energy to become a carbon-neutral company (Unilever, 2019), fight climate change (Apple, 2018), address the world's most serious environmental concerns (P&G, 2019), or assist in carbon [emissions] reduction (Nestle, 2018).

However, ESG may increase bank expenditures due to the additional investment requirements in environmental activities, such as reduction in carbon emissions, use of renewable energy, prevention of air and water pollution, planting trees, etc. Many banks implemented environmental activities as a result of government requirements that need to be considered when evaluating the performance of listed firms (Crespi & Migliavacca, 2020). The question of whether over-investment in environmental activities leads to a favorable financial position remains unanswered in the literature (Shakil, Mahmood, Tasnia & Munim, 2019).

Prior studies indicated that the impact of environmental activities on bank performance varied. Some researchers found that environmentally friendly activities improved a bank‘s financial performance. In other words, banks that disclosed efforts of minimizing carbon emissions generated greater profits. Such disclosure also increased the bank‘s market value (United Nation, 2020). Buallay (2019) studied the performance of 235 banks from 2007 to 2016 and ascertained that environmental disclosure positively affected the banks‘ return of assets (ROA) and market value as measured by Tobin‘s Q. Similarly, Miralles-Quirós et al. (2019) studied 51 banks in the U.S. and Europe from 2002 to 2015. These authors claimed that environmental endeavors positively influenced the banks‘ market value and earnings per share (EPS). Crespi et al. (2020) examined ESG activities and financial performance using data for 727 financial firms from 22 developed countries from 2006 to 2017. The results revealed that a higher environmental score led to increased profitability.

In contrast, other studies found that the disclosure of environmental activities had a negative impact on banks. For example, Forgione et al. (2020) used a one-step SFA method to examine ESG and bank efficiency in primarily developed economies from 2013 to 2017. They found the disclosure of environmental activities reduced bank efficiency. Similarly, Dell‘Atti et al. (2017) investigated the impact of the banking industry during the 2008 subprime mortgage crisis by studying the correlation between bank reputation and economic performance. The results suggested that environmental activities had a negative but insignificant effect on reputation and bank performance. In a study by Tommaso and Thornton (2020), the European banks that received high ESG

scores by engaging in more carbon-emission-reduction activities became less willing to take a risk, thus diminishing bank value for the shareholders.

However, the move to renewable energy, reduction in carbon emission, and combating climate change is a capital-intensive decision that will necessitate significant engagement from financial institutions. Banks are likely to be crucial in helping a country transition to renewable energy and strengthen its financial resilience to environmental threats according to Semieniuk and Mazzucato, (2018). In the quest of assisting to solve environmental challenges, the banks reduce their assets in the form of granting loans, which threaten their financial performance. In addition, loans granted by banks to customers that increase environmental risk led to an increase in the non-performing loans of the banks most especially in this era where countries enact various anti-pollution laws. Environmental indicators such as electricity production from coal sources energy, $CO_2$ emission and methane emission indicating amount of carbon dioxide and methane in the atmosphere, people using safely managed drinking water services, PM2.5 air pollution, mean annual exposure, access to clean fuels and technologies for cooking, forest area, fossil fuel energy consumption, nitrous oxide emissions, people using safely managed sanitation services renewable electricity output, renewable energy consumption, terrestrial and marine protected area, and natural resources depletion. These indicators are environmental metrics used to assess how effective and efficient countries are promoting a sustainable environment. A lower value for environmental factors indicates a poor concern for environmental issues hence increased in environmental risk. However, higher value for the environmental factor suggests a move towards more eco-friendly environment.

#### *2.2.2.2 Social Factors*

The existence of a bank in a country supports the citizens' social needs. These CSR activities include the production of high-quality products and services for customers, payment of fair salaries to employees, provision of health care and educational programs to the community, in addition to profit maximization for shareholders.

The banking sector performs social responsibilities that promote the well-being of the people. As the banks give to society, in exchange society reciprocates by patronizing their products and services which increases the profitability of the banking sector making them more stable. The banking sector as part of its social responsibilities advocates for gender equality, respect for human rights, implementation of community-based development projects, and many more which generate loyalty and trust with its workforce, customers, and society which is positively related to bank efficiency (Bauer, Derwall, & Otten, 2007). The social variable is made up of factors such as proportion of seats held by women in national parliaments (gender), strength of legal right index (human rights), population density (population) and access to electricity (access to service).

However, CSR may produce a positive influence on bank performance due to a better perception of the stakeholders of the firm‘s attitude toward social responsibility. Shakil et al. (2019) argued that because stakeholders were more interested in the firms‘ disclosure of social activities, and the implementation of CSR programs may lead to an overall improvement of the firm performance. Dell‘Atti et al. (2017) studied the correlation between firm reputation and economic performance using 75 large

international banks during the 2008 subprime mortgage crisis. The results suggested that social welfare was positively correlated with firm reputation with some possibility of improving the firms‘ economic performance. Similarly, Forgione et al. (2020) found that the disclosure of CSR activities had a positive impact on bank efficiency only in common law countries, such as the U.S., Australia, and countries with stakeholder protection. These studies confirmed the stakeholder theory that activities benefiting stakeholders increase their contributions to the firms and led to improved financial results.

Population of a country affects the number of people who use the banking service. The human right index also suggests how the rights of the citizens are protected and respected in the country. A higher value for the social factor suggests satisfaction of citizens with the services provided by the banking industry hence banks being efficient.

#### *2.2.2.3 Governance Factor*

Good corporate governance aims to align the interests of shareholders and managers so that the two groups of people cooperate to strengthen firm performance (Forgione et al., 2020). Hence, companies with strong corporate governance may reduce the conflict between shareholders and managers (Barnea & Rubin, 2010). Companies with poor corporate governance are likely to face high agency problems and lower profitability (Miras-Rodríguez et al., 2015).

Institutional and country governance quality is important for bank efficiency. For example, to safeguard the interest of depositors and investors the regulators of the banking sector make macro-prudential policies that protect them. Corporate governance that prioritizes stakeholders may be essential for boosting social goals and bank moral

capital. Gaganis et al. (2020) conducted extensive study for a large cross-country sample. They concluded that there is an emergence of positive impact of corporate governance as macro prudential policies tighten.

Prior studies reported mixed results regarding the impact of corporate governance on bank performance. Birindelli et al. (2018) used a fixed-effects panel regression model to analyze the relationship between the composition of the board of directors and the ESG performance among 108 listed banks in the U.S. and Europe from 2011 to 2016. They used female directors, the board size, and the Corporate social responsibility (CSR) committee as the governance variables. The empirical results presented an inverted U-shaped relationship between the female directors and firm performance. The evidence suggested that only a gender-balanced board had a positive impact on the bank‘s overall ESG performance. In addition, ESG programs produced a positive impact on the board size and the existence of the CSR committee. Miralles-Quirós et al. (2019) investigated the relationship between ESG and bank performance using 51 banks in the U.S. and Europe from 2002 to 2015. The results indicated that governance had a positive influence on market value and EPS. In addition, Miralles-Quirós et al. (2019) scrutinized ESG and bank financial performance in Europe and found that the governance factor produced a positive effect on bank market value.

However, other researchers found governance negatively affected bank performance in emerging countries and some European countries. Azmi et al. (2021) examined the relationship between the disclosure of ESG activities and bank value based on 251 banks from 2011 to 2017 from 40 emerging economies. The results revealed that governance had a negative impact on bank market value. El Khoury et al. (2021) investigated the

financial performance of 46 banks in the Middle East, North Africa, and Turkey (MENA region) from 2007 to 2019. The empirical evidence showed that in the long run, bank costs exceeded the benefits of social and governance programs. Similarly, Buallay (2019) found that governance disclosure negatively impacted the financial performance of European banks.

A recent study in Africa on corporate governance, regulation and banking by Agbloyor, Kusi, Abor, and Ntim (2022) discovered a negative correlation between banks and the corporate governance structure at the country level. The selected indicators are government effectiveness, regulatory quality, rule of law, political stability and absence of terrorism and control of corruption. These selected governance indicators were used in studies by Ozili (2018) and Kaufmann et al. (2011) as control variables. However, this application differs in our study, as they constitute one of the pillars of sustainable investment (ESG) which is a variable of interest. A higher value for governance factor suggests effective government and institutional quality in the country in which banks operate. Thus, the more effective the governance and institutional quality of a country, the more efficient the banks become in terms of operations.

From the literature, the study analyzes the null and alternative hypotheses and they are as follows;

$H1_0$: Sustainable investment has no effect on the cost efficiency level of banks in SSA countries.

$H1_a$: Sustainable investment has a positive effect on the cost efficiency level of banks in SSA countries.

### *2.2.3 Banking Stability*

Banking stability is attained when all banks in the banking system are stable, which is characterized by the absence of banking crises (Brunnermeier et al., 2009). Banking stability can also be described as the banks' direct or indirect interdependence, such as credit to popular sectors and private equity (Goodhart & Segoviano, 2009). The absence of unusual disruptions in bank lending, payment services, or financial products is referred to as banking stability (Ozili, 2018). An analysis of banks‘ stability is key as it contributes to the growth and stability of the entire economy.

#### *2.2.3.1 Moderating role of Stability in the relationship between Sustainable Investment and Cost Efficiency in SSA Banks*

Some studies have examined the relationship between bank stability and bank efficiency separately and relationship between sustainable investment and bank stability separately, using different methodologies and samples. Some of the main findings are:

Asongu and Odhiambo (2019) used a panel data analysis to investigate the impact of banking system stability on economic growth in 42 SSA countries over the period 1980–2014. They found that banking system stability had a positive and significant effect on economic growth, both in the short run and in the long run. They also found that the effect was stronger for countries with higher levels of financial development, trade openness, and institutional quality.

Fiordelisi and Mare (2014) used a frontier analysis to estimate the cost efficiency of 301 banks from 21 SSA countries over the period 2000–2009. They found that the average cost efficiency score was 0.74, indicating that banks could reduce their costs by

26% on average. They also found that cost efficiency had a positive and significant effect on bank stability, measured by the Z-score. They suggested that cost efficiency could enhance bank stability by improving profitability, capitalization, and risk diversification.

In a study by Alguindigue (2020), explored the relationship between sustainable financial practices and financial stability. The study used data from a sample of 149 banks from 17 Latin American countries for a period of 11 years (2008 to 2018), obtained from the databases of the International Monetary Fund (IMF) and banks' consolidated financial statements. The countries with sustainable finance regulation practices and those without were classified depending on the banks that were sampled. For the analyses, the study used the Z-score as a proxy for financial stability and employed various statistical tools such as the random effect regression model, Wald test, binary logit regression and dynamic panel 2-step GMM estimator. The study found statistically significant differences between banks in countries without and with sustainable banking regulations. The findings also indicated that sustainable finance regulations enhance sustainable banking practices and financial stability. Moreover, there is higher financial stability in banks found in nations with sustainable finance regulations.

Adegbite et al. (2020) used a panel data analysis to examine the relationship between ESG performance and bank stability in 18 SSA countries over the period 2007–2016. They found that ESG performance had a positive and significant effect on bank stability for sustainable investment.

Tan and Anchor (2016) looked into the link between stability and profitability in the Chinese banking system. Between 2003 and 2013, 12 joint-stock commercial banks, 5 state-owned commercial banks and 83 city commercial banks were examined. The study

used return on assets as a proxy for profitability and employed the GMM approach to analyze the data. They discovered greater bank instability to be associated with higher profitability, which suggests that greater bank fragility in the Chinese commercial banks results from higher profitability. Tan and Anchor (2016) concluded that bank efficiency is also a considerable determinant when it comes to banking stability.

According to research by Chiaramonte et al. (2021) which examined the independent and joint effects of social, environmental and governance ratings on the stability of banks. From 2005 to 2017, the study employed 21 banks from various European countries. The panel linear regression model was employed, and the results indicate that the ESG score and its component pillars reduce bank fragility during recessions. Banking institutions with higher ESG ratings experience this stabilizing effect more strongly. Results indicate that the benefits to stability increase with the length of ESG disclosures during financial crises. The study shows that depending on the characteristics and operational contexts of the banks, the relationships between ESG and bank stability vary significantly.

A study by Tóth, Lippai-Makra, Szládek, and Kiss, (2021) investigated how different ESG scores affect capital adequacy ratio estimation (total and environmental only). ESG score as a proxy variable for capturing a bank's non-financial soft skills. Thus, it is used to represent a bank's ethical standards in the long-run. The study employed quantile regression and an unbalanced panel regression model to analyze the data obtained from 2002 to 2018 from 247 banks in the European Economic Area. The result showed that the ESG score is a significant contributor to financial stability. It makes it easy in identifying certain, more financially stable market segments. The

findings from the quantile regression indicated that greater ESG score was associated with higher capital adequacy ratio. Thus, it explains the disparities between banks with low and high capital adequacy levels.

This study examines the role of social and governmental responsibility on bank stability and profitability in 14 countries. The study used cross-country bank-level panel data spanning from 2011 to 2018 is used. Two-step system generalized methods of moments alongside both panel-corrected standard error and feasible generalized least squares models were applied to ensure the robustness of the results. The authors find that social factors, such as the degree of financial inclusion and literacy, can affect bank stability by influencing the demand and supply of credit (Kanapiyanova et al., 2022).

This study investigates the role of governance factors, such as board of directors, ownership structure, CEO compensation, risk, and audit committee, on bank stability in the Middle East and North Africa (MENA) region from 2008 to 2016. The authors find that governance factors have a significant influence on bank stability, and that different types of banks have different optimal governance structures (Nesrine Djebali, 2023). The study also found that state-owned banks have lower stability than private banks, and that foreign banks have higher stability than domestic banks.

The empirical studies have not explicitly examined the moderating role of bank stability in the relationship between cost efficiency and sustainable investment in SSA countries; previous work tends to address them separately.

From the literature, the study analyzes the null and alternative hypotheses and they are as follows;

$H2_0$**:** Bank stability does not moderate the relationship between cost efficiency and sustainable investment in SSA countries.

$H2_a$**:** Bank stability moderates the relationship between cost efficiency and sustainable investment in SSA countries.

## 2.3 Control variables

The variables used as independent variables to explain the cost efficiency were categorized into banks‘ specific performance, financial structure, macroeconomic factors, and environmental, social, and governance factors.

### *2.3.1 Banks Specific Performance*

The study used four variables to represent the banks-specific performance which are control variables: net income margin (NIM), capital adequacy ratio (CAR) and cost to income ratio (CIR). NIM measures the profitability in the banking sector (Athanasoglou et al., 2008; Ozili & Uadiale, 2017; Ozili, 2018). This is because profitable banks have higher NIMs hence are more cost efficient than unprofitable banks (Dwumfour, 2017).

Bank capital adequacy ratio (CAR) indicates how much they are required to keep as risk capital in order to cover the risks they take. Higher CARs enable banks to have enough capital to absorb possible unforeseen losses when they occur according to theory. Olalere et al. (2017) found that CAR has a positive and significant effect on ROA of Nigerian banks. They argued that higher CAR indicates better management of assets and lower operational costs. However, Rastogi et al. (2022) found that CAR has a negative and significant impact on ROA and ROE of banks in different countries. They suggested that higher CAR may imply lower leverage and lower returns for shareholders. Moreover,

Almazari (2014) found that CAR has no significant effect on ROA and NIM of UK commercial banks.

The cost to income ratio (CIR) variable measures the effectiveness of the banks. Thus, CIR indicates the operational efficiency of the banking sector. A lower CIR should be correlated with improved banking efficiency. When bank profitability is higher and stability is higher, a lower CIR improves bank profitability (Pasiouras & Kosmidou, 2007; Athanasoglou et al., 2008; Olson & Zoubi, 2011).

These variables are important because they can directly impact a bank's cost structure and operational effectiveness, which in turn can influence its cost efficiency. Therefore, bank specific performance may affect the cost efficiency of banks through various channels. For example, higher profitability may enhance the capital base and reduce the reliance on external funding, which may improve the cost efficiency of banks. However, higher asset quality may imply lower risk-taking and lower returns, which may reduce the cost efficiency of banks (Fiordelisi & Mare, 2014; Adegbite et al., 2020).

### *2.3.2 Financial Structure*

The study employed three variables to proxy the financial structure of the banking sector of a country namely: size of the banking sector (SIZE), banking concentration (BCON) and the presence of foreign banks in the banking sector of the country (FBP).

The SIZE of the banking sector is measured in this study as private deposit money to GDP as employed by Ozili (2018). How large or small a country's banking industry is has a direct impact on the size and scope of financial intermediation within its financial system. If there is a strong regulatory structure in place to address the systemic risk, it is

expected in the large banking sector than small banking sector to be cost efficient. The size of the banking industry should be positively correlated with cost efficiency. A large banking industry may be associated with increased inefficiency. (Ozili, 2017b). If competition is high, it causes banks to take enormous risks which may lead to losses in times of poor economic condition. In this case, a negative relationship is likely to be assumed between size and banking efficiency.

The depth and breadth of a financial system's financial intermediation are increased by the presence of foreign banks in a banking industry. This is because foreign banks bring innovation to financial services offered to users through the introduction of new technologies and financial products and services. The foreign bank presence (FBP) variable for this study is measured as the ratio of the number of foreign banks among the total number of banks in the banking sector of a country. It anticipates a positive relationship between FBP and banking cost efficiency. Abdul-Majid et al. (2010) found that foreign-owned banks were more cost efficient than domestic-owned banks, and that macroeconomic stability, financial development, and institutional quality had positive effects on cost efficiency.

In this study, banking concentration (BCON) is determined by comparing the assets of the three major commercial banks to all commercial banks in a given banking sector. The association between banking efficiency and banking concentration, or whether bank concentration is good or bad, is the topic of numerous theories, according to Safarzyska and Vanden Bergh (2017a). We therefore do not have a firm expectation of the relationship between bank concentration and banking efficiency.

Therefore, financial structure, such as bank size, ownership, etc., may affect the cost efficiency of banks by influencing their market power, economies of scale, diversification benefits, and governance. For example, larger banks may have lower costs due to scale economies and market power, which may improve their cost efficiency. However, foreign-owned banks may have higher costs due to cultural and regulatory differences, which may reduce their cost efficiency (Abdul-Majid et al., 2010; Claessens et al., 2001).

### *2.3.3 Macroeconomic Factors*

The study adopted three macroeconomic factors which may influence the stability in the banking sector such as unemployment (UNE) and economic growth (EG).

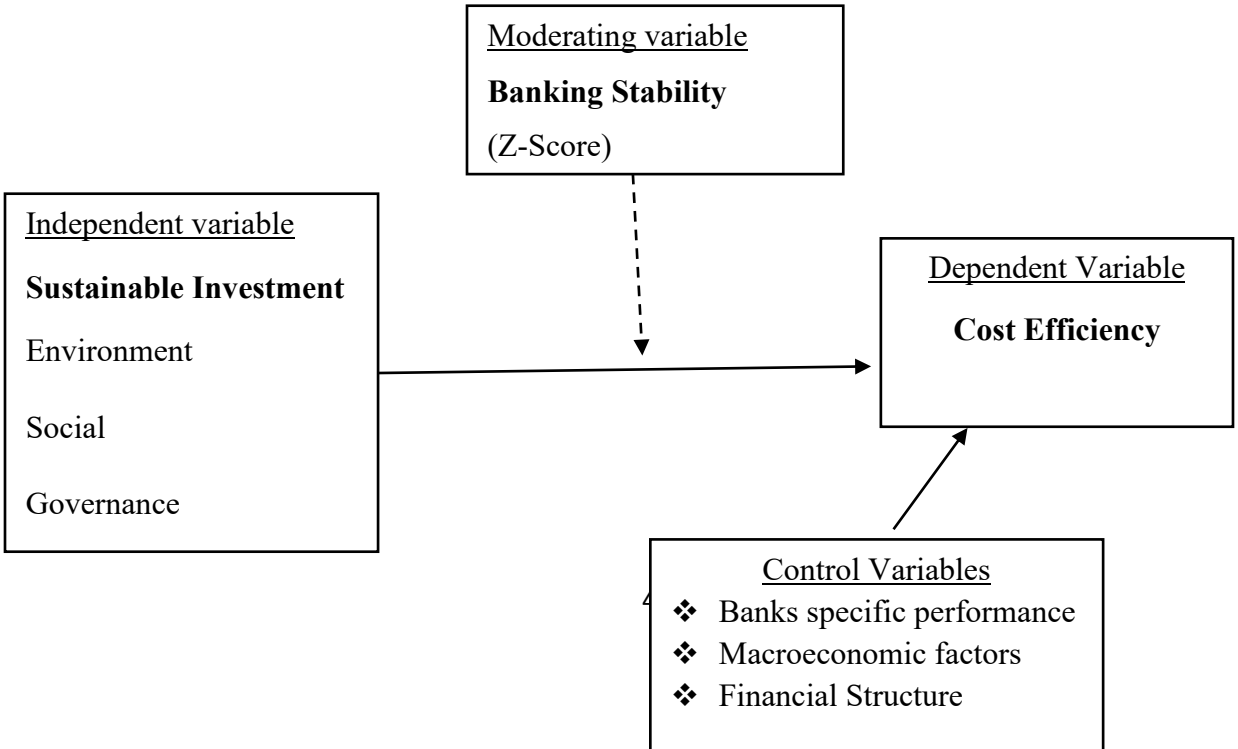
A macroeconomic factor that could affect the cost efficiency of the banking industry is unemployment, as borrowers are more likely to apply for loans when unemployment is high. In a period of high unemployment and job loss, borrowers mostly default on the interest on loan or loan repayment. Boating et al. (2015) indicated that high unemployment leads to high loan default which increases the credit risk of banks resulting in greater banking efficiency.

Another macroeconomic factor which the study considered to influence efficiency in the banking system is economic growth (EG). During a period of higher economic growth, loan defaults tend to reduce (Laeven & Majnoni, 2003) and banks enjoy improved performance making them more efficient. Economic growth is measured in this study as real GDP growth rate.

Macroeconomic factors may affect the demand and supply of credit, the cost of funds, the value of collateral, and the risk of default, which in turn may influence the cost efficiency of banks. For example, higher GDP growth may increase the demand for credit and reduce the default risk, which may improve the cost efficiency of banks. However, higher inflation may increase the cost of funds and erode the value of collateral, which may reduce the cost efficiency of banks (Bikker & Hu, 2002; Boateng et al., 2018).

### 2.4 Conceptual Framework

The set of ideas, presumptions, expectations, convictions, and theories that serve as the researcher‘s guide and direction make up a conceptual framework (Boateng, 2020). Thus, a conceptual framework is developed from a review of literature, concepts, and theories to develop suggestive theory. In this study, the objective is to assess the impact of sustainable investment particularly, environmental, social, and governance (ESG) factors on cost efficiency, using stability as a moderating variable. The conceptual framework is as follows;



**Source: Authors construct**

Figure 1: Conceptual Framework of Sustainable Investment on Cost Efficiency, a moderating role of bank stability

The conceptual framework in Figure 1. illustrates the relationship between sustainable investment and cost efficiency, with bank stability as the moderating variable. The framework is based on the researcher's model and includes control variables such as bank-level variables, macroeconomic factors, and financial structure.

The framework suggests that sustainable investment can contribute to cost efficiency. This is because sustainable investment can help banks identify financially stable market segments and improve their risk management practices. Additionally, sustainable investment can help banks reduce costs by improving their operational efficiency and reducing their exposure to risks.

The control variables in the framework are important because they can affect the relationship between sustainable investment and cost efficiency. For example, macroeconomic factors such as unemployment and economic growth can affect the profitability of banks and their ability to maintain their operations. Financial structure, such as the bank size, bank concentration and foreign bank presence can also affect bank efficiency.

The conceptual framework provides a useful guide for understanding the complex relationship between sustainable investment and cost efficiency. It highlights the importance of considering ESG factors in banking practices and provides a framework for analyzing the impact of these factors on bank performance.

## 2.5 Chapter Summary

The above literature reveals the following research gaps. First, most of the studies that explore the linkage between sustainable investment and cost efficiency studies have concentrated on advanced banking markets with less attention being paid to sub-Saharan African (SSA) countries. Consequently, empirical evidence on this linkage on the SSA countries banking sectors is relatively scarce. Again, virtually nothing has been published to examine the role of bank stability on the relationship between sustainable investment and cost efficiency on the SSA banks. Even though there have been some studies done separately on bank stability on cost efficiency and sustainable investment on bank stability across countries in Africa. In light of these knowledge gaps, the present study provides new empirical evidence on the effect of the role of bank stability in the relationship of bank cost efficiency and sustainable investment.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.0 Overview

This chapter presents the methods and materials used to undertake the study. The chapter is organized as follows; The research paradigm and the design of the study are described in this chapter. The data and sample selected for the study were described. This

is followed by the description of the study variables, the model specification and the estimation strategy.

### 3.1 Research Paradigm

According to Gillani et al. (2016) a paradigm provides a conceptual framework for seeing and making sense of the social world. The significance of paradigms is that they shape how researchers perceive the world and are reinforced by those around them and the community of practitioners. Within the research process the beliefs a researcher holds will be reflected in the way the research is designed, how data is both collected and analyzed, and how research results are presented thus, it is very important for the researchers to recognize their paradigm as it allows them to identify their role in the research process, determine the course of any research project and distinguish other perspectives (Gropper et al., 2012).

From this backdrop, positivism was used as a paradigm in this study. Looking at variables of the study, that is sustainable investment, cost efficiency and bank stability, they can be quantitatively measured and for that matter the study used positivism paradigm because it ensures that the data collected is free from bias or personal interpretation. This allows for more accurate and reliable results when testing hypotheses about the relationships between variables.

### 3.2 Research Design

The study employed the explanatory design in analyzing how bank‘s sustainable investment influence cost efficiency of banks in the SSA and the role of banking sector stability in this relationship (Sunney, 2020, p. 1). Research design apparently is the

overall blueprint that the study follows is achieving the objectives of the study. The explanatory research design is also referred to as the causal research and it provides the extent to which one or more variables influence another variable (Zikmund, Babin, Carr, & Griffin, 2012). The explanatory ~~d~~design focuses on an analysis of a situation or a specific problem to explain the patterns of relationships between variables" (Zikmund, Babin, Carr, & Griffin, 2012, p. 5).

There are some advantages related to the employment of explanatory design. Firstly, it plays important role in terms of identifying reasons behind a wide range of processes (Zikmund, Babin, Carr, & Griffin, 2012, p. 5), as well as, assessing the impacts of changes on existing norms, processes on another arch Design variable. Explanatory design also offers the advantages of replication if necessity arises" (Zikmund, Babin, Carr, & Griffin, 2012, p. 5). More so, the explanatory design ~~i~~s associated with greater levels of internal validity due to systematic selection of subjects in the study (Zikmund, Babin, Carr, & Griffin, 2012, p. 43).

The main disadvantages associated with explanatory study are that coincidences in events may be perceived as cause-and-effect relationships. It can also be difficult to reach appropriate conclusions on the basis of causal research findings. This is due to the impact of a wide range of factors and variables in social and economic environment. In other words, while casualty can be inferred, it cannot be proved with a high level of certainty. It certain cases, while correlation between two variables can be effectively established; identifying which variable is a cause and which one is the impact can be a difficult task to accomplish (Zikmund, Babin, Carr, & Griffin, 2012).

To investigate the objectives of the research, explanatory research design is appropriate because it allows for establishing causality between variables by manipulating one variable and observing its effect on another variable while controlling for other factors that may influence this relationship (Bryman, 2016).

To achieve the research objectives, the study used a quantitative approach. The primary purpose of quantitative research, according to Bryman (2016), is to collect numerical data to characterize a specific occurrence. This method involves gathering data and then subjecting it to various statistical tests, and analyzing it from the researcher's point of view (Asor, Abraham, Yeboah, Torviawu & Laryea, 2018). The quantitative technique must be employed when it's important to deduce statistical inferences and relationships among different variables. Therefore, a considerable segment of the population can be assumed when generalizing the conclusion from the analysis. Therefore, a quantitative method is acceptable given that the study's aim is to examine and understand statistical data on banking stability, sustainable investment and cost efficiency.

### 3.3 Population for the study

The population for the study is all the 48 sub-Saharan African countries. According to a report by the Global Sustainable Investment Alliance, the global market for sustainable investment reached $35.3 trillion in 2020, representing 36% of all professionally managed assets. However, the share of sustainable investment in Sub-Saharan Africa remains very low, accounting for only 0.01% of the global total. This is partly due to the lack of data, knowledge, and technology that can support sustainable

investing in the region (The Elephant in the Room: Bringing Sustainable Investment to Africa, 2022).

Nonetheless, some Sub-Saharan African countries are making progress in promoting and implementing sustainable investment practices which is yielding positive results; for instance, South Africa is said to be the leader in sustainable investment in this region, with billions of assets under management using ESG criteria in 2020. Kenya has a vibrant green bond market that supports projects in renewable energy, energy efficiency, green buildings, and sustainable transport. Kenya also has a national green economy strategy that aims to foster inclusive and sustainable growth. Also, Nigeria issued its first sovereign green bond in 2017, raising $29.7 million for renewable energy and afforestation projects. Nigeria also launched a national sustainable finance roadmap in 2019, which provides guidelines and incentives for financial institutions and stakeholders to integrate ESG factors into their operations (Sustainable Investing in Sub-Saharan Africa: Better Data, More Knowledge, Using Technology, 2021). However, the sub-Saharan Africa least can be said of them therefore it becomes necessary to access this region.

### 3.4 Sampling and sampling technique

Out of these populations, a sample of twenty-five countries from sub-Saharan Africa was used for the study for which data was available.

The period for the study is eight years from 2010 to 2017. This study period is appropriate because most sub-Saharan Africa were affected by the global financial crisis

which occurred between 2007-2008 which led most Africa banks to be redeemed through recapitalization, restructuring, consolidation, or liquidation.

During the early part of 2010, banks suffered decrease in their cost efficiency due to the impact of the world financial crisis and as a result most banks sought to spread their portfolios into sustainable investment to boost cost efficiency. For example; The crisis stimulated the demand and supply of sustainable investment in South Africa, as investors sought to diversify their portfolios, reduce their risks, and enhance their returns by incorporating environmental, social, and governance (ESG) factors into their investment decisions and strategies. In Kenya, the crisis created opportunities and challenges for sustainable investment, as investors recognized the potential and value of investing in sectors that contribute to social and environmental impact, such as renewable energy, agriculture, health, education, and microfinance.

Due to limitation to data, the study was not able to be extended to cater for other macroeconomic issues like the Covid-19.

### 3.5 Source of Data

The study made use of country level bank secondary data. A balanced panel data of twenty-five countries over eight years which had two hundred observations. The World Bank's Global Financial Development database was used to access data on banking stability, bank level performance, foreign-bank presence, bank size, net income margin, regulatory capital ratio and cost to income ratio. The World Bank's Governance Indicator was used to obtain data on governance. Data on economic growth, unemployment, social, and environmental factors were obtained from World Development Indicators. Lastly, the variables used in estimating cost efficiency that;

inputs (total deposit, equity), output (loans, off-balance sheet activities) and endogenous (total cost) variables were generated from the BankScope Database.

### 3.6 Variable Selection, Model Specification and Estimation Approach

This section discusses the variables selected for the study, specification of models and estimation approach applied in estimating the parameters of the models. The section is structured as follows; first, a description of the variables, models for efficiency estimation and the estimation approach for the efficiency estimation is discussed. This is followed by description of the variables and models for determining the relationship between sustainable investment and cost efficiency of sub-Saharan African banks. The final part of the section details out the variables and model specification as well as the estimation approach for determining the sustainable investment-cost efficiency relationship and the role played by bank stability in such a relationship.

#### 3.6.1 Measurement of cost efficiency

##### *3.6.1.1 Selection of Input and Output Variables*

In modelling a bank‘s efficiency, one of the most challenging tasks is the selection of the relevant inputs and outputs variables. Though there are a number of approaches that have been proposed to guide in selection of inputs and output for efficient computation, there is no accord in the literature as to what constitutes inputs and outputs of a bank (Casu & Girardone, 2009; Sathye, 2003). However, the most common approaches applied to efficiency modeling are production (or the value added) approach, operating approach and intermediation approach (Barry et al., 2011; Hermes et al., 2009).

One common feature about these approaches is that they all apply the traditional microeconomic theory of a firm to banking. They however differ in terms of their specification to banking activities.

The study adopts an intermediation approach. This seems to be mostly applied in empirical research in the area of banking. The approach was proposed by Sealey and Lindley (1977) in which banks are treated as financial intermediaries whose prime object is to channel funds between surplus and deficit units. That is, a bank is considered as a unit that accepts deposits backed by their capital assets and invests or transfers them to deficit units, using labor and capital in the form of investments or loans respectively and gains profits in the process. Under this treatment, the value of loans and investments is the appropriate measure of bank output, while deposits and costs involved in the production process such as capital, labor should be measured as inputs.

Consequently, the study adopted two outputs namely, loans proxied by bank credit to bank deposit. Bank credit to bank deposits include financial resources provided to the private sector by domestic money banks as a share of total deposits. To account for fee-based service and other non-banking related services such as asset-backed securitization, non-interest income is included as output as proxy for off-balance sheet activities. The bank non-interest income to total income, this is denoted by bank‘s income that has been generated by non-interest related activities as a percentage of total income including fee, commission, and other operating income.

Two inputs were used for the study namely, total deposits proxied by bank deposit. Bank deposit includes the total value of demand, time and saving deposits at domestic deposit money banks. Equity was another input used proxied by bank capital which is denoted by

capital and reserves including funds contributed by owners, retained earnings, general and special reserves, provisions, and valuation adjustments.

To determine the cost efficiency, it will require the use of the input prices. For the total deposit, the input prices were proxied by bank deposit to GDP. This was described by the total value of demand, time and saving deposits at domestic deposit money banks as a share of GDP. Then, for the equity input prices were proxied by bank capital to total assets which is the ratio of bank capital and reserves to total assets.

Total cost was used as an endogenous variable which was proxied by bank cost to income ratio denoted by operating expenses of a bank as a share of sum of net-interest revenue and other operating income.

The summary of the output, input and endogenous variables together with the input prices are shown on Table 1.

Table 1: Variables for estimating cost efficiency.

| Variable | Proxy | Data source |
|---|---|---|
| Output | | |
| Loans ($y_1$) | Bank credit to bank deposit | BankScope Database |
| Off-balance sheet activities ($y_2$) | Bank non-interest income to total income | BankScope Database |
| Input | | |
| Total deposit ($x_1$) | Bank deposit | BankScope Database |
| Price of deposit ($w_1$) | Bank deposit to GDP | |
| Equity ($x_2$) | Bank capital | BankScope Database |
| Price of equity ($w_2$) | Bank capital to total asset | |
| Endogenous | | |
| Total cost (c) | Bank cost to income ratio | BankScope Database |

Source: Author‘s construct.

### *3.6.1.2 The SFA cost model*

Cost efficiency was estimated using the stochastic frontier analysis (SFA). The study used stochastic frontier analysis other than different models such as data envelopment analysis (DEA). This is because SFA reports the random disturbance term separately from the one-sided inefficiency scores of the individual firm, whereas the DEA reports both the inefficiency scores and the random error term as one, which consequently provides inaccurate efficiency measures (Coelli, Rao, O'Donnell, & Battese, 2005). Thus, the SFA approach therefore gives a more robust estimate of the bank's efficiency scores.

A typical theoretical cost frontier model for panel data as proposed by Aigner et al. (1977) and Meeusen and Van den Broeck (1977) is specified as follows.

$$\ln C_{it} = \propto_0 + \sum_{m=1}^{M} \beta_m \ln y_{mit} + \sum_{j=1}^{J} \gamma_j \ln w_{jit} + u_{it} + v_{it} \quad (1)$$

Where $\ln C_{it}$ is the total cost for the country banks i (i = 1…N) at time t (t = 1…T), $\ln y_{mit}$ is the $m^{th}$ (m = 1…M) output for the country banks i at time t, $\ln w_{jit}$ is the $j^{th}$ (j = 1…J) input price for the country banks i at time t $u_{it} \geq 0$ is the cost inefficiency while $v_{it} \sim idd\ N\ (0, \sigma_v^2)$ is random errors that are beyond the control of the country banks.

### *3.6.1.3 Empirical model specification*

In formulating the empirical model for the study, the translog cost functional form with two output variables, two input prices. The study used translog functional form

instead of Cobb-Douglas functional form because it is more flexible and general than Cobb-Douglas production function, as it allows for variable elasticities of substitution and returns to scale, as well as interactions and nonlinearities among the inputs. Cobb-Douglas production function assumes constant elasticities of substitution and returns to scale, and no interactions or nonlinearities among the inputs, which may not be realistic or accurate in some cases (Coelli, Rao, O'Donnell, & Battese, 2005). The translog functional form is formulated as follows.

$$\ln C_{it} = \propto + \sum_{m=1}^{2} \beta_m \ln y_{mit} + \frac{1}{2}\sum_{m=1}^{2}\sum_{n=1}^{2} \beta_{mn} \ln y_{mit} \ln y_{nit} + \sum_{j=1}^{2} \gamma_j \ln w_{jit} + \frac{1}{2}\sum_{j=1}^{2}\sum_{k=1}^{2} \gamma_{jk} \ln w_{jit} \ln w_{kit} + \sum_{m=1}^{2}\sum_{j=1}^{2} \delta_{mj} \ln y_{mit} \ln w_{jit} + \theta_1 t + \theta_2 t^2 + \sum_{m=1}^{2} \varepsilon_m \ln y_{mit} t + \sum_{j=1}^{2} \rho_j \ln w_{jit} t + u_i + v_{it} \quad (2)$$

Where $\ln C_{it}$ is the total cost of bank i (i = 1, …, 25) at time t given as a function of two output $\ln y_{mit}$ (m = 1,2) and two input prices $\ln w_{jit}$ (j = 1,2) as defined in Table 1. A time trend t is included in the model to capture technological change in the study period.

### *3.6.1.4 Estimation of the empirical model*

As explained in the earlier sections, Equation (2) is estimated under two models, classed under time variant models. The time varying models include the time varying

inefficiency model (BC 95) and the Battese and Coelli (1992) time decaying model (BC 92). Cost inefficiency may be time invariant for a short period. However, considering the period of the study, it is inappropriate and unrealistic to assume cost inefficiency to be time-invariant for such a long time period especially in financial markets where variables change rapidly. Thus, for such a study period, it is more desirable to relax the time-invariant assumption. This, therefore leads to the development of time-varying panel data models in which efficiency is allowed to change over time. Notable among them in the extant literature are Battese and Coelli (1992) model (herein referred to BC 92) and Battese and Coelli (1995) model (herein referred to BC 95).

The models and their estimation strategy are summarized in Table 2 indicating their distribution of the error terms. The two parameter estimation methods are necessary for methodological cross check, comparability and consistency check and that panel data stochastic frontier estimation produces efficiency results that are sensitive to the composed error specification used. Hence, by comparing different composed error specifications, the consistency of the efficiency results can be compared across different specifications and the arbitrary choice of specification can be avoided.

Table 2: Estimation models

| Model | Estimation method | Distribution of error |
|---|---|---|
| Random effect time varying inefficiency model (BC 95) (Battese&Coelli, 1995) | MLE | $v_{it} \sim idd\ N(0, \sigma_v^2)$; $u_i \sim idd\ N^+(0, \sigma_u^2)$; $u_{it} = \delta_0 + \delta_1 z_{it}$. |
| Random effect time decaying efficiency model (BC 92) (Battese & Coelli, 1992) | MLE | $v_{it} \sim idd\ N(0, \sigma_v^2)$; $u_{it} \sim idd\ N^+(0, \sigma_u^2)$. $u_{it} = u_i e^{-\eta(t-T)}$ |

Source: Author's construct

BC92 model measures cost efficiency as the ratio of the minimum cost to the observed cost, given the output level, input prices, and environmental factors. It decomposes cost efficiency into two components: allocative efficiency and technical efficiency. Allocative efficiency measures how well the bank chooses the optimal mix of inputs, given their prices. Technical efficiency measures how well the bank transforms inputs into outputs, given the production technology (Berger & Mester, 1992) whereas BC95 model measures cost efficiency as the ratio of the minimum cost to the observed cost, given the output level, input prices, environmental factors, and profit maximization behavior. It decomposes cost efficiency into three components: allocative efficiency, technical efficiency, and profit efficiency. Allocative efficiency and technical efficiency are defined as in the BC92 model. Profit efficiency measures how well the bank chooses the optimal output level and mix, given the market conditions (Berger & Mester, 1995).

Thus, the main difference between BC92 and BC95 models is that the BC92 model assumes that banks operate at their optimal output level and mix, while the BC95 model relaxes this assumption and allows for output inefficiency. The BC95 model can capture the effects of market power, demand uncertainty, and regulatory constraints on cost efficiency. Thus, BC 95 modifies the previous model by not only relaxing the specific structure of time effect imposed on inefficiency, but also incorporating more variables that can affect inefficiency. With this model, the level of inefficiency can be evaluated and at the same time access the factors that affect it; hence, the BC 95 is known as the one-stage estimation approach which is much preferred.

### 3.6.2 Cost Efficiency, Sustainable Investment (ESG) and Bank Stability

In this subsection, we described the variables, models specification and estimation method for estimating the linkage between cost efficiency and sustainable investment with the role of bank stability. This section is organized as follows; the description of the sustainable investment (ESG) variables and bank stability variables, their empirical model specification and estimation technique is discussed.

#### 3.6.2.1 Sustainable Investment (ESG)

Sustainable investment was measured using the variables from World Development Indicators. Consequently, sustainable investment was measure from three perspective; the environment factors, social factors and governance factors

#### *3.6.2.2 Environment*

In this study, we used principal component analysis to construct an environmental index using some selected World Bank environmental indicators such as electricity production from coal sources energy, $CO_2$ emission and methane emission indicating amount of carbon dioxide and methane in the atmosphere, people using safely managed drinking water services, PM2.5 air pollution, mean annual exposure, access to clean fuels and technologies for cooking, forest area, fossil fuel energy consumption, nitrous oxide emissions, people using safely managed sanitation services renewable electricity output, renewable energy consumption, terrestrial and marine protected area, and natural resources depletion. These indicators are environmental metrics used to assess how effective and efficient countries are promoting sustainable a environment. A lower value for environmental factors indicates a poor concern for environmental issues hence

increased in environmental risk. However, higher value for the environmental factor suggests a move towards more eco-friendly environment.

#### *3.6.2.3 Social*

In this study, the social variable used as an independent variable is an index constructed from the principal component analysis made up of factors such as proportion of seats held by women in national parliaments (gender), strength of legal right index (human rights), population density (population) and access to electricity (access to service). Population of a country affects the number of people who use the banking service. The human right index also suggests how the rights of the citizens are protected and respected in the country. A higher value for the social factor suggests satisfaction of citizens with the services provided by the banking industry hence banks being efficiency.

#### *3.6.2.4 Governance*

The study constructed an index for governance from the World Bank governance indicators using the principal component analysis. The selected indicators are government effectiveness, regulatory quality, rule of law, political stability and absence of terrorism and control of corruption. These selected governance indicators were used in studies by Ozili (2018) and Kaufmann et al. (2011) as control variables. However, this application differs in our study, as they constitute one of the pillars of sustainable investment (ESG) which is a variable of interest. A higher value for governance factor suggests effective government and institutional quality in the country in which banks operate. Thus, the more effective the governance and institutional quality of a country, the more efficient the banks become in terms of operations.

#### *3.6.2.5 Bank Stability*

The study adopted Z-score as a moderating variable in accessing banking sector stability. Most researchers have employed Z-score for measuring banking stability in that it has an inverse relationship with the possibility of bank insolvency. The insolvency risk of a bank is measured by Z-score and is computed as regulatory capital plus return on asset divided by the standard deviation of the return on asset. According to Strobel and Lepetit (2013), a greater Z-score value suggests lesser insolvency risk and an improved banking stability and a lower value implies high insolvency risk and higher instability. In order to normalize the extreme skewness of the Z-score, a number of recent studies, including (Houston et al., 2010; Laeven and Levine, 2009; Fernández et al., 2016; Beck et al., 2013; and Ozili, 2018), have adopted the natural logarithm of Z-score as a measure for a bank bankruptcy risk when assessing banking stability.

#### 3.6.2.6 Control variables

#### *3.6.2.6.1 Banks Specific Performance*

The study used three variables as proxies to represent the banks-specific performance which are control variables: net income margin (NIM), capital adequacy ratio (CAR) and cost to income ratio (CIR). The net income margin (NIM) was measured using is a ratio that measures the percentage of profit in relation to revenue, capital adequacy ratio (CAR) was measured using the amount banks are required to keep as risk capital in order to cover the risks they take and cost to income ratio (CIR) was measure using a ratio that measures the effectiveness of the banks. These three variables‘ data sourced from World Bank's Global Financial Development database.

#### *3.6.2.6.2 Financial Structure*

The study employed three variables to proxy the financial structure of the banking sector of a country namely: size of the banking sector (SIZE), banking concentration (BCON) and the presence of foreign banks in the banking sector of the country (FBP). The size of the banking sector (SIZE) was measured using private deposit money to GDP, banking concentration (BCON) was measured comparing the assets of the three major commercial banks to all commercial banks in a given banking sector and the presence of foreign banks in the banking sector of the country (FBP) was measured using a ratio of number of foreign banks among the total number of banks in the banking sector of a country.

#### *3.6.2.6.3 Macroeconomic Factors*

The study adopted two macroeconomic factors which may influence the cost efficiency in the banking sector which was proxied by unemployment (UNE) and economic growth (EG). The unemployment (UNE) was measured using high unemployment and job loss and economic growth (EG) was measured using real GDP growth rate.

All the variables used for the study are all summarized under Table 3 together with their proxies and data sources.

Table 3: Variables for the study for all the objectives

| Variable | Proxy | Data source |
|---|---|---|
| *Dependent variable* | | |

| | | |
|---|---|---|
| Cost Efficiency | Stochastic Frontier Analysis | Efficiency Scores estimated from Equation (2) |
| *Independent variables* | | |
| Environment (E) | Environment index | World Development Indicators, 2020. |
| Social (S) | Social index | World Development Indicators, 2020 |
| Governance (G) | Governance index | World Bank's Governance Indicator, 2020 |

Table 3: Continued

| Variable | Proxy | Data source |
|---|---|---|
| *Moderating variable* | | |
| Bank stability | It used z-score as its measurement | World Bank's Global Financial Development database, 2020 |
| *Control variables* | | |
| Foreign-bank presence (FBP) | Ratio of number of foreign banks among the total number of banks in the banking sector of a country | World Development Indicators, 2020 |
| Bank concentration (BCON) | Comparing the assets of the three major commercial banks to all commercial banks in a given banking sector | World Bank's Global Financial Development database, 2020 |
| Bank size (SIZE) | Private deposit money to GDP | World Bank's Global Financial Development database, 2020 |
| Unemployment (UNE) | High unemployment and job loss | World Development Indicators, 2020 |
| Economic growth (EG) | Real GDP growth rate | World Development Indicators, 2020 |
| Net interest margin (NIM), and | A ratio that measures the percentage of profit in relation to revenue | World Bank's Global Financial Development database, 2020 |

| | | |
|---|---|---|
| Capital adequacy ratio (CAR) | The amount banks are required to keep as risk capital in order to cover the risks they take | World Bank's Global Financial Development database, 2020 |
| Cost to income ratio (CIR) | A ratio that measures the effectiveness of the banks | World Bank's Global Financial Development database, 2020 |

**Source:** Author's construct

### 3.6.2.7 Empirical model specification

The study's second objective is the determined effect of sustainable investment on cost efficiency and the third objective being the moderating role of bank stability between the relationship between sustainable investment and cost efficiency.

To achieve the second objective that is; to estimate the effect of sustainable investment on cost efficiency in African banks, the following empirical model was stated;

$$CE_{it} = \beta_0 + \beta_1 E_{it} + \beta_2 S_{it} + \beta_3 G_{it} + \sum_{3}^{n} \beta_i X_{it} + \varepsilon_{it} \quad (3)$$

Where:

CE is a dependent variable that measures the cost efficiency scores.

E is environment, S is social and G is governance are the independent variables

$X_{it}$ are the various control variables

$\beta_1 - \beta_i$ are the coefficient of the independent variables

$\varepsilon_{it}$ is an error term.

With the bank stability as moderating role in the relationship between cost efficiency and sustainable investment in the Sub-Saharan African countries is specified as follows;

$$CE_{it} = \beta_0 + \sum_{m=1}^{3} \beta_m y_{imt} + \beta_4 BS_{it} + \sum_{n=5}^{7} \beta_n y_{int} * BS_{it} + \sum_{j} \beta_j X_{ijt} + \varepsilon_{it} \quad (4)$$

Where:

CE is a dependent variable that measures the cost efficiency scores.

BS is a moderating variable which is bank stability

$y_{imt,}\, y_{int}$ is the ESG factors for sustainable investment which is the independent variable

$X_{imt}$ are the various control variables

$\beta_m, \beta_n, \beta_j$ are the coefficient of the independent variables

$\varepsilon_{it}$ is an error term.

### 3.6.2.8 Estimation technique

A panel econometric model is then used to analyze the data. Panel econometric models are statistical methods that can analyze data that have both cross-sectional and time-series dimensions. This fit the study as the study has data on 25 different SSA countries over 8 years making it a panel dataset. The panel econometric model allows you to control for unobserved heterogeneity across entities and time-varying factors that may affect the relationship between the study‘s variables. The estimation techniques for the study are the system generalized method moment (GMM), a dynamic panel

regression and fixed effect model because they capture the persistence or adjustment of the dependent variable over time, as well as the effects of other explanatory variables.

The study employed a dynamic panel system GMM estimation model for estimating the impacts of sustainable investment on the cost efficiency at the bank level. According to Roodman (2009), the system GMM is appropriate when the dependent variable is persistent, thus the previous dependent variable affect its current, the time period (eight years) is lesser than the number of cross-sections (twenty-five countries), existence of individual specific effect, endogeneity problem, serial correlation and panel heterogeneity. Therefore, this model was deemed appropriate for the data due to its ability to control for the aforementioned problems.

### 3.7 Chapter Summary

The chapter describes the data and the methods applied in achieving the objectives of the study. The research design adopted was discussed and the quantitative approach used was in line with fulfilling the objectives of the study. The data used was mainly obtained from bankscope, world development indicators, world bank's governance indicators and world bank's global financial development database of the sampled sub-Saharan African countries over the eight-year study period. The data collected was a balanced panel data meant to bring out the heterogeneity of the study units.

In modeling bank efficiency, the choice of inputs and output variables was informed by the intermediary approach where the banking units were considered as an intermediary unit that transforms input from the environment, processes it and gives it out

to the environment. The theoretical and empirical specification of two models applied in estimating efficiency scores were also discussed and justified. An approach to test the qualities of the cost function derived from the specified model was also discussed. Also, in modeling the cost efficiency, sustainable investment and bank stability, the study used the dynamic panel GMM as the estimation technique.

# CHAPTER FOUR

# RESULTS AND DISCUSSION

## 4.0 Overview

This chapter presents the result of analysis of the data on the variables defined in this study and the discussions of the results obtained. The chapter further sheds more light on the nexus between sustainable investment and cost efficiency, the moderating role of bank stability of the Sub-Saharan African region. This chapter is organized as follows; The descriptive statistics, the parameter estimation, the level of cost efficiency of banks in sub-Saharan Africa, GMM estimation for the effect of sustainable investment on cost efficiency level of the SSA banks and the role of bank stability in the relationship between sustainable investment and cost efficiency.

## 4.1 Descriptive Statistics

The Table 4 results shows that; Bank capital to total assets, which measures the proportion of the bank‘s assets financed by equity, averaged 9.486%, with a variation among banks of 5.267% and with some countries showing 1.490% of their bank capital to total assets as against 23.68% to total assets. This indicates that banks in sub-Saharan Africa have diverse levels of financial strength and solvency. Considering the depth of financial development to the economy, the average bank deposits to GDP is 23.042%, with a of variation 20.748% and with some countries showing 4.462% of their deposit to GDP as against 98.560% to GDP. Bank credit to bank deposits, which measure how much of bank‘s deposits are used for lending activities. The average bank credit to bank deposit is 63.28%, with a of variation 34.937% and with some countries showing 25.264% of their credit to deposits as against 130.29% to bank deposits. This indicates that banks in sub-Saharan Africa have varied levels of liquidity and intermediation. Also, banking noninterest income to total income, which measures how much of a bank‘s income comes from non-interest sources, such as fees, commissions, and trading income. The average banking noninterest income to total income is 25.96%, with a of variation 22.68%. The result shows that, there were countries with 21.740% of their banking noninterest income to total income as against 90.46% to total income. This indicates that banks in sub-Saharan Africa have different sources of income, and some banks rely heavily or exclusively on noninterest income such as fees, commissions, and trading income. The bank cost to income ratio, which measures how much of your bank‘s income is spent on operating expenses. The average bank cost to income ratio is 36.047%, with a of variation 31.09% and with some countries showing 30.821% of their bank cost to

income ratio as against 150.00% to income ratio. This indicates that banks in sub-Saharan Africa have different levels of efficiency and performance, and some banks have very high or low operating costs relative to their income.

Table 4 – Descriptive summary statistics of cost efficiency variables

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| *Input prices* | | | | |
| Bank capital to total asset | 9.486% | 5.267% | 1.490% | 23.677% |
| Bank deposits to GDP | 23.042% | 20.748% | 4.462% | 98.560% |
| *Output variables* | | | | |
| Bank credit to bank deposit | 63.277% | 34.937% | 25.264% | 130.286% |
| Bank non-interest income to total income | 25.958% | 22.681% | 21.740% | 90.456% |
| *Endogenous variable* | | | | |
| Bank cost to income ratio | 36.047% | 31.09% | 30.821% | 150.000% |

***Source:*** *World development indicators, data from World Bank's Governance Indicator and World Bank's Global Financial Development database.*

### 4.2 Parameter estimation

In estimating the parameters of the stochastic frontier cost function defined in two models were considered (see Table 2) based their assumptions on time variation and on the error terms. The estimation of parameters was obtained using the *sfpanel* command in Stata (Belotti et al., 2012) and result presented in Table 5. Generally, the direction and significance of the major estimated parameters is consistent first, across the models and secondly, with prior expectation, the literature and finally, with cost theory.

First, total cost increases initially with output at a decreasing rate. This is indicated by the negatively signed coefficients on the squared output terms. However, as the diminishing return sets in, total cost increases with output at an increasing rate, which is consistent with economic theory. This is indicated by the estimated parameters for the

two outputs being positive with the parameter of $y_2$ (off balance sheet activities) being statistically significant at 1% but the parameter of $y_1$ (total loan) is statistically insignificant.

Also, the parameter of the interaction term for $y_1y_2$ is positive and statistically significant across the model which suggest that there might be some scope economies in the joint production of loans with other off-balance sheet activities.

The parameters of the input prices are also positive but insignificant which means input prices do not affect bank cost efficiency. It is also observed that the estimated coefficient of the time trend (t) is negative across models and is statistically significant suggesting that banks included in the sample experienced technical change over the sample period which, as a result, shifted down the cost frontier.

Generally, the statistics such as Likelihood ratio in both models show goodness of fit for the regressions. The estimate for gamma (γ) across the models indicates that over 60% of the total error's variations in the data is accounted for by cost inefficiency rather than by the random error. This provides fascinating evidence that the estimation of cost function as a frontier is appropriate for the data. Also, the estimate for eta across the time varying models is statistically significant, suggesting that time varying models might be more appropriate for the data. This is expected as efficiency in an industry such as banking is expected to change over time.

Table 5 – SSA banks cost efficiency estimated coefficients (25 countries for 200 observations).

| Variable | Parameter | BC (92) | BC (95) |
|---|---|---|---|
| $\ln y_1$ | $\beta_1$ | 0.2370 (0.2736) | 0.0646 (0.2362) |
| $\ln y_2$ | $\beta_2$ | 1.9380*** (0.1170) | 1.8662***(0.0976) |
| $\ln y_1 \ln y_1$ | $\beta_{11}$ | -0.0037 (0.1019) | -0.1530* (0.0854) |

| | | | |
|---|---|---|---|
| $\ln y_2 \ln y_2$ | $\beta_{22}$ | -0.4704*** (0.0427) | -0.4769*** (0.0301) |
| $\ln y_1 \ln y_2$ | $\beta_{12}$ | 0.1057*** (0.0227) | 0.0988*** (0.0293) |
| $\ln w_1$ | $\gamma_1$ | 0.0086 (0.1119) | -0.0517 (0.1404) |
| $\ln w_1$ | $\gamma_2$ | 0.0786 (0.3068) | -0.1102 (0.2490) |
| $\ln w_1 \ln w_1$ | $\gamma_{11}$ | 0.0283 (0.0533) | 0.0832 (0.0537) |
| $\ln w_2 \ln w_2$ | $\gamma_{22}$ | -0.097 (0.0785) | -0.2951*** (0.0447) |
| $\ln w_1 \ln w_2$ | $\gamma_{12}$ | 0.0487 (0.1047) | 0.1352 (0.1002) |
| $\ln y_1 \ln w_1$ | $\delta_{11}$ | -0.0226 (0.0871) | -0.1046 (0.0848) |
| $\ln y_2 \ln w_1$ | $\delta_{21}$ | -0.0399 (0.0401) | -0.0368 (0.0505) |
| $\ln y_1 \ln w_2$ | $\delta_{12}$ | 0.1084 (0.1138) | 0.4642*** (0.0965) |
| $\ln y_2 \ln w_2$ | $\delta_{22}$ | -0.1196*** (0.0240) | -0.1337*** (0.0305) |
| $t$ | $\theta_1$ | -0.0367 (0.0317) | -0.0087 (0.0319) |
| $t^2$ | $\theta_2$ | 0.0006 (0.0021) | -0.0008 (0.0019) |
| $t \ln y_1$ | $\varepsilon_1$ | 0.0196 (0.0132) | -0.0007 (0.0141) |

Table 5 (Continued).

| Variable | Parameter | BC (92) | BC (95) |
|---|---|---|---|
| $t \ln y_2$ | $\varepsilon_2$ | -0.0142** (0.0071) | 0.0056 (0.0061) |
| $t \ln w_1$ | $\rho_1$ | -0.0073 (0.0129) | -0.0069 (0.0159) |
| $t \ln w_2$ | $\rho_2$ | -0.0030 (0.0126) | -0.0033 (0.0110) |
| cons | | 0.2759 (0.1763) | -0.0145 (0.2082) |
| $LLR$ | | 368.6617 | 336.6392 |
| $\sigma_u$ | | 0.0001 | 0.0291 |
| $\sigma_v$ | | 0.0012 | 0.0449*** |
| $\gamma$ | | 0.729 | 0.607 |
| $\sigma^2$ | | 0.0011 (0.0001) | 0.0008** (0.0707) |
| $eta$ | | 0.3163*** (0.0388) | 0.6465** (0.015) |

***Source:*** *computed from world development indicators, data from World Bank's Governance Indicator and World Bank's Global Financial Development database. ∗∗∗p<0.01; ∗∗p<0.05; ∗p<0.1.* Coefficient is the first figure followed by the standard error which is in brackets.

### 4.2.1 Level of cost efficiency of banks in sub-Saharan Africa

This section discusses aggregate cost efficiency scores across the whole sample analyzed into sub-samples based on oil difference. The classified the sample into oil

producing and non-oil producing countries to observe how efficient countries banks cost are when involved in sustainable investment. For example, it is expected of oil-producing counties to be more invested in sustainability since the activities of the companies into oil may have a harmful effect. It then looks at annual efficiency changes for the full sample and the sub-samples.

### 4.2.2 Average cost efficiency level of banks in sub-Saharan Africa

Summary of the cost efficiency score of SSA banks between 2010 to 2017, analyzed into oil and non-oil producing countries for each model employed is shown in Table 6. Both of the models report that banks are at least 70% cost efficient relative to the best practice bank.

The BC 92 model which specifies inefficiency as a function of time alone reports an average cost efficiency score (72%) with higher standard errors compared to BC 95. However, the BC 95 model reports even a higher average cost efficiency score (79%) with lower standard errors than the BC 92 model, suggesting that the banks could theoretically have produced the same output while incurring only about 79.85% of their actual cost.

Table 6 – Average cost efficiency scores full and sub-samples from 2010 to 2017

| Model | Sample | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|---|
| BC92 | All | 0.7255 | 0.0646 | 0.4572 | 0.7975 |
| | Oil-producing | 0.7985 | 0.0021 | 0.7917 | 0.7999 |
| | Non-oil producing | 0.7619 | 0.0429 | 0.5179 | 0.7989 |
| BC95 | All | 0.7989 | 0.0001 | 0.7988 | 0.7990 |
| | Oil-producing | 0.7995 | 0.0004 | 0.7992 | 0.8000 |
| | Non-oil producing | 0.7784 | 0.0147 | 0.7067 | 0.7938 |

**Source:** Author's construct, (2023)

### 4.2.3 Annual cost efficiency of banks in sub-Saharan Africa

We now turn our attention to annual efficiency scores across the sample and the sub-sample, which enable us to identify the trend of efficiency changes over the time. As indicated earlier, eta the parameter for the change in cost efficiency through time are found to be statistically significant for both models. The annual mean cost efficiencies for the complete sample and each sub-sample are presented in Table 7 and Figures 2 and Figure 3 shows the yearly movement of cost efficiency scores under BC92 and BC 95 model respectively.

The two models show different trends of changes in efficiency levels over the sample period (2010-2017). It can be observed from Figure 2 that, BC 92 model shows an improvement in cost efficiency over the sample period. Conversely, the BC 95 minimally increases in the initial years then decreases in the mid years and again increases in the later years.

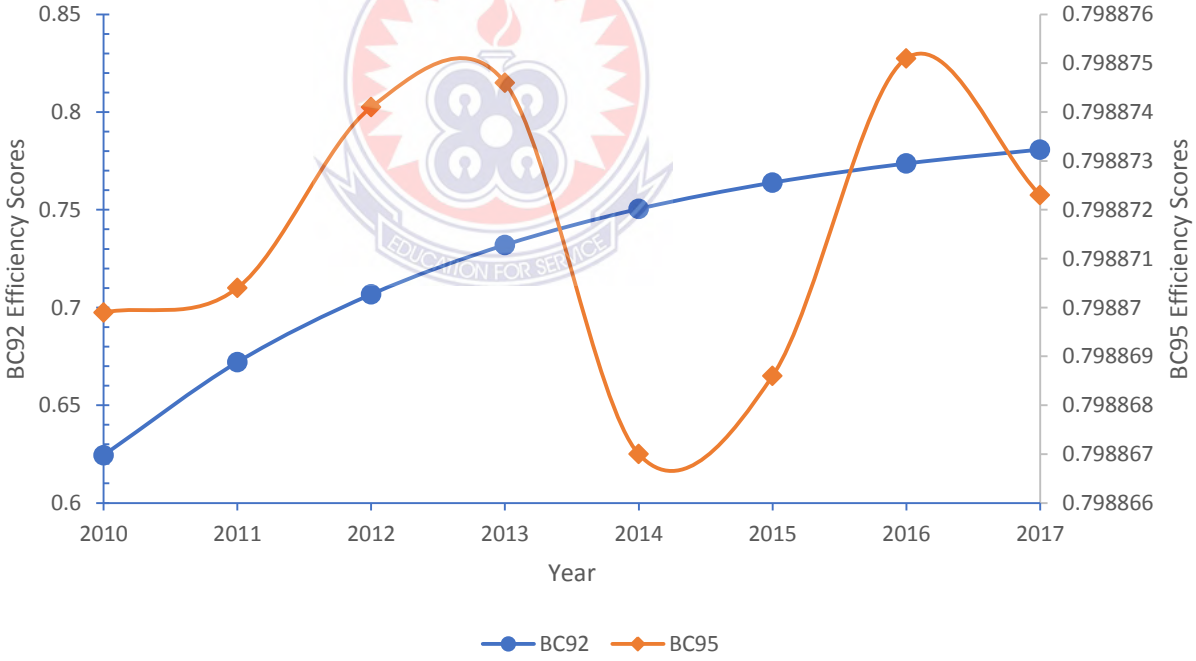
Table 7 – Annual cost efficiency scores for complete sample and sub-sample

| Year | BC92 | | | BC95 | | |
|---|---|---|---|---|---|---|
| | All | Oil producing | Non-oil producing | All | Oil producing | Non-oil producing |
| 2010 | 0.6244567 | 0.7936808 | 0.7121515 | 0.7988699 | 0.799609 | 0.7769715 |
| 2011 | 0.6720576 | 0.7969121 | 0.7353126 | 0.7988704 | 0.7994169 | 0.773331 |
| 2012 | 0.7067508 | 0.7984911 | 0.7523673 | 0.7988741 | 0.7995152 | 0.7730923 |
| 2013 | 0.7320365 | 0.7992626 | 0.7649256 | 0.7988746 | 0.7995114 | 0.7791431 |
| 2014 | 0.7504657 | 0.7996397 | 0.7741729 | 0.798867 | 0.7994153 | 0.7762696 |
| 2015 | 0.7638976 | 0.7998239 | 0.7809822 | 0.7988686 | 0.7994163 | 0.7819298 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2016 | 0.7736872 | 0.799914 | 0.7859962 | 0.7988751 | 0.7995193 | 0.7830027 |
| 2017 | 0.7808223 | 0.7999579 | 0.7896883 | 0.7988723 | 0.7992287 | 0.7833599 |

**Source:** Author's construct, (2023)

Even though the two time-varying models show an inconsistent trend of cost efficiency changes over time, the BC 95 model gives a more reliable cost efficiency level and trend. This is because the structure specified by the BC 92 model artificially imposes the trend on efficiency change which either always increases or always decreases hence influencing efficiency trend. Thus, the trend obtained by the BC 95 model is closer to the true efficiency changes for our sample. In addition, the BC 95 model has lower standard errors suggesting that there is small deviation in efficiency among the sampled banks.




**Source:** Author's construct, (2023)

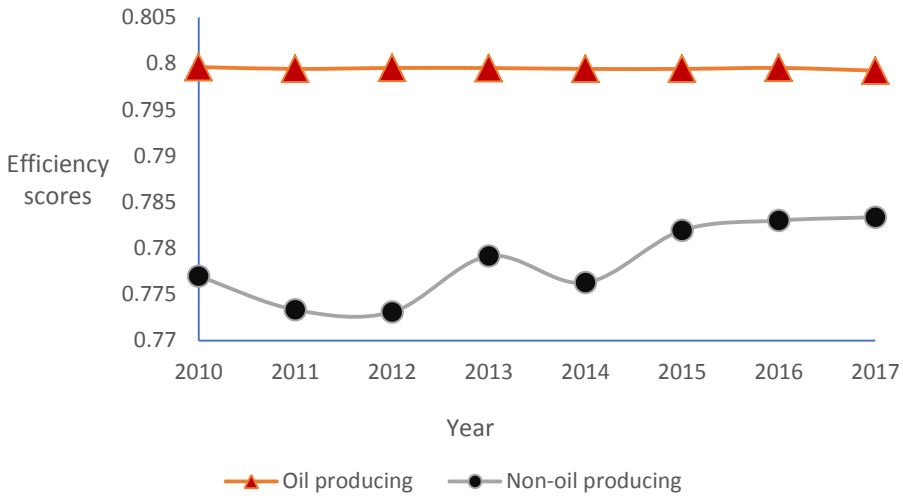
Figure 2 – Annual cost efficiency score for both models of complete sample

Additionally, the empirical justification of the trend shown by BC 95 is eminent and consistent with the happenings in the banking industry over the study period. During the early part of 2010, banks suffered decrease in their cost efficiency due to the impact of the world financial crisis and as a result the balance sheet of most banks in Africa from 2010 to 2016 was filled with _toxic assets‘. As a result, most countries in SSA such as Ghana instituted a lot of financial sector reforms meant to _dean up‘ the financial sector which include recapitalization, asset quality audit and enhanced corporate governance structures which in effect saw an improvement in the cost efficiency of these banks during the latter part of the study period, hence the trend.

With respect to the level of efficiency of the sub-samples, the results obtained from BC 95 models achieve a consensus, that the oil producing country banks are the most efficient from cost perspective relative to the non-oil producing country banks. The trend of efficiency level of the sub-samples is shown in Figure 3 which clearly demonstrates that the cost efficiency trend of oil producing country banks always lies above that of the non-oil producing country banks over the entire eight-year period.

According to Kaffash et al. (2019) it was observed that the oil producing country banks are more cost efficient than the non-oil producing country banks is that the former benefit from the positive effects of oil price changes on their income and expenses. Oil price changes affect the efficiency of banks in the Middle Eastern Oil-Exporting (MEOE) countries through both direct and indirect channels (Kaffash et al., 2019). For example, higher oil prices can increase the demand for loans and deposits from the oil sector, which can boost the banks‘ interest income and reduce their funding costs. Higher oil prices can also improve the macroeconomic conditions and fiscal balances of the oil

producing countries, which can enhance the banks‘ asset quality and reduce their credit risk. Moreover, higher oil prices can create incentives for the banks to invest in new technologies or infrastructure that can improve their operational efficiency and performance. Therefore, oil price changes can have a positive impact on the cost efficiency of the oil producing country banks by increasing their revenues or decreasing their costs. On the other hand, the non-oil producing country banks may not enjoy these benefits or may even face negative effects of oil price changes on their efficiency. For example, higher oil prices can increase the inflation and exchange rate volatility in the non-oil producing countries, which can reduce the demand for loans and deposits and increase the funding costs for the banks. Higher oil prices can also worsen the macroeconomic conditions and fiscal balances of the non-oil producing countries, which can deteriorate the banks‘ asset quality and increase their credit risk. Furthermore, higher oil prices can create pressures or constraints for the banks to comply with new regulations or standards that aim to reduce carbon emissions or promote green finance, which can increase their costs or limit their opportunities. Therefore, oil price changes can have a negative impact on the cost efficiency of the non-oil producing country banks by decreasing their revenues or increasing their costs.




**Source:** Author's construct, (2023)

Figure 3 – Annual efficiency scores of complete sample and sub-samples based on BC 95 from 2010 to 2017.

### 4.3 The Effect of Sustainable Investment on Cost Efficiency Level of the SSA Banks

Table 8 presented the result of the effect of sustainable investment factors that is grouped according to; environmental factors (E), social factors (S) and governance factors (G) on cost efficiency.

Table 8: GMM output for the effect of Sustainable Investment on Cost Efficiency

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| BC92 | | | | | |
| E | -0.0015618**<br>(0.0006394) | | | | -0.0013088 **<br>(0.000639) |
| S | | 0.0002001<br>(0.0001273) | | | 0.0000455<br>(0.0001236) |
| G | | | 0.023778***<br>(0.0084929) | | 0.0202669**<br>(0.0088631) |
| ESG | | | | 0.000626<br>(0.0005182) | |
| NIM | 0.0037673**<br>(0.0017027) | 0.0030604*<br>(0.0017715) | 0.0027139<br>(0.0017941) | 0.0030928*<br>(0.0017818) | 0.0030797*<br>(0.0017683) |

| | | | | | |
|---|---|---|---|---|---|
| CIR | 0.0006676*** | 0.0006733** | 0.0007196*** | 0.0006657** | 0.0007288*** |
| | (0.0002513) | (0.0002651) | (0.0002536) | (0.0002642) | (0.0002482) |
| CAR | 0.000349 | 0.0006117 | 0.000501 | 0.0006741 | 0.0002572 |
| | (0.0006002) | (0.0006166) | (0.0005895) | (0.0006236) | (0.0005738) |
| BCON | -0.0007022*** | -0.0006317*** | -0.0006434*** | -0.0006044*** | -0.0007282*** |
| | (0.0002062) | (0.0002096) | (0.0002093) | (0.000211) | (0.0002064) |
| SIZE | -0.0001253 | -0.0002641 | -0.0002971* | -0.0002255 | -0.0002842 |
| | (0.0001825) | (0.0001991) | (0.0001739) | (0.0001984) | (0.0001963) |
| FBP | -0.0005485*** | -0.0006329*** | -0.0007502*** | -0.0006513*** | -0.0006535*** |
| | (0.0001281) | (0.0001247) | (0.0001119) | (0.000121) | (0.0001241) |
| EG | -0.0030981** | -0.003145** | -0.0036804** | -0.0031649** | -0.0035459** |
| | (0.0013923) | (0.0014086) | (0.0014706) | (0.0014295) | (0.0014153) |
| UNE | 0.0012645* | 0.0014252* | 0.0002361 | 0.001224 | 0.0007379 |
| | (0.0007358) | (0.0008609) | (0.0007339) | (0.0008096) | (0.000981) |
| _cons | 0.7461502*** | 0.7125034*** | 0.7503554*** | 0.7085651*** | 0.7665657*** |
| | (0.0207786) | (0.0210832) | (0.0200932) | (0.0228467) | (0.0221813) |
| AR(1) p-value | 0.042 | 0.000 | 0.030 | 0.001 | 0.004 |
| AR(2) p-value | 0.994 | 0.975 | 0.988 | 0.674 | 0.648 |
| Number of obs | 175 | 175 | 175 | 175 | 175 |
| Number of instruments | 169 | 170 | 171 | 170 | 175 |

*Source: Author's construct, (2023).*

*Note: adjeffbc92 (Cost Efficiency Scores), E (Environmental Factors), S (Social Factors), G (Governance Factors), ESG (Overall Factors), NIM (Net Interest Margin), CIR (Cost-Income-Ratio), CAR (Capital Adequacy Ratio), BCON (Bank Concentration), FBP (Foreign Bank Presence), EG (Economic Growth), UNE (Unemployment). ***p<0.01; **p<0.05; *p<0.1. Coefficient is the first figure followed by the standard error which is in brackets.*

### *4.3.1 Environmental factors*

The Environmental factors coefficient has negative and significant effect on cost efficiency in Model 1 and 5 in Table 8, which shows that when banks engage in Environmental projects, it leads to a reduction in their cost efficiency. This is indicated by the negative coefficient of -0.0015618 and -0.0013088 in both Model 1 and 5 respectively. This implies that there is a trade-off between environmental performance and bank cost efficiency, such that countries with higher environmental scores tend to have lower bank cost efficiency scores, and vice versa.

### *4.3.2 Social factors*

According to the Table 8 of Model 2 and Model 5, Social factors have a positive but not significant coefficient of 0.0002001 and 0.0000455 respectively, which means that an increase in social factors are associated with a very small increase in bank cost efficiency. This implies that there is no effect of social performance on bank cost efficiency, such that countries with higher or lower social scores do not have significantly different bank efficiency scores.

### *4.3.3 Governance factors*

From the results presented on Table 8, Governance factors on Model 3 and 5 has a positive and significant coefficient of 0.0202669 for Model 5 and 0.023778 for Model 3, which means that an increase in Governance factor is associated with an increase in bank cost efficiency. This implies that there is a positive relationship between governance performance and bank cost efficiency, such that countries with higher governance scores tend to have higher bank efficiency scores, and vice versa.

### *4.3.4 Overall ESG factors*

Table 8 shows ESG has a positive but not significant coefficient of 0.000626 in Model 4, which means that an increase in ESG is associated with an increase in cost efficiency. This implies that there is no effect of all the sustainable factors put together (ESG) performance on bank efficiency.

Sustainable investment used ESG factors as its proxy, thus, the study tests the objective two hypothesis using the overall ESG factors. Based on the result presented on Table 9, the study‘s hypothesis for objective two is, the study fails to reject the null

hypothesis that sustainable investment has no positive effect on cost efficiency level of banks in SSA countries.

### *4.3.5 Control variables*

On Table 8, the results show that net interest margin (NIM) has a positive and significant effect on bank cost efficiency in all models except Model 3, which means that aside the net interest margin on Model 3 which does not have any influence on cost efficiency, banks that have higher net interest margin tends to have higher cost efficiency. This is because higher net interest margin indicates higher profitability or market power of banks, which enable them to reduce costs or increase revenues.

Cost-income-ratio (CIR) has a positive and significant effect on cost efficiency across all the models, which means that an increase in cost-income-ratio is associated with an increase in efficiency on Table 8. This implies that countries with higher cost-to-income ratios tend to have higher bank efficiency scores.

On Table 8, capital adequacy ratio (CAR) has a positive but not significant effect in all the models, which means that an increase in capital adequacy ratio is associated with a very small increase in cost efficiency. This implies that there is no significant relationship between capital adequacy ratios and bank efficiency scores, such that countries with higher or lower capital adequacy ratios do not have significantly different bank efficiency scores.

The result shown on Table 8, bank concentration (BCON) has a negative and significant effect on cost efficiency, which means that an increase in bank concentration

is associated with a decrease in cost efficiency. This implies that countries with higher bank concentration ratios tend to have lower bank efficiency scores.

Table 8 shows SIZE has a negative but not significant effect on cost efficiency across the model except the model 3 which is significant, which means that an increase in size is associated with a decrease in cost efficiency. This implies that there is no significant relationship between total assets and bank efficiency scores, such that countries with larger or smaller banking sectors do not have significantly influence on bank efficiency scores while the size on model 3 influences bank cost efficiency.

Foreign bank presence (FBP) has a negative and significant effect on cost efficiency in the result presented on Table 8, which means that an increase in foreign bank presence is associated with a decrease in cost efficiency. This implies that countries with higher foreign bank presence ratios tend to have lower bank efficiency scores.

Economic growth (EG) has a negative and significant effect on cost efficiency as presented on Table 8, which means that an increase in EG is associated with a decrease in cost efficiency. This implies that countries with higher economic growth rates tend to have lower bank efficiency scores.

On Table 8, unemployment (UNE) has a positive with significant effect on cost efficiency in Model 1 and 2 but insignificant coefficients on the remaining models. This means that an increase in UNE is associated with an increase in bank cost efficiency on all the models but this effect does not have any significant influence on cost efficiency in model 3, 4 and 5. This implies that there is a significant relationship between

unemployment rates and bank efficiency scores on Model 1 and 2, such that countries with higher or lower unemployment rates significantly influence bank efficiency scores.

### 4.4 The Role of Bank Stability in the Relationship between Sustainable Investment and Cost Efficiency

Table 9 presented the result of the relationship of sustainable investment factors that is grouped according to; environmental factors (E), social factors (S) and governance factors (G) with cost efficiency and also the moderating role of the bank stability on this relationship. The result of how bank stability influences the relationship between sustainable investment factors on cost efficiency. This result section is separated into individual factor; Environment, Social, Government, the combined ESG factors, bank stability and control variables are presented as follows;

Table 9 – GMM result for the role of Bank Stability between Sustainable Investment and Cost Efficiency

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| BC92 | | | | |
| E | -0.0058776***<br>(0.0015993) | | | |
| S | | 0.0005741<br>(0.0003686) | | |
| G | | | 0.0296358*<br>(0.015838) | |
| ESG | | | | 0.0014704<br>(0.0015794) |
| Zscore | -0.0050166***<br>(0.001565) | -0.0006001<br>(0.0009877) | -0.001474*<br>(0.0008434) | -0.0003715<br>(0.001505) |

| | | | | |
|---|---|---|---|---|
| E*Zscore | .0002599**<br>(.0001033) | | | |
| S*Zscore | | -0.0000203<br>(0.0000207) | | |
| G*Zscore | | | -0.0002763<br>(0.0010325) | |
| ESG*Zscore | | | | -0.0000456<br>(0.0000892) |
| NIM | 0.0041959**<br>(0.0017345) | 0.0034642*<br>(0.0018495) | 0.003132*<br>(0.0018937) | 0.0034718*<br>(0.0018575) |
| CIR | 0.0005893**<br>(0.0002371) | 0.0006004**<br>(0.000282) | 0.0006817**<br>(0.0002669) | 0.0006128**<br>(0.0002735) |
| CAR | 0.000307<br>(0.0005785) | 0.0007125<br>(0.0006316) | 0.000559<br>(0.0005977) | 0.0007512<br>(0.0006437) |
| BCON | -.0003896*<br>(0.000204) | -0.0004149*<br>(0.00022) | -0.0004422**<br>(0.0002114) | -0.0004262*<br>(0.000223) |
| SIZE | -0.0000272<br>(0.0001675) | -0.0002248<br>(0.0001882) | -0.0002347<br>(0.0001653) | -0.0001819<br>(0.0001897) |
| FBP | -0.0005228***<br>(0.000123) | -0.0006576***<br>(0.0001239) | -0.0008***<br>(0.0001143) | -0.0006789***<br>(0.0001203) |
| EG | -0.002802**<br>(0.0012616) | -0.003023**<br>(0.0013489) | -0.0036571**<br>(0.0014672) | -0.0030829**<br>(0.0013986) |
| UNE | 0.0011404<br>(0.0007192) | 0.0013206<br>(0.0008298) | 0.0000287<br>(0.0006978) | 0.0011007<br>(0.0007824) |
| _cons | 0.8087785***<br>(0.0281721) | 0.7034083***<br>(0.0265412) | 0.7582521***<br>(0.0217295) | 0.6978107***<br>(0.037186) |

Table 9: Continued

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| AR(1) p-value | 0.058 | 0.057 | 0.006 | 0.005 |
| AR(2) p-value | 0.202 | 0.232 | 0.432 | 0.112 |
| Number of obs | 200 | 200 | 200 | 79 |
| Number of instruments | 73 | 73 | 73 | 200 |

**Source:** Author's construct, (2020)

Note: *BC92 (Cost Efficiency Scores), E (Environmental Factors), S (Social Factors), G (Governance Factors), ESG (Overall Factors), Zscore (Bank Stability), NIM (Net Interest Margin), CIR (Cost-Income-Ratio), CAR (Capital Adequacy Ratio), BCON (Bank Concentration), FBP (Foreign Bank Presence), EG (Economic Growth), UNE (Unemployment).*

****p<0.01; **p<0.05; *p<0.1. Coefficient is the first figure followed by the standard error which is in brackets.*

### *4.4.1 Environmental factors*

In Table 9, model 1 shows that environmental factors (E) have a negative and significant relationship with bank cost efficiency (BC92) at the 1% level. This means that banks that invest more in environmental sustainability tend to have lower cost efficiency. However, this effect is moderated by bank stability (Zscore), as shown by the positive and significant coefficient of the interaction term E*Zscore at the 5% level. This means that the negative effect of environmental factors on cost efficiency becomes weaker as bank stability increases in a way that banks that are more stable or less risky can afford to invest more in environmental sustainability, as they do not lose much from it in terms of their cost efficiency. Banks that are less stable or more-risky may have to sacrifice some environmental sustainability to improve their cost efficiency.

### *4.4.2 Social factors*

The result on Table 9, Model 2 shows that social factors (S) have a positive but insignificant relationship with bank cost efficiency at any conventional level. This means that banks that invest more in social sustainability do not have a significant impact on their cost efficiency. Moreover, this effect is not moderated by bank stability, as shown by the insignificant coefficient of the interaction term S*Zscore. This means that the effect of social factors on cost efficiency does not depend on bank stability.

### *4.4.3 Governance factors*

Governance factors (G) have a positive and significant relationship with bank cost efficiency at the 10% level at Model 3, on Table 9. This means that banks that invest more in governance sustainability tend to have higher cost efficiency. However, this

effect is not moderated by bank stability, as shown by the insignificant coefficient of the interaction term G*Zscore. This means that the effect of governance performance on cost efficiency does not depend on bank stability.

### *4.4.4 Overall ESG factors*

Model 4 in Table 9 shows that overall ESG factors (ESG) have a positive but insignificant relationship with bank cost efficiency at any conventional level. This means that banks that invest more in ESG sustainability do not have a significant impact on their cost efficiency. Moreover, this effect is not moderated by bank stability, as shown by the insignificant coefficient of the interaction term ESG*Zscore. This means that the effect of ESG performance on cost efficiency does not depend on bank stability.

Since sustainable investment uses ESG factors as its measurement, the study tests the objective three hypothesis using the overall ESG factors. From the result presented on Table 9, the study‘s hypothesis for objective three is, we fail to reject the null hypothesis that bank stability does not moderate the relationship between cost efficiency and sustainable investment.

### *4.4.5 Bank stability*

The results show that Zscore has a negative and significant relationship with bank cost efficiency (BC92) in all models, which means that banks that are more stable or less risky tend to have lower cost efficiency. This is because more stable banks have lower incentives to reduce costs or pursue higher returns, as they face less pressure from regulators or creditors. Also, because more stable banks have higher capital buffers or liquidity reserves, which increase their costs but reduce their risks.

### *4.4.6 Control variables*

Net interest margin (NIM): On Table 9, the results show that NIM has a positive and significant relationship with bank cost efficiency in all models, which means that banks that have higher net interest margin tend to have higher cost efficiency. This is because higher net interest margin indicates higher profitability or market power of banks, which enable them to reduce costs or increase revenues.

Cost-income-ratio (CIR): The results in Table 9 show that CIR has a positive and significant relationship with bank cost efficiency in all models, which means that banks that have higher cost-to-income ratio tend to have higher cost efficiency. Higher cost-to-income ratio indicates lower operating expenses or higher operating income of banks, which improve their cost efficiency.

Capital adequacy ratio (CAR): The Table 9 results show that CAR has a positive but insignificant relationship with bank cost efficiency in all models, which means that banks that have higher capital adequacy ratio do not have a significant impact on their cost efficiency. Capital adequacy ratio does not capture the quality or composition of capital or assets of banks, which may affect their cost efficiency differently.

Bank concentration (BCON): There is a negative and significant relationship with BCON on bank cost efficiency in all models, which means that banks that operate in more concentrated or less competitive banking sectors tend to have lower cost efficiency. More concentrated or less competitive banking sectors reduce the incentives or opportunities for banks to reduce costs or increase revenues, as they face less pressure from rivals or customers.

SIZE: The results in Table 9 show that SIZE has a negative but insignificant relationship with bank cost efficiency in all models, which means that banks that are larger in size do not have a significant impact on their cost efficiency, holding other variables constant. Size does not capture the scale or scope economies or diseconomies of banks, which may affect their cost efficiency differently.

Foreign bank presence (FBP): On Table 9, the results show that FBP has a negative and significant relationship with bank cost efficiency in all models, which means that banks that operate in banking sectors with higher foreign bank presence tend to have lower cost efficiency. This means, higher foreign bank presence increases the competition or spillover effects in the banking sector, which force domestic banks to reduce costs or increase revenues to survive or compete.

Economic growth (EG): The Table 9 presents results showing that EG has a negative and significant relationship with bank cost efficiency (adjeffbc92) in all models, which means that banks that operate in countries with higher economic growth tend to have lower cost efficiency. Implying that, higher economic growth increases the demand or supply of credit in the country, which may increase the costs or reduce the revenues of banks.

Unemployment (UNE): The results on Table 9 show that UNE has a positive but insignificant relationship with bank cost efficiency in all models, which means that banks that operate in countries with higher unemployment rate do not have a significant impact on their cost efficiency, holding other variables constant. Unemployment rate does not capture the quality or composition of the labor force or the labor market conditions of the country, which may affect the cost efficiency of banks differently.

## 4.5 Discussion of findings

The study investigated the effect of sustainable investment on cost efficiency, with the role of bank stability of banks in the sub-Saharan African countries. This chapter is devoted to the discussion of the findings of the study. This section is organized according to the objective two and three of the study; Discussion on the effect of sustainable investment on cost efficiency level of the sub-Saharan African Banks and discussion on the role of bank stability in the relationship between sustainable investment and cost efficiency.

### 4.5.1 Effect of Sustainable Investment on Cost Efficiency Level of the sub-Saharan African Banks

Table 8 presented the result of the effect of sustainable investment factors that is grouped according to; environmental factors (E), social factors (S) and governance factors (G) on cost efficiency. The discussion of the effect of each factor, the combined factors (ESG) and the control variables on cost efficiency is presented as follows;

#### *4.5.1.1 Environment factors*

The result represented on Table 8 on the effect of environmental factors on cost efficiency is this is consistent with the physical and transition theory in the sense that, when moving towards less pollution, a greener economy, an eco-friendly environment or a low-carbon economy causes transition risk, such a transition could shift the banking sector‘s asset values or increase the costs of doing business (Platinga & Scholtens, 2016; Carney, 2015).

The results support some empirical studies that found that the costs associated with sustainable investment can outweigh the benefits, some of these studies are; Fontaine and Sylvestre (2017) found that the costs of implementing sustainable investment practices can be high, and the benefits may not be realized immediately. Forgione et al. (2020) found the disclosure of environmental activities reduced bank efficiency. Similarly, Dell'Atti et al. (2017) investigation results suggested that environmental activities had a negative but insignificant effect on reputation and bank performance. In a study by Tommaso and Thornton (2020), the European banks that received high ESG scores by engaging in more carbon-emission-reduction activities became less willing to take a risk, thus diminishing bank value for the shareholders.

Also, the following literature findings were inconsistent with the result of this study as presented on Table 8; Banks that disclosed efforts of minimizing carbon emissions generated greater profits. Such disclosure also increased the bank's market value (United Nations, 2020). Buallay (2019) ascertained that environmental disclosure positively affected the banks' return of assets (ROA) and market value as measured by Tobin's Q. Similarly, Miralles-Quirós et al. (2019) studied 51 banks in the U.S. and Europe from 2002 to 2015. These authors claimed that environmental endeavors positively influenced the banks' market value and earnings per share (EPS). Crespi et al. (2020) revealed that a higher environmental score led to increased profitability.

#### *4.5.1.2 Social factors*

Though social factors may not influence cost efficiency, the social actions must be disseminated in both formal and informal ways so that investors and stakeholders understand the firm's social responsibilities (Hwang & Gaur, 2009).

The result on social factors on cost efficiency was a positive but insignificant effect as presented on the Table 8 which conforms to the stakeholder‘s theory. Some studies on the stakeholder‘s theory say; the firm's social activities have increased its social performance, which has improved the firm's financial performance, and the stakeholders are more concerned about these activities (Velte, 2017). Shakil et al. (2019) argued that because stakeholders were more interested in the firms‘ disclosure of social activities, and the implementation of CSR programs may lead to an overall improvement of the firm performance.

The result of this study is consistent with the result of other authors such as; Dell‘Atti et al. (2017) results suggested that social welfare was positively correlated with firm reputation with some possibility of improving the firms‘ economic performance. Also, Forgione et al. (2020) found that the disclosure of CSR activities had a positive impact on bank efficiency only in common law countries, such as the U.S., Australia, and countries with stakeholder protection.

#### *4.5.1.3 Governance factors*

The stakeholder theory is also consistent with the finding presented on Table 8, there was a positive and significant effect of governance factors on cost efficiency. For instance, Shakil et al. (2019) said that firms should follow good business ethics, as well

as disclosure and accountability practices. Sustainable business policies cover the areas such as disclosure of financial and operational information to increase stakeholders' confidence in the company. The agency theory explains the reasons for the increasing importance of good corporate governance over the last decade. Good corporate governance aims to align the interests of shareholders and managers so that the two groups of people cooperate to strengthen firm performance (Forgione et al., 2020).

This result supports the findings of some literature such as; Paredes-Gazquez et al. (2017) discovered a positive correlation between bank financial performance and corporate governance. Velte (2017) which indicated that, collectively social, environmental and governance performance boost profitability. However, individual governance performance has the highest effect on financial performance, followed by environmental and social performance. The study by Ahmed et al. (2018) reveals that among the ESG factors governance was the most significant in influencing cost efficiency of banks. Miralles-Quirós et al. (2019) results indicated that governance had a positive influence on market value and EPS. In addition, Miralles-Quirós et al. (2019) scrutinized ESG and bank financial performance in Europe and found that the governance factor produced a positive effect on bank market value. Again, some studies such as those of (Dincer, Celik, Yilmaz & Hacioglu, 2014; Miras-Rodrguez, Carrasco-Gallego & Escobar- Pérez, 2015; Esteban-Sanchez, Paredes-Gazquez & Cuesta-Gonzalez, 2017) all indicated a positive and significant relationship between financial performance and corporate governance.

However, this study's result is in contradiction with some previous studies; Azmi et al. (2021) results revealed that governance had a negative impact on bank market

value. El Khoury et al. (2021) empirical evidence showed that in the long run, bank costs exceeded the benefits of social and governance programs. Similarly, Buallay (2019) found that governance disclosure negatively impacted the financial performance of European banks. Agbloyor, Kusi, Abor, and Ntim (2022) discovered a negative correlation between banks and the corporate governance structure at the country level.

#### *4.5.1.4 Overall ESG factors*

The stakeholder theory has become a premise for debate on sustainable investment positive but insignificant effect on cost efficiency presented on Table 8. Thus, it supports the inclusion of the issues of environmental, social and governance (ESG) in the operations of the firm as a way of improving the long-term returns of investors or shareholders while at the same time satisfying the needs of other stakeholders.

The result of ESG is consistent with the findings of Ahmed, Ahmed, and Hasan (2018), who found that banks considering environmental, social, and governance factors in their lending decisions perform better. A study by Velte (2017) findings indicated that collectively social, environmental and governance performance boost profitability. Adu (2022) results showed that sustainable banking initiatives help banks in Sub-Saharan Africa enhance their financial performance. The findings by Bolibok (2021) indicate that financial disclosures of banks included in ESG indexes are more value relevant. Also, banks with a more commitment to sustainable responsibility have market prices that are more (less) responsive to book value of equity (net earnings) than competitor banks which are less responsible. A study by Tommaso and Thornton (2020) revealed that high ESG ratings are significantly associated with a decreased bank value and risk-taking which is very inconsistent with the result.

#### *4.5.1.5 Control variables*

On Table 8, the results show that net interest margin (NIM) has a positive and significant effect on bank cost efficiency. This supports Dwumfour (2017) that says profitable banks have higher NIMs hence more cost efficient than unprofitable banks.

Cost-income-ratio (CIR) has a positive and significant effect on cost efficiency. This result is inconsistent with the findings that there is a consistent negative relationship between CIR and bank profitability in various studies. A lower CIR should be correlated with improved banking efficiency. When bank profitability is higher and stability is higher, a lower CIR improves bank profitability (Pasiouras & Kosmidou, 2007; Athanasoglou et al., 2008; Olson & Zoubi, 2011).

On Table 8, capital adequacy ratio (CAR) has a positive but not significant effect on cost efficiency. This result is consistent with Almazari (2014) that found that CAR has no significant effect on ROA of UK commercial banks.

The result shown on Table 8, bank concentration (BCON) has a negative and significant effect on cost efficiency. According to Safarzyska and Vanden Bergh (2017), there is no firm expectation to the relationship between bank concentration and banking efficiency which goes contrary to this result.

Table 8 shows SIZE has a negative but not significant effect on bank cost efficiency. Many authors have different views on the size of a bank either having a significant impact on bank cost efficiency or not. A study by Ozili, (2017) argued that the large banking industry may be associated with increased inefficiency which is not consistent with this result.

Foreign bank presence (FBP) has a negative and significant effect on cost efficiency. The result goes contrary to the study, Abdul-Majid et al. (2010) found that foreign-owned banks were more cost-efficient than domestic-owned banks, which may be attributed to their better governance practices.

Economic growth (EG) has a negative and significant coefficient of as presented on Table 8. The result is contrary to a study that found that, during a period of higher economic growth, loan defaults tend to reduce (Laeven & Majnoni, 2003) and banks enjoy improved performance making them more efficient.

Unemployment (UNE) has a positive with significant coefficients as presented on Table 8. Though the result may be consistent with Boating et al. (2015) that indicated that high unemployment leads to high loan default which increases the credit risk of banks resulting in greater banking efficiency, other macroeconomic factors are more important for cost efficiency than unemployment.

### 4.5.2 The Role of Bank Stability in the Relationship between Sustainable Investment and Cost Efficiency.

Table 9 presented the result of the relationship of sustainable investment factors that is grouped according to; environmental factors (E), social factors (S) and governance factors (G) with cost efficiency and also the moderating role of the bank stability on this relationship. The discussion of how bank stability influences the relationship between sustainable investment factors on cost efficiency. This discussion is separated into individual factor; Environment, Social, Government, the combined ESG factors, bank stability and control variables are presented as follows;

#### *4.5.2.1 Environment factors*

The results presented in Table 9, which show that there is a negative relationship between environmental factors and cost efficiency in banks. Here, this relationship is also consistent with the physical and transition theory, which suggests that transitioning to a greener economy or a low-carbon economy can cause transition risks that may increase the costs of doing business or shift the banking sector's asset values (Platinga & Scholtens, 2016; Carney, 2015).

Some studies have shown that investing in sustainability can have more drawbacks than advantages; Tommaso and Thornton (2020) argued that European banks that reduced their carbon emissions by getting high ESG scores also reduced their risk appetite and shareholder value. Fontaine and Sylvestre (2017) reported that adopting sustainable investment practices can be expensive and take a long time to pay off. Forgione et al. (2020) revealed that banks that disclosed their environmental activities became less efficient. Dell'Atti et al. (2017) found no significant positive impact of environmental activities on bank reputation and performance.

Based on Table 9, it tells us that the moderating variable, which is bank stability (Zscore), has a significant influence on the relationship between environmental factors (E) and bank cost efficiency (BC92), this means that bank stability influences how environmental sustainability affects bank cost efficiency.

Some studies have found that bank stability has a positive influence on the relationship between environmental factors and bank cost efficiency by enhancing the resilience and competitiveness of banks. According to the physical and transition theory,

banks that have higher z-scores can better cope with the physical and transition risks associated with climate change, such as environmental damages, regulatory requirements, market shifts, and stranded assets. They can also better exploit the opportunities and benefits of green finance and investment.

#### *4.5.2.2 Social factors*

The social factor had a positive and insignificant relationship with cost efficiency but bank stability does not influence this relationship. The result of the effect of social factors is consistent with some studies findings; Dell'Atti et al. (2017) results suggested that social welfare was positively correlated with firm reputation with some possibility of improving the firms. Shakil et al. (2019) argued that because stakeholders were more interested in the firms' disclosure of social activities, and the implementation of CSR programs may lead to an overall improvement of the firm performance. economic performance. Also, Forgione et al. (2020) found that the disclosure of CSR activities had a positive impact on bank efficiency only in common law countries, such as the U.S., Australia, and countries with stakeholder protection.

#### *4.5.2.3 Governance factors*

The governance factor had a positive and significant relationship with cost efficiency but bank stability does not influence this relationship. This result is inconsistent with the study finding, governance factors have a significant influence on bank stability, and that different types of banks have different optimal governance structures (Nesrine Djebali, 2023). Though, the result on the effect of the sustainable investment is consistent with the findings of some studies; Miralles-Quirós et al. (2019)

results indicated that governance had a positive influence on market value and EPS. Paredes-Gazquez et al. (2017) discovered a positive correlation between bank financial performance and corporate governance. The study by Ahmed et al. (2018) reveals that among the ESG factors governance was the most significant in influencing cost efficiency of banks. Velte (2017) which indicated that, collectively social, environmental and governance performance boost profitability. However, individual governance performance has the highest effect on financial performance, followed by environmental and social performance.

#### *4.5.2.4 Overall ESG factors*

The results on Table 9 showed a positive and significant relationship between ESG and cost efficiency but this relationship is independent of bank stability. These results are inconsistent with some study findings; Adegbite et al. (2020), they found that ESG performance had a positive and significant effect on bank stability for sustainable investment which leads to banks to be cost efficient. Also, the study by Alguindigue (2020), indicated that sustainable finance regulations enhance sustainable banking practices and financial stability hence improving cost efficiency. Moreover, there is higher financial stability in banks found in nations with sustainable finance regulations. A study by Tóth, Lippai-Makra, Szládek, and Kiss, (2021) results showed that the ESG score is a significant contributor to financial stability. But this effect is not moderated by bank stability which is also inconsistent with the finding, social factors, such as the degree of financial inclusion and literacy, can affect bank stability by influencing the demand and supply of credit (Kanapiyanova et al., 2022).

The result of ESG on cost efficiency, the stakeholder theory has become a basis for discussing sustainable investment and how it supports the inclusion of environmental, social, and governance (ESG) issues in a firm's operations. This approach can improve long-term returns for investors while also meeting the needs of other stakeholders.

#### *4.5.2.5 Bank stability*

This result is consistent with the findings of Tan and Anchor (2016), they discovered greater bank instability to be associated with higher profitability but it is inconsistent with the findings of Asongu and Odhiambo (2019) which found that that banking system stability had a positive and significant effect on economic growth, both in the short run and in the long run.

#### *4.5.2.6 Control variables*

Net interest margin (NIM): On Table 9, the results show that NIM has a positive and significant relationship with bank cost efficiency. This supports Dwumfour (2017) that says profitable banks have higher NIMs hence more cost efficient than unprofitable banks.

Cost-income-ratio (CIR): The results in Table 9 show that CIR has a positive and significant relationship with bank cost efficiency. This result is inconsistent with the findings that there is a consistent negative relationship between CIR and bank profitability in various studies. A lower CIR should be correlated with improved banking efficiency. When bank profitability is higher and stability is higher, a lower CIR improves bank profitability (Pasiouras & Kosmidou, 2007; Athanasoglou et al., 2008; Olson & Zoubi, 2011).

Capital adequacy ratio (CAR): The Table 9 results show that CAR has a positive but insignificant relationship with bank cost efficiency. This result is consistent with Almazari (2014) that found that CAR has no significant effect on ROA of UK commercial banks.

Bank concentration (BCON): There is a negative and significant relationship with BCON on bank cost efficiency. According to Safarzyska and Vanden Bergh (2017), there is no firm expectation to the relationship between bank concentration and banking efficiency which does not support this result.

SIZE: The results in Table 9 show that SIZE has a negative but insignificant relationship with bank cost efficiency. According to literature, size of a bank does not have a significant impact on bank cost efficiency. A study by Ozili, (2017) argued that the large banking industry may be associated with increased inefficiency which is not consistent with this result.

Foreign bank presence (FBP): On Table 9, the results show that FBP has a negative and significant relationship with bank cost. The result goes contrary to the study, Abdul-Majid et al. (2010) found that foreign-owned banks were more cost-efficient than domestic-owned banks, which may be attributed to their better governance practices.

Economic growth (EG): The Table 9 presents results showing that EG has a negative and significant relationship with bank cost efficiency (adjeffbc92). During a period of higher economic growth, loan defaults tend to reduce (Laeven & Majnoni, 2003) and banks enjoy improved performance making them more efficient. This is very inconsistent with the result.

Unemployment (UNE): UNE had a positive but insignificant relationship with bank cost efficiency. Though the result may be consistent with Boating et al. (2015) that indicated that high unemployment leads to high loan default which increases the credit risk of banks resulting in greater banking efficiency, other macroeconomic factors are more important for cost efficiency than unemployment.

### 4.6 Chapter summary

This study provides new empirical evidence on the potential effect of sustainable investment on cost efficiency and the influence of bank stability in this effect. The study covered periods between 2010 and 2017 and controls for a wide array of bank specific performance and macroeconomic and financial structure variables. Using system GMM and data from 25 sub-Saharan African banks, we found that banks are at least 70% cost efficient relative to the best practice bank. The BC 92 model reports an average cost efficiency score (72%), however, the BC 95 model reports even a higher average cost efficiency score (79%), suggesting that the banks could theoretically have produced the same output while incurring only about 79.85% of their actual cost. Also, efficiency was assessed based on oil or non-oil producing countries, and it was observed that the bank at the oil producing countries is cost efficient than their counterpart in the non-oil producing countries on both models.

The result of the study affirms that investments in environmental sustainability can increase costs for companies, while investments in social and governance factors can lead to improved performance and cost savings. This supports the findings of Nguyen et al. (2019) analyzed European banks and found that those with higher sustainability scores

had higher efficiency ratios, indicating that sustainable investment can improve cost efficiency. Similarly, Kraussl and Kraussl (2018) found that ESG performance can be a valuable indicator of credit risk, which can improve loan pricing and reduce credit losses.

Finally, the result of the influence of bank stability showed that, when banks that are stable engage in an environmentally friendly project improves their bank cost efficiency. Other factors that are social and the governance factors are independent of the stability of the banks though their effects boost bank cost efficiency.

# CHAPTER FIVE

# SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

## 5.0 Overview

This contains a summary of the entire research work, that is the summary of findings, conclusions, recommendations and suggestion for further research according the specific objectives of the study. Conclusions are drawn based on the findings of the study and recommendations made for the appropriate institutions to act on them.

## 5.1 Summary of findings

This study examined the effect of a bank‘s sustainable investment on cost efficiency of banks in SSA using bank stability as a moderating variable between this relationship. The study focuses on banks in sub-Saharan African (SSA) countries, the study used 25 SSA. It defined sustainable investment as non-harmful practices that benefits the environment as a whole that banks support with their investment, using ESG

data. Thus, the study measures sustainable investment using ESG factors which are environment, social and governance factors. The environmental factor talks about the climate change due to human activities and organizational operations; the social factor is concerned about the social needs of the citizen where an organization operates and the governance is about government effectiveness, regulatory quality, rule of law, political stability and absence of terrorism and control of corruption.

It defined bank stability by the z-score, which measures the probability of commercial banks defaulting on discharging their mandate of providing financial resources to borrowers in times of financial crises and difficulties. Furthermore, bank stability was described to cover the level of resilience of the banking sector and the banks can withstand economic pressures while performing their mandate to banking customers. Cost efficiency was measured by modeling input (total deposit and equity), output (loans and off-balance sheet activities) and endogenous (total cost) variables on the stochastic frontier analysis to determine the efficiency scores of banks at their country level.

The study was based on the correlational research design and the quantitative research approach which allows for the parametric statistical measure of the relationship between sustainable investment and cost efficiency of SSA banks. The dependent variable of the study was cost efficiency while the main independent variable was sustainable investment using the ESG factors and the control variables were eight which were; NIM, CIR, CAR, BCON, FPB, UNE, EG and SIZE. The study used a sample size of 25 countries out of 48 SSA countries and a study period of eight (8) years, being 2010-2017. The sources of the study‘s data were; BankScope Database, World Development

Indicators and World Bank's Global Financial Development database for country level data.

The study was organized into three objectives and their corresponding questions and hypotheses for objective two and three. The first objective is to estimate the cost efficiency level of banking activities in SSA countries. The second objective is to analyze the effect of sustainable investment on cost efficiency level of banks in SSA countries, with the null hypothesis; Sustainable investment has no effect on cost efficiency level of banks in SSA countries. The last objective is to examine

the moderating role of bank stability in the relationship between cost efficiency and sustainable investment in SSA countries, with a null hypothesis of Bank stability does not moderate the relationship between cost efficiency and sustainable investment in SSA countries.

The SFA model for objective 1 estimated the cost efficiency levels of banks in SSA countries. Two models were used in such estimation, these include the true random effect of Battese and Coelli 1992 (BC92) and Battese and Coelli 1995 (BC95). The observations from the findings include;

Both models report that banks are at least 70% cost efficient relative to the best practice bank. The BC 92 model which specifies inefficiency as a function of time alone reports an average cost efficiency score (72%) with higher standard errors compared to BC 95. However, the BC 95 model reports even a higher average cost efficiency score (79%) with lower standard errors than the BC 92 model, suggesting that the banks could

theoretically have produced the same output while incurring only about 79.85% of their actual cost.

Efficiency was assessed based on oil or non-oil producing countries, and it was observed that the bank at the oil producing countries is cost efficient than their counterpart in the non-oil producing countries on both models. However, over time, the cost efficiency of the banks appears to be increasing across the study period that is 2010 to 2017.

The dynamic panel GMM estimation was used for objective 2 which studied the relationship between sustainable investment (ESG) and cost efficiency. The objective used the system GMM to assess the relationship on SSA banks. It was observed that;

There is a significant negative relationship between sustainable investment's environmental factor and cost efficiency which means, when banks engage in environmental projects, it leads to a reduction in their cost efficiency. This implies that there is a trade-off between environmental performance and bank cost efficiency, such that countries with higher environmental scores tend to have lower bank cost efficiency scores, and the other way around. This endorses the studies that found that the costs associated with sustainable investment can outweigh the benefits, particularly in the short term.

For the other factor of sustainable investment that is social and governance, there was a positive and significant relationship between government and cost efficiency while there was a positive and insignificant relationship between social and cost efficiency. This means that an increase in Governance factor is associated with an increase in bank

cost efficiency whereas an increase in social factors is associated with no effect on bank cost efficiency.

There is a positive but no significant relationship when the three factors of sustainable investment (ESG) are combined and cost efficiency. This relationship shows that, regardless of an increase of the ESG, shows no influence on cost efficiency.

Also, objective 3 used a dynamic panel GMM model to assess how bank stability influences the objective 2 that is, the relationship between sustainable investment and cost efficiency. The third objective also used system GMM to analyze the effect of the relationship when banks are stable and when they are not. The following observations were made;

When environmental factors were assessed on cost efficiency; it was found that there was a negative and significant relationship between environment and cost efficiency but bank stability had a positive relationship between environment and cost efficiency. This means that banks that are more stable or less risky can afford to invest more in environmental sustainability, as they do not lose much from it in terms of their cost efficiency. Banks that are less stable or more-risky may have to sacrifice some environmental sustainability to improve their cost efficiency.

It was found that social factors(S) have a positive but insignificant effect on bank cost efficiency at any conventional level. This means that banks that invest more in social sustainability do not have a significant impact on their cost efficiency. Moreover, this effect was moderated by bank stability, which showed an insignificant relationship

between social and cost efficiency. This means that the effect of social factors on cost efficiency does not depend on bank stability.

Governance factors (G) have a positive and significant effect on bank cost efficiency. This means that banks that invest more in governance sustainability tend to have higher cost efficiency. However, this effect is not moderated by bank stability, which showed an insignificant relationship between governance and cost efficiency. This means that the effect of governance performance on cost efficiency does not depend on bank stability.

Combining the overall ESG factors (ESG) have a positive but insignificant effect on bank cost efficiency at any conventional level. This means that banks that invest more in ESG sustainability do not have any influence on their cost efficiency. Moreover, this effect is not moderated by bank stability, as shown by the insignificant relationship between ESG factors combined and cost efficiency. This means that the effect of ESG performance on cost efficiency does not depend on bank stability.

## 5.2 Conclusion

This study sought to find the effect of sustainable investment on cost efficiency while examining the influence of the banks‘ stability in this effect in the sub-Saharan Africa region. Using the BC95 model, the study concluded that the banks in oil producing countries are more cost efficient than the banks in non-oil producing countries, and that the cost efficiency of banks in Africa improved over time from 2010 to 2017 with at least being 70% cost efficient.

In relation to environmental, social, and governance (ESG) factors effect on cost efficiency of banks in Africa. Environmental factors reduce cost efficiency, banks spend more to earn less when they invest in environmental projects. Social factors do not affect cost efficiency at all, the amount banks spend yields the same amount when they invest in social projects. Governance factors increase cost efficiency, banks spend less to earn more when they invest in governance projects. The overall ESG factor does not affect cost efficiency either, the amount banks spend yields the same amount when they invest in ESG projects.

Also, the environmental, social, and governance (ESG) factors relationship with cost efficiency of banks in Africa, and whether this depends on how stable or risky the banks are. The environmental factors reduce cost efficiency, but this is not the case for stable banks, that is when banks are stable, cost efficiency increases when banks engage in environmental projects. Social factors do not affect cost efficiency at all, regardless of bank stability. Governance factors increase cost efficiency, but this is also independent of bank stability. The overall ESG factors do not affect cost efficiency either, and neither does bank stability.

Finally, it can be concluded that social and governance factors of sustainable investment have a positive effect on bank cost efficiency. Though, the social factor neither decreases nor increases the cost efficiency, it is better than to invest in environmental projects as its effect is adverse on the bank‘s cost efficiency. With the influence of bank stability in the relationship between sustainable investment and cost efficiency, only the environmental factor becomes beneficial to cost efficiency when the banks are operating in a stable system.

## 5.3 Recommendations

For the first objective of the study, it can be recommended that banks in Sub-Saharan African countries should focus on improving their cost efficiency by identifying areas where they can reduce costs by up to 30%. This could involve implementing cost-cutting measures such as optimizing operational processes, reducing overhead costs, and improving the use of technology to streamline operations. Also, banks in SSA can benchmark their efficiency performance against the best practice bank to identify areas of improvement.

For the second objective of the study, it can be recommended that banks in sub-Saharan African countries should focus on improving their corporate governance practices such as improving transparency, accountability, and risk management practices to improve their cost efficiency. Additionally, banks could consider investing in socially responsible projects though it has no implication on their cost efficiency. By doing so, banks can improve their financial performance while promoting positive social and governance outcomes.

For the third objective of the study, it can be recommended that banks in Sub-Saharan African countries should prioritize environmental sustainability practices to enhance their stability and reduce risks. Bank regulatory and policy makers can encourage banks to invest in environmentally friendly projects by providing incentives such as tax breaks, grants, and subsidies. Additionally, bank regulatory and policy makers can create awareness among banks about the benefits of investing in environmentally friendly projects. Bank regulatory and policy makers can also provide training and capacity building programs to banks to enhance their understanding of environmental

responsibility and its benefits. Also, banks can collaborate with other stakeholders such as governments, non-governmental organizations, and communities to implement environmental projects that promote bank cost efficiency while the bank is stable.

### 5.4 Suggestions for Further Studies

For future research, the study may be conducted by considering individual bank data for a particular country instead of country level bank data that this study used. Also, the number of study periods could be expanded to take care of some economic downturns such as covid which due to data limitation, this study could not investigate. Such study will be necessary to bring out the exact relationship between sustainable investment and cost efficiency, and how bank stability could moderate this relationship among individual banks in a single chosen country.

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