

UNIVERSITY OF GHANA

**BANKING COMPETITION AND EFFICIENCY: EMPIRICAL EVIDENCE FROM
SUB-SAHARAN AFRICA.**

BY

AWALIGA BLATTER AKAMBASE

(ID.NO. 10551966)

**A THESIS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL
FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DEGREE OF
MASTER OF PHILOSOPHY IN FINANCE.**

DEPARTMENT OF FINANCE

JULY 2018

DECLARATION

Certainly, any research work carried out depends on related ones. Hence, while acknowledging information from other sources, I would like to certify that this research is a record of my own work and effort and that it has never been presented or submitted in part or whole anywhere by anyone for any academic award or any purpose. I accept responsible for any error or omission found in the work.

.....
AWALIGA BLATTER AKAMBASE
(10551966)

.....
DATE

CERTIFICATION

We hereby certify that this thesis was supervised in accordance with procedures laid down by the University.

.....

.....

DR. AGYAPOMAA GYEKE-DAKO

DATE

(PRINCIPAL SUPERVISOR)

.....

.....

DR. (MRS.) VERA OGEH LASSEY FIADOR

DATE

(CO-SUPERVISOR)

DEDICATION

This project work is first and foremost dedicated to the almighty God without whom this work would not have been a success. I also dedicate this work to my lovely family.

ACKNOWLEDGEMENT

I would like to express my profound appreciation and praise to the almighty God for offering me yet another opportunity to pursue my second degree and for His divine grace and protection throughout the entire period of my study.

I wish to thank my supervisors, Dr. Agyapomaa Gyeke-Dako and Dr. (Mrs.) Vera Ogeh Lassey Fiador for their priceless comments and guidance throughout the preparation of this research. In spite of their busy schedules, they still made time to go through every word, phrase and sentence in the work. May the almighty God richly bless you!

My special thanks to my brothers, Dominic Akambase, David Akambase and William Akambase for providing the necessary financial support to enable me pursue this programme successfully. I also thank my sister-in-law, Asana Akambase for her financial support and encouragement.

I truly remain indebted to my uncle, Mr. Alex Akambase and my mother, Madam Paulina Azure Akambase without whom I could not have had the opportunity to educate myself, thank you for your immense contributions in my education, my spiritual life and social wellbeing.

Finally, I wish to express my profound gratitude to Chrisantus Be-Imwin Kpinye for his hospitality during the course of my study.

TABLE OF CONTENTS

DECLARATION	ii
CERTIFICATION	iii
DEDICATION	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENT	vi
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF ABBREVIATIONS	xi
ABSTRACT	xii
CHAPTER ONE	1
INTRODUCTION	1
1.1 Background to the study.....	1
1.2 Statement of the Problem.....	2
1.3 Purpose of the Study.....	5
1.4 Research Questions.....	5
1.5 Research Objectives.....	5
1.6 Significance of the Study.....	6
1.7 Scope and Limitation of the Study.....	7
1.8 Thesis Structure.....	7
CHAPTER TWO	9
LITERATURE REVIEW	9
2.1 Introduction.....	9
2.2 The Relationship between Competition and Efficiency.....	9
2.2.1 The ‘Quiet Life’ Hypothesis.....	9
2.2.2 The Efficient-Structure Hypothesis.....	11
2.2.3 “Banking Specificities” or Information Hypothesis.....	12
2.3 Empirical Review.....	13
2.4 Bank Market Power and Cost Efficiency by Income Level.....	20
2.5 Measuring bank competition.....	22
2.6 Financial Reforms, Competition and Efficiency in SSA Banking Sector.....	33
2.7 The Concept of Cost Efficiency.....	26

2.7.1 Theoretical Review of Efficiency	28
2.8 Measuring Bank Cost Efficiency	29
CHAPTER THREE	43
METHODOLOGY	43
3.1 Introduction	43
3.2 Research Design	43
3.3 Population and Sampling techniques.....	44
3.4 Data.....	45
3.5 Measuring Bank Competition.....	47
3.5.1 Measuring the Lerner Index	48
3.5.1.1 The Basic Cost Model	49
3.6 DEA Technique as a Measure of Bank Cost Efficiency	53
3.6.1 Cost Efficiency	55
3.6.2 Variables used in the Computation of Bank Cost Efficiency.....	57
3.7 Measuring the effect of Competition on Cost Efficiency.....	59
3.8 Comparison of Cost Efficiency of Income Groups of Countries	61
3.9 Variable Measurements	63
3.10 Model Estimation Technique.....	71
3.11 Tools for the Data Analysis	74
3.12 Chapter Summary	74
CHAPTER FOUR.....	75
ANALYSIS AND DISCUSSION OF FINDINGS	75
4.1 Introduction	75
4.2 Descriptive Statistics	75
4.3 Correlation Matrix for Cost Efficiency	78
4.4 Empirical Results.....	79
4.5 The relationship between competition and cost efficiency in SSA banking sector.....	92
4.6 Regression Results.....	99
4.7 Sensitivity analysis	110
4.8 Chapter summary.....	111
CHAPTER FIVE	75
SUMMARY, CONCLUSION AND RECOMMENDATIONS	113

5.1 Introduction	113
5.2 Summary of Findings	113
5.3 Contributions of the Study.....	117
5.4 Conclusions	119
5.5 Policy Recommendations	120
5.6 Limitation of the Study and Areas for Further Studies	123
REFERENCES	125
APPENDICES	139
Appendix A: Model Diagnostic Test.....	139
Appendix B: Estimation of translog cost function	140
Appendix C: Tukey’s multiple comparisons of means 95% family-wise confidence level	141
Appendix D: Variance Inflation Factor	141
Appendix E: Regression results with OLS fixed effects model.....	130

LIST OF TABLES

Table 2: Explaining overheads costs in SSA.....	40
Table 3.1 Definition of Variables for Estimation of Competition and Cost Efficiency	59
Table 3.2: Variable description and expected signs	61
Table 3.3: World Bank Criterion for the Classification of countries.....	63
Table 4.1: Descriptive statistics of variables Used for competition and cost efficiency estimates	77
Table 4.2: Correlation matrix of cost efficiency variables	79
Table 4.3: Average Lerner index by country and year	81
Table 4.4: Mean Lerner index by income level	86
Table 4.5: DEA efficiency scores by year and country	88
Table 4.6: Mean cost efficiency by income group	91
Table 4.7: Descriptive statistics by country income group for competition-cost efficiency nexus	95
Table 4.8: Correlation matrix for cost efficiency and competition analysis	97
Table 4.9: Effects of Competition on bank cost efficiency	104
Table 4.10: Effects of competition on bank cost efficiency by country income group	109

LIST OF FIGURES

Figure 2.1: Aggregate financial development in Africa in international comparison39

Figure 2.2: Non-performing Loans.....42

Figure 4.1: Trend of market power of banks in SSA banking sector82

Figure 4.2: Differences in levels of market power across countries83

Figure 4.3: Cost efficiency trend of SSA banks..... .90

Figure 4.4: Cost efficiency scores by income.....91

LIST OF ABBREVIATIONS

SSA	Sub-Saharan Africa
IMF	International Monetary Fund
EIB	European Investment Bank
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
OLS	Ordinary Least Square
Lerner	Lerner Index
CE	Cost Efficiency
VRS	Variable returns to scale
Bsize	Bank size
CAP	Capitalisation
Assetg	Asset growth
Mktsha	Market share
GDP	Gross domestic product
GDPCPG	Gross domestic product per capita growth rate
MC	Marginal cost
2SLS	Two stage least square
LMIC	Low middle income countries/nations
LRMIC	Lower middle income countries/nations
UMIC	Upper income countries/nations

ABSTRACT

This study aimed at evaluating the effects of competition on cost efficiency in the Sub-Saharan African (SSA) banking sector. The study also evaluated how competition affects bank cost efficiency in the various income classifications of countries in SSA. Due to the endogeneity issue between competition and cost efficiency, a two-stage least square method was employed to examine the data of 235 banks from 17 SSA during the period 2006-2012. The results of the study show evidence that competition and cost efficiency levels in SSA banking system are low and have been unstable over the study period, although they have improved marginally. There is also evidence of significant variations in cost efficiency of banks operating in the three different income groups of countries in SSA. Higher market power of banks in SSA banking industry is found to improve cost efficiency and, thus, it does not allow bank managers in SSA to enjoy a quiet life with no motivation to increase cost efficiency. Concerning the control variables, the coefficients of bank size and asset growth are positive and have no significant effect on bank cost efficiency. Market share, bank capitalization, Credit risk and asset growth square have a negative and significant effect on cost efficiency. The coefficients of inflation rate and Per capita GDP growth are positive and statistically significant. Regarding how competition affects cost efficiency of banks in the three-income classification of SSA countries, the findings reveal that competition is harmful to cost efficiency in low- and lower-middle income countries. However, it has no effect on cost efficiency in upper-middle income countries. The control variables in the various income groups of countries also exhibit different effects on cost efficiency in terms of significance and signs of coefficient and this suggests varied policy prescriptions.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

One of the critical roles played by commercial banks is the provision of funds to firms or households through financial intermediation. Thus, commercial banks (banks) serve as the primary intermediaries through which suppliers and demanders of funds in both developed and developing countries are linked to transaction businesses (Sun, Mohamad & Ariff, 2017). This intermediation role played by banks implies that banks assume some level of risks which require that banks make conscious efforts to manage their assets and liabilities with utmost efficiency and better management practices (Ho & Saunders, 1981).

Therefore, efficient financial intermediation matters, just as identifying the particular factor that drives efficiency in the banking sector. This is due to the fact that efficiency in the banking industry is an indication of bank health and a significant catalyst for economic development and growth (Doan, Lin & Doong, 2017; Allen & Gale, 2000; Levine, 2005). Yet the empirical evidence shows that the financial markets, especially the banking sector in Sub-Saharan Africa (SSA), are still in their infancy stage (Leon, 2015; Beck & Cull, 2013), characterized by inefficiency as shown via the increasing rate of non-performing loans and as such are not in good standing to provide the essential financial support to meet the growing financial requirement of firms to boost economic growth in the Sub-region. As a result of this, most businesses operating within this jurisdiction obtain external funds to finance sacrosanct projects. This is a worrying situation because it has negatively affected the level and spate of economic growth that would have improved the standard of living of the citizenry in the region (Oluitan, 2014).

Efforts at improving banking efficiency have been made in terms of banking sector reforms, which are still ongoing. These include processes such as deregulation and liberalization of the banking sector. These processes are viewed as the objective means for the expansion of the banking and financial service industries. The above-mentioned processes are also assumed to enhance income diversification of the banking market and the arrival of private sector financial institutions, all in the name of stimulating the competition among banks in order to improve banking sector efficiency which would in turn provide the needed financial support to enhance economic growth (Edirisuriya, Gunasekarage & Dempsey, 2015). Of particular importance is how competition and diversification activities have impacted the efficiency of the banking market, especially in Sub-Saharan Africa (SSA) where these issues still remain woefully unexplored despite their importance in providing clear policy guidance for regulators.

1.2 Problem Statement

The existing literature on bank efficiency has identified certain factors such as competition, capitalisation, size, etc. that influence cost efficiency in the banking sector. However, among these factors, the one that has received a lot of attention by finance researchers is that which focuses on the influence of competition on cost efficiency while controlling for the other factors (see Weill, 2004; Schaek & Cihak, 2008, 2010). Investigating the competition-efficiency relationship is crucial given that SSA has pursued financial reform policies with much enthusiasm and consistency for the past 15 years with significant progress which has consequently increased the competitive pressure of banking in SSA. The increase in competition is believed to enhance the efficiency of the banking sector. However, there are still concerns

about the ambiguity of the influence of policy reforms such as competition on bank efficiency. Even so, reforms in the banking system are continuous processes and not an event. Therefore, it is important to conduct research from time to time to update and inform policy directions.

Indeed, theoretical and empirical investigations into the effect of competition on bank efficiency have been largely ambiguous. For instance, the Quiet Life Hypothesis envisages that competition increases efficiency in the banking market. In contrast to this hypothesis, Demsetz's (1973) Efficient-Structure hypothesis concludes that competition worsens banking efficiency. Surprisingly, the empirical studies on this issue have been skewed in favour of developed countries (with exception to Turk-ariss (2010) whose study combined developed and developing countries), despite the importance of this issue in the SSA banking sector. Nevertheless, given the fact that there are disparities in bank competition and efficiency levels, as well as the institutional set up between advanced countries' markets and less developed countries' banking markets (Eldomiaty, 2007), it might be inappropriate to generalize those findings to those of developing countries like those in Sub-Saharan Africa. Therefore, given the uniqueness of SSA countries, a study dedicated to assessing this issue in the Sub-Saharan African banking sector only will provide some understanding on it for regulators and policy makers.

A related issue that is worth investigating is the need to ascertain whether market power exerts different effects on cost efficiency in the various income categorisations of the countries in SSA. So far, there is at least evidence to show that bank profitability determinants differ fairly extensively depending on the income status of the country that the bank operates in, in terms of significance and quantum of effects. Such studies range from single country studies (like

Dietrich & Wanzenried (2011) on Switzerland, Sufian & Habibullah (2012) on Indonesia, etc.) to cross-country studies (including Dietrich & Wanzenried (2014) for low income nations, middle income nations and high-income nations, Brissimis et al. (2008), Goddard et al. (2007) and Pasiouras & Kosmidou (2007) for many European economies.

As far as it can be ascertained, no study until now has assessed whether the effects of competition on cost efficiency is even across various countries with diverse income levels or not. Even so, Mirzaei and Moore (2014) has established that there are unique features of competition drivers across diverse income groups of countries. Their study further reveals that high market power in the banking system endangers competitiveness in developing economies. Yet, such a causal nexus is not present for advanced and emerging economies. Since banking competition is used as a tool to influence efficiency in the banking sector (Casu & Girardone, 2009; Schaeck & Čihák (2008); Coccoresse & Pellicchia, 2010) and has been established to exhibit varied effects in diverse economies, it would be interesting to understand whether competition exerts different impacts of a country's income situation on bank cost efficiency. This will help inform policy direction towards the recent effort aimed at consolidating the banking system of SSA to enhance financial deepening.

This study, therefore, attempts to fill this potential gap in the literature by classifying the countries into their respective income brackets, to investigate whether the supposed elements influencing bank cost efficiency incorporated in the model have different effects on bank cost efficiency across the different income groups of countries in SSA and to finally test whether cost efficiency differences exist in the SSA banking sector.

1.3 Purpose of the Study

The main purpose of this research is to ascertain the level of competition and cost efficiency in the SSA banking sector and to determine how market power affects bank cost efficiency both in the SSA banking sector as a whole and in the various income categorizations of countries in this region. Cost efficiency and competition are measured using data envelopment analysis and the Lerner index, respectively. The effects of competition on cost efficiency are then assessed using a two-stage least square approach.

1.4 Research Questions

The study tried to find answers to the following research questions.

1. What is the level of banking competition and cost efficiency in the SSA banking sector?
2. What is the relationship between banking competition and cost efficiency in SSA?
3. Do the effects of competition on cost efficiency depend on a country's income level?

1.5 Research Objectives

The study aimed to:

1. Measure the level of banking competition and cost efficiency in the SSA's banking industry.
2. Evaluate the impact of competition on bank cost efficiency in the SSA's banking industry.
3. Determine whether the impact of competition on cost efficiency depends on a country's income level.

1.6 Significance of the Study

The outcomes from this research have implications for policy, business practice and academic research. The inception of 1980's and 1990's, and the 2008/9 banking crises have compelled most SSA countries to implement banking reforms to adjust their banking practices to conform to international standards with the hope that this will elevate the financial system competition, stability and efficiency and result in increases in financial intermediation and inclusion. Despite the implementation of the reforms, SSA countries are still being heavily vilified for not living up to the expectation of increasing financial intermediation and inclusion due to their old-fashioned tactics to regulation (Kouki & Al-Nasser, 2017). Consequently, the discoveries unearthed by this study have highlighted the areas that need much attention or those that have to be revised to ensure SSA enjoys the benefits from growth enhancing effects resulting from a well-functioning banking system. The results from this study could also be replicated to enlighten policymakers in other emerging countries experiencing similar problems faced by SSA.

As far as can be ascertained, this study serves as a major international study on banking that investigates the effects of market power on bank cost efficiency that is solely devoted to SSA banking system by covering as many as seventeen (17) countries. Previous studies carried out cross-country studies on Africa with a combination of developed and developing countries (Turk-Ariss, 2010), or developed countries alone (Schaeck et al., 2009). This study will help to enrich the scanty banking literature on the SSA banking sector.

1.7 Scope and Limitation of the Study

This research is restricted to the assessment of the impact of competition on cost efficiency of banks and to also ascertain whether such a determinant can explain the perceived differences in commercial banks' performance across low middle nations, lower middle nations, and upper middle income nations in SSA over a 7-year period from 2006-2012. In each case, control variables – both macroeconomic and bank specific factors directly determining cost efficiency – are included. The period of the study was strictly influenced by the accessibility of data which was obtained mainly from the Bankscope database.

A major limitation of this study was the inability of the researcher to obtain comprehensive data on all the banks in SSA and the short time frame for the study. Most banks in SSA are still in their infant stage (Leon, 2014) which makes data collection on them difficult. As a result, the study depended solely on the data made available by BankScope which does not have data on all the banks in SSA. This notwithstanding, the findings from this study could reflect the condition of the banking sector of SSA so that the results obtained herein may be applicable to similar developing economies elsewhere because the sample considered contains the biggest banking markets in SSA.

1.8 The Structure of the thesis

The study is divided into five chapters. Chapter one covers the introduction of the research, the background, problem statement, research objectives, research questions, significance of the research, scope and limitation of the study and how the chapters of the thesis are organised. Chapter two occupies itself with a review of relevant literature across the globe. It discusses

relevant theories on the link between banking efficiency and competition by reviewing empirical findings on the link between banking competition and efficiency. Chapter three highlights the methodological approaches and the description of the variables as well as the data source for all banking competition, income diversification and cost efficiency assessments. Chapter four presents the analyses of empirical data and discussions of the outcomes of the research. Finally, the thesis is concluded in chapter five by providing a summary of the entire study whilst making recommendations to policy makers and suggesting areas for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This second chapter of the thesis seeks to review relevant theories and empirical studies on competition and bank efficiency as well as theories on the measurement of competition. The chapter also reviews the concept and theory of efficiency. It focuses particularly on recent empirical literature on areas closely related to the present research objectives.

2.2 The Relationship between Competition and Efficiency

This section reviews theoretical literature by looking at the relationship between banking competition and cost efficiency, with a focus on the Quiet Life Hypothesis, the Efficient-Structure Hypothesis and the Information Hypothesis. The section further analyses previous studies on competition and efficiency in the banking business.

Theoretical literature on the link between competition (the inverse of market power) and efficiency are scarce. The few studies that are available provide conflicting findings on the issue. Reviewing these theories or hypotheses will, therefore, render some insights into the controversies.

2.2.1 The Quiet Life Hypothesis

The Quiet Life Hypothesis lays emphasis on the internal organization of the firm that affects its output strategy and operational efficiency. It showcases managerial behaviour under competitive and uncompetitive (where banks have market power) circumstances. The theory, which was

opined by Hicks (1935), postulates that the greater the market power enjoyed by a firm, the lesser the effort exerted by managers in order to optimize cost efficiency, thereby leading to a negative association between market power and cost efficiency. Thus, this hypothesis posits that high market power in banking is associated with lower cost efficiency, with causality running from competition to efficiency (Berger & Hannan, 1988); competition determines efficiency. The low competition/high market power among banks deteriorates banks' cost efficiency. Berger and Hannan (1998) encapsulate reasons for the inefficiency in uncompetitive banking market. First and foremost, market power, by concealing the indicators, could breed managerial incompetence or non-profit maximization behaviours not to be identified by the principal and this may continue into the future without these inefficient managers wilfully shirking work efforts (Maudos & de Guevara, 2007).

In contrast, when there is high competition, bank owners can evaluate the performance of their entities by comparing their entities to other banks. In so doing, the slightest deviation from profit maximization is promptly noticed. In addition, in high concentrated banks, managers may employ resources to gain and sustain market power, thereby increasing costs and slowing down efficiency. Lastly, market power could permit managers to focus on objectives rather than profit maximization such as empire building (Berger & Hanann, 1988). So, under the Quiet Life Hypothesis, increased competition among banks is expected to bring about better efficiency in banking. Indeed, heightened concentration stifles bank efficiency. The implication of this theory is that market concentration leads to a greater loss in social welfare and, therefore, anti-trust measures are prescribed as a means of improving consumer welfare. This hypothesis is rarely tested in the context of SSA.

According to Andries and Capraru (2014), Berger and Hannan (1988) were the first to test this hypothesis, using a sample of 5000 U.S. banks over the period 1980 to 1989. They used the Herfindahl-Hirschman Index to measure market power. Later studies replaced the Herfindahl-Hirschman Index with the Lerner index amid concerns that the former is not a good measure of market power. A number of these studies, including Casu and Girardone (2009), Schaeck and Čihák (2008) and Coccoresse and Pellicchia (2010), provides support for the quiet life hypothesis. On the other hand, studies such as Weill (2003), Maudos and Fernandez de Guevara (2007) and Pruteanu-Podpiera et al (2008) reject the quiet life hypothesis.

The implication of this theory is that market concentration leads to a greater loss in social welfare and, therefore, anti-trust measures are prescribed as a means of improving consumer welfare (Maudos & de Guevara, 2007). This hypothesis is rarely tested in the context of SSA.

2.2.2 The Efficient-Structure Hypothesis

Many authors cast doubt on the proposition by the Quiet Life Hypothesis that inadequate competition reduces managers' efforts to reduce operational cost thereby leading to inefficiencies in banking. This led to the idea of the Efficient-Structure Hypothesis (ES Hypothesis) by Demsetz (1973) which provides a different exposition on the correlation between bank efficiency and market power. This hypothesis predicts an inverse causality between competition and cost efficiency. According to the ES Hypothesis, banks that are best managed and banks that are more efficient tend to have the least costs. Subsequently, the most efficient banks earn the biggest market shares usually to the disadvantage of inefficient banks. This in turn

results in greater profits and eventually, more market concentration (Berger, 1995). Since market power/concentration is an inverse measure of competition, it implies that higher bank concentration lowers competition. Hence, this hypothesis suggests that cost efficiency slows competition. Therefore, since cost efficiency results in higher market concentration which reduces competition among banks, there should also be an indirect link between competition and efficiency which consequently withdraws the causality running from competition to efficiency in the Quiet Life Hypothesis (Tregenna, 2009).

2.2.3 Banking Specificities or Information Hypothesis

Marquez (2002) opined this hypothesis and advocates that competition exerts a harmful effect on cost efficiency of banks. Both the Quiet Life Hypothesis and the ES hypothesis have only outlined the relationship between competition and efficiency which are not peculiar to the banking markets. In accordance with the banking literature, most studies (Bikker & Haaf, 2002; Weill, 2004; Carbo et al., 2009) have discovered that the banking market has a structure of imperfect competition and this specific characteristic distinguishes it from others. The theoretical literature in banking proposes that the imperfect market structure could be the consequence of the inability of banks to get adequate information about their clients before granting loans which results in adverse selection and moral hazard problems. Therefore, to reduce the effects of moral hazard and adverse selection, banks have to devise some mechanisms such as customer relationship building and screening (Leon, 2015; Fungacova, Pessarosi & Weill, 2013; Pruteanu-Podpiera, Weill & Schobert, 2013; Petersen & Rajan 1995; Mayer, 1988). These mechanisms, if well implemented, can lessen the issue of information asymmetry which often causes adverse selection and moral hazard problems.

Nonetheless, heightened competition may deteriorate the length of relationship a bank has established with a borrower and as a result increase costs to the bank. Therefore, increased competition worsens cost efficiency. On the contrary, the studies on banking relationship (e.g. Petersen & Rajan 1995) indicate that banks that have more market power enjoy lower costs of monitoring and dealings with borrowers. Furthermore, market power permits banks to take advantage of greater profits, which could in turn motivate banks to behave rationally. The rational behaviour helps banks to select undertakings with less risk and lesser monitoring costs. By implication, when banks acquire some level of market power, there is no pressure on them to raise the quality of banking services and this tends to reduce operational costs. In such situations, a direct association between cost efficiency and market power occurs. This view is further supported by proponents of scale economies derived from bank efficiency (such as Martin 1996; Bertolotti & Poletti 1996) that the presence of scale economies in a market implies that the rise in the number of competing banks leads to greater average costs for every existing bank.

2.3 Empirical Review

A review of the empirical findings on the competition-efficiency nexus will now be carried out in this section. The section critically examines studies that lend support to the Quiet Life Hypothesis, Efficient-Structure Hypothesis and the Banking Specificity Hypothesis. Also, studies that do not favour any of the theories are also reviewed.

The empirical findings on the competition-efficiency nexus have been inconclusive, likewise their theoretical predictions. Berger and Udell (1998) were the first to examine the intuitive Quiet Life Hypothesis on U.S. banks. They reported that high market concentration lessens

banks' ability to minimize operating cost and, therefore, concluded that this evidence supports the Quiet Life Hypothesis. Berger and Hannann (1998) sampled 5,000 U.S. banks. However, the deficiency in their research is that they employed concentration measures such as the Hirfindahl-Hirschman index as proxies for market power. Concentration measures have been shown by most studies not to be a suitable measure of banks' market power (Berger & Humphrey, 1997; Marquez, 2002; Angelini & Cetorelli, 2003; Maudos & Fernandez de Guevara, 2004; Claessens & Laeven, 2004; Fernandez de Guevara et al., 2005, 2007; Carbó et al., 2009). This could be the reason why Berger and Hannann's (1998) findings are different from the findings of Koetter, Kolari and Spierdijk (2008) and Maudos and Fernandez de Guevara (2007) who conducted their studies on U.S. banks to examine the Quiet Life Hypothesis. Both studies rejected the Quiet Life Hypothesis for the U.S. banks. Differences exist in their methodological approach to measuring competition.

To begin with, Koetter, Kolari and Spierdijk, (2008) employed the Efficiency-Adjusted Lerner to compute the market power of banks from the U.S. The Efficiency-Adjusted Lerner was adopted to resolve the problem of endogeneity as recent study by Williams (2012) has shown that the Quiet Life Hypothesis is supported for research works that failed to solve the problem of simultaneity bias (e.g. see Berger & Hannann, 1998). Furthermore, Coccorese and Pellicchia (2010) found evidence in support of the Quiet Life Hypothesis for banks operating in Italy. However, market power was found to partially or weakly influence cost efficiency. Coccorese and Pellicchia used data on Italian banks from the period 1988-1996 to compute the Lerner index and cost efficiency. Ariss (2010) also supported the Quiet Life Hypothesis when the author found that banks that possess greater market power (proxied by the Lerner index) exhibit low

cost efficiency. In a similar method, Delis and Tsionas (2009) reported an inverse relation between cost efficiency and market power when they used a panel data of banks from Economic and Monetary Union banks in Europe.

Other studies too did not find any link between competition and bank efficiency. Fu and Heffernan (2009), for instance, analysed the interrelationship between profitability, cost efficiency and market structure in Chinese banking market covering the period 1985-2002. They gauged competition using market shares and found that competition had no relationship with cost efficiency. However, their study was criticised by studies such as Ariss (2010) and Delis and Tsionas (2009) for measuring competition with the Herfindahl-Hausmann index which has serious limitations. Their study did not perform the Granger-causality test. To correct this shortcoming in Fu and Heffernan's (2009) study, Fungacova, Pessarossi and Weill (2013) evaluated the link between bank competition and cost efficiency of banks from China during the time period 2002-2011. They applied the Lerner index to compute competition and the stochastic frontier analysis to compute cost efficiency and test the relationship using the GMM techniques. The authors still discovered the absence of statistically significant link between bank competition and cost efficiency which is opposite to similar empirical studies which show that competition adversely affects cost efficiency in most Western economies' banking market. They concluded that competition among banks has no harmful or positive effects on cost efficiency in China.

The banking specificities hypothesis could be used to explain this finding. The authors argued that banks in china might not suffer from information asymmetry as banks offer more of their

loan portfolio in favour of large state-owned companies. Therefore, this hypothesis plays an insignificant role in China.

In a similar fashion, Fare, Grosskopf, Maudos and Tortosa-Ausina (2015) examined the competition-efficiency link in the context of Spanish banking industry for some types of banking firms, i.e. commercial and savings and loans banks. They analysed the relationship in these types of banks for the different components of efficiency (cost, technical and allocative efficiency). Their empirical evidence indicates that the association fluctuates, depending on the extent of market power, the element of efficiency being evaluated (cost, technical or allocative) and whether the bank is a commercial bank or a saving bank. These pieces of evidence point out that the Quiet Life Hypothesis may be present only for certain types of banks. For the link between cost efficiency and market power in commercial banks, their study reported a fragile evidence to rule out or confirm the Quiet Life Hypothesis. In contrast, they found a negative relationship for savings banks. Andries and Capraru (2014), investigating a similar relationship in 27 European countries' banking sector as a whole by means of Granger-type causality estimation technique, did not reveal any evidence to confirm the Efficient Structure Hypothesis. Nevertheless, their results indicate no or weak evidence in rejection or support of the Quiet Life Hypothesis.

So far, the review has only been based on some empirical evidence about studies that give support to the positive and/or no correlation between competition and efficiency. That is, the study now focuses on prior studies that favour the Efficient-Structure Hypothesis. Few studies have affirmed this hypothesis. Pruteanu-Podpiera et al. (2008) evaluated the link between bank competition and cost efficiency in Czech banking market over the period 1994-2005. They

measured competition using the Lerner index and cost efficiency with distribution-free approach. They used Granger-causality tests to test the sign and direction of causality between competition and cost efficiency. Granger-causality estimates were ran using the GMM dynamic panel technique. They revealed that cost efficiency could be raised by decreasing competition but not the reverse. Their results, therefore, did not find enough evidence to support the intuitive Quiet Life Hypothesis by Hicks (1934). Their results rather pointed out an inverse association between bank competition and efficiency. In a similar study, Casu and Girardone (2009) investigated the same relationship in the five biggest European countries' banking markets. The authors found partial evidence to back the negative influence of competition on cost efficiency with causality moving from competition to cost efficiency. However, they did not find evidence for reverse causality. These two empirical studies validate findings in earlier literature indicating an inverse linkage between competition and cost efficiency. Furthermore, the Casu and Girardone (2009) recommended that since the source of the relationship originates from bank competition, it implies that the relationship might best be justified by employing the Banking Specificities Hypothesis instead of the Efficient-Structure Hypothesis.

Maudos and de Guavara (2007) report that there is a direct association between market power and cost X-efficiency in the European banking system, permitting a rejection of the so-called Quiet Life Hypothesis. The authors further document that the welfare benefits in connection with rising market power far outweighs the harm to bank cost efficiency. This implies that policy makers should incorporate this into formulating or revising existing policies which presume that market power is essentially bad. They conclude that the divergence between their results and earlier ones found in U.S banks provide further evidence that it is important for more studies to

be carried out in other countries' financial sectors, since studies evaluating the perceived harm of market power on either social welfare or bank cost efficiency are scarce and provide varied conclusions.

In a paper devoted to testing the Efficient-Structure Hypothesis (ES Hypothesis) in the Japanese banking industry, Homma, Tsutsui and Uchida (2014) found evidence for both the Efficient-Structure Hypothesis and the Quiet Life Hypothesis. However, their findings advocate that the Efficient-Structure Hypothesis leads the Quiet-Life Hypothesis with respect to economic influence. They measured market power using the concentration ratio and bank efficiency with the distribution-free approach.

Financial reforms, such as deregulation which permits the permeation of foreign banks into the local market, promote competition which may worsen the inefficiency of banks in accordance with the Banking Specificities Hypothesis. In a study to analyse the correlation among industry competition, productive efficiency and economic growth in Egypt, Poshakwale and Qian (2011) employed the Endogenous Growth Model and discovered that in the long run, competition is harmful to cost efficiency. They hypothesized that the results may be due to the fall in cost efficiency of the existing banks in their sample, resulting in decreased operational scale triggered by the addition of new banks all in the name of financial reforms.

Arrawatia, Misra and Dawar (2015) estimated the extent and evolution of competition and the connection between bank competition and efficiency in India between 1996 and 2011. They measured competition and cost efficiency with the Lerner index and DEA, respectively. Their

findings show a rising pattern for competition from 1996 to 2004 and thereafter, competitive levels declined. The Granger causality tests revealed that efficiency is positively affected by competition and vice-versa. Thus, they found a bi-directional causality.

Studies examining the association between bank competition and efficiency in SSA banking sector are limited. The few studies focus on the extent and evolution of bank competition and efficiency. A study by Mlambo and Ncube (2011) examined the progress of competition and efficiency of the banking industry of South Africa by means of firm-level data for the period 1999–2008. The authors computed competition by means of the Panzar-Rosse H-statistic and efficiency with the DEA and found that the average efficiency increased during the study period. Nevertheless, banks' efficiency kept on declining. These authors further found that the banking industry of South Africa is monopolistic in nature, probably as a result of the dominance of the banking sector by the five largest banks with assets worth over 85% of the total banking assets. Earlier literature (see Bikker & Haaf, 2002; Shaffer, 2004) have shown that the Panzar-Rosse H-statistic is not a good proxy for competition, especially for cross country studies as it aggregates competitive behaviour of banks. One of the significant contributions of this study to the SSA banking literature is the use of the Lerner index to measure competition. This method measures competition at the firm level and as indicated by Koetter and Vins (2008), Shaffer (2004), Evanoff and Fortier (1988), testing the link between competition and cost efficiency requires competition to be measured at the firm level because cost efficiency is measured at the firm level. This ensures a uniform unit of analysis for better outcome.

Leon (2015) also investigated the competition-efficiency nexus in seven West African Economic and Monetary Union countries. The study used the Lerner index to proxy competition and the stochastic frontier, and not the DEA, to calculate cost efficiency. Study shows that banks that possess market power can increase cost efficiency. However, in terms of profit maximization, there is no significant variation between them and the more competitive banks. Cognizant of the fact that the correlation between market power and bank efficiency is affected by banks and countries characteristics, extending the study to cover other SSA countries would be of great importance especially in terms policy implications given the fact that banks remain the main source of funds for businesses in SSA owing to its underdeveloped stock markets.

2.4 Bank Market Power and Cost Efficiency by Income Level

A plethora of studies (Delis, 2012; Claessens & Laeven, 2004; Jeon et al., 2011) have assessed the factors that influence competitive-behaviour in the banking industry by differentiating between developed, emerging and developing nations. A study conducted by Delis (2012), for instance, assesses the effectiveness of financial reforms in enhancing competition among banks. Specifically, the author evaluated how financial restructuring and the superiority of institutions influence competition in eighty-four (84) countries' banking sectors. Delis (2012) observed that even though these factors actually enhanced competition among banks, the extent to which a country enjoys the benefits of the enhanced competition, such as diversified, efficient and a competitive banking system (which is a prerequisite for an efficient financial intermediation) (Mirzae and Moore, 2014), largely hinges on the strength of the country's institutions and the level of institutional development.

Therefore, financial reforms could not have led to the enhancement of banking competition in countries that have fragile institutions and little institutional growth. The authors stress that these problems appear to be smaller or completely absent in well developed nations with deeper banking structures as well as strong legal and regulatory systems. This facet has been analysed and the effect of competition is known for different institutional, environmental and developmental levels. Similarly, the potential effects of competition on cost efficiency could also be influenced by the type of economy, i.e. low-, lower-, or upper-middle country that a bank carries its operations in. Yet, as far as it could be ascertained, no study has analysed similar effects of competition on cost efficiency in different country income groups, especially in the SSA. Investigating this issue across different country income groups is important because banks still remain the major important foundation of funding businesses since the stock markets which would be an alternative source, till date remain in their infancy stage (Beck and Cull, 2013).

Given that certain distinctive characteristics of competition have different effects in different country income groups, analysing the impacts of competition on cost efficiency for the various income brackets of countries in SSA is indeed crucial so as to identify the alterations in the findings of the theoretical disagreements existing in the literature and to further develop a suitable regulatory environment that meets each country's level of development in the ever-changing economic settings and growth.

As indicated by Beck, Demirguc-Kunt and Levine (2009), "the financial systems and standard indicators of financial intermediary across the world deepened over the past decades along many dimensions". Nonetheless, the advancement in financial intermediation is still not uniform across

the various income brackets. Unfortunately, the expansion has been skewed in favour of high-income countries, whereas there is still no significant growth in middle- and low-income countries. According to Dietrich and Wanzenried (2014), several economic and institutional structures are not the same across low, middle- and high-income countries. Hence, one can suggest that competition could have significantly different implications on bank cost efficiency in the various income groups of countries which may demand different policy prescriptions to ensure a healthy financial intermediation.

Several studies on cost efficiency have revealed that the ever-changing economic setting and growth have different influences on bank performance indicators. Notable among such studies is Doan, Lin and Doong (2017) who discovered that there are no insignificant dissimilarities in average cost efficiency between developed countries and developing countries in Europe and in Latin America.

2.5 Measuring bank competition

Generally, the literature on how bank competition is measured is grouped into two: the traditional industrial organization literature and the new empirical industrial organisation literature. The traditional industrial organization literature suggests the structural approach to examining competition in banking based on the Structure-Conduct-Performance (SCP) paradigm. Many of the earlier studies on bank competition, precisely, until the 1990s used the structural approach which is based on the Structure-Conduct-Performance (SCP) paradigm. The SCP model was established by Mason (1939) and Bain (1956). The SCP posits that greater bank concentration encourages banks to exhibit collusive behaviour which in turn gives banks an

advantage to enjoy greater profits at the expense of their clients (Pruteanu-Podpiera, Weill & Schobert, 2007). In other words, higher concentration results in uncompetitive behaviour of banks and, consequently, leads to low output but higher prices (high interest on loans) which gives rise to greater profitability. The SCP Hypothesis and its associated measures of concentration states that market power, which is an inverse computation of bank competition, is calculated by concentration indicators like the concentration ratios or the market shares of the five biggest banks and/or by the Herfindahl-Hirschman index. The shortfall in these measures is that they infer the intensity of competition from the structure of the market. Thus, structure determines competition. The severity of this problem is more pronounced when Baumol, Panzar and Willig (1982) in their theory of contestability suggest that a banking industry could be concentrated and yet behaves competitively as if banks could freely enter and leave the market without any hurdles. By implication, the market structure is not the only factor that determines the actual behaviour of banks.

To outwit the problems inherent in the traditional industrial organization approach in measuring competition, the new empirical industrial organisation approach (non-structural approach) emerged. This approach incorporates contestability in measuring bank competition. Hence, it enables researchers to assess the actual behaviour of banks directly without making any indirect inference from the structure of the market as it is in the case of the traditional industrial organization approach (Claessens & Laeven, 2004; Berger et al., 2004). This literature is proposed mainly from the models of Lerner (1934), Iwata (1974), Bresnahan (1982) and Panzar and Rosse (1987). Some of the measures of competition from this approach mostly used by researchers include the Panzar-Rosse (1987) H-statistic and the Lerner (1934) index. A brief

account of the two approaches and the justification for selecting the Lerner index for this current study over the Panzar-Rosse approach are given in the subsequent paragraphs.

The Panzar-Rosse (1987) H-statistic is one of the non-structural approaches that can be employed to estimate the level of competition in the banking sector. The approach is based on the reduced-form revenue functions and it uses bank-level data to measure the market power of banks with an index called the H-statistic. The Panzar-Rosse H-statistic sums the elasticities of total revenues to input prices and this value decides the competitive nature of the market. A value below or equal to 0 indicates monopoly. If it is within 0 and 1, it shows monopolistic competition (Rosse & Panzar, 1977; Panzar & Rosse, 1987) and 1 indicates perfect competition (see Mamatzakis et al., 2005; Park, 2009). The H-statistic indicates the degree to which variations in factor prices influence bank revenues.

According to Hall and Simper (2013), the idea behind the Panzar–Rosse model is to detect whether a firm’s total revenue fluctuates in the same or reverse trend when input prices change due to market conditions. That is, if the total revenue and input prices change in the same direction, this will indicate a competitive market, whereas changes in the opposite direction tend to reflect a certain amount of market power. The strength of this approach lies in its ability to reveal the structure and conduct of the market to which the bank belongs (Mirzaei & Moore, 2014). Its major limitation, however, is that it measures the market power of banks over a particular period of time, not enabling researchers and policymakers to evaluate the progress of bank-market power over time. Another shortfall of the H-statistic relates to its interpretation. The common interpretation of the H-statistic is that when $H = 1$, the firm exhibits a competitive

behaviour while that of a monopoly yields $H \leq 0$. Yet, recent empirical works show that the H-statistic may exhibit negative values in situations where the market is competitive and positive values in monopoly markets. Shaffer (2004) indicates that in the short-run, the H-statistic may attain negative values even under a very competitive setting. Bikker et al. (2012) also show that it becomes negative under constant average cost.

Due to the challenges of the Panzer-Rosse (1987) approach, an alternative approach developed by Lerner (1934) is recently embraced by many scholars. The Lerner index which is derived from the static theory of firm models under equilibrium conditions is based on the New Empirical Industrial Organisation approach. That is a non-structural approach which assesses the level at which a firm can set its prices (charges and interest rates) over its marginal costs as a proportion of prices (Weill, 2003). The divergence between prices and marginal costs is the source of the market power. In a competitive setting, marginal cost is expected to be equal to price. Hence, the higher the disparity between marginal cost and price, the higher the pricing power of banks. The Lerner (1934) index is extensively used to study bank competition because of its simplicity and direct interpretation. It also does not require large data and the most important fact is that it takes into consideration contestability and measures banking competition at the firm level.

Moreover, the Lerner (1934) index provides researchers with the opportunity to assess the pattern of bank pricing behaviour over time (Leon, 2014; Marquez, 2002; Angelini & Cetorelli, 2003). In addition, it permits the market power to be calculated individually for the different geographical markets and different banking products. These attributes of the Lerner index make

it particularly promising for cross-country studies as it allows researchers to gauge competition for different banking markets. Since the Lerner index is both time-variant and bank specific (Angelini & Cetorelli, 2003), it helps to examine policies put in place to stimulate competition across time (Benink, 2000). Furthermore, the bank specific measures of competition allow regulators and policy-makers to evaluate and find banks that offer efficient products and services to clients (Koetter, Kolari & Spierdijk, 2008). Nonetheless, the Lerner index has certain limitations. It is a method of measuring market power and is not a direct means to measure competition in banks. Recent studies provide theoretical evidence that there are situations where the Lerner index rises with extreme competition (Stiglitz, 1989; Bulow & Klemperer, 2002). Put differently, as the Lerner indices increase over time it does not essentially denote deterioration in competitive environments. In contrast, this can be indicative of growing competitive situations. Consequently, this measure is, at least in practice, deceptive (Boone, 2008).

Despite the demerits of the Lerner index, it is still the most widely used measure of competition because its merits overshadow its disadvantages. Interestingly, one key reason that makes the Lerner index a more robust measure of competition in our setting is that in SSA the banking sector is still in its infant stage (Leon, 2014), thereby causing data limitations.

2.6 The Concept of Cost Efficiency

Farrell (1957) and Debreu (1951) pioneered Cost efficiency (CE) which was operationalized by Färe et al. (1985) in the DEA literature by employing linear programming techniques. One of the leading objectives of managers include effective and efficient allocation of production units which propels them to continually evaluate the efficiency of firms' operating processes in

accordance with the various inputs and outputs employed (Sherman & Zhu, 2006). The estimation of cost efficiency is, of course, one way of examining a firm's performance because it measures how best a firm uses its inputs to produce the desired products or services (Zainal & Ismail, 2010). According to Hollingsworth and Parkin (1998), efficiency is "the allocation of scarce resources that maximizes the achievement of aims". From the foregoing papers, cost efficiency can be defined as using scarce resources judiciously to ensure a firm produces its optimum output given the input prices. Cost efficiency is also known as the overall efficiency, economic efficiency or x-efficiency. The overall efficiency score reflects both technical and allocative efficiencies whilst the technical efficiency represents the proficiency of a firm to achieve optimum output from a specified set of inputs. With this, the firm strives to avoid wastage of scarce resources which have alternative uses. As indicated by Koopmans (1951), "a producer is considered technically efficient if, and only if, it is impossible to produce more of any output without producing less of some other output or using more of some inputs." (as cited in Mokhtar, Al-Habshi & Abdullah, 2006).

Allocative efficiency refers to a firm's ability to apply inputs in their best quantities when their respective prices are given (Farrell, 1957). In this case, the aims of producers may include the following: to yield a specified output at a lowermost cost; to use a set of inputs so that revenue can be maximised; and to apportion inputs and outputs in a manner that profit can be optimised. Allocative efficiency simply implies the ratio of cost efficiency to technical efficiency. An allocative efficiency score of 0.63 will mean that the firm could have saved 37% if a good allocation of funds were made towards a less expensive but sufficient input mix. Berger and

Mester (1997) emphasize that cost efficiency remains a key concept in quantifying firm performance. To this end, the current study examines banks' cost efficiency in SSA.

2.6.1 Theoretical Review of Efficiency

Several theories have been propounded to explain the efficiency of financial institutions as well as banks. They include the X-efficiency Hypothesis by Leibenstein (1966) and the scale-efficiency.

The Leibenstein (1966) X-efficiency Hypothesis maintains that better management practices enable banks to reduce costs and increase profit, thereby pushing the bank closer to the best-practice frontier. The X-efficiency Hypothesis is applied in banking studies to explain why there is inefficiency in firms. It also accounts for why these inefficiencies tend to decrease due to a considerable rise in competition in the banking market. It is worth noting that the inefficiencies are caused by imperfections within the organization of the banks and these deficiencies have an implication on the degree of information asymmetries between firm owners and managers. The information asymmetry between owners and managers makes it difficult for owners to measure the discretionary effort exerted by managers due to incomplete labour contracts (Pruteanu-Podpiera, Weill & Schobert, 2007). Accordingly, the overall factor that influences the reduction of the inefficiencies is the rise in competitive pressure. The reason is that the increase in competition enables owners to be able to benchmark performance of their firms with similar firms. In addition, the increase in competition could cause a poorly managed firm to collapse. Hence, to circumvent the personal cost of bankruptcy, managers are self-motivated to exert more effort (Weill, 2003) to increase the efficiency of their organisations.

The Scale-efficiency Hypothesis suggests that certain banks attain a better scale of operation which enables them to have lesser expenses (Seelanatha, 2010). Reduced outlays bring about greater profits and quicker expansion for scale-efficient banks. Consequently, the hypothesis suggests that the variations in performance among banks exist not because of disparity in the pre-eminence of management and production techniques but due to the differences in levels of economies of scale (Seelanatha, 2010). The hypothesis, therefore, envisages that banks which are functioning at optimal scale can produce goods and services at comparatively lesser costs and can, hence, benefit from greater profits which would enable banks to gain higher market shares.

2.7 Measuring Bank Cost Efficiency

In measuring bank efficiency, two key approaches are often used; the parametric and non-parametric methods. The *Stochastic Frontier analysis* (SFA) (Aigner, Lovell & Schmidt, 1977; Meeusen & Van den Broeck, 1977), *Thick Frontier Analysis* (TFA) (Berger & Humphrey, 1992), and *Distribution-Free Approach* (DFA) (Berger, 1993) are the three major techniques of the parametric method. These approaches assume random errors and permit the random disturbance along with inefficiency residuals to be accounted for when estimating the efficient frontier and to allow for statistical inferences to be made (Molyneux & Iqbal, 2005).

Despite its merits, the parametric approach is subject to several limitations. First, it requires a large sample size. Unfortunately, in the case of SSA where data on banks is limited, applying this approach may be inappropriate. Secondly, the parametric approaches rely on imposing a specified functional form that assumes the shape of the frontier. If it is not specified correctly, it

will mean that the cost efficiency score computed from it may be fraught with specification errors (Berger, 1993). Also, modern establishments use multiple inputs and outputs in their operations instead of single inputs and outputs (Sherman & Zhu, 2006). However, the parametric approach cannot accommodate several inputs and outputs to make the results all-inclusive (Thanassoulis et al., 1996). The possible problems of the parametric approach have led many authors to resort to the nonparametric deterministic frontier approaches which include the Data Envelopment Analysis (DEA) (Charnes, Cooper & Rhodes, 1978; Banker et al., 1984) and Free Disposal Hull (FDH) (Deprins, Simar & Tulkens, 1984). Detailed information and discussions on the development of frontier approaches are found in the joint works of Førsund and Sarafoglou (2002), Kumbhakar and Lovell (2003) and Coelli et al. (2005). This study uses the DEA technique to estimate the cost efficiency of SSA banks. The reasons are highlighted below.

One benefit of the DEA approach is that it can incorporate numerous inputs and outputs as compared to the parametric methods (Charnes et al., 1978; Camanho & Dyson, 2008). The banking industry uses various inputs, including labour, capital, fixed asset and so on, to produce multiple outputs, including investment income, loans and net profit. This approach, therefore, offers a better measure of cost efficiency. Furthermore, the specification of particular restrictive functional form of the production or cost frontier in ascertaining the cost efficiency of decision-making units (DMUs) (the firms accountable for the perceived output and input quantities) is not required in DEA approach. It also does not decompose the composed error term into inefficiency and stochastic noise (Eling & Luhn, 2010). Such specifications can lead to misspecification errors. There are also unrealistic distributional assumptions to be made for the inefficiency term. As an alternative, the DEA frontier is constructed through a piecewise linear combination of the

actual input–output correspondence set that envelops the data of all the banks in the sample (Das & Ghosh, 2006). It allocates efficiency scores to every DMU by relating the efficiency score of every unit with the best practice frontier in the sample (Arrawatia Misra & Dawar, 2015). The methodology estimates the efficiency production-possibility frontier from which we can quantify the distance of each DMU from the frontier. The efficient DMUs draw up the frontier while less efficient ones are positioned beneath the frontier. The efficiency score is, therefore, estimated as the weighted sum of outputs divided by the weighted sum of inputs. The application of the DEA has provided better results to firms than those approaches previously used to measure cost efficiency (Cooper, Seiford & Tone, 2007). In addition, it makes it possible for banks to ascertain corresponding efficient units or reference set which can be used as benchmarks. This makes managers identify the peers of the industries to emulate so as to increase performance.

However, the major drawback of the methodology is that, due to its deterministic nature, all abnormalities emanating from the frontier are ascribed to inefficiency, thus, ignoring any stochastic noise in the data (Fried et al., 2008; Ohene-Asare, 2011). This makes it difficult to disentangle inefficiencies from random errors in the production technology. Again, the DEA measures relative and not absolute efficiency of a DMU. Hence, the best in the sample determines the efficient point to be reached and not the ideal best point. This means that excluding or including certain DMUs may affect the efficiency assessments in the analysis (Avkiran, 1999). The DEA is, thus, sensitive to measurement errors because of outliers or missing regressors (Dyson, Allen, Camanho, Podinovski, Sarrico & Shale, 2001; Ohene-Asare, 2011).

Despite the above shortfalls of the DEA approach, it is still one of the most popular techniques applied in measuring bank cost efficiency for both individual and cross-country studies. Out of the one-hundred and thirty (130) frontier studies on financial institution efficiency in twenty-one (21) countries reviewed by Berger & Humphrey (1997), sixty-nine (69) applications used the nonparametric techniques whilst sixty (60) used the parametric approaches. Banks employ multiple inputs to produce varied outputs and it is the capability of the DEA to incorporate these multiple inputs and outputs which motivates researchers to adopt this technique in efficiency estimation in the banking market (Arrawatia, Misra & Dawar, 2015). Moreover, the DEA is assumed to require relatively less data and, as a result, it performs better in small samples. This is very important due to the small number of banks in this study.

In using the DEA techniques, it is vital to identify whether the input-oriented or output-oriented approach should be used in constructing the DEA frontier because the choice of orientation has the tendency to affect the results of the efficiency scores. With regard to the input-oriented approach, banks minimize inputs for a certain set of outputs. In the case of output-oriented approach, banks yield the optimum potential quantity of outputs for a certain set of inputs.

Several studies have not settled on the best orientation for the estimation of efficiency (Casu & Molyneux, 2003). However, the literature reviewed in the present study shows that most studies have applied input-orientation approach in efficiency estimation because input quantities are considered the main decision making variables. Nonetheless, this is not likely to hold in all situations (Casu & Molyneux, 2003). Where cost-control is considered essential, input orientation has been the ultimate choice (Casu & Molyneux, 2003). Interestingly, banks in the

SSA are under immense pressure to reduce costs of production because the banking structure is characterised by high overhead costs, making it appropriate to adopt the input-oriented approach. In view of this, the present study adopts the input-oriented approach to evaluate bank cost efficiency as seen in Drake (2001) and Adjei-Frimpong, Gan and Hu (2014).

This study used the DEA model with variable returns-to-scale (VRS) (Banker et al., 1984) to estimate cost efficiency. The justification for the use of this method is that banks in SSA do not operate at optimum scale as a result of regulatory changes and other structural impediments. This is due to factors such as constraints to access to finance, imperfect competition and rigid regulatory requirements which inhibit banks from producing the optimum outputs (Coelli et al., 1998). Besides, banks in the SSA vary in size (big banks and smaller banks with different economies of scale) and this leads to VRS. VRS is the extension of Charnes, Cooper and Rhodes (1978) model which is known in the literature as CCR model. The CCR model was also an extension of Farrell's single input and output measure of technical efficiency to several inputs and outputs by considering an input orientation and assuming constant return to scale (CRS) with the implication that DMUs operate on an optimal scale.

2.8 Brief Overview of the SSA Banking System

2.8.1 Financial Reforms, Competition and Efficiency in SSA Banking Sector

Most Sub-Saharan African countries in the past three decades or more underwent major restructuring in the banking zone. The purpose of the financial sector reforms was to avert the problems of the oppressive financial policies of the after-independence period. The speed and the

degree of the policy reforms differed from country to country (Moyo, Nandaw & Simpasa, 2014).

The reforms included the liberalisation of interest rate and credit market to allow banks to determine interest rates on deposits and lending. Another salient feature of the reforms was the elimination of credit ceilings and quantitative controls. Senbet and Otchere (2005) show that these rates are now determined by market conditions. Furthermore, privatisations of state-owned banks were implemented alongside the introduction of regulatory and supervisory schemes. The major motive of the restructuring was to increase banking competition which has the potential to spark financial transformation and efficiency in the banking industry to enable it to allocate the needed resources to industry which will trigger the engine of economic growth (Beck & Cull, 2013).

The reforms have actually resulted in enhanced competition in some SSA countries. Brownbridge and Harvey (1998) provide proof that the liberalization in banking during the 1990s has led to greater competition among banks for mobilizing deposits and providing services. In a study to evaluate the effectiveness of the financial sector restructuring in enhancing competition and efficiency in Uganda, Hauner and Peiris (2005) report that banking competition has risen and this has also stimulated efficiency. A study by Cihak and Podpeira (2005) also indicate that the restructuring in the banking industry of East Africa has allowed the entry of foreign banks and as a result, the banking sector of SSA seems generally contestable. On the contrary, authors found that the restructurings have rather hampered competition in the Kenyan banking sector. This could be as a result of the existence of many fragile banks that cannot exert

the necessary competitive pressure on the quite strong ones and of low information sharing among these banks about the creditworthiness of borrowers.

Some studies also show that the effectiveness of the financial sector reforms also depends on the country's characteristics. For instance, studies such as Ariss (2010) and Beck, Demirguc-Kunt and Levine (2009) have established that the implementation of the financial sector reforms has relatively enhanced competition in developing nations with transparent financial systems than those without a transparent financial system. For instance, Yildirim and Philippatos (2007), Berger, Klapper and Ariss (2009) and Mugume (2007) have found evidence that the financial sector restructuring has encouraged competition in the SSA banking sector. Nevertheless, the current findings are not even. Studies conducted by Saab and Vacher (2007) and Mathisen and Buchs (2005), on the other hand, indicate little influence of financial restructuring on competition which in the worst-case scenario can lead to bank failures in some countries (Fowowe, 2013). The gap between the interest rate charged on loans and for deposit is expected to rise initially within the reform period and then narrow under a more efficient banking practice. Ironically, however, there is an emergence of a wide wedge between deposit rate and lending rate in most SSA banking sector during and after the reform periods (Senbet & Otchere, 2005), which points to a mal-functional financial intermediation and to a completely insufficient competition in the SSA financial market. This is despite the financial sector reforms.

Regarding the influence of the restructuring on banking efficiency, Cihak and Podpiera (2005) examining banking sector reforms found evidence of inefficiency and limited intermediation in the Ugandan, Tanzanian and Kenyan banking sectors in spite of reforms. Hao, Hunter and Yang

(2001) report that there is a slight or insignificant improvement in efficiency in the Korean banking sector as a result of the country's financial sector reformation. Bonaccorsi Di Patti and Hardy (2005) investigated the effect of financial reforms on Pakistani banking sector and report an increase in cost and revenue efficiency. Similarly, Isik and Hassan (2003) document an efficiency improvement following financial reforms over the period 1981 to 1990 in Turkey.

The conflicting findings regarding the effectiveness of the restructuring on competition and efficiency could be the consequence of the process of the financial reforms pursued by specific countries and the superiority of institutions. Lensink, Meesters and Naaborg (2008) indicate that, in all, the reforms have a beneficial impact if there are good quality institutions, mostly prior to the reforms. Yet, the "deeper and politically sensitive issues of institutional development, such as contractual and legal systems, accounting and disclosure rules, and regulatory and supervisory mechanisms are still incomplete" (Beck & Cull, 2013) in most SSA countries (Cihak & Podpeira, 2005). However, substantial efforts have been made in most SSA countries with a great assistance from the World Bank and the International Monetary Fund to improve financial sector reforms, finalise the privatization initiative, and address the institutional weaknesses impeding financial sector development. This, therefore, calls for constant studies to evaluate the effect of competition and efficiency to the continuous financial sector reforms in SSA. The current study examines the extent of competitiveness and efficiency of the banking sector among others to provide a comprehensive direction on these important indicators to guide regulatory and supervisory authorities on the consequences and values of the restructurings, especially following the recent financial crunch. The findings in this study can be deduced as giving

evidence of the success or otherwise of the financial reform policy pursued to stimulate more competition and efficiency in the SSA banking industry.

2.8.2 Uniqueness of the SSA banking sector

This section highlights the recent conditions in the banking system of SSA that makes it different from those of comparable developing countries and establishes if there is indeed a Sub-Saharan Africa-specific feature to banking business. Tables and figures are used to pinpoint the difference within the region and variation across time. This will bring to the fore the banking structure of SSA across the region.

One cannot talk about banking in SSA without considering the numerous variations within the region. While countries like Mauritius and South Africa have a somewhat developed stock market and banking system to advance the course of financial intermediation, minor and poorer countries such as Burkina Faso and Benin exhibit shallow financial and banking services and thus, offer especially basic banking products, with little, if any at all, capital market or non-bank financial institution (Beck & Cull, 2013; Honohan and Beck, 2007).

Quite apart from the variation from country to country, there are other three features in SSA that make banking in the region very challenging (Beck and Cull, 2013). The first feature is that the economies of most SSA countries are still limited in size, thereby inhibiting banks and non-bank financial institutions from reaping the benefits of economies of scale. This stems from the fact that there are limited demands for bank credit, savings and insurance, including payment transactions. This, couple with the sparse population across various economies in SSA means

that, a large section of the SSA population is not viable consumers of financial services except those in urban centers.

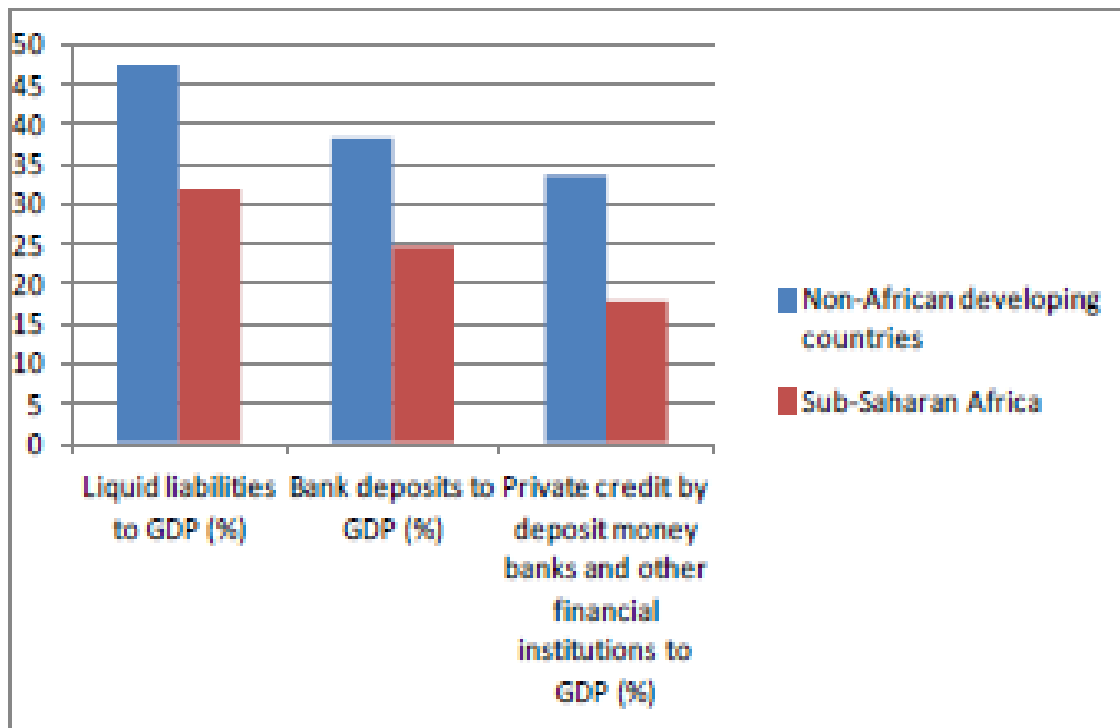
Again, SSA economies are dominated by the informal sector. Thus, most of the people operating in the informal sector do not own the required documentation such as business registration certificate, land titles, formal addresses without which financial transaction would be very difficult, if not impossible. This situation leads to high costs and risks for banks and to avoid these problems, banks exclude this large population from their services, Meanwhile, there may be good borrowers among them. Finally, many SSA countries are exposed to volatility due to over reliance on commodity exports, which makes SSA countries more vulnerable to world price fluctuations.

2.8.3 Aggregate financial development in Africa in international comparison

In the ensuing discussions, the study uses data from Bankscope and previous studies to document the state of development and the banking structure of SSA. To ensure appropriate benchmarking for the sake of comparison, only low middle income and lower middle-income countries in SSA were considered in this study. So, the median for these countries in SSA is compared to the median of low middle income and lower middle-income countries outside SSA. Three standard indicators of financial development are presented using 2011 data: Bank deposit to GDP, private credit to GDP and liquid liability to GDP. It is observed in Figure 2.1 that the median SSA country has a very shallow financial sector as compared to a non-SSA country. While SSA has a median deposit to GDP of 25%, the median deposit to GDP for non-African developing country is 38%. Again, the ratio of private credit to GDP for countries outside SSA is 34% and 18% for

countries within SSA. The ratio of liquidity liability to GDP is 32 percent for SSA, though it is 47 percent for a country outside SSA. Gauging the SSA gap between credit and deposit data, it is observable that banks in SSA are not good in financial intermediation.

Figure 2.1: Aggregate financial development in Africa in international comparison



Source: Adopted from Beck and Cull (2013)

2.8.4 Bank overhead cost in SSA

One of the unique features of SSA banks is that they are less efficient as compared to banks in other developing regions of the world. Consequently, financial services in this part of the world are very expensive. The study used interest rate spreads and margins to explain the high overhead costs in SSA. The regression results which relate bank level changes in overhead costs to bank-level and country-level traits are presented in Table 2. The results compare banks outside SSA (non-African developing countries) with banks within SSA.

Table 2: Explaining overheads costs in SSA

		overhead costs
SSA banks		235
Rest of the world banks		155
Difference		80
of which:	contractual framework	12
	Non-interest income	93
	Bank size	18
	Equity-asset ratio	5
	other bank characteristics	-3
	inflation	11
	Africa residual	18

Source: Beck and Cull (2013)

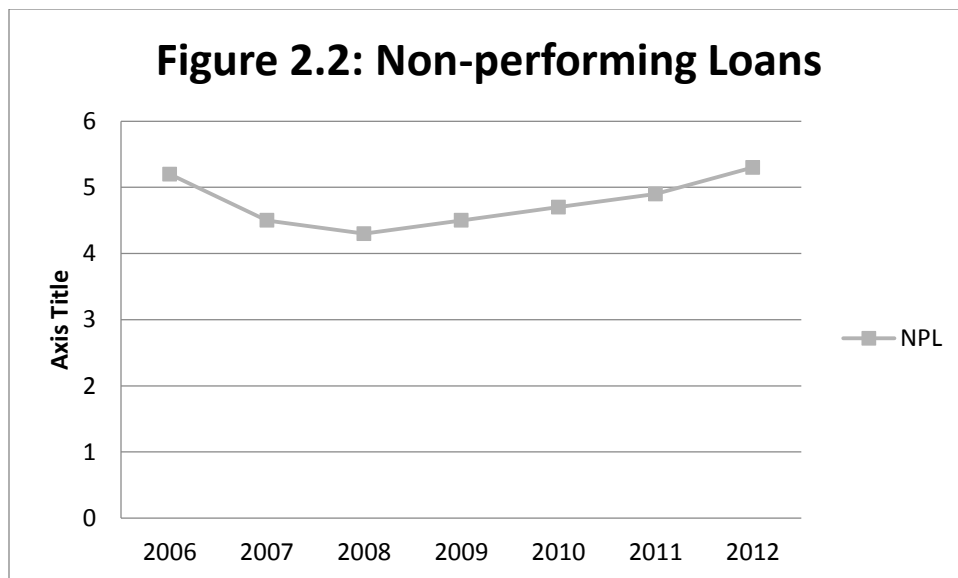
Since overhead costs is among the major components of interest rate spreads, 2011 data on overhead costs were regressed for a cross-country sample of banks on (i) the 16 share of non-interest income, (ii) the equity-asset ratio, (iii) the liquidity ratio, (iv) loan growth over previous year, (v) the log of total assets, (vi) inflation rate and (vii) the Kaufman, Kraay and Mastruzzi indicator of Rule of Law. The results in Table 2 indicate the extent to which these different factors contribute to substantially higher overhead costs of banks in SSA (6.05%) than in banks outside Africa (4.51%). Relatively high reliance by SSA banks on non-interest income and their smaller size can explain 93 and 18 basis points, respectively, of the difference in overhead costs. Higher inflation in SSA countries and less efficient contractual frameworks can explain 11 and 12 basis points, respectively. Even after accounting for these bank and country characteristics, there is still an unexplained African residual of 18 basis points. Honohan and Beck (2007) argue that even though there are sizable differences between countries within the region, it is well

known that, on average, African finance performs well below that of other regions of comparable levels of income or development.

2.8.5 Non-performing loans (NPL)

Upsurge in non-performing loans (NPL) can be a signal to the dawn of banking crisis (Reinhart & Rogoff, 2010; Louzis et al., 2012). As banking systems in SSA are linked to the rest of the world's banking system through international trade, the global economic downturn fed into reduced exports and slower domestic economic growth, thereby adversely affecting borrowers and contributing to rising levels of nonperforming loans. As shown in figure 2.2, the share of the ratio of NPL witnessed a decline from 2006 to 2008. Thereafter, it began rising sharply from 2008 to 2012. This increasing rate of NPL provides credence to the researcher's assertion in the introductory part of this thesis that NPL in SSA is on the rise.

The rise in NPL compromised the efficiency of SSA banks. These effects were more marked in countries where income growth slowed substantially, as happened in several middle-income countries (IMF, 2013).



Source: Author's calculation using Bankscope data

Also, sharp exchange rate depreciations in a number of countries during 2008–09 created difficulties for bank clients with significant net open foreign exchange positions. This further fed into a rising NPL in SSA.

In conclusion, the banking sector of SSA mirrors a mixture of issues, comprising the small absolute size of banks and banking systems: low income levels, large informal sectors, and low levels of financial literacy; weak contractual frameworks for banking activities, including weak creditor rights and judicial enforcement mechanisms; and political risk (Andrianaivo & Yartey, 2009; McDonald & Schumacher, 2007).

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter encompasses the research design and sampling technique, data source, models for measuring competition and cost efficiency in banking. Precisely, it clarifies how the Lerner index and the DEA methodology are used in computing bank competition and efficiency and the associated variables for the measurement, respectively. It also discusses the technique used in studying the cost efficiency differences, if any, among the different categorizations of income groups of countries' banking sectors. Finally, it outlines the estimation method for evaluating the effects of competition on cost efficiency and then considers the control variables which typically affect these relationships.

3.2 Research Design

This study adopted a quantitative technique. Specifically, the research strategy used is the regression analysis to test the association between market power and cost efficiency in the sample under study and other variables of interest. In addition, the Frontier Analysis was used to estimate efficiency. The choice of this approach was influenced by the fact that the study, as part of its objectives, tried to model the likelihood of cause and effect association between market power and cost efficiency for nations of different income levels in SSA. Creswell (2013) suggests that this approach is often suitable for studies that test the links among variables using statistical and mathematical approaches. Moreover, the analytical techniques adopted in this study were comparable to those usually used in the banking literature and as such, could be depended upon to provide reliable and valid answers for the research questions. For example, on

the estimation of competition employing the Lerner index, the study followed Weill (2004) and Fernandez de Guevara and Maudos (2007) to model the cost structure of the sample under study. For the estimation of cost efficiency, the DEA approach proposed by Banker, Cooper and Charnes (1987) was used. Ariff and Can (2008) adopted the same approach to study the cost efficiency of twenty-eight (28) Chinese commercial banks over the period 1995 to 2004. The study's methodology in investigating the association between competition and cost efficiency and whether this relationship is constant across various countries with different income categorization is in tandem with that used by Schaeck and Cihak (2008) and Andries and Capraru (2014).

3.3 Population and Sampling Techniques

The study population comprises all commercial banks accepting deposits from customers and granting loans to borrowers in seventeen (17) SSA countries over the period 2006-2012. Due to challenges with access to data, secondary data on two hundred and thirty-five (235) commercial banks were used for the analysis. Nevertheless, this sample still covers the largest banking markets in SSA (Economic Intelligence Unit, www.eiu.com) and, thus, will yield generalizable findings.

The countries that host these two hundred and thirty-five (235) banks were further grouped into the various income groups, i.e. upper middle-income nations (South Africa, Botswana, Mauritius and Namibia), lower income nations (Cameroon, Cote d'Ivoire, Ghana, Kenya and Zambia) and low-middle income countries (Benin, Burkina Faso, Mali, Ethiopia, Malawi, Mozambique, Tanzania and Uganda) to help study variability of market power on cost efficiency of banks in

these groupings. The number of banks for each income group included fifty-two (52) for upper-middle income, eighty-six (86) for lower income countries and ninety-seven (97) for low-middle income countries.

It must be stressed that the data limitations resulted in an unbalanced panel data. Using a balanced panel would have implied that only banks that have data available within the time period would be considered; hence, ignoring the contributions of banks whose data is incomplete within the period. This has the potential of causing a loss of vital data and, possibly, provide less reliable results. Employing an unbalanced data certifies that the outcomes are not fixed to a specific period.

3.4 Data

The study used two hundred and thirty-five (235) commercial banks' data from seventeen (17) countries in SSA for the analysis. The data on banks was obtained from the Bankscope database. The bank data pulled out from the Bankscope database comprises deposits and loans, interest expenses, total assets, other operating expenses, personnel costs, total securities, interest income and other variables needed to conduct this cross-country study. The study considered only commercial banks accepting deposits to ensure consistency of the analysis.

The data was evaluated to remove outliers, reporting errors and other inconsistencies. Thus, entries in one percentile and 99th percentile range were deleted. Again, banks that have less than three consecutive years of missing entries were not included because those values necessary to estimate the key variables may not be present and, therefore, including such banks would not

provide sufficient sample points needed to notice the significant differences. If this study was to pull out all banks with omitted values from the sample, vital information would have been lost. Consequently, the study considered removing years with omitted values on both input and output variables. Overall, the above impositions resulted in a sample of an unbalanced panel consisting of two hundred and thirty-five (235) banks from seventeen (17) countries in SSA to conduct the study. An unbalanced panel ensures that mergers and acquisitions, if any, and entry and exit during the study period are adequately accounted for (Casu & Girardone, 2009). All banks in the present sample used a common accounting reporting standard, which is the International Financial Reporting Standards (IFRS). This enhances comparison of banks across countries. The data on the control variables such as real per capita GDP, real per capita GDP growth rate and inflation rate were obtained from World Development Indicators database.

The creation of a common regional market triggered by the introduction of a single banking license (Beck & Cull, 2013) as well as the transformation of the banking market has made SSA a suitable setting to conduct this cross-country research. The intuition behind a cross-country study is that assessing the level of competition, country by country, poses econometric problems as a result of the inadequate degrees of freedom. The study is, therefore, carried out on the following seventeen (17) SSA countries: Benin, Botswana, Burkina Faso, Cameroon, Cote D'Ivoire, Ethiopia, Ghana, Kenya, Malawi, Mauritius, Mozambique, Namibia, South Africa, Tanzania, Uganda, Mali and Zambia. These are SSA countries that Bankscope has a considerable amount of information on over a huge number of banks working in the sub-region. This sample covers the largest banking markets in SSA (Economic Intelligence Unit, www.eiu.com).

3.5 Measuring Bank Competition

In view of the continued financial sector reforms undertaken by SSA countries at different periods of time to increase competition, it is important that regulatory authorities be updated about the consequences and standards of the financial sector restructurings, especially, in the wake of the recent financial recession. These crises rarely occur in economies with little restrictions on bank entry and economies with strong institutions that favour competition (Beck, Demirguc-Kunt & Levine, 2002). This study is motivated by these and aims to compute the extent of competition in the sampled banks from seventeen (17) SSA countries.

In order to achieve the objectives indicated in chapter two, this study adopted the Lerner index which is a non-structural measure of competition. The structural approaches use concentration ratios like the HHI to estimate the level of competition. The challenge of using these approaches is that they do not give a direct measure of competition. However, the extent of competition is rather inferred from the concentration proxies (e.g. HHI, concentration ratios). Hence, a reliable degree of competition cannot be obtained from concentration (Maudos & Fernandez de Guevara, 2004; Fernandez de Guevara et al., 2005).

It was due to these shortfalls that this study resorted to an alternative approach called the New Empirical Industrial Organisation (NEIO) approach which is a non-structural measure of competition. The New Empirical Industrial Organisation tries to deduce the conduct (e.g. pricing policies) of firms directly while not bearing in mind the analysis of market structure (Degryse et al., 2009). The Lerner index is one of the approaches in the New Empirical Industrial Organisation used in testing competitive conditions in contestable markets. The key strength of

the Lerner index is that it is calculated at the bank level. Consequently, the association between competition and bank efficiency which is also measured at the bank level can be tested without scale bias. Moreover, since each year's Lerner index can be assessed, changes in competition over the sample period can be observed and analysed for each year in each country's banking sector. The Lerner index further considers broader banking activities rather than focusing on only the loan and deposit services (Carbó, Humphrey, Maudos, & Molyneux, 2009).

3.5.1 Measuring the Lerner Index

The Lerner index assesses the market power of banks and is a non-structural measure of competition among banks advanced under the framework of the new industrial organization literature. The Lerner index is the deviations between the price of a bank's output and its marginal cost weighted over its price. Consistent with Weill (2004) and Fernandez de Guevara and Maudos (2007), the Lerner index can be expressed as follows:

$$L_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \quad (3)$$

Where L is the Lerner index, P is output price (proxied by total assets) and it is obtained as total revenue divided by total assets, MC is the marginal cost of creating an extra unit of output, i and t denote firms (banks) and year respectively. When the index is zero (0), it shows a perfect competition and when it is exactly one (1), it shows that the banks are enjoying monopoly power (Casu & Girardone, 2009 and Girardone & Casu, 2007). However, it is crucial to stress that marginal cost is not noticeable and therefore requires to be calculated from the total cost function. In the next section, a less sophisticated benchmark cost model, which mimics the cost

structure of the banks is introduced and this serves as the framework from which the cost function is modelled.

3.5.1.1 The Basic Cost Model

As indicated already, this study used the intermediation approach proposed by Sealy and Lindley (1977) where the core business of banks has to do with the mobilisation of monies from depositors and convert them as credits to potential investors. Deposits are, hence, regarded as one of the inputs. The quantity of loans created from depositors' funds are classified as the vector of output, y_{it} of bank i at time t . The fundamental question here is how bank i can produce y_{it} at minimum cost possible? Before this question is answered, certain assumptions would have to be made. First, it is assumed that each bank applies a vector of inputs, x_{jt} ($j = 1,2,3$) to produce the desired output vector y_{it} . Specifically, these inputs are labour, physical capital and customer deposits. Of course, these inputs are not free and each bank has to pay w_k , ($k = 1,2,3$) for every factor employed in the input-output transformation process. It is further assumed that banks purchase their inputs in a perfectly competitive market at the going rate and as such, have no influence on the normal market price of these inputs. If the input requirement set of feasible inputs of bank i needed to produce the output vector y_i is $F(x_j)$, then the optimal input choice of each bank can be derived by minimizing the total cost function:

$$C(w_k, y) = \text{Min} \sum (w * x) \quad (3.1)$$

$$\text{s.t} \quad y = F(x_j)$$

The Lagrangian for this minimization problem is written as:

$$L(\lambda, w, y) = \sum (w_k * x_j) + \lambda [y - F(x_j)]$$

capital and deposits) are adopted to create earning assets (See table 3.1). Specifically, bank total costs, C are measured by the sum of personnel expenses, total non-interest expenses and interest expenses and expenses on physical capital, α_i is the unobserved specific factor. Bank output (y) is proxied by total assets such as loans, securities and other earning assets (like insurance, investments and derivatives), w_1 is the price of labour (the ratio of personal expenses to total assets), w_2 is the price of physical capital (the ratio of other non-interest expenses to total fixed assets), w_3 is the price of the deposits (the ratio of interests paid to customer deposits and short-term funding). We account for technological differences over time across banks by introducing time trend (T). Environmental and bank specific factors influence the differences in costs among banks (Leon, 2014). We therefore, introduce into the translog cost function environmental variables such as GDP per capita ($GDPPC$) and inflation ($INFL$) to reflect their effect on the total cost function and implicitly, the Lerner index. Difference in risk taking which is a bank specific variable is controlled for using the bank equity divided by total assets $y, \left(\frac{equity}{y}\right)$. $\alpha, \beta, \gamma, \delta, \rho, \sigma$ and φ are coefficients which we seek to estimate and ε_{it} is the error term. We express a common cost function for all countries in our sample due to inadequate data as most banks in SSA are still in their infancy stage (Leon, 2014). Linear homogeneity of degree one in input prices and symmetry of cross-partial derivatives as observed in the literature (see Fernandez de Guevara & Maudos, 2007, 2011; Fungacova & Weill, 2009) is imposed. The former condition is enforced because of the underlying assumption that all banks are fully efficient in input employment. It is done by scaling the input prices and C by w_3 , the financial cost. Regarding the latter condition, it is satisfied when $\delta_{kj} = \delta_{jk} \forall k \neq j$. These restrictions are put in place in order to reduce heteroskedasticity problems (Fernandez de Guevara & Maudos,

This study estimates a panel data set for the trans-logarithmic cost function with fixed effects model over the random effect model. The incentive for using a fixed effects model to estimate the total cost function is that most of the key explanatory variables in the model change across banks and over time. Wooldridge (2013) suggests that when the most important exogenous variables are not constant across time, fixed effects are most suitable for policy analysis. This is further confirmed when the Null Hypothesis of the Hausman test is rejected (Hausman, 1978).

The coefficients determined in equation (3.6) precisely $\beta_1, \beta_2, \beta_7, \beta_8,$ and β_{12} are then substituted in equation (3.7) to calculate the marginal cost. That is, the total cost function is differentiated with respect to the total output (y) to obtain the mc for each bank in its respective country.

$$mc = C * /y[\beta_1 + \beta_2 \ln y + \beta_7 \ln \left(\frac{w_1}{w_3}\right) + \beta_8 \ln \left(\frac{w_2}{w_3}\right) + \beta_{12} T] \quad (3.7)$$

3.6 DEA Technique as a Measure of Bank Cost Efficiency

This section provides a brief motivation for estimating cost efficiency and an explanation of the DEA methodology and the specification of the cost model used in measuring it. The section also provides information on the variables used in the estimation.

This study concentrates on cost efficiency of bank business instead of profit efficiency following the financial reforms. This is because banks in the SSA are highly profitable but there are great deficiencies in curtailing bank costs and this is evident by the high overhead costs triggered by large non-performing loans. Furthermore, focusing on cost efficiency is important in examining the effects of the reforms on competition since banks compete among themselves by reducing costs (Schaeck & Cihak, 2008).

This study estimates cost efficiency of SSA banks via the DEA technique. A detailed description of the DEA methodology was given in Chapter Two, section 2.1 of this thesis. This section presents a summary of the motivation for using the DEA and a specification of the DEA models. As a result of data constraints, the current study considered a small number of banks although the sample is considered the largest sample by the SSA standard (Economic Intelligence Unit, www.eiu.com). Accordingly, following Xiaogang, Skully and Brown (2005), Maudos and Pastor (2003) and Ariff and Can (2008), this study uses the DEA technique to compute cost efficiency of SSA banks for the reason that the approach works best if the sample size is small unlike the parametric approach which produces reliable estimates when the sample size is considerably large (Ariff and Can, 2008). An up-to-date survey by Berger and Humphrey (1997) shows that out of one-hundred and twenty-two (122) bank efficiency studies, sixty-nine (69) studies used nonparametric (DEA) approach (mostly in developing countries), while fifty-three (53) studies applied the parametric technique. This is possibly due to the fact that the specification of the functional form of the basic production relationship is not required in the DEA approach as opposed to parametric approach which requires specifying the functional form in which a misspecification results in unreliable estimates.

Following Adjei-Frimpong, Gan and Hu (2014), Tecles and Tabak (2010) and Mlambo and Ncube (2011), this study explains the variations in the size of the study's sample using variable return to scale (VRS) model (Banker et al., 1984) since constant returns-to-scale (Charnes et al., 1978) postulation is not likely to be present in SSA banks for reasons explained in Chapter Two. Since bank management can exert more control over its costs rather than its outputs (Drake,

2001; Adjei-Frimpong, Gan & Hu, 2014) and given the high operating costs of banks in SSA (Beck & Cull, 2013), this study assumes an input-orientation approach.

3.6.1 Cost Efficiency

Cost efficiency can be referred to as the minimization of a firm's costs indicated via how close a firm's cost is to what a best-practiced firm's costs would be for creating the same amount of outputs which are sold at certain prices with the given prices of inputs. In specifying cost efficiency, we hypothesise there are N firms ($k=1, \dots, N$) that use a vector of q inputs $x_k = (x_{k1}, \dots, x_{kq}) \in \mathcal{R}_{++}$ (which are respectively labour, deposits and physical capital) for which they pay prices $w_i = (w_{i1}, \dots, w_{iq}) \in \mathcal{R}_{++}$ (which are respectively price of labour, price of deposits and interest paid on customer short term deposits and price of physical capital) to produce a vector of z outputs $y_k = (y_{k1}, \dots, y_{iz})$ (which correspond to net loans and other earning assets).

Following Ariff and Can (2008), Banker, Cooper and Charnes (1978) and Fare and Grosspof (1997), the cost efficiency of firm d is specified in a linear programming problem under VRS as follows:

$$\begin{aligned}
 & \min \sum_q w_{dq} x_{dq} \\
 & \text{s. t.} \\
 & \sum_k \lambda_k y_{kz} \geq y_{dz} \quad \forall z
 \end{aligned} \tag{3.8}$$

$$\sum_k \lambda_k x_{kq} \leq x_{dq} \quad \forall q$$

$$\sum_k \lambda_k = 1; \lambda_k \geq 0; k = 1, \dots, N$$

In the formulation above, w_{dq} is the price of input q for firm d under the assessment, λ_k is a vector of constants or weights, x_{kz} and y_{kz} is the respective input and output for any firm in the industry. Given the current prices of firm d and the technology set, x_{dq} is a variable that gives the amount of input q to be used by firm d at the optimal solution in order to generate the present outputs at minimal cost. Solving equation (3.8) using linear programming gives the solution set, $x_d^* = (x_{d1}^*, \dots, x_{dq}^*)$ which corresponds to the vector of input needed to produce at minimum costs with the given input prices. This minimum cost is achieved through a linear mixture of firms that yields at least as much outputs as firm d does, applying the same or less quantity of inputs. The minimum cost this imaginary firm would now be $C_d^* = \sum_q w_{dq} x_{dq}^*$ and this could be equal or smaller than the firm d 's actual cost, $d(C_d = \sum_q w_{dq} x_{dq})$. The cost efficiency of firm d (CE_d) is then computed by dividing the minimum cost by the actual cost as follows:

$$CE_d = \frac{C_d^*}{C_d} = \frac{\sum_q w_{dq} x_{dq}^*}{\sum_q w_{dq} x_{dq}} \quad (3.9)$$

The estimated cost efficiency (CE_d) ranges from 0 to 1. An efficient firm (bank) has an efficiency mark of 1 while any mark less than 1 suggests the firm is less efficient relative to the best practice bank in the sample. As a corollary, a cost efficiency score estimated against a cost frontier of 30% means that the decision making unit (bank) would have been able to reduce its costs by 70% without changing its outputs.

3.6.2 Variables Employed in Computing Bank Cost Efficiency

Ariff and Can (2008) show that the selection of different inputs and outputs to be used in the cost efficiency model could lead to different outcomes due to observing banks as production or intermediation units. Yet, in spite of the extensive studies on bank efficiency, there is still no agreement among researchers as to which variables to be used as outputs or inputs in the cost efficiency frontier (Sathye, 2003). Berger and Humphrey (1997) show that the choice of inputs-outputs variables and the suitable number of these variables to be included in the cost frontier lie in the discretion of the researcher who is largely influenced by data availability. Berger and Humphrey, however, proposed two approaches: the intermediation approach and the production approach. However, since the production approach ignores interest costs which constitute a large proportion of banks' overall costs (Berger & Humphrey, 1997), adopting this approach would make the empirical results bias and unreliable. Hence, this study assumes the intermediation method which is favoured by Elyasiani and Mehdiian (1990) because the approach considers interest expenses which constitute a huge percentage of banks' expenses. This is in line with the focus of this new study whose intention is to assess the total cost efficiency of the overall sampled banks.

The study considered three inputs (customer deposits and short-term fixed deposits (deposits), labour and physical capital) and two outputs (specifically total net loans and other interest earning assets). The three inputs are the most important resources banks require to undertake production. Deposits are the major input resources banks in SSA use to execute their banking undertakings like lending and investing. Labour (proxied as expenses on labour) and physical capital (proxied as capital expenses) are the additional input resources used in the creation of

bank products and services. In the case of the outputs, loans and other earning assets like government securities make up the main business of banks in SSA. Thus, banks channel their funds into lending and investment to make higher profits. Studies such as Beck and Cull (2013) and Adjei-Frimpong (2014) show that other earning assets and loans form the largest assets of SSA's banks, accounting for about two-thirds of the assets and representing a significant source of revenue generation. In assessing cost efficiency, it is noteworthy to compute the input prices, however, because when information on the number of personnel and prices of inputs are unavailable, proxies are used in doing the calculations (Maudos & Fernandez de Guevara, 2004). Broad explanations of the variables have been offered in Table 3.1.

Table 3.1 Definition of Variables for Estimation of Competition and Cost Efficiency

Variable	Description
<i>Panel A: inputs</i>	
Labour	Personnel expenses of banks staff such as wages, salaries and staff allowances.
Physical capital	This is sum of all fixed assets of the bank.
Deposits	Total deposits mobilized from depositors. It comprises customer deposits and short term deposits.
<i>Panel B: Input prices</i>	
Price of labour	Ratio of personnel expenses to total assets.
Price of deposits	Ratio of deposits to total assets.
Price of physical capital	The quotient between operating expenses – personnel expenses and total fixed assets.
<i>Panel C : Outputs:</i>	
Total loans	These are total loans given out to customers.
Other earning assets	These are investment in securities such as government T-bills, mutual funds, bonds and other investments.
Total Assets	These are aggregates from the balance sheet. They are the sum of total assets and other earning assets such as investment in government securities, bonds etc. from the balance sheet

3.7 Measuring the effect of Competition on Cost Efficiency

The examination of the effect of competition on bank cost efficiency follows the model specification used by Schaek and Cihak (2008, 2010) and Koetter et al. (2008) to explore similar relationships in five European countries as well as in the U.S.A. and to examine the Quiet Life Hypothesis in the U.S.A. respectively. The formulation is expressed as follows:

$$\text{Eff}_{ijt} = \alpha + \beta \text{Lerner}_{ijt} + \gamma \text{Bsize}_{ijt} + \delta \text{LLP}_{ijt} + \varphi \text{cap}_{ijt} + \theta \text{MS}_{ijt} + \sigma \text{AG}_{ijt} + \rho \text{RGDPG}_{jt} + \vartheta \text{inflation}_{jt} + u_i + \varepsilon_{it} \quad \text{eqn(3.11)}$$

Where the dependent variable Eff_{ijt} is the cost efficiency mark of bank i in country j at period t obtained from equation (3.10), α is the constant term, Lerner_{ijt} is the Lerner index of bank i in country j at period t , Bsize_{ijt} is bank size of bank i in country j at period t , LLP_{ijt} is the proxy for credit risk of bank i in country j at period t , cap_{ijt} is capitalization of bank i in country j at period t , MS_{ijt} is market shares of bank i in country j at period t , AG_{ijt} is growth in assets of bank i in country j at period t , RGDPG_{jt} is real per capita GDP growth of country j at period t , inflation_{jt} is inflation rate in country j at period t . $\beta, \gamma, \delta, \varphi, \theta, \rho$ and ϑ are coefficients that would be evaluated, u_i is the individual effects and ε_{it} is the random error term. Detailed variable definition, measurement and expected signs are provided in Table 3.2. It should be emphasised that ϑ estimates the effect of diversification between net interest and non-interest income on cost efficiency resulting from a move away from interest income towards non-interest income.

Table 3.2: Variable Description and Expected Signs

Variable Symbol	Variable Definition	Measurement	Expected sign
Dependent			
Eff	cost efficiency	Estimated (see eqn. (3.9)).	
Independent			
Lerner	Lerner index of market power	Estimated (see eqn. (3)).	Uncertain
Bank specific characteristics			
Bsize	Bank size	natural log of total assets.	uncertain
Crk	Credit risk	Proportion of total loans and advances to total assets.	Uncertain
CAP	Capitalisation	Equity divided by total assets.	Uncertain
MS	market share of assets	See text.	Uncertain
AG	Assets growth	See text.	Positive
Ag2	Asset growth square	See text	Positive
Macroeconomic Characteristics			
GDPG	Real Gross domestic product per capita growth rate	See text	Positive
Inflation	Inflation	See text	negative

Source: Author's compilation

3.8 Comparison of Cost Efficiency of Income Groups of Countries

To establish whether differences exist in bank cost efficiency among the different income groups of countries in the study sample over the period 2006-2012, the single factor annova and the Tukey's multiple comparison test was used. Specifically, we determined whether the differences in cost efficiency among low-middle income nations, lower-middle income nations, and upper middle income nations in SSA are statistically significantly different. Ncube (2009) used this approach in his study to investigate differences in the performance of South Africa's banks during the time 2005- 2009.

To estimate whether the consequence of market power on cost efficiency is uniform across countries with different levels of income group (i.e. low-income nations, lower-middle income nations and upper-middle income nations), the full sample is divided into sub-samples according to the three-income classification. The analyses of the relationships are carried out using eqn. (3.11).

The current form of the income classification by the World Bank has been in existence since 1989. It divides countries into four groups—low income, lower middle income, upper middle income, and high income—using gross national income (GNI) per capita valued annually in US dollars using a three-year average exchange rate (World Bank, 1989). This study adopts this criterion to classify SSA into their various income groups as shown in Table 3.3.

Table 3.3: World Bank Criterion for the Classification of countries

Income bracket	Income group
\$4,036 – \$12,475	upper-middle income countries (UMIC)
\$1,026 – \$4,035).	lower-middle income countries (LMIC)
\$1,025 or less	low-middle income countries (LMC)
country	Income group
South Africa	UMIC
Botswana	UMIC
Mauritius	UMIC
Namibia	UMIC
Cameroon	LMIC
Cote D'Ivoire	LMIC
Ghana	LMIC
Kenya	LMIC
Zambia	LMIC
Benin	LMC
Burkina Faso	LMC
Ethiopia	LMC
Malawi	LMC
Mozambique	LMC
Tanzania	LMC
Uganda	LMC

Source: Author.

3.9 Variable Measurements

In this section, the variables taken to study the association between competition and cost efficiency in the SSA banking industry are discussed. The key focus of this study is to estimate the consequence of competition on cost efficiency and to discover whether this relationship is not uneven across various nations with diverse income categorization. The study selected control variables that have the potential to affect cost efficiency as in the work of Andreis and Capraru (2014) (summarized in Schaeck & Cihak, 2008). Subsequently, revising the literature on the influential factors determining banks' cost efficiency, the study identified six (6) bank specific

factors (namely: bank size, credit risk, capitalization, market share, asset growth and loan growth) and two macroeconomic variables (namely: gross domestic product growth per capita and inflation to soak the variation in country level). It is crucial to underscore that the choice of these variables is primarily due to their confirmed effects on cost efficiency (Weill, 2004; Cavallo & Rossi, 2002) and data is available for only these factors. How these variables are measured and their predicted effects on cost efficiency as well as the justification for their inclusion in the analysis are elaborated briefly.

Dependent Variable

The dependent variables employed for the analysis are the cost efficiency scores which were computed with DEA methodology. However, because cost efficiency marks attained from the DEA range between 0 and 1, following the literature (e.g. Maudos & Fernandez de Guevara, 2007; Solís & Maudos, 2008), a no-leaner logistic specification is used to enable the transformation of the estimated efficiency values into $Eff_T = Ln\left(\frac{Eff_{ijt}}{1-Eff_{ijt}}\right)$ which is a monotonic transformation.

Nevertheless, Eff_T usually becomes undefined if Eff_{ijt} is either 0 or 1. This situation causes a loss in data because the quantity of observations decline by amount of the undefined Eff_{ijt} . To resolve this issue, as seen in Voos and Mishel (1990), the logistic transformation is adapted by adding $1/2n$ each to the numerator and the denominator. n is the number of observations for Eff_{ijt} . This ensures that the number of observations is not eliminated when efficiency scores are

either 0 or 1 (Banker & Chang, 2006). The dependent variable (Eff_T) is, therefore, the transformed logit transformation.

Explanatory Variables

I. Lerner index (Lerner)

The main independent variable relied on in this study is the level of banking market power, proxied by the Lerner index. The index ranges from 0 to 1, with lower values indicating less market power and more competitive market conditions and vice versa. The choice of the Lerner index to measure market power instead of the traditional measures that use market structures is grounded on the fact that the Lerner index measures market power at the bank level and this unit of measurement is in conformity with the unit of the DEA approach which also assesses cost efficiency at bank level. The effect of the Lerner index on cost efficiency is mixed. The Quiet Life Hypothesis suggests that banks with a high market power enjoy a ‘quiet life’ and therefore trade this for inefficiency because under this circumstance, bank costs are not minimized (Berger & Hannan, 1998). The proponents of the Efficient-Structure Hypothesis, however, argue that market power enables banks to salvage benefits from economies of scale which lead to acquisition and mergers, therefore, high market power results in improvement in cost efficiency. As a result, either negative or positive effect could be expected.

Control Variables

Bank specific factors

II. Bank Size

Bank size is proxied as a natural log of total assets. Its inclusion in the equation is to account for economies of scale and diseconomies of scale (Bokpin, 2013). The exact effect that bank size has on cost efficiency is not known. There are arguments in favour of bigger banks being more cost efficient than smaller ones since large banks have improved diversification choices and can initiate better ways and prospects for diversifying risks as compared to smaller banks (Isik & Hassan, 2002). Moreover, these larger banks have higher economies of scale in information generation, monitoring and transaction costs and as such can deal well with issues of information asymmetric (Doan, Lin & Doong, 2017) which usually leads to higher cost efficiency in large banks. On the contrary, cost efficiency of big banks is often found to be low because the big banks have a greater challenge in controlling costs due to their size (Berger & Mester, 1997). Evidently, the effect of bank size on cost efficiency could be negative or positive. Bokpin (2013) found that bank size exerts a positive but insignificant impact on bank cost efficiency. In contrast, Tecles and Tabak (2010) and Ataulloh and Le (2006) report that banks with bigger size have the tendency to improve cost efficiency in Brazilian, Indian and Pakistani banking systems. This means that a rise in bank size also raises cost efficiency. Moreover, Kablan (2010) in his study on the determinant of cost efficiency in SSA found a direct and substantial influence of bank size on cost efficiency. The author's findings are in contrast with studies such as (Isik & Hassan, 2002; Girardone et al., 2004 and Altunbas et al., 2007) who found an adverse impact of bank size on cost efficiency.

III. Market share

There are three criteria to estimate the market shares of banks viz: industry total assets, industry deposits and industry net advances. Following Schaek and Cihak (2008), total assets are used to compute market share because total assets dominate the other variables and, hence, generate better proxies. Banks with large market share relative to the industry can have easy access to enhanced production technologies and better management which translate into improvement in cost efficiency at the expense of the smaller banks with small market share (Schaek & Cihak, 2008). The Efficient-structure Hypothesis also hypothesizes that efficient banks can acquire high market share which enhances them to gain high market power. Therefore, market share is predicted to correlate positively with cost efficiency.

IV. Capitalization

Capitalization refers to the amount of funds provided by the owners themselves and represented as a fraction of owners' equity to total assets of the bank. A greater fraction denotes that the bank is well capitalized. Intuitively, well capitalized banks have good credit rating which indicates lower risk and, therefore, can borrow at lower interest rate which in turn increases bank cost efficiency. Nevertheless, high capitalization of large banks builds too much self-confidence in management to operate under the assumption of 'too big to fail'. Thus, they take on too much risk which generates more non-performing loans (Louzis et al., 2011). This negatively affects cost efficiency because proliferation of non-performing loans erodes the gains in cost efficiency. Given this, the effect of capitalization on cost efficiency cannot be certain. Previous studies have found mixed outcomes on the influence of capitalization on efficiency. Past studies that found a positive effect include Pasiouras (2008), Chang and Chiu (2006) and Yildirim and Philipatos

(2007) while studies like Altunbas et al. (2007) and Kwan and Eisenbeis (1997) found an inverse relationship. Others have documented no significant impact of capitalization on efficiency (see Staub, da Silva e Souza and Tabak, 2010; Ariff & Can, 2008). Given the high non-performing loans in SSA, the gains in cost efficiency are eroded by the increase in non-performing loans.

V. Credit risk

Cost efficiency may vary across banks as a result of the differences in risk exposure. To account for this, credit risk is introduced into the model. It is obtained via dividing loan loss provision by total loans. It has become very necessary to control for credit risk due to upsurges in bad loans recorded in the books of SSA banks in recent times. In the intermediation process, banks anticipate to incur bad loans and other losses but not too high. Relatively high bad loans imply high loan default rate by borrowers and banks who are compelled to set aside a greater proportion of the total loan portfolio against this uncertainty. This situation results in high credit risk which signifies poor asset quality because the banks have failed in their core objective of minimizing losses associated with their loan portfolio (Casu, Molyneux & Girardone, 2006). Extant literature shows banks with high credit risk are less cost efficiency (Casu & Girardone, 2004; Yildirim & Philippatos, 2007).

However, banks that have lower loan loss reserves for total loans tend to be more cost efficient because they can screen and monitor borrowers. As a result, an inverse relationship is expected between credit risk and cost efficiency (Leon, 2015). Staub, da Silva e Souza and Tabak (2010) also found an insignificant relationship. The increasing non-performing loans in the SSA

banking sector provides a strong support to examine whether loan loss provisions made by SSA banks are sufficient to mitigate the effect of the increasing non-performing loans.

VIII. Asset Growth

The Asset Growth is computed as the current level of assets at time t minus its one-period lagged value divided by its one-period lagged value again of bank i at time t . Large banks usually experience greater growth in assets and might not be able to monitor borrowers if there are no strong internal risk control measures in place. Therefore, an inverse association is projected between cost efficiency and loan growth. Empirically, Schaek and Cihak (2008, 2010) found that asset growth is inversely related to cost efficiency.

IX. Asset growth square

Banks (especially aggressively growing ones) are likely to experience differences in growth. To account for these apparent non-linearities in the growth of banks, a quadratic term of asset growth is included in the model following Schaek and Cihak (2008, 2010). The authors found that asset growth square is harmful to cost efficiency for sampled banks in the U.S.

Macroeconomic Environment Factors

X. Gross Domestic Product Per Capita Growth Rate

GDP growth is one of the important indicators used to gauge the health of a country's economy. It measures the speed at which the economy is expanding and it does this by matching one quarter of the country's GDP with the last quarter per the population. Increase in GDP growth raises aggregate demand and consequently increases the demand and supply of banking services.

GDP per capita growth therefore exerts a beneficial consequence on banks' cost efficiency through improvement in banks' loan portfolios because nonperforming loans are likely to be very minimal during the period of high economic growth (Weill, 2004). Therefore, it is anticipated to exert a favourable effect on cost efficiency. Yildirim and Philippatos (2007) document a positive effect of per capita GDP growth rate on banking efficiency while Di Patti and Hardy (2005) found that a rise in per capita GDP growth has a harmful consequence on bank cost efficiency.

XI. Inflation rate

The researcher controlled for inflation because there is a high incidence of inflationary pressure in SSA countries. Inflation measures year-on-year changes in consumer prices and it is expected to exert a harmful effect on bank efficiency. This is because during the period of high inflation, borrowers gain at the expense of the banks, thereby increasing the cost of lending and reducing cost efficiency. Kasman and Yildirim (2006) found that inflation increases cost of banking businesses since in the period of high inflation, banks are induced to enlarge their branch network to enhance their competitiveness. On the contrary, Guru et al. (2002) and Tan and Floros (2012) also document a favourable effect of inflation on cost efficiency. Banks can predict increases in inflation and curtail its detrimental effects on revenue generation by charging higher interest rate to commensurate the expected interest losses (Chan and Karim, 2010). A positive effect can, therefore, also be expected.

3.10 Model Estimation Technique

The literature on competition and cost efficiency shows a reverse causality between these two concepts. Competition is generally observed to offer some incentives to intensify cost efficiency. Nevertheless, there may be aggressive competition among more efficient banks. These opposing views are respectively represented by the Quiet Life Hypothesis and Efficient-structure Hypothesis (Demsetz, 1973). For instance, the pioneers of the Efficient-structure Hypothesis (Demsetz, 1973) suggest that banks that are efficient gain large market shares and become concentrated. This leads to higher profits and consequently helps them to acquire more market power. Thus, efficiency leads to more market power. On the other hand, the Quiet Life Hypothesis contends that market power of banks is the sole determinant of a bank's efficiency. A study conducted by Koetter, Kolari and Spierdijk (2012) shows that controlling for potential endogeneity between bank competition and cost efficiency measures is important in determining competition-efficiency nexus.

Due to the supposed presence of endogeneity between bank competition and cost efficiency scores, the Ordinary Least Square (OLS) estimator is not appropriate because there is a great possibility that the Lerner indices may correlate with the residuals in equation (3.11). Clearly, this is a violation of one of the key assumptions of the Ordinary Least Square (OLS) regression. Hence, the fixed effects model for panel data would be bias if implemented herein. That is, the error term should not correlate with any of the regressors within the model and its mean expected to be zero. When the error term correlates with the independent variables, it causes the fixed effects models to produce bias parameters in the sense that the unobserved effect, which is assumed not to explain the variation in the dependent variable, bank cost efficiency except the

Lerner indices and the control variables, partially account for the actual variation in the cost efficiency. Therefore, it becomes difficult, if not impossible, to disentangle the predicted effect size of the exogenous variables on cost efficiency.

To resolve this problem, this study employed the two-stage-least square (2SLS) estimator as used in Schaek and Cihak (2008, 2010), Fosu (2013), and Koetter, Kolari and Spierdijk (2012) to estimate eqn(3.11). The technique evaluates the parameters of the model using two-step processes: the first stage involves creating new variables outside the model and then using them to instrument the endogenous variable(s), whereas in the second stage, the model-estimated values from the first stage are then substituted for the real values of the endogenous variable(s) to calculate the parameters. In addition, when endogeneity bias exists in data and the structural equation model is accurately specified, in the presence of heteroskedasticity, the 2SLS estimator gives more consistent and accurate estimates of the parameters than those produced by the three stage least squares (3SLS) (Wansbeek and Bekker, 1996).

It is important to note that the appropriateness of the 2SLS estimator is dependent on the existence of endogeneity. Hence, the Durbin-Wu-Hausman test is adopted to test whether the 2SLS estimator is necessary at all. If the Null Hypothesis that the Lerner index is exogenous is rejected, then the 2SLS estimator is necessary.

In addition, the use of 2SLS is subject to obtaining instruments outside those variables in eqn(3.11) that are relevant determinants of the endogenous variable, the Lerner index, and as well correlate with the Lerner index. But these instruments should not relate with the disturbance

term in the model. To this end, following the literature, two instruments discovered to affect market power significantly were employed: two lagged values each of the Lerner index of market power and the interacting term of market shares and loan growth of banks. These instruments are equally used in the study by Schaek and Cihak (2008, 2010) when they used a 2SLS technique to study the competition-efficiency nexus in European and U.S. banking systems. Lagged values of the Lerner indices were employed as an instrument because it might be difficult to prove that cost efficiency now affects market power of banks a year or two ago. The interaction between market share and loan growth is used to instrument the Lerner index in the sense that market power falls anytime there is a proliferation in these variables. This fall indicates a fierce competition among banks in the SSA banking sector. Hence, a strong upsurge in these interactive terms of a bank is likely to impact the competitiveness of the bank in question, faced by such expansions.

However, these instruments must satisfy the overidentifying restrictions. The Hansen J-statistic which is a Chi square distribution was employed to evaluate the degree to which the instruments meet the orthogonality condition. The Hansen J test is more robust to heteroskedasticity under non-i.i.d. errors (Baum, Schaffer & Stillman, 2007), hence its adoption. The Null Hypothesis is that the instruments are exogenous. For the model to be devoid of any misspecification problems, the Null Hypothesis must be rejected. Otherwise, the instruments are either incorrectly excluded from the structural model or are not really exogenous (Baum et al. 2003, 2007).

The instruments could be valid, but weakly correlated with the Lerner index, i.e. the endogenous variable. Thus, in addition to the instruments which are relevant, they should as well be strongly

correlated with the endogenous variable (Baum, Schaffer & Stillman, 2007) to rule out any problem of weak instruments. Nevertheless, Staiger and Stock (1997) show that weak instruments issue may occur even if the correlations between the endogenous variables and the instruments excluded from the model are significant at the conventional one percent and five percent levels. Therefore, there is the need to conduct a weak instrument identification test by calculating Kleibergen-Paap rk Wald F statistic and gauging it with the Stock-Yogo IV critical values. The null hypothesis states that the instruments are weakly identified. Baum (2006) suggests that Kleibergen-Paap Wald rk F statistic more than 10 is needed to reject the Null Hypothesis to be able to conclude that the instruments are not weakly identified.

3.11 Tools for the Data Analysis

The Stata 13 version was used to analyse the data. Specifically, the translog cost function and equation (6) was used to analyse the consequence of market power and income diversification on cost efficiency. To analyse the cost efficiency scores, the MaxDEA Pro 6.3 was used and the R codes were also used for the annova and Tukeys multiple comparison analysis.

3.12 Chapter Summary

This chapter has explained in detail the methods and econometric techniques used to realize the objectives of this research. Thus, the chapter has provided insights into the strategy for this research, where the information/data for the study was acquired from and the specification of the models. The chapter has also revealed the rationale for the variables designated in assessing the Lerner index, cost efficiency and the link among market power, income diversification and cost efficiency. Finally, the instruments used to analyse the data have also been explained.

CHAPTER FOUR

ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter reports on the results of the study and explains the findings pursuant to available literature on banking competition and cost efficiency studies. The chapter consists of nine subdivisions. The first unit comprises the descriptive statistics for the variables assessed. The second unit explains the correlation matrix for the variables employed in the estimation of cost efficiency. The third sub-section describes the pattern of competition and cost efficiency in SSA over the period 2006-2012. The fourth and fifth sections depict a summary of descriptive statistics and correlation matrix respectively for some of the selected variables for the study of the association between competition and cost efficiency. The sixth sub-section presents the two-stage-least square regression results using Eq (3.11). The seventh sub-section re-estimates Eq (3.11) by grouping the sampled countries according to their income classification. Sub-section eight provides the robustness check. The final sub-section provides an outline of the chapter.

4.2 Descriptive Statistics

This sub-section presents a summarized description of the variables applied to calculate the translog cost function, Lerner index and cost efficiency. The descriptive statistics, like the mean, standard deviations, maximum and minimum values of the variables used in computing the trans-logarithmic cost function as well as the other variables used in calculating the Lerner index are depicted in Panel A of Table 4.1. It is observed from Table 4.1 that, on average, a bank in SSA incurred a total cost of \$256.2977 million to produce its output over the period 2006-2012. Comparatively, this is much less than the \$2.865 billion found by Doan, Lin and Doong (2017)

in their study as the average total cost of commercial banks in 83 countries in Europe, South America and Asia. However, considering the relatively small output of banks in SSA and the associated average total cost incurred, it can be inferred that banks in SSA have higher costs. This could possibly be as a consequence of the relatively small size of economies in SSA which inhibit banks from reaping the advantages of economies of scale coupled with high wages and sunk costs, and the desire of banks to invest in information technology to invent in new products. The mean value of bank output proxied by total assets is \$2,379.1030 million with standard deviation \$11,824.4400 million. This standard deviation signifies that the sampled banks in the study operate with different sizes, reflecting varying techniques of production. On average, output price of banks is 31.92%. This means that banks in SSA charge an average of 31.92% interest on loans to borrowers. The mean value of price of physical capital is 1.6372 during the study period. These results imply that banks in SSA spend more on physical capital than the expenses incurred on labour which averaged 0.0262 over the same period.

In contrast, the price of deposits which is the financial cost recorded an average of 0.0746 during the sample era. These results mean that banks pay an average of 7.46% interest on customer deposits over the entire study period. This is higher than the 0.042 found by Doan, Lin and Doong (2017), confirming the earlier conclusion that, banks in SSA incur high costs in rendering financial services. Regarding the bank specific control variables examined, the mean value and standard deviation of fixed assets are 28.1183 and 109.5289 respectively, while those of bank capitalization are 0.1555 and 0.1383 respectively for the period 2006-2012.

Table 4.1 Descriptive Statistics of Variables Used for Competition and Cost Efficiency Estimates

	Obs	Mean	Std. Dev.	Min	Max
Panel A					
Total cost (in millions US \$)	1468	256.298	1223.714	1.000	11371.000
Output (in millions US \$)	1468	2379.103	11824.440	3.000	126730.000
Output price	1460	0.319	0.116	0.008	1.206
Input prices					
w1	1413	0.026	0.019	0.042	0.154
w2	1342	1.637	1.927	0.053	25.000
w3	1386	0.075	0.364	0.023	12.046
Bank specific control variables					
fa (in millions US \$)	1454	28.118	109.529	12.000	1245.000
Eq	1465	0.156	0.138	0.008	1.000
Macroeconomic control factors					
Lngdppc	1468	6.750	1.116	5.168	8.810
Inflation	1268	0.098	0.070	0.009	0.444
Panel B					
Inputs					
Physical Capital	1456	39.385	160.631	0.000	1641.000
Labour	1425	39.342	178.112	0.000	1840.000
Deposits	1442	1826.189	9273.454	0.000	92873.000
Outputs					
Loans	1438	1519.251	8047.710	0.000	74440.000
Investments	1384	531.063	2879.679	0.000	40314.000

Table 4.1 depicts the summary descriptive statistics on variables used for the translog cost function, and the Lerner index and cost efficiency. Panel A depicts the descriptive statistics of variables for modelling the translog cost function and estimation of the Lerner index whereas panel B shows the descriptive statistics of variables (including input prices in panel A) for estimating cost efficiency. Total cost = personnel expenses + interest expenses + other non-interest expenses. Output is proxied by total assets of banks. Output price (price) is the price of total assets calculated as total revenue divided by total asset. W_1 is the price of labour proxied as the ratio of personnel expenses to total assets. W_2 is the price of physical capital calculated as other non-interest expenses. W_3 is the price of deposits computed as the ratio of interest expense on deposits to all funding costs. fa = fixed assets is the expenses on plant and machinery and other administrative cost either than personnel expenses. eq = bank capitalisation proxied by ratio of equity capital to total assets. lngdppc is the natural log of per capital gross domestic product. Inflation = inflation rate is the change in annual average retail/consumer price level in percent. Physical Capital is the book value of all fixed assets. Labour should have been the number of employees but due to data concerns it is proxied as a ratio of personnel expenses to total assets. Deposits = customer deposits and other funds. Loans are net loans and other interbank lending. Obs=number of observation. Std. dev. = standard deviation, Min = minimum value and Max =maximum values. The number of observation for most of the variables is different because the study used an unbalance panel data due to limited data concerns.

Source: Bankscope and Author's own computation.

The latter results show that about 15.55% of banks' assets in SSA are financed by equity, suggesting that most banks in SSA have passed the Basel-type minimum capital threshold of 11%. With regard to the macroeconomic control variables, natural log of GDP per capita

averaged 6.7501 with corresponding standard deviation, minimum and maximum values of 1.1164, 5.1680 and 8.8095. The value of the standard deviation shows that there is fairly low disparity in economies across SSA countries. Finally, on descriptive statistics for variables used for estimating competition and inflation rate averaged 9.67% across the countries sampled, recording minimum and maximum values of 0.0092% and 44.39% respectively.

The descriptive statistics of the variables used for the estimation of the cost efficiency scores of banks in the study is presented in panel B in Table 4.1 above. It can be observed from Table 4.1 panel B that the mean scores of physical capital, labour and deposits are \$39.3853 million, \$39.3418 million and \$1826.1890 million respectively and their respective standard deviations are \$173.0077million, \$182.793million and \$10080.28 million over the study period. Comparatively, banks in SSA combine more deposits with physical capital and labour to produce their outputs (loans and investments) given their smaller size. Noticeably, banks in SSA vary in terms of operational activities and the loans and investments that they make, evident by the large standard deviation of loans (\$8047.7100 million) and investments (\$2879.6790 million) together with a wider variation in their respective minimum and maximum values of \$0.0000 and \$74440 million and \$0.0000 and \$40314 million. These results provide support for the adoption of the variable returns to scale model of Banker Charnes Cooper (1984) instead of the constant returns to scale model to estimate cost efficiency.

4.3 Correlation Matrix for Cost Efficiency

The DEA model for estimating cost efficiency dwells on certain assumptions which must be satisfied to avoid bias estimates. One such key assumption is the isotonicity condition.

According to Avkiran (2006), this condition is usually satisfied when the correlation coefficient between the variables are more than 0.5. The study, therefore, analyses the variables employed in estimating cost efficiency to affirm if they are consistent with this assumption to ensure effective estimates. The results of the correlation of inputs (physical assets, labour expenses and deposits) and the outputs (loans and investments) are presented in Table 4.2.

Table 4.2 Correlation Matrix of Cost Efficiency Variables

	Physical capital	Labour	Deposits	Netloans	Investments
Physical capital	1				
Labour	0.9828***	1			
Deposits	0.9601***	0.9762***	1		
Netloans	0.9785***	0.9834***	0.9931***	1	
Investments	0.8573***	0.8752***	0.9106***	0.8775***	1

Source: Author's computation in Stata13. *** stands for significance level at 1%

Evidently, the results in Table 4.2 illustrate that the variables have certified the isotonicity requirement since the correlation coefficient between the pairs of variables are positive, and greater than 0.5 and significant at 1% level of significance.

4.4 Empirical Results

The first objective of this study was to evaluate the market power of SSA banks using the Lerner index and cost efficiency of banks using the DEA approach under variable returns to scale. The result of the Lerner index is presented first, followed by the cost efficiency scores of each country's banking sector across the study period.

4.4.1 Competition Results

It must be emphasized that before the Lerner index is computed, marginal cost should be obtained first. In this study, the marginal cost was computed by running a regression on the trans-logarithmic total cost function as indicated earlier. The model diagnosis and the regression results of the trans-logarithmic total cost function are presented in appendices A and B respectively. On the model diagnosis, the results of both the Breusch and Pagan and the Hausman tests indicate that ordinary least square (OLS) with fixed effects fits the data. This is because the results of both tests show a significant p-value (0.0000) signalling that the null hypothesis that random effects fit the data can be rejected. Concerning the regression output of the translog cost function (see results in appendix A), generally, the results show that the model is well fitted as the R-square is 81%. Similarly, the estimates of the independent variables including the control variables are fairly significant. Furthermore, the coefficients of the input prices (price of labour and physical capital) are both positive, showing that the cost function estimated satisfies the non-negative marginal cost regularity condition. Therefore, the marginal cost can now be calculated and used to estimate the Lerner index.

Table 4.3 presents the average Lerner index of market power for each SSA country's banking industry in the sample during the time 2006 – 2012. The overall average Lerner index for the entire SSA banking sector is 56.5% and it ranges from 39.4% in Mali to 79.5% in Namibia as displayed in Figure 4.2. Delis and Pagoulatos (2009) consider any bank with a Lerner index ranging from 10% to 40% as being abstemiously competitive and all banks with Lerner index above 40% as having a high monopoly power. Consequently, with a high Lerner index of 56.5%, it can be generally suggested that banks in SSA possess a greater level of market power. This

finding means that the sampled banks have the power to charge their products and services over and above their marginal cost in the intermediation process, perhaps to compensate themselves for the high costs of operation. This could be an explanation for banks being highly profitable in this region as suggested by Beck and Cull (2013). They observe that banks in Africa are highly profitable and have short term loan maturity. This finding is in line with a study by Clerides, Delis and Kokas (2015) which investigated the level of competition in the banking industries of 148 countries across the world, including some SSA countries for the period 1997-2010.

Table 4.3: Average Lerner Index by Country and Year

Country	2006	2007	2008	2009	2010	2011	2012	Overall Average
Benin	0.715	0.630	0.334	0.367	0.345	0.497	0.465	0.479
Botswana	0.805	0.792	0.785	0.672	0.560	0.603	0.685	0.700
Burkina Faso	0.353	0.022	0.887	0.740	0.229	0.425	0.170	0.404
Cameroon	0.277	0.251	0.427	0.509	0.609	0.513	0.658	0.463
Cote D'ivoire	0.544	0.393	0.503	0.504	0.505	0.317	0.429	0.456
Ethiopia	0.402	0.491	0.460	0.310	0.385	0.409	0.423	0.412
Ghana	0.880	0.291	0.491	0.485	0.552	0.638	0.689	0.575
Kenya	0.556	0.695	0.609	0.553	0.730	0.696	0.523	0.623
Malawi	0.622	0.749	0.764	0.760	0.581	0.557	0.596	0.661
Mali	0.473	0.279	0.391	0.334	0.375	0.439	0.467	0.394
Mauritius	0.174	0.268	0.481	0.468	0.542	0.700	0.666	0.471
Mozambique	0.769	0.826	0.682	0.681	0.709	0.680	0.609	0.708
Namibia	0.814	0.746	0.719	0.752	0.789	0.885	0.860	0.795
South Africa	0.431	0.541	0.545	0.560	0.644	0.719	0.773	0.602
Uganda	0.621	0.578	0.512	0.392	0.374	0.576	0.532	0.512
Tanzania	0.925	0.764	0.769	0.554	0.624	0.588	0.481	0.672
Zambia	0.842	0.752	0.681	0.886	0.607	0.404	0.575	0.678
Yearly Average	0.600	0.533	0.591	0.560	0.539	0.567	0.565	0.565

Source: Author's own calculation.

In terms of evolution of the market power in the SSA banking sector across the years of the study's sample, market power was not steady (see Figure 4.1). For instance, in Figure 4.1, the greater value is observed in 2008 (59.1%) and this same value represents the year with the sharpest increase in market power whereas the lowest market power was recorded in 2007. Although the index declines from 60% in 2006 to 53.3% in 2007, it declines further between 2008 and 2010. Since market power is a reverse computation of competition, the fall in market power indicates improvement in banking competition during the time of the decrease in market power. Figure 4.1 further shows that the Lerner index generally continues rising from 2010 to 2011 but experiences a marginal drop in 2012.

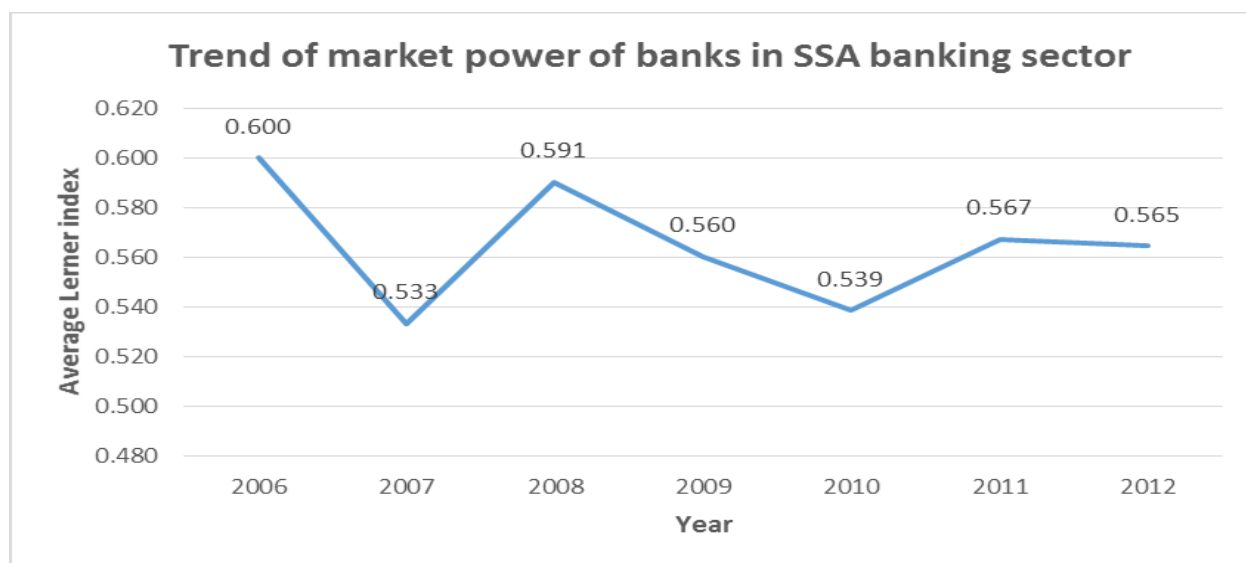
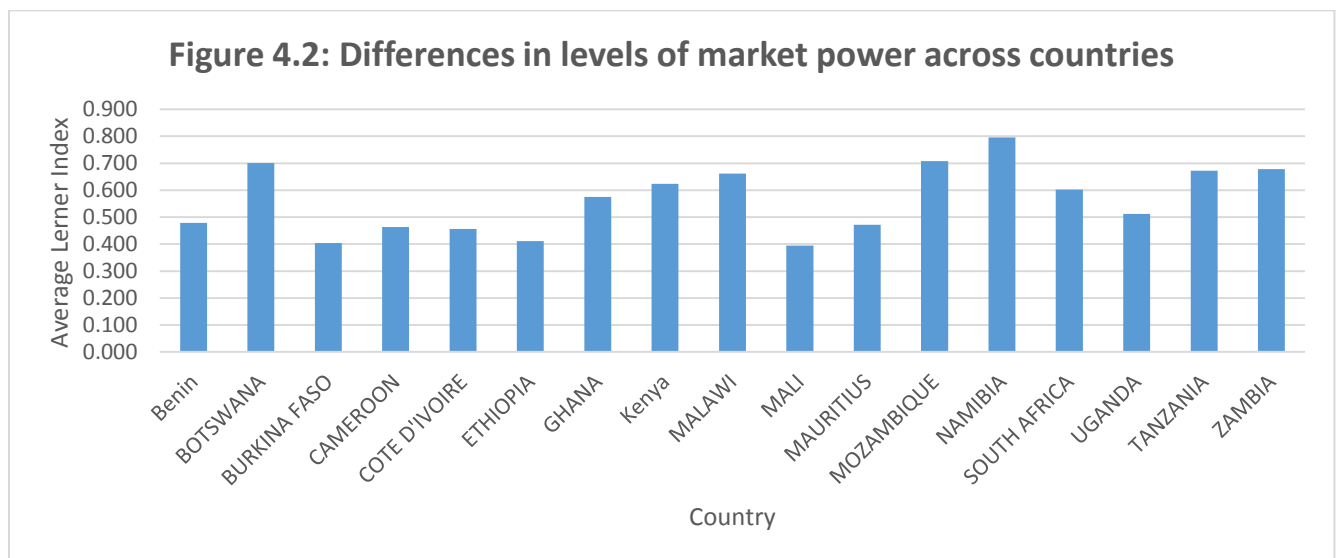


Figure 4.1
Source: Author.

Figure 4.2 highlights the presence of some important inequalities in market power in the SSA banking sector. Although the results in Figure 4.2 and Table 4.3 show that variations exist in the levels of market power across countries in SSA, all the countries under consideration closely align around 45% and 70% with the exclusion of a small number of countries (e.g. Burkina Faso,

Ethiopia and Mali). Namibia, Mozambique and Botswana show the highest average Lerner index (see Figure 4.2 below). Specifically, Namibia recorded a Lerner index of 79.5%, Mozambique had 70.8% while Botswana recorded a Lerner index of 70%. Consequently, these are the countries that have the highest amount of market power and, therefore, had the least competitive banking sector. These results can be aligned to those estimated by Kouki and Al-Nasser (2017). Their results display the following Lerner indices: 63%, 65% and 67% for Namibia, Mozambique and Botswana, respectively.



Source: Author

Delving further, figure 4.2 shows that Mali, Burkina Faso and Ethiopia have the least Lerner indices (39.4%, 40.2% and 41.2% respectively) and therefore can be described as countries with the least market power in SSA. Thus, these countries can be characterised as having a moderately competitive banking sector. The average Lerner indices for the remaining countries, Benin, Cameroon, Ghana, Kenya, Malawi, Mauritius, South Africa, Tanzania, Uganda and

Zambia are 47.9%, 46.3%, 57.5%, 62.3%, 66.1%, 47.1%, 60.2%, 67.2%, 51.2% and 67.8% respectively. The Lerner indices of these countries' banking sectors are closely aligned to the first three countries with the highest Lerner indices. These estimates can be compared to those of Maudos and Nagore (2005), Clerides, Delis and Kokas (2015) and Leon (2014b). It is observable, though, that two of these works (Maudos and Nagore, 2005; Leon 2014b) did not capture all the countries in our sample. Maudos and Nagore (2005), for instance computed 39% and 36% for Ghana and Zambia respectively over the period 1995-1999. Clerides, Delis and Kokas (2013) estimated 0.31, 0.43, 0.34, 0.33, 0.20, 0.40, 0.37 and 0.23 for Burkina Faso, Cameroon, Ghana, Kenya, South Africa, Tanzania, Uganda, and Zambia in that order. Leon (2014b) estimated the following Lerner indices for two countries, Benin and Burkina Faso, 36.4% and 33.7% correspondingly. Judging from the above, all three previous studies including the current study have different estimates for the countries concerned herein. The apparent instability of the Lerner indices in these cross-country and individual studies can be pinned down to differences in sample selection and periods covered by each study and selection of variables used for the econometric estimation (Bos et al., 2005).

Overall, the changes in the market power of the SSA banking sector over the study period may be explained from the perspective of the continuous financial restructurings and the outset of the 2008/9 financial crunch. Per this study's results, banks' market power peaked in 2008. This trend can be attributed to the financial reforms; that is, the improvement in monitoring mechanism and a strong restructuring of the banking sector. In particular, banks in SSA were under obligation to raise their capital requirement to satisfy the Basel II least capital prerequisite and this had the tendency to reduce the number of banks because banks that were not able to

meet the capital requirement had to fold up or merge with other banks. This further increased banking concentration; hence, the decrease in competition and the sharp rise in market power.

Furthermore, the observed decrease in market power from 2008 through 2010 can be attributed to improvement in the liberalization of the banking system and the steady diffusion of overseas banks coupled with the expansion of Pan African banks fortified by the introduction of single banking license in the banking markets of SSA. However, downward trend also marked the period of the 2008/9 financial meltdown. Hence, the decline in market power can also be link to the financial crisis. During this period, banks had to reduce their prices to whip up customers' demand for financial services as a means of helping them survive the crisis and reclaim their market share. Consequently, banks could not charge higher prices over their marginal cost of providing these services. The upward movement just before the end of the study date may be linked to the rather weakened institutions in SSA nations (Delis, 2012). The rise in market power could also be ascribed to liberalization in the banking sector which permitted the penetration of overseas banks in the domestic market. With their large capital base, they acquired distressed banks; yet, they struggled to come out of the crisis which heightened bank concentration and consequently resulted in a rise in market power during the period.

For the purpose of identifying which income level of countries dominates in terms of market power, the Lerner index of the various countries' banking sector under consideration were classified according to their income classification based upon the World Bank standards. An outline of the outcomes is offered in Table 4.4. It was observed that the upper-middle income countries had the highest market power (71.7%) followed by lower income countries (55.9%)

and then the low-income countries (52%). This new finding is contrary to the evidence put out by Kouki and Al-Nasser (2017) that low income countries in Africa possess the highest market power.

Table 4.4 Mean Lerner Index by Income Level

YEAR	2006	2007	2008	2009	2010	2011	2012	Total
Low-middle income	0.609	0.542	0.500	0.515	0.477	0.521	0.472	0.520
Lower-Middle income	0.620	0.476	0.542	0.587	0.601	0.514	0.575	0.559
Upper-middle income	0.747	0.654	0.732	0.687	0.684	0.752	0.761	0.717

Source: Author's calculation.

4.4.2 Bank Cost Efficiency in SSA

The cost efficiency scores of the banking industry of the countries sampled were computed using the DEA methodology. The yearly and overall average cost efficiency scores of the sampled banks in SSA countries over the entire study period from 2006 to 2012 are depicted in Table 4.5. The outcomes reveal that the total cost efficiency of the SSA's banking sector averaged 0.632, representing 63.2% for the period 2006-2012. The implication of this finding is that the sampled banks in SSA wasted 36.8% of their costs in comparison with the "best practice" banks. Put differently, the results suggest that banks in SSA overuse 36.8% of their assets to provide the same output produced by the "best-practice" bank. Therefore, the SSA banking industry can reduce an average of 36.8% input wastage and still produce the same output. This inefficiency in input usage found by this study is close to what Oluitan (2014) reported that cost inefficiency in Africa range between 10% and 26%. Leibenstein (1966) ascribes these input deviations from the optimum output to the inability of bank managers to

combine inputs efficiently. Therefore, the results indicate that management of the SSA banking sector could not use their input resources judiciously though there is a great opportunity for banks to improve their cost savings. In contrast to Leibenstein's (1966) proposition, there are other elements that bank management cannot control which tend to adversely affect bank cost efficiency.

For example, the skilled set of labour in SSA is very low (Oluitan, 2014) and the market size in SSA is generally limited which could inhibit banks in SSA from enjoying the gains in economies of scale. Generally, the results suggest relatively low mean cost efficiency marks during the period 2006-2012, which implies that banks in SSA are functioning far away from the cost efficiency frontier. This finding is similar to that found by Kablan (2010) for one-hundred and thirty-seven (137) banks in twenty-nine (29) African countries (76%) but differs considerably from that of Kiyota (2009) which realised an overall cost efficiency score of 48% in an examination of the efficiency of banks in twenty-nine (29) Sub Saharan African countries during the period 2000-2007. The findings are also in contrast with what Nlambo and Ncube (2011) found. They found cost efficiency of 41.2% for a study of ten (10) Southern African countries. The low efficiency scores recorded by Kiyota (2009) and Nlambo and Ncube (2011) may not necessarily reflect improvement in bank efficiency but could be credited to alterations in methodology, sample size and sample period (Bos et al., 2005).

Another key finding is the observed differences in measured bank cost efficiency across the countries sampled. Specifically, the results differ in the range of 60.9%, 66.5%, 56.1%, 77.9%, 80.0%, 55.4%, 85.5%, 59.9%, 48.2%, 36.6%, 46.8%, 91.7%, 81.2%, 82.0%, 47.7%, 42.5% and

54.9% for Benin, Botswana, Burkina Faso, Cameroon, Cote D'Ivoire, Ethiopia, Ghana, Kenya, Malawi, Mali, Mauritius, Mozambique, Namibia, South Africa, Uganda, Tanzania and Zambia respectively. Cost efficiency of Mozambique's banking sector tops all the countries in the sample and Mali had the least bank cost efficiency score during the sample period, 2006-2012.

Table 4.5 DEA Efficiency Scores by Year and Country

COUNTRY	2006	2007	2008	2009	2010	2011	2012	Average 2006-2012
Country								
Benin	0.703	0.604	0.495	0.482	0.577	0.660	0.742	0.609
Botswana	0.504	0.610	0.559	0.668	0.788	0.773	0.753	0.665
Burkina Faso	0.506	0.402	0.776	0.552	0.665	0.500	0.526	0.561
Cameroon	0.457	0.822	0.743	0.955	0.780	0.699	1.000	0.779
Cote D'ivoire	1.000	0.543	0.761	0.826	1.000	0.750	0.718	0.800
Ethopia	0.528	0.475	0.457	0.452	0.402	0.561	1.000	0.554
Ghana	0.832	0.688	0.794	0.840	0.914	0.930	0.972	0.853
Kenya	0.423	0.410	0.748	0.714	0.839	0.643	0.420	0.599
Malawi	0.542	0.482	0.548	0.404	0.317	0.516	0.562	0.482
Mali	0.376	0.365	0.308	0.280	0.258	0.297	0.679	0.366
Mauritius	0.416	0.255	0.434	0.298	0.236	0.782	0.851	0.468
Mozambique	0.908	0.924	0.922	0.912	1.000	0.804	0.950	0.917
Namibia	0.682	0.973	0.644	1.000	0.540	1.000	0.846	0.812
South Africa	0.847	0.890	1.038	0.633	0.700	0.693	0.943	0.820
Uganda	0.421	0.481	0.635	0.494	0.424	0.417	0.470	0.477
Tanzania	0.768	0.423	0.627	0.489	0.100	0.215	0.352	0.425
Zambia	0.624	0.623	0.857	0.495	0.583	0.235	0.426	0.549
Yearly Mean	0.620	0.587	0.667	0.617	0.595	0.616	0.718	0.632

Source: Author's own calculation.

To ascertain how cost efficiency in the SSA banking sector has evolved over the study years, average cost efficiency across years were analysed (see Figure 4.3 and Table 4.5). Interestingly, the outcomes in Figure 4.3 and Table 4.5 show that in the beginning of study period, i.e. from 2006 to 2007, cost efficiency of the SSA banking sector declined from 62% to 58.7%, signifying deterioration in input usage as indicated by the downward trend of cost efficiency curve exhibited in Figure 4.3. However, this trend was reversed when cost efficiency increased from 58.7% in 2007 to 66.7% in 2008. Thereafter, there was rather a remarkable decrease in cost efficiency from 2008 – 2010 (see Figure 4.3). The fall in efficiency during these periods could be attributable to the 2008/9 banking crisis as shown in the work of Delis (2012). The declining trend could also be explained by the increasing information asymmetry costs in financial intermediation coupled with heightened competition which increased banks' appetite to take more risk. This consequently increases the non-performing loans and capital losses and eventually causes high costs for banks in SSA, thereby reducing bank cost efficiency. This evidence is in accordance with the conclusions of Besanko and Thakor (1993) and Keeley (1990). They found that deregulation and related financial reforms improved bank competition but worsened efficiency. This evidence seems to contradict the conventional wisdom that deregulation improves efficiency. Nevertheless, banks in SSA seem to have the highest cost efficiency marks over the period 2011 to 2012 and this could mark the period of the recovery from the financial crunch or perhaps as a result of implementation of good supervisory and regulatory system by the various countries.

The study was also interested in ascertaining whether any significant variations exist in cost efficiency across the three income groups of SSA countries, namely the low-middle income

nations (LMIC), the lower middle income nations (LRMIC) and the upper-middle income nations (UMIC), since this has regulatory implications. Table 4.6 and Figure 4.4 depict the outcomes of the comparison of cost efficiency of the three income groups.

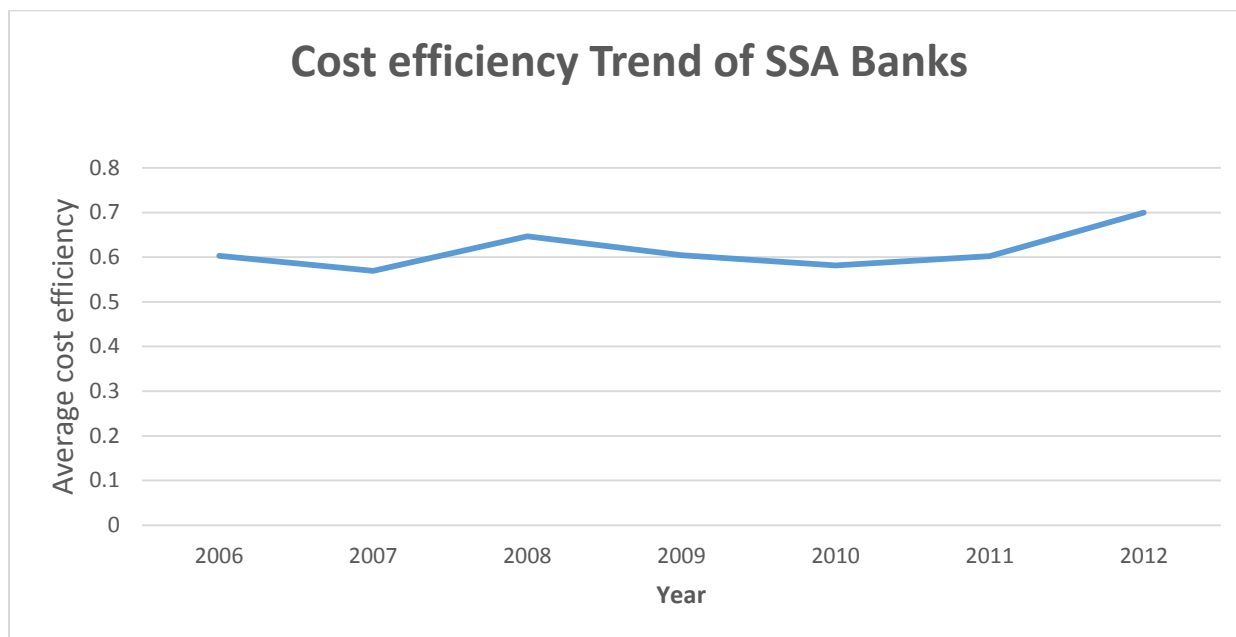


Figure 4.3

Source: Author's calculation.

Table 4.6 reveals that LRMIC banking sectors have the greatest cost efficiency marks with all period mean cost efficiency score of 71.6%, followed by UMIC banking sectors with an estimated cost efficiency of 69.1% and LMIC banking sectors with a cost efficiency score of 65.2%, being the worst. This finding contradicts Kouki & Al-Nasser's (2017) finding that low-middle income countries are somewhat more efficient as compared to the upper- and lower-middle income countries in Africa. The differences in findings could be as a result of different periods, input and output variables being examined (Ariff & Can, 2008).

Table 4.6: Mean Cost Efficiency by Income Group

Year	2006	2007	2008	2009	2010	2011	2012	All
UMIC	0.612	0.682	0.669	0.650	0.566	0.812	0.848	0.691
LRMIC	0.667	0.617	0.781	0.766	0.823	0.651	0.707	0.716
LMIC	0.594	0.520	0.596	0.508	0.468	0.496	0.660	0.549
Yearly mean	0.625	0.606	0.682	0.641	0.619	0.653	0.738	0.652

Source: Author's calculation.

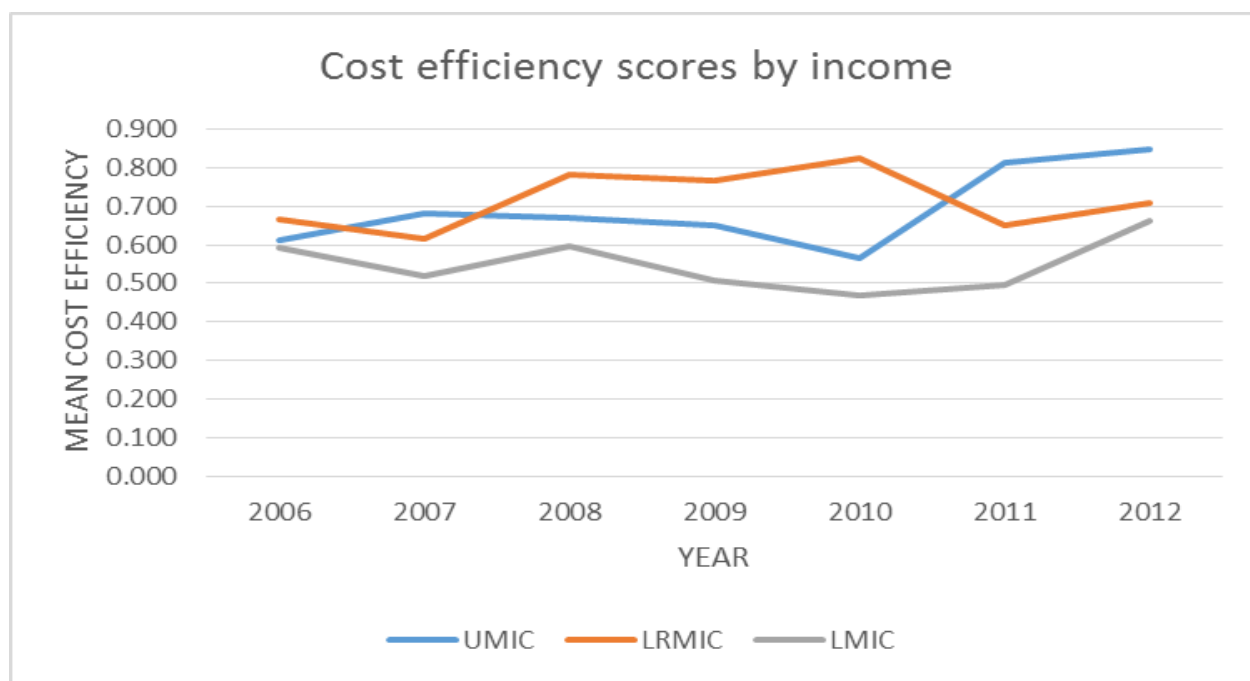


Figure 4.4

Source: Author's calculation.

Figure 4.4 illustrates that while the level of cost efficiency of the UMIC and LMIC have significantly increased by 38.6% and 11.1% respectively over the study period, there has not been any significant improvement in the level of cost efficiency for LRMIC's banking sector. Overall, there is the existence of cost efficiency difference among the three income groups. However, this evidence is not enough to conclude whether the differences among them are significant. To test this, the Tukey honest significant difference test was conducted. The results

summarized in appendix D confirm the existence of significant disparities between the pairs of means of the three income groups of countries. Thus, the results indicate P-values of 0.004, 0.013 and 0.06 in that order for the test of differences between the means of low middle and lower middle-income nations, upper-middle and low-middle income countries, as well as upper-middle and lower-middle income nations. This implies that the Null Hypothesis of no difference in means between them can be rejected. Hence, this new study settles that a significant difference exists between the mean cost efficiency of low-income, lower-income as well as upper middle-income nations in the SSA banking sector. The implication of this finding is that these economies exhibit dissimilar characteristics.

4.5 The Relationship between Competition and Cost Efficiency in SSA Banking Sector

To examine the association between cost efficiency and competition in the SSA banking sector as a whole and across the three income categories, it is important to analyse the descriptive statistics and test the degree of multicollinearity across the explanatory variables to ascertain whether the variables considered in this study meet the econometric conditions. These important statistics are respectively presented in Tables 4.7 and 4.8. Specifically, Table 4.7 displays the summary statistics for bank cost efficiency, Lerner index of market power, and the control variables including bank specific variables such as market share, capitalization, credit risk, asset growth and macroeconomic environment variables like inflation rate and GDP per capita growth. It reports the mean as well as the standard deviation (in parenthesis) for the whole sample including the three income groups of countries. Included in the table is the creation of three columns under the captions “Sign. of diff. btw (1) and (2)”, “Sign. of diff. btw (2) and (3)” and “Sign. of diff. btw (1) and (3)” (as seen in Dietrich and Wanzenried, 2014) to ascertain whether

or not there is existence of some significant dissimilarities between the variables of the three income groups.

The overall mean cost efficiency for the full sample is 0.63. As is expected, differences exist in cost efficiency among banks in low-income and lower-income nations as well as in low-income and upper-income nations and these differences are significant at 1% level. This clearly provides the justification for grouping the countries into three different income groups. The mean value of Lerner index for the entire sample is 0.57; showing that, on average, banks in SSA price their loans and other products 57% over their marginal cost of providing them. Interestingly, the Lerner index of banks, the main variable for the study, varies greatly between country income groups. In particular, low-income nations' banking sectors appear to be most competitive as compared to their counterparts in lower-middle income nations, where mark-up over marginal cost, the Lerner index, amounted to 50% (0.499) on average.

Again, banks in upper-middle income bracket of countries possess a more considerable market power than those in the lower-middle income countries. These findings might be due to a greater variation of institutions and differences in regulatory intervention carried out in countries at various stages of economic development. Among the bank specific variables examined, the bank size averaged 5.86 with a standard deviation of 1.54 for the full sample which is greater than the 3.76 found by Doan, Lin and Doong (2017). The authors examined the association between income diversification and cost efficiency in 83 countries over the period 2003 – 2012. The fairly high standard deviation (1.54) shows a somewhat low variation in bank size across countries (Doan, Lin and Doong, 2017). In comparison, banks in lower-income countries (0.067) exhibit a

relatively smaller size than those in upper-income countries (0.082) and the difference is statistically significant at 1% level. Market share also shows a mean value of 8.1%, implying that the largest banks in the SSA banking sector control 8.1% of the banking market. Market shares increase according to each country's income bracket. Thus, upper income nations indicate an average of 20.3%, while the lower middle-income nations and low-income nations followed with the averages 14.9%, and 11.3% respectively. The mean of the proportion of equity to total assets (capitalization) is 15.5% for the full sample but varies across banks in the three income groups as indicated by standard deviation recorded for capitalization for each income group. Specifically, the banking sector of both lower income and upper income nations are more sufficiently capitalized than the low-income nations' banking sectors where bank capitalisation amounted to an average of 53.4%.

On the other hand, upper-income nations' banking sectors are well capitalized as compared to the banking sectors of the lower-income countries and the difference in capitalization of these income groups are significant at 1% level. This confirms the conclusions of Dietrich and Wanzenried (2014). The authors attributed their findings to the fact that the countries under consideration conducted various regulatory interventions at different periods of time. Credit risk which measures the proportion of banks' assets set aside for lending activities averaged 50% in the SSA banking sector. Banks in lower-income countries devoted greater assets (65%) towards lending activities relative to the low- and upper-income countries, which respectively devoted 40% and 44% of their assets for loans. With regard to asset growth, low-income countries exhibit the highest average of 1.4%, followed by the upper-income countries that showed a mean value of 0.9% and the worst are the lower-income countries (0.8%).

The overall conclusion is that there is a reverse trend between competition and cost efficiency over the period 2006 – 2012, since market power is a converse measure of competition. However, both market power and cost efficiency exhibit similar trends: where banks witness a drop in market power, cost efficiency also displays a decrease.

Table 4.7 Descriptive Statistics by Country Income group for Competition-Cost Efficiency Nexus

Variable	All countries		Low-income countries(1)		Sign. of diff. btw (1) and (2)	Lower-income countries(2)		Sign. of diff. btw (2) and (3)	Upper-income countries(3)		Sign. of diff. btw (1) and (3)
	Obs.	Mean	Obs.	Mean		Obs.	Mean		Obs.	Mean	
Cost efficiency	1447	0.616 (0.394)	598	0.549 (0.026)	***	515	0.716 (0.029)	***	334	0.691 (0.039)	***
Lerner	1465	0.580 (0.540)	606	0.499 (0.636)		518	0.584 (0.428)	***	341	0.717 (0.474)	***
Bank size	1468	5.856 (1.536)	608	0.093 (0.114)		518	0.067 (0.071)	***	342	0.082 (0.094)	***
Market shares	1468	0.081 (0.097)	608	0.133 (0.071)	***	518	0.149 (0.116)	**	342	0.203 (0.223)	*
Capitalisation	1468	0.155 (0.138)	608	0.534 (1.226)	**	518	0.570 (1.193)	***	342	0.701 (1.864)	***
credit risk	1258	0.496 (0.616)	521	0.40 (0.042)	***	447	0.650 (0.074)	***	290	0.440 (0.067)	
Asset growth	1432	0.011 (0.146)	602	0.014 (0.161)		509	0.008 (0.128)		321	0.009 (0.144)	
Asset growth sq.	1467	0.021 (0.096)	607	0.026 (0.121)		518	0.016 (0.049)		342	0.019 (0.097)	
inflation rate	1228	0.099 (0.070)	529	0.104 (0.088)		443	0.105 (0.062)		296	0.071 (0.027)	
GDPPG	1468	6.750 (1.116)	608	5.856 (0.308)	***	518	6.549 (0.238)	***	342	8.645 (0.141)	***
No. of banks		235		97			87			52	
No. of countries		17		8			5			4	

Table 4.7 displays means as well as the standard deviations (in bracket) of the variables employed in the studying how competition influences cost efficiency in SSA banking sector as a whole and by country income group. The full sample is made up of 235 banks from 17 countries over the period 2006-2012. ***, **, and * represent significance level at the 1%, 5%, and 10% respectively for differences in means of the three income brackets of countries and is created from Tukey's multiple comparison test. Sign. of diff. btw = significant of difference between

This revelation shows a negative association between and competition and cost efficiency. This notwithstanding, a further examination is necessary to evaluate this relationship. Hence, it is investigated in detail in the next section. The other variables that are of utmost importance are the macroeconomic variables. On average, inflation rates in both lower income and low-income countries are 10.5% and 10.4%, respectively, which are higher as compared to the upper-income countries' average of 7.1%. The higher inflation rates in lower- and low-income countries could be aligned to the high budget deficit in these countries, which is usually resolved through inflationary monetary policy. Finally, real per capita GDP growth recorded an average of 6.8 for the entire sample. However, statistically significant difference at 1% level exists between the three income groups and this shows alterations exist in income growth levels across the countries under consideration.

As far as simultaneous inclusion of independent variables could raise issues of multicollinearity, the correlation matrix presented in Table 4.8 provides a test of these concerns. Interestingly, the results show that there are no multicollinearity concerns as no pairs of independent variables have a correlation coefficient greater than 0.5 (Hair et al. 2006). Even so, variance inflation factor (VIF) for all explanatory variables was conducted as a further test of multicollinearity. The results, presented in Appendix D, indicate that there are no variables that are collinear since the VIF for each variable is less than 10 (Smith, Koper & Fahrig, 2009).

The results of the pairwise correlation matrix also give preliminary relationships between the variables. The most interesting ones are briefly highlighted. The study's variable of interest,

Lerner index of market power (Lerner), shows a positive and statistically significant relation with cost efficiency (eff), implying that banks with more market power have better cost efficiency.

Table 4.8: Correlation Matrix for Cost Efficiency and Competition Analysis

	1	2	3	4	5	6	7	8	9	10	11
1. Eff	1										
2. Lerner	0.1278*** (0.000)	1									
3. MS	0.062** (0.018)	0.1297*** (0.000)	1								
4. Cap	0.0781*** (0.003)	0.1175*** (0.000)	-0.2715*** (0.000)	1							
5. Bsize	0.2867*** (0.000)	0.1669*** (0.000)	0.4532*** (0.000)	-0.2139*** (0.000)	1						
6. Crk	-0.069** (0.015)	-0.039 (0.171)	-0.036 (0.197)	0.2612*** (0.000)	-0.061** (0.030)	1					
7. Ag	-0.038 (0.150)	-0.012 (0.655)	0.1285*** (0.000)	-0.1183*** (0.000)	0.1818*** (0.000)	-0.0929*** (0.001)	1				
8. Ag2	0.1120*** (0.000)	0.039 (0.134)	-0.038 (0.147)	0.1184*** (0.000)	0.1550*** (0.000)	0.001 (0.963)	0.1903*** (0.000)	1			
9. GDPPG	0.1661*** (0.000)	0.141*** (0.000)	0.014 (0.597)	0.1648*** (0.000)	0.4194*** (0.000)	-0.010 (0.715)	0.003 (0.896)	-0.031 (0.241)	1		
10. Infl	0.029 (0.311)	0.013 (0.636)	-0.1807*** (0.000)	0.052* (0.067)	0.0779*** (0.006)	0.068** (0.024)	-0.019 (0.517)	-0.031 (0.277)	-0.2979*** (0.000)	1	
11. Msasgr	0.029*** (0.002)	0.432*** (0.001)	0.3078*** (0.000)	0.0678*** (0.009)	0.1260*** (0.000)	0.014 (0.622)	0.475*** (0.000)	0.3261*** (0.000)	-0.037 (0.160)	-0.025 (0.379)	1

P-values are in the parenthesis. ***, ** and * respectively show the significance level at 1%, 5% and 10%. For definition of variables refer to Table 3.2.

Similarly, the indicator shows a significantly positive relation with MS, Cap, Bsize, Ag2 and GDPPG. It, however, correlates negatively with Crk and Ag. The correlation matrix in Table 4.8 shows a positive and statistically significant (at 1% level) correlation between Lerner and MS

and again between Cap and Lerner. The same correlation exists between Lerner and Bsize. These correlations indicate that well capitalized banks and banks with high market shares as well as the ones with more assets have the tendency to possess higher market power. Nevertheless, Lerner index scored a negative and statistically significant correlation with Crk, suggesting that the higher the proportion of loans to total assets, the lesser the market power of banks. Furthermore, Ag depicts a positive and statistically significant correlation with MS, implying that banks that have large market shares experience improvement in their asset growth. Ag, however, shows a negative correlation with Lerner though not significant. This suggests there is less market power and high competition when banks expand their assets.

In addition, Table 4.8 shows a rise in GDPPG and Infl tends to raise the market power of banks. Besides, Msasgr has a statistically significant positive relation with Lerner. This strong correlation buttresses the idea of using the interacting term of market shares and asset growth to instrument the Lerner index. The correlation between the pairs of variables analysed does not show causality but mere associations. Therefore, to determine how the Lerner index together with the control variables affect bank cost efficiency in SSA as a whole and across the three income groups of countries, the econometric model stated in section 3.7, equation 3.11 was estimated. The outcomes of the full sample are depicted in Table 4.9. In each case, equation 3.11 was run twice, one without the control variables and the other with the control variable. The sub-samples' outcomes are depicted in Table 4.10.

4.6 Regression Results

4.6.1 Effects of Competition on Bank Cost Efficiency

As indicated in Table 4.9, the Durbin-Wu-Hausman test shows p-values of 0.0012 and 0.0014 for model (1) and model (2), respectively. Hence, the null hypothesis that the Lerner index is exogenous is rejected. Therefore, the adoption of the 2SLS estimator is justified. The Hansen J-test statistic checks the null hypothesis that the instruments are exogenous. The test results in Table 4.9 show that the P-values of the Hansen J-statistic for model (1) and model (2) are 0.4234 and 0.2510, respectively, suggesting that the null hypothesis that the instruments are exogenous cannot be rejected. Therefore, the instruments for models are valid. On the contrary, the instruments could be valid but weakly correlated with the Lerner index (i.e. the endogenous variable). The weak instruments identification test statistic obtained from Kleibergen-Paap rk Wald F statistic tests the Null Hypothesis that the instruments are weakly identified. Since the Kleibergen-Paap Wald rk F statistic is more than the Stock-Yogo maximum relative bias critical value at 5%, the Null Hypothesis is rejected and it can be concluded that the instruments are not weakly identified.

Per the estimations of the 2SLS estimator, the outcomes depicted in Table 4.10 indicate that there is a positive and statistically significant (1% level of significance) link between the Lerner indices of market power and cost efficiency in both estimations. This result supports the findings of Weill (2004). Based on model 1, on average, a one percent rise in banks' market power induces 21.26% rise in cost efficiency holding any other variable that affects cost efficiency constant. After controlling for the bank specific and macroeconomic factors (model (2)), the positive influence of the Lerner index on cost efficiency still persists even at 1% level of

significance, although the magnitude of economic significance reduces from 0.2126 to 0.0673. Thus, in the SSA banking sector, banks with a high market power do well with regard to cost reduction relative to those with high competition. The reason for this is that market power offers motivations for banks to undertake low risky investments (Vives, 2001).

In view of the fact that the market power reduced from the year 2006 to 2010 during the study period, the findings which suggests that competition is harmful to bank cost efficiency in SSA may be elucidated using the Banking Specificities Hypothesis also known as the Information Generating Hypothesis by Marquez (2002). This hypothesis seeks to explain why competition hinders bank cost efficiency. The surge in competition during the time of the study does not favour cost efficiency of banks since it impedes banks from benefiting from economies of scale in checking debtors and establishing long term customer relationship. Consequently, this weakens banks' natural relative ability in generating information on borrowers which leads to too much lending to unscrupulous borrowers which in turn results in a high default rate and non-performing loans. All these culminate in the inefficiency of banks in SSA despite their high market power.

The results support other empirical findings in the literature. Maudos and De Guevara (2007) found that market power helps European banks to manage their operational cost. The findings also support Koetter, Kolari and Spierdijk (2012) who report that in the U.S.A., banks with a high market power are the most cost efficient. Furthermore, the findings corroborate Pruteanu-Podpiera, Schobert and Weill (2008) who found evidence for positive association between cost efficiency and market power of banks in the Czech banking sector. On the contrary, these

findings are not consistent with those of Ariss (2010) when the author examined the issue in developing countries. The author found a negative association between cost efficiency and bank competition and concluded that market power of banks is harmful to cost efficiency. The results also do not provide evidence in support of those found by Arrawatia, Misra and Dawar (2015) in the Indian banking sector and Schack, Cihak (2010) for European and U.S. banks, Fungacova et al. (2013) in the Chinese banking sector, Fare et al. (2015) in the Spanish banking sector and by Andries and Capraru (2014) in 27 European countries' banking sectors.

Turning to the effects of the control variables on cost efficiency, the results show that some of the control variables significantly explain cost efficiency. Bank size exerts a positive but insignificant effect on bank cost efficiency in SSA banking industry contrary to the expectation of this study. This implies that the size of a bank is not vital in explaining cost efficiency in the SSA banking industry. This evidence confirms the empirical evidence by Bokpin (2013) who found a positive and statistically insignificant effect of bank size on the cost efficiency of Ghana's banking system. The finding is, however, not consistent with Pasiouras and Kosmidou (2007) and Isik and Hassan (2002) who found a harmful effect of bank size on efficiency.

Market share is also found to affect cost efficiency negatively and is statistically significant at 1%. The result means that banks with a large market share do not gain from cost efficiency increases, relative to their smaller peers. This result confirms prior studies by Schack and Cihak (2008) who report that market share decreases cost efficiency for European and U.S. banks. The low-cost efficiency experienced by banks with large market shares could be due to the difficulty of these large banks to control costs due to their size (Berger & Mester, 1997). This may be in

line with the Quiet Life Hypothesis which postulates slack management practices in banks with large size.

With reference to capitalisation, it had a statistically significant negative relation with bank cost efficiency, suggesting that banks with a large equity capital in the SSA banking sector perform significantly better in cost savings in comparison with those with relatively small capital. In view of the fact that banks in the SSA are well capitalized, the outcome supports the argument of Louzis et. al. (2011) that highly capitalized banks put too much self-confidence in management to operate under the assumption of 'too big to fail' and, therefore, take on too much risks which generate more non-performing loans. As a result, the gains in cost efficiency are eroded by the recent increase in non-performing loans across SSA countries.

Credit risk shows a negative and statistically significant relationship with cost efficiency at 5% significance level, thereby indicating that banks that offer a greater proportion of their assets as loans do not benefit from cost efficiency increases. This may also mean that SSA banks have poor asset quality because they are exposed to greater risk. This finding is what was expected. The result confirms the findings of Casu and Girardone (2007) and Yildirim and Philippatos (2007).

Concerning asset growth, a positive but insignificant relationship is found and this is akin to that found by Schaeck and Cihak (2010) for U.S. banks. Thus, the finding suggests that asset growth in the SSA banking sector does not matter for cost efficiency improvement. This result is

contrary to that found by Schaek and Cihak (2010) for the European banking market. The authors found that a rise in asset growth adversely affects cost efficiency.

Asset growth square had a positive and insignificant effect on cost efficiency. This finding suggests that even though banks in SSA experience nonlinear growth in assets, such increases do not significantly improve the cost efficiency of its banking sector. The finding provides support for the argument of Schaek and Cihak (2010) that an aggressively growing bank in the U.S. does no better in improving its efficiency.

On the macroeconomic factors, the coefficient of inflation rate is found to be positive and significantly different from zero contrary to expectation. The finding corroborates the findings of Guru et al. (2002) and Tan and Floros (2012). The implication of this finding is that during the period of high inflation, banks in SSA increase interest rates on their products and services in order to raise enough revenue to offset the expected revenue losses (Chan and Karim, 2010). Hence, these provisions put forward by banks in SSA might cushion them against interest rate losses as there is a high interest rate spread in SSA according to Beck and Cull (2013) which is largely blamed on heightened inflation in the continent. The evidence does not agree with Yildirim (2006) who found a negative association.

Regarding GDP per capita growth, the estimate is positive and not insignificant at 1%. This empirical evidence supports Weill (2005) and Yildirim and Philippatos (2007).

Table 4.9 Effects of Competition on Bank Cost Efficiency

Estimator	2SLS Model 1	2SLS Model 2
Dependent variable	Cost efficiency	Cost efficiency
Measure of competition:		
Lerner index	0.2126*** (0.0061)	0.0673*** (0.0103)
Bank specific variables:		
Bank size		0.0021 (0.2626)
Market share		-0.2579*** (0.0400)
Capitalisation		-0.0514* (0.0278)
Credit risk		-0.1262** (0.0600)
Asset growth		0.1785 (0.1252)
Asset growth square		-0.2299 (0.6926)
Macroeconomic environment variables:		
Inflation rate		0.0176** (0.0307)
GDP per capita growth		0.01908*** (0.0024)
Observations	952	659
Number of banks	235	235
R-squared	0.4030	0.7934
Durbin-Wu-Hausmann test χ^2	5.431	10.2010
P-value	0.0012	0.0014
Hansen J-Test χ^2	1.7270	1.495
P-value	0.4216	0.2510
Kleibergen-Paap rk Wald $F\chi^2$	57.607	26.083
F-Test model χ^2	1181.38***	380.82***

The results are estimated using 2SLS estimators. The dependent variable is cost efficiency. Our main variable of interest is the Lerner index, a proxy for market power. The literature shows that the Lerner index is endogenous, hence using the OLS regression may produce bias results. Therefore, there 2SLS technique is employed to deal with this issue. The Lerner index of market is instrumented with two lagged values of itself and the interactive term of market share and loan growth. The robust standard errors are reported in parenthesis. *** p<0.01, ** p<0.05, * p<0.1 indicates significance at 1%, 5% and 10% respectively.

The positive relationship between GDP per capita growth and cost efficiency means that banks in SSA can raise their cost efficiency in a period of rising economic growth because during this period nonperforming loans are likely to be very minimal (Weill, 2004).

4.6.2 Effects of Competition on Bank Cost Efficiency by Country Income Group

To investigate whether market power or competition affects cost efficiency differently across different income groups of countries (i.e. low-, lower- and upper-middle income countries), the study re-estimated Eq. (3.11) with a 2SLS estimator by splitting the sampled countries according to their income categorizations. The outcomes are depicted in Table 4.10.

Table 4.10 provides evidence that a 2SLS estimator is necessary because the Durbin-Wu-Hausman tests in all regressions show p-values less than 0.05, highlighting a rejection of the null hypothesis of exogeneity of the Lerner index. The results further show that the test of over-identifying restrictions is satisfactory as the P-values in all regressions are well over 0.1, suggesting that the Null Hypothesis that the instruments are valid cannot be rejected. The test of weak instruments identification using Kleibergen-Paap rk Wald F statistic indicates that the instruments are not weakly identified, evidenced by the Kleibergen-Paap Wald rk F statistic being more than the Stock-Yogo maximum relative bias critical value at 5% across each regression.

Generally, the study observed certain significant and important variations between the estimated results for the country income classification, in terms of both significance and the magnitude of

coefficient. As a result of the differences in findings for each country income group, it is crucial to examine the country income groups separately.

The results in Table 4.10 reveal that the Lerner index has a positive and statistically significant effect on cost efficiency in low-middle and lower-middle income countries. The implication of this finding is that intensifying banking competition in low- and lower-middle income countries erodes bank cost efficiency. This finding supports the proposition of the Banking Specificities Hypothesis that highlights that competition in banking does not enhance cost efficiency. This is opposed to the Quiet Life Hypothesis which suggests that banks' market power enables banks to seek monopoly rent at the expense of cost efficiency enhancement. Thus, the underdeveloped nature of the banking markets in these income groups has exacerbated the information asymmetry problem among banks.

Consequently, increased banking competition results in increased monitoring costs, resulting from the decline in the length of relationship between the bank and the borrower and the existence of scale economies (Pruteanu-Podpiera, Weill & Schobert, 2007). Interestingly, the Lerner index does not exert any significant effect on cost efficiency in upper-middle income countries. The Banking Specificities Hypothesis could explain this finding. As indicated by Fungacova, Pessarossi and Weill (2012), this hypothesis does not have much influence on banks which suffer less from information asymmetries. Unlike banks in low-middle and lower-middle income countries, banks in upper-middle income countries are not likely to endure information asymmetries. This is because large companies with better corporate governance strategies dominate in upper-middle income countries and banks tend to bias their loans towards these

companies instead of lending to small and medium enterprises for which information asymmetries have greater influence in the lending relationship. Fungacova, Pessarossi and Weill (2012) argue that small and medium enterprises are rationed with respect to credit in China as a means of dealing with the information asymmetries in small and medium enterprises.

Regarding the bank specific control variables, bank size has negatively statistically significant association with cost efficiency in lower-middle income nations. This impact is significant at 1% level. Thus, in concrete terms, a 1% rise in banks assets on average decreases the mean of cost efficiency by 2.6%. This result conforms to the empirical finding of Berger and Mester (1997). Contrary to upper-middle income countries, bank size is positively significant at 1% level. This could imply that the economies of scale enjoyed by large banks in upper-middle income countries aid banks to boost their cost efficiency whenever they increase their assets size. For low-middle income countries, increase in bank size does not explain the variation in cost efficiency. This empirical evidence supports the findings of Bokpin (2013), who found a positive and insignificant effect of bank size on cost efficiency.

In upper- and low-middle income countries, increase in market share is negatively significant in influencing cost efficiency. This greatly supports the idea that managers in large banks may enjoy slack management at the expense of reaching higher cost efficiency. Conversely, the estimate of market share is negative but insignificant in lower-middle income countries.

For the rest of the bank specific control variables, although capitalization negatively affects cost efficiency in both lower- and upper-middle income countries, such negative effects are not

significant in upper-middle income countries. This suggests poor asset quality in these income groups of countries (Gosh, 2015) as banks often tend to take on higher risks to raise more profits to compensate the informational disadvantage they face. However, this estimate is positive but not significant for low-middle income nations, suggesting that banks in low income nations reap no cost efficiency benefits through increasing or decreasing their capitalization. Therefore, regulatory policies that seek to raise bank capitalization as a prerequisite to increase cost efficiency in low-income countries only expose banks to severe risks and are not beneficial to cost efficiency (Mirzaei & Moore, 2014).

Credit risk has an insignificant negative relationship with cost efficiency in lower income countries but is significantly negatively related at 5% level with cost efficiency in both low and upper income countries. The negative association between credit risk and cost efficiency in all the regressions points to the fact that although banks in these countries face credit risk, such credit risks do not explain the variation in cost efficiency in lower income countries. This supports the finding of Staub, da Silva e Souza and Tabak (2010). Nevertheless, the result shows the rise in exposure of banks to credit risk points to deterioration in cost efficiency for low and upper-income countries' banking systems. The reason is that banks in these countries do not have enough monopoly power to overcome the information asymmetries banks face so as to be able to screen and monitor borrowers. In addition, as indicated by Mathieson and Roldòs (2001), the banking industries in low and upper-income countries, especially low-income countries, have undergone financial reforms which have increased banking competition.

Table 4.10: Effects of Competition on Bank Cost Efficiency by Country Income Group

Estimator	2SLS	2SLS	2SLS	2SLS
	Full sample	Low-income countries(1)	Lower-income countries(2)	Upper-income countries(3)
Dependent variable: Cost efficiency				
Measure of competition:				
Lerner index	0.2126*** (0.0061)	0.0850*** (0.0185)	0.0849*** (0.0214)	0.0166 (0.0159)
Bank specific variables:				
Bank size	0.0021 (0.2626)	0.0103 (0.0021)	-0.02625*** (0.0052)	0.0217*** (0.0033)
Market share	-0.2579*** (0.0400)	-0.2858*** (0.0666)	-0.1097 (0.0986)	-0.4772*** (0.0716)
Capitalisation	-0.0514* (0.0278)	0.0245 (0.0771)	-0.1439*** (0.0448)	-0.0075 (0.0349)
Credit risk	-0.1262** (0.0600)	-0.2895** (0.1257)	-0.0793 (0.0649)	-0.2146** (0.0873)
Asset growth	0.1785 (0.1252)	0.1622 (0.1578)	0.0543 (0.1683)	0.0081 (0.1961)
Asset growth square	-0.2299 (0.6926)	-1.8456** (0.7892)	0.3813 (0.4062)	-1.4776 (1.5111)
Macroeconomic variables:				
Inflation rate	0.0176 (0.0307)	-0.1894*** (0.0456)	0.1014* (0.0548)	-0.4212** (0.1687)
GDP per capita growth	0.01908*** (0.0024)	0.0401*** (0.0052)	0.0388*** (0.0049)	0.0100*** (0.0027)
Observations	659	265	303	952
Number of banks	235	97	86	52
R-squared	0.4030	0.8721	0.784	0.8870
Durbin-Wu-Hausmann test χ^2	5.4310	4.223	7.954	2.8400
P-value	0.0012	0.0399	0.0048	0.0419
Hansen J-Test χ^2	1.7270	0.420	0.1768	3.4910
P-value	0.4216	0.8106	0.8190	0.3219
Kleibergen-Paap rk Wald $F\chi^2$	57.6070	18.745	60.8510	48.9720
F-Test model χ^2	1181.3800***	266.3500***	255.2700***	163***

The results are estimated using 2SLS estimators. The dependent variable is cost efficiency. Our main variable of interest is the Lerner index, a proxy for market power. The literature shows that the Lerner index is endogenous, hence using the OLS regression may produce bias results. Therefore, there 2SLS technique is employed to deal with this issue. The Lerner index of market is instrumented with two lagged values of itself and the interactive term of market share and loan growth. The robust standard errors are reported in parenthesis. *** p<0.01, ** p<0.05, * p<0.1 indicates significance at 1%, 5% and 10% respectively.

It is observed that asset growth does not explain the changes in cost efficiency in all three income groups. Assets growth square is negative in both low and upper-income countries but it is not significant in upper-income countries, while it has an insignificant positive relationship with cost efficiency in lower-income countries.

Regarding the macroeconomic environment control variables, different observations were made for each country income group. The significant coefficient of inflation rate with the negative sign which is reported in low and upper-income countries attests to the fact that increases in consumer price index decreases cost efficiency in these countries' income groups. This appears to be a phenomenon in low and upper-income countries because it is opposite for the lower -income country groups though the level of significance is 10%. Finally, the study observed that GDP per capita growth boosts cost efficiency among all the three income groups.

4.7 Sensitivity Analysis

To test the consistency of the results of this study, a robustness check was conducted employing the Ordinary Least Square (OLS) with fixed effects similar to Schaeck and Cihak (2010). All the independent variables are lagged by a period to deal with the endogeneity issue between the Lerner index and cost efficiency as seen in Schaeck and Cihak. The results displayed in Appendix E are in tandem with the main results of this study except in a few instances where the level of significance and sign of coefficients differ slightly from the main results. For the Full sample, a slight difference was observed between the two results with respect to the level of significance of capitalization. Capitalisation was significant at 10% in the main results while it is significant at 5% in the sensitivity analysis. Although market share and asset growth square

maintained their negative signs in the low-income countries, their coefficients were not significant in the sensitivity analysis. This can be attributed to the inability of the OLS to deal with the exogenous nature of the Lerner index. Similarly, the significance level of the coefficient of capitalization for lower income countries dropped from 1% level to 10%, whereas the level of significance for inflation rose to 5%. For the upper income countries, only credit risk was significant in the main results though not significant in the fixed effects regression.

Overall, the outcomes of the sensitivity analysis are consistent with findings in the available literature, thereby showing that findings of this study using a two stage least square estimator are robust.

4.8 Chapter Summary

The chapter has presented the findings and discussions of these findings in the light of the study objectives set out by the researcher. It began with a descriptive statistics of all the important variables employed by the study to achieve each objective. The initial objective which was to determine the level of banking competition and cost efficiency in SSA's banking industry was achieved by evaluating the Lerner index of market power and the DEA model, respectively. The study found that the Lerner index of market power averaged 56.5% over the study period, suggesting that banks in SSA are less competitive or possess high market power. In terms of the pattern of competition over the study period, generally, competition improved during the period 2008 to 2010 and worsened there on. It was also observed that banks in SSA over the study period were 63.2% cost efficient, wasting 36.8% of their costs relative to the "best practice"

banks. It ranged from 36.6% in Mali to 91.7% in Mozambique. Cost efficiency was also found to have declined remarkably from 2008 to 2010 and the trend reversed upwards thereafter.

To achieve the second objective, which was to determine the relationship between banking competition and cost efficiency, a two-stage least square (2SLS) method was employed. The study found evidence that competition negatively affects cost efficiency in SSA.

In determining whether the effects of competition on bank cost efficiency depend on a country's income level or not, Eq (3.11) was estimated for each country income group. The findings show that competition is harmful to cost efficiency in low- and lower- middle income countries, but has no significant effect on cost efficiency in upper-middle income nations. These results were robust to the fixed effects estimator.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This is the final chapter of the thesis. The aim of this chapter is to conclude the study and present a summary of the findings. It also aims at providing recommendations to policy makers and future researchers.

5.2 Summary of Findings

5.2.1 Bank Competition and Cost Efficiency

The first objective of this study was to determine the degree of competition and the level of cost efficiency in the SSA banking sector. To achieve the first part of this objective, the study relied on the Lerner index as a measure of competition. The overall average Lerner index for the banking sector of the countries included in the study was 0.565 over the period 2006-2012, implying that the intermediation activities of banks in SSA are exercised under non-competitive conditions. In addition, this suggests that banks in SSA have the unlimited ability to charge their products and services over the marginal cost of offering such products and services to their clients. This indirectly explains why banks in the region are most profitable. In terms of the pattern of market power during the sample period, the results reveal that competition improved from 2008 to 2010 and thereafter worsened towards the end of 2012. This suggests that the arrival of cross-border banking groups, the continuous financial sector reforms and deregulation activities pursued by various countries in the sample, which aimed at stimulating competition among banks, have, to some extent, yielded positive results.

To attain the second aspect of the study's objective, the DEA was employed to estimate cost efficiency of SSA banks. The study found empirical evidence that the SSA banking sector is operating under low cost efficiency, with cost efficiency averaging 63.2% over the 2006-2012 period. It was further disclosed that even though bank cost efficiency was not stable over the years of the study, little improvement in bank efficiency was experienced especially towards the latter years of this study. It can, therefore, be inferred that the continuous financial reforms and the deregulation only helped to fortify competition amongst banks in SSA but contributed very little in improving cost efficiency, signifying that more efforts need to be committed towards increasing the cost efficiency of banks in SSA since fierce competition could cause crisis in the banking sector. The study found that Mozambique and Mali have the highest and lowest cost efficiency respectively among the banking sector of the countries under study.

The study found amongst other things that cost efficiency levels differ significantly in the banking sector of low-middle, lower-middle and upper-middle income countries in SSA. It was also observed that the banking sector of the low-middle income nations was the least cost efficient followed by the banking sector of the upper-middle income nations whilst the lower-middle income nations banking sector tops all.

5.2.3 Relationship between Competition and Cost Efficiency

The second objective of the study was to determine the connection between competition and cost efficiency in the SSA banking sector. To accomplish this objective, a 2SLS method was employed to solve the endogeneity issue between competition and cost efficiency. Since the core interest of the study was to determine the real effects of competition on bank cost efficiency, a

number of control variables, including bank size, capitalisation, market share, credit risk, asset growth, inflation rate and GDP per capita growth that mostly affect cost efficiency were introduced into the model. The regression results provided evidence that there is a positive and significant link between cost efficiency and market power of banks, suggesting that competition is harmful to cost efficiency. The positive influence of market power on banks' cost efficiency did not change when the study assessed the direct impact of market power alone on cost efficiency and when bank specific factors and macroeconomic factors were controlled. This signifies that banks with a high level of competition in SSA are inefficient relative to those that have high market power. The finding supports the Information Hypothesis in contrast to the Quiet Life Hypothesis. Thus, the empirical evidence indicates that more market power does not permit bank managers in Sub-Saharan Africa to enjoy a quiet life with no motivation to increase cost efficiency as proposed by the Quiet Life Hypothesis.

With reference to the control variables, starting with the bank specific variables, the study found that the coefficient of bank size is positive. This, however, but does not explain cost efficiency in the SSA banking industry. This implies that large banks in SSA do not benefit from cost savings relative small banks. On the other hand, market shares have a negative and significant effect on cost efficiency. This shows that banks with more market shares are less cost efficient. The evidence in this study shows that bank capitalisation is a key factor of cost efficiency in the SSA banking sector. Moreover, this study has observed that credit risk is negative and significantly explains the variability of bank cost efficiency. This means that as banks in SSA increase their lending activities, their exposure to risks is also increased and this is harmful to cost efficiency.

Concerning asset growth and its quadratic term, it was observed that both variables do not matter for cost efficiency improvement in the SSA banking sector.

With regard to the macroeconomic factors, the results have shown that the coefficient of inflation rate is positive and statistically significant, denoting that during inflationary periods banks in SSA are able to increase their cost efficiency. This is because banks can anticipate periods of inflation and make provision to compensate the anticipated revenue shortfall during heightened inflation era. Regarding per capita GDP growth, it was found that the coefficient is positive and significant, implying that as per capita GDP growth rate rises, banks' cost efficiency also increases.

5.2.4 Effects of Competition on Bank Cost Efficiency by Country Income Group

The last objective of this research was to ascertain whether competition affects cost efficiency differently across different country income groups (i.e. low-, lower- and upper-middle income countries). The regression was conducted using a 2SLS estimator by splitting the sampled countries into their income classification in accordance with the World Bank criteria for grouping countries. The results indicate that competition is harmful to cost efficiency in both low-middle and lower-middle income countries, while competition is not significant in influencing cost efficiency of banks in upper-middle income countries in SSA.

With regard to the control variables, the study found that bank size depicts a negatively statistically significant association with cost efficiency in lower-middle income nations. However, the opposite is true for upper-middle income nations. Alternatively, bank size does not

explain cost efficiency in low-middle income nations. Bank market share indicates negative relationship with cost efficiency in upper- and low-middle income nations, implying a trade-off between increase in market share and cost efficiency improvement. Nevertheless, the coefficient of market share is negative but insignificant in lower-middle income countries. The coefficient of bank capitalisation is negative and insignificant in lower- and upper-middle income countries but positive and insignificant in low-middle income countries. This points to the fact that capitalization does not explain cost efficiency in these countries' income group. Credit risk has an insignificant negative relationship with cost efficiency in lower income countries but is significantly negatively related with cost efficiency in low and upper income countries. Asset growth was found not to explain the changes in cost efficiency in all three income groups. The coefficient of inflation rate with the negative sign was reported in low and upper income countries. The reverse is true for lower-middle income countries. Finally, the study observed that GDP per capita growth boosts cost efficiency among all the three income groups.

5.3 Contributions of the Study

This study has contributed immensely to the literature on banking competition and efficiency, especially, in SSA. To begin with, previous studies on the link between competition and efficiency often combine few SSA countries with other developed countries or consider just a region which provides a limited view on the issue despite its important policy implications. This study is believed to be the first cross-country study that provides empirical proof regarding the effects of competition on cost efficiency that is devoted to the SSA banking sector employing a big sample of 235 banks from 17 nations. In effect, this study provides a clear and broad perspective on this association in SSA banking sector.

Also, for the first time in SSA, this study has classified the nations in the study's sample into low-middle income, lower-middle income and upper-middle income countries in order to assess separately the relationship between cost efficiency and competition for each country's income group and to know which country income group has the most cost-efficient banking market and the one lagging behind. The analysis has indicated that competition is harmful to cost efficiency in low-middle and lower-middle income nations, while it has no effects on cost efficiency in upper-middle income countries. As far as it can be ascertained, this finding is new in the banking competition and cost efficiency literature. The analysis of the results further shows that banks in the low-middle income group are the least cost efficient followed by banks in the lower-middle income group and then those in upper-middle income group. These interesting findings should provide direction for policymakers in crafting and framing strategies aimed at raising the cost efficiency levels in the various classifications of countries by income in SSA.

In addition to the above, the results of this study discard the Quiet Life Hypothesis, which has been neglected in the context of SSA banking sector. It provides additional evidence that SSA banks with market power do not trade their monopoly rent for inefficiency. The policy challenge of this is that it has the tendency to worsen consumer welfare.

Finally, Koetter, Kolari and Sperdijk (2012) report that studies that do not use the adjusted-Lerner index to investigate the competition-cost efficiency nexus always find support for the Quiet Life Hypothesis. This study nullifies those concerns as the Quiet Life Hypothesis is rejected even though the study uses the conventional Lerner index to study the impact of competition on cost efficiency in the SSA banking sector. This marks an important innovation in

the banking literature of SSA as it assures researchers in the banking and academic fraternity of the flexibility of using either measures for further studies on the competition-efficiency relationships

5.4 Conclusions

Inspired by the quest to examine the level of banking competition and cost efficiency following the continuous financial reforms and other emerging issues in the SSA banking sector and the competition-efficiency nexus, this study sought to evaluate the effects that competition in the SSA banking sector has on cost efficiency. The study also evaluated how competition affects cost efficiency of banks in the various income classifications of countries in SSA (i.e. low-middle, lower-middle and upper-middle income countries). As a result of the endogeneity issue between competition and cost efficiency, a two stage least square method was employed to examine the data of Sub-Saharan African banks during the period 2006-2012. Consequently, the following observations were made: competition and cost efficiency levels in the SSA banking system is low and has been unstable over the study period, although they have improved marginally over the study period. There was also evidence of significant variations in cost efficiency of banks operating in the different income groups of countries in SSA. Higher market power of banks in SSA banking industry improves cost efficiency and, thus, it does not permit bank managers in SSA to enjoy a Quiet Life with no motivation to increase cost efficiency.

With reference to the control variables, starting with the bank specific variables, the study found that the coefficient of bank size is positive but does not significantly explain bank cost efficiency in the SSA banking industry. The coefficient of market share is negative and significantly

influence cost efficiency. The evidence in this study indicates that bank capitalisation is an important determinant of cost efficiency in the SSA banking sector. Credit risk is negative and significantly explains the variability of bank cost efficiency. Concerning asset growth and its quadratic term, it was observed that both variables do not matter for cost efficiency improvement in the SSA banking sector. With regard to the macroeconomic factors, the results have shown that the coefficient of inflation rate is positive and statistically significant. Per capita GDP growth was found to be positive and significant, implying that as per capita GDP growth rate rises banks cost efficiency also increases.

Regarding how competition affects cost efficiency of banks in the various income classification of countries in SSA, the findings have revealed that competition is harmful to cost efficiency in low- and lower-middle income countries. However, it has no effect on cost efficiency in upper-middle income countries. The control variables in the various income groups of countries also exhibited different effects on cost efficiency in terms of significance and sign of coefficient. This suggests varied policy prescriptions.

5.5 Policy Recommendations

Certainly, the results of this research have serious policy consequences. Regulators and policy makers over the past 20 years have undoubtedly embraced the idea that paving the way for a high market power against a high competition in the financial markets as whole and the banking industry in particular is detrimental for efficiency of the banking institution. This is because it may build high monopoly power and its associated consequence of reducing innovation and deteriorating consumer welfare. Nevertheless, the results of this study have provided a new

thought that policies enhancing banks in SSA to have certain degree of market power may well be essential to guaranteeing cost efficiency. Therefore, policy makers should exercise restraint in designing, formulating and implementing policies that will lead to a complete removal of the market power of banks. Indeed, it is true to some extent that giving banks too much pricing power is associated with larger profits to the disadvantage of the other sectors of economy. This, however, puts policy makers in a dilemma and it certainly needs to be controlled. In this case, it seems policy actions aimed at minimising bank market power moderately would be a step in the right direction.

Undeniably, the fact that the overall average of the Lerner index for the SSA banking sector is 0.563 implies that banks' core business of providing financial intermediation services is relatively expensive. This has the tendency to affect investment as investors would be deterred by the high price (interest rate) which consequently slows down economic growth. One way to raise competition in the SSA banking industry is for policy makers to put in measures that will ensure that bank customers easily switch from one bank to another without any hindrance. There are, however, costs associated with switching from one bank to the other. Therefore, if the cost of switching (e.g. amount needed to end your account with a bank) is high then the possibility of a new bank to get customers to increase its market shares becomes difficult and vice-versa (Barry, 2010). This means that switching cost serves as a stumbling block for bank customers to leave one bank to another bank to enjoy new products. So, policy makers should take the over side responsibility to ensure that banks justify high cost of switching. Policy makers can also clear all entry barriers to allow foreign banks to participate in the financial markets.

While competition stifles cost efficiency in low- and lower-middle income nations, the findings show that competition does not affect cost efficiency in upper-middle income nations. The findings in low- and lower-middle income countries suggest that policies that favour market power of banks can be used to enhance cost efficiency in the banking industry of these countries' income groups but at the expense of lower banking prices. In view of the trade-off from the negative effect of competition on cost efficiency, this study recommends that policy makers maintain a balance on procompetitive policies and policies favouring market power of banks so as to ensure reduced banking prices and minimize losses from lesser cost efficiency resulting from fierce competition. On the other hand, upper-middle income countries' banking sector may not endure the opportunity cost emanating from the adverse effects of competition on cost efficiency as witnessed in low- and lower-middle income countries. The implication of this finding is that policies that favour competition may not necessarily influence bank cost efficiency in upper-middle income countries and this therefore requires separate policy formulation.

The inefficiencies observed in SSA banking leaves much to be desired. This study recommends that the leadership in the SSA banking fraternity should step up their internal risk strategies to be able to screen borrowers to remove adverse selection and to monitor borrowers to circumvent the moral hazard as a means to reduce the dire state of non-performing loans in SSA banking industry.

The results indicate that there are differences in the cost efficiency of the banking sector across the different income groups of countries. Therefore, it is suggested that bank management in

SSA should realign their business strategies by leaving areas that have high operational cost with low returns to business lines that can match the risk involved with the associated returns. Furthermore, regulators in the banking sector of these economies should open up their financial markets to foreign banks since these foreign banks usually come with the expertise and technical-know-how. However, this should be exercised with caution as the penetration of foreign banks has the tendency to push indigenous banks out of business and subsequently acquire them to build their monopoly power at the expense of consumer welfare.

5.6 Limitation of the Study and Areas for Further Studies

Although this study has made many serious discoveries and contributions, the study is saddled with some limitations. The lack of data on some important economies posed a serious challenge to the researcher, making him unable to cover all banks in the SSA countries. Future research should attempt to get data on all banks in SSA countries for the analysis to attain a clear direction of the relationship between cost efficiency and competition so that the findings can generally be used for policy prescriptions. In addition, this research used the DEA and the Lerner index methodology to gauge cost efficiency and competition, respectively. Future work should also endeavour to use the Stochastic Frontier Approach and the Boone indicator for cost efficiency and competition respectively to support these results.

The banking literature suggests that there is an endogeneity between cost efficiency and competition but the few studies that have examined the competition-efficiency nexus in the SSA banking sector have not focused on investigating whether there is a reverse causality between

cost efficiency and competition. It is recommended that further work be done to test this feedback effect of competition on cost efficiency in the SSA banking industry.

Furthermore, since cost efficiency only considers input inefficiency, future studies can also consider using profit efficiency which considers banks' revenue inefficiencies to investigate the competition-efficiency nexus in the SSA banking sector.

REFERENCES

- Adjei-Frimpong, K. (2013). *Bank efficiency and bank competition: empirical evidence from Ghana's banks industry* (Doctoral dissertation, Lincoln University).
- Adjei-Frimpong, K., & Gan, C., Hu, B. (2014). Cost efficiency of Ghana's banking industry: A panel data analysis.
- Aigner, Lovell, & Schmidt. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics*, 6(1), 21-37.
- Allen, F. & Gale, D. (2000). *Comparing financial systems*. Cambridge, MA: MIT Press.
- Al-Muharrami, S. (2009). The competition and market structure in the Saudi Arabia banking. *Journal of Economic Studies*, 36(5), 446-460.
- Altunbas, Y., Carbo, S., Gardener, E. P., & Molyneux, P. (2007). Examining the relationships between capital, risk and efficiency in European banking. *European Financial Management*, 13(1), 49-70.
- Andrianaivo, M., & C. A. Yartey, (2009). "Understanding the Growth of African Financial Markets." IMF Working Paper, 09/182 (Washington: International Monetary Fund)
- Andrieş, A. M., & Căpraru, B. (2014). The nexus between competition and efficiency: The European banking industries experience. *International Business Review*, 23(3), 566-579.
- Angelini, P., & Cetorelli, N. (2003). The effects of regulatory reform on competition in the banking industry. *Journal of Money, Credit, and Banking*, 35(5), 663-684.
- Ariff, M., & Can L. (2008). Cost and profit efficiency of Chinese banks: A non-parametric analysis. *China Economic Review*, 19(2), 260-273.
- Ariss, R. (2010). On the implications of market power in banking: Evidence from developing countries. *Journal of Banking and Finance*, 34(4), 765-775.
- Ataullah, A., & Le, H. (2006). Economic reforms and bank efficiency in developing countries: the case of the Indian banking industry. *Applied Financial Economics*, 16(9), 653-663. available at: <http://www.bath.ac.uk/management/research/papers.html>
- Avkiran, N. K. (1999). The evidence on efficiency gains: The role of mergers and the benefits to the public. *Journal of banking & finance*, 23(7), 991-1013.
- Bain, J. S. (1956). *Barriers to new competition, their character and consequences in manufacturing industries* (No. HB771 B23).

- Banker, R. D., & Chang, H. (2006). The super-efficiency procedure for outlier identification, not for ranking efficient units. *European Journal of Operational Research*, 175(2), 1311-1320.
- Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management science*, 30(9), 1078-1092.
- Barry, A. (2010). *Switching cost hinder bank competition: NAB*. Retrieved (www.abc.net.au/news).
- Baum, C. F., Schaffer, M. E., & Stillman, S. (2003). Instrumental variables and GMM: Estimation and testing. *Stata journal*, 3(1), 1-31.
- Baumol, W. J., Panzar, J. W., & Willig, R. (1982). RD [1982]: Contestable markets and the theory of industry structure. *San Diego: Hartcourt Brace Janovich*.
- Beck, T., & Cull, R. (2013). *Banking in Africa*. The World Bank.
- Beck, T., Demirguc-Kunt, A., & Levine, R. (2009). Financial institutions and markets across countries and over time. World Bank Policy Research Working Paper No. 4943.
- Benston, G. (1965). Branch banking and economies of scale. *Journal of Finance*, 20, 312-33.
- Berg, S. A., & Kim, M. (1994). Oligopolistic interdependence and the structure of production in banking: an empirical evaluation. *Journal of Money, Credit and Banking*, 26(2), 309-322.
- Berger, A. N. (1995). The profit-structure relationship in banking-tests of market-power and efficient-structure hypotheses. *Journal of Money, Credit and Banking*, 27(2), 404-431.
- Berger, A. N., & DeYoung, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking & Finance*, 21(6), 849-870.
- Berger, A. N., & Hannan, T. H. (1998). The efficiency cost of market power in the banking industry: A test of the "Quiet Life" and related hypotheses. *The Review of Economics and Statistics*, 80(3), 454-465.
- Berger, A. N., & Humphrey, D. B. (1992). Measurement and efficiency issues in commercial banking. In *Output measurement in the service sectors* (pp. 245-300). University of Chicago Press.
- Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: International survey and directions for future research. *European Journal of Operational Research*, 98(2), 175-212.
- Berger, A. N., Klapper, L. F., & Turk-Ariss, R. (2009). Bank Competition and Financial Stability. *Journal of Financial Services Research*, 99-118
- Berger, A. N., & Mester, L. J. (1997). Inside the black box: What explains differences in the efficiencies of financial institutions? *Journal of Banking & Finance*, 21(7), 895-947.

- Berger, A. N., Hanweck, G. A., & Humphrey, D. B. (1987). Competitive viability in banking: Scale, scope, and product mix economies. *Journal of Monetary Economics*, 20(3), 501-520.
- Berger, A. N., Hanweck, G. A., & Humphrey, D. B. (1987). Competitive viability in banking scale, scope and product mix economies. *Journal of Monetary Economics*, 20, 501-520.
- Berger, A. N., Hunter, W. C., & Timme, S. G. (1993). The efficiency of financial institutions: A review and preview of research past, present and future. *Journal of Banking & Finance*, 17(2), 221-249.
- Berger. (1993). "Distribution-free" estimates of efficiency in the U.S. banking industry and tests of the standard distributional assumptions. *Journal of Productivity Analysis*, 4(3), 31
- Bertoletti, P., & Poletti, C. (1996). A note on endogenous firm efficiency in Cournot models of incomplete information. *Journal of Economic Theory*, 71(1), 303-310.
- Besanko, D., & Thakor, A. (1993). Response to " A Note on the Nonexistence of a Rationing Equilibrium in the Besanko-Thakor Model." *International Economic Review*, 34(3), 739-740.
- Bikker, J. A., & Groeneveld, J. M. (1998). *Competition and concentration in the EU banking industry* (pp. 1-31). De Nederlandsche Bank NV.
- Bikker, J. A., & Haaf, K. (2002). Competition, concentration and their relationship: An empirical analysis of the banking industry. *Journal of Banking & Finance*, 26(11), 2191-2214.
- Bokpin, G. A. (2013). Ownership structure, corporate governance and bank efficiency: an empirical analysis of panel data from the banking industry in Ghana. *Corporate Governance: The international journal of business in society*, 13(3), 274-287.
- Bokpin, G. A. (2016). Bank governance, regulation and risk-taking in Ghana. *Journal of African Business*, 17(1), 52-68.
- Bonaccorsi di Patti & Hardy D. C.(2005). Financial sector liberalization, bank privatization, and efficiency: Evidence from Pakistan. *Journal of Banking & Finance*, 29(8-9), 2381-2406.
- Bonin, J. P., Hasan, I., & Wachtel, P. (2005). Bank performance, efficiency and ownership in transition countries. *Journal of banking & finance*, 29(1), 31-53.
- Boone, J. (2008). A New Way to Measure Competition. *The Economic Journal*, 118(531), 1245-1261.
- Bos, J. W., Heid, F., Koetter, M., Kolari, J. W., & Kool, C. J. (2005). Inefficient or just different? Effects of heterogeneity on bank efficiency scores. *Effects of Heterogeneity on Bank Efficiency Scores*.

- Brissimis, N.S., Delis, M.D, Papanikolaou, N. I. (2008). Exploring the nexus between banking sector reform and performance: evidence from newly acceded EU countries. *Journal of Banking and Finance*, 32 (2008), pp. 2674-2683.
- Broome, A. (2010). The International Monetary Fund, crisis management and the credit crunch. *Australian Journal of International Affairs*, 64(1), 37-54.
- Brownbridge, M., Harvey, C. & Gockel, A. F. (1998). *Banking in Africa: The Impact Of Financial Sector Reform Since Independence*, James Currey Publishers, oxford.
- Bulow, J., & Klemperer, P. (2002). Prices and the Winner's Curse. *RAND journal of Economics*, 1-21.
- Camanho, A. S., & Dyson, R. G. (2008). A generalisation of the Farrell cost efficiency measure applicable to non-fully competitive settings. *Omega*, 36(1), 147-162.
- Carbó, S., Humphrey, D., Maudos, J., & Molyneux, P. (2009). Cross-country comparisons of competition and pricing power in European banking. *Journal of International Money and Finance*, 28(1), 115–134.
- Casu, B., & Girardone, C. (2006). Bank competition, concentration and efficiency in the single European market. *The Manchester School* 74(4), 441–468.
- Casu, B., & Girardone, C. (2009). Testing the relationship between competition and efficiency in banking: A panel data analysis. *Economics Letters*, 105(1), 134-137.
- Casu, B., & Girardone, C. (2009). Testing the relationship between competition and efficiency in banking: A panel data analysis. *Economics Letters*, 105(1), 134-137.
- Casu, B., & Molyneux, P. (2003). A comparative study of efficiency in European banking. *Applied Economics*, 35(17), 1865-1876.
- Cavallo, L., & Rossi, S. P. (2002). Do environmental variables affect the performance and technical efficiency of the European banking systems? A parametric analysis using the stochastic frontier approach. *The European Journal of Finance*, 8(1), 123-146.
- Chang, T. C., & Chiu, Y. H. (2006). Affecting factors on risk-adjusted efficiency in Taiwan's banking industry. *Contemporary Economic Policy*, 24(4), 634-648
- Charnes, A., & Cooper, W. W. (1962). Programming with linear fractional functionals. *Naval Research logistics quarterly*, 9(3-4), 181-186.
- Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European journal of operational research*, 2(6), 429-444.
- Cihák, M., & Podpiera, R. (2005). Bank behavior in developing countries: *Evidence from East Africa* (No. 2005-2129). International Monetary Fund.
- Clerides, S., Delis, M. D., & Kokas, S. (2015). A new data set on competition in national banking markets. *Financial Markets, Institutions & Instruments*, 24(2-3), 267-311.

- Coccorese, P., & Pellecchia, A. (2010). Testing the 'quiet life' hypothesis in the Italian banking industry. *Economic Notes*, 39(3), 173-202.
- Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An introduction to efficiency and productivity analysis*. Springer Science & Business Media.
- Cooper, W. W., Seiford, L. M., & Tone, K. (2007). A comprehensive text with models, applications, references and DEA-solver software. *Springer Science+ Business Media*.
- Creswell, J. W. (2013). *Educational research: Planning, conducting, and evaluating*. W. Ross MacDonald School Resource Services Library.
- Cummins, J. D., & Weiss, M. A. (1993). Measuring cost efficiency in the property-liability insurance industry. *Journal of Banking & Finance*, 17(2), 463-481.
- Das, A., & Ghosh, S. (2006). Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period. *Review of Financial Economics*, 15(3), 193-221.
- De Bandt, O., & Davis, E. P. (2000). Competition, contestability and market structure in European banking sectors on the eve of EMU. *Journal of Banking & Finance*, 24(6), 1045-1066.
- Debreu, G. (1951). The Coefficient of Resource Utilization. *Econometrica*, 19(3), 273-292.
- Degryse, H., Kim, M., & Ongena, S. (2009). *Microeconometrics of banking: methods, applications, and results*. Oxford University Press, USA.
- Delis, M. D. (2012). Bank competition, financial reform, and institutions: The importance of being developed. *Journal of Development Economics*, 97(2), 450-465.
- Delis, M. D., & Pagoulatos, G. (2009). Bank competition, institutional strength and financial reforms in Central and Eastern Europe and EU. *MPRA Paper No. 16494* Delis,
- Delis, M. D., & Tsionas, E. G. (2009). The joint estimation of bank-level market power and efficiency. *Journal of Banking & Finance*, 33(10), 1842-1850.
- Demsetz, H. (1973). Industry structure, market rivalry, and public policy. *Journal of Law and economics*, 16(1), 1-9.
- Deprins, Simar, & Tulkens. (1984). Measuring labor-efficiency in post offices. In M. Marchand, P. Pestieau & H. Tulkens (Eds.), *The Performance of public enterprises - Concepts and Measurement* (pp. 243-267). Amsterdam, North-Holland: Springer US.
- Dietrich A. and Wanzenried G. (2014), The determinants of commercial banking profitability in low-,middle-, and high-income countries. *The Quarterly Review of Economics and Finance*, 54(1) 337-354.
- Dietrich, A., & Wanzenried, G. (2011). Determinants of bank profitability before and during the crisis: Evidence from Switzerland. *Journal of International Financial Markets, Institutions and Money*, 21(3), 307-32.

- Dietrich, A., & Wanzenried, G. (2014). The determinants of commercial banking profitability in low-, middle-, and high-income countries. *The Quarterly Review of Economics and Finance*, 54(3), 337–354.
- Doan A., Lin K. & Doong S. (2017). What drives bank efficiency? The interaction of bank income diversification and ownership, *Journal of International Review of Economics and Finance*, 1-17.
- Drake, L. (2001). Efficiency and productivity change in UK banking. *Applied Financial Economics*, 11(5), 557-571.
- Dyson, R. G., Allen, R., Camanho, A. S., Podinovski, V. V., Sarrico, C. S., & Shale, E. A. (2001). Pitfalls and protocols in DEA. *European Journal of operational research*, 132(2), 245-259.
- Edirisuriya, P., Gunasekarage, A. & Dempsey M., (2015). Bank diversification, performance and stock market response: Evidence from listed public banks in South Asian countries. *Journal of Asian Economics* 41 69–85.
- Eldomiaty, T.I. (2007), Determinants of corporate capital structure: evidence from an emerging economy, *International Journal of Commerce and Management*, 17(1/2), 25-43.
- EIB. (2013). Banking in sub-Saharan Africa: Challenges and Opportunities: European Investment Bank.
- Elyasiani, & Mehdiian. (1990). Efficiency in the commercial banking industry, a production.
- Eling, M., & Luhnén, M. (2010). Efficiency in the international insurance industry: A cross-country comparison. *Journal of Banking & Finance*, 34(7), 1497-1509.
- Evanoff, D. D., & Fortier, D. L. (1988). Reevaluation of the structure-conduct-performance paradigm in banking. *Journal of Financial Services Research*, 1(3), 277-294.
- Färe, R., Grosskopf, S., & Lovell, C. K. (1985). The measurement of efficiency of production. Kluwer-Nijhoff Publishing, Boston.
- Färe, R., Grosskopf, S., Maudos, J., Tortosa-Ausina, E., (2015). Revisiting the quiet life hypothesis in banking using nonparametric techniques. *Journal of Business Economics and Management* 16 (1): 159-187.
- Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society. Series A (General)*, 253-290.
- Ferrier, G. D., & Valdmanis, V. (1996). Rural hospital performance and its correlates. *Journal of Productivity Analysis*, 7(1), 63-80.
- Fischer, S. (2005). IMF essays from a time of crisis: the international financial system, stabilization, and development. *MIT Press Books*, 1.
- Førsund, F. R., & Sarafoglou, N. (2002). On the origins of data envelopment analysis. *Journal of Productivity Analysis*, 17(1-2), 23-40.

- Fosu, S. (2013). Capital structure, product market competition and firm performance: Evidence from South Africa. *The quarterly review of economics and finance*, 53(2), 140-151.
- Fowowe, B. (2013). Financial Liberalisation in Sub-Saharan Africa: What do we know? *Journal of Economic Surveys*, 27(1), 1–37.
- Fried, H. O., Lovell, C. K., Schmidt, S. S., & Schmidt, S. S. (Eds.). (2008). *The measurement of productive efficiency and productivity growth*. Oxford University Press.
- Fries, S., & Taci, A. (2005). Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries. *Journal of Banking & Finance*, 29(1), 55-81.
- Fries, S., & Taci, A. (2005).). Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries. *Journal of Banking & Finance*, 29(1), 55-81.
- Fu, X., & Heffernan, S. (2005). Cost X-efficiency in China's banking sector *Cass Business School Working Papers WP-FF-14-2005*.
- Fungáčová, Z., Pessarossi, P., & Weill, L. (2013). Is bank competition detrimental to efficiency? Evidence from China. *China Economic Review*, 27, 121-134.
- Girardone, C., & Casu, B. (2007). Does Competition Lead to Efficiency: The Case of EU Commercial Banks.
- Girardone, C., Molyneux, P., & Gardener, E. P. (2004). Analysing the determinants of bank efficiency: the case of Italian banks. *Applied Economics*, 36(3), 215-227.
- Goddard, J., Molyneux, P., Wilson, J.O.S., & Tavakoli, M. (2007). European banking: an overview. *Journal of Banking and Finance*, 31, pp. 1911-1935.
- Goddard, J. A., Molyneux, P., & Wilson, J. O. S. (2001). *European Banking: Efficiency, Technology and Growth*. John Wiley & Sons.
- Ghosh, A. (2015). Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states. *Journal of Financial Stability*, 20, 93-104.
- Grigorian, D., & Manole, V. (2002). Determinants of commercial banks performance in transition: An application of data envelopment analysis.
- Guru, B. K., Staunton, J., & Balashanmugam, B. (2002). Determinants of commercial bank profitability in Malaysia. *Journal of Money, Credit, and Banking*, 17, 69-82.
- Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate Data Analysis* (6th ed.). New Jersey: Pearson Prentice Hall.
- Hall, M. J., & Simper, R. (2013). Efficiency and competition in Korean banking. *Applied Financial Economics*, 23(10), 881-890.
- Hao, J., Hunter W. C., & Yang W. K (2001). "Deregulation and efficiency: the case of private Korean banks." *Journal of Economics and Business*, 53(2) 237-254.

- Hauner, D., & Peiris, S. (2005). Bank efficiency and competition in low-income countries: the case of Uganda.
- Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the Econometric Society*, 1251-1271.
- Hermes, N., & Nhung, V. T. H. (2010). The impact of financial liberalization on bank efficiency: evidence from Latin America and Asia. *Applied Economics*, 42(26), 3351-3365.
- Hicks, J. R. (1935). Annual Survey of Economic Theory: The Theory of Monopoly, *Econometrica*, 3(1), 1-120.
- Ho, T. S., & Saunders, A. (1981). The determinants of bank interest margins: theory and empirical evidence. *Journal of Financial and Quantitative analysis*, 16(4), 581-600.
- Hollingsworth, B., & Parkin, D. (1998). Developing efficiency measures for use in the NHS. *Health Economics Group: A report to the NHS Executive Northern & Yorkshire R&D Directorate. Newcastle.*
- Homma, T., Tsutsui, Y., & Uchida, H. (2014). Firm growth and efficiency in the banking industry: A new test of the efficient structure hypothesis. *Journal of Banking & Finance*, 40, 143-153.
- Honohan, P., & Beck, T. (2007). Making finance work for Africa. The World Bank.
- Hughes, & Mester. (1993). A quality and risk-adjusted cost function for banks: Evidence on the “too-big-to-fail” doctrine. *Journal of Productivity Analysis*, 4(3), 293-315. *Industrial Economics*, 35, 443-456.
- IMF (2013). Banking in Sub-Saharan Africa. The Macroeconomic Context.
- Isik, I., & Hassan, M. K. (2002). Technical, scale and allocative efficiencies of Turkish banking industry. *Journal of Banking & Finance*, 26(4), 719-766.
- Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of financial economics*, 3(4), 305-360.
- Kablan, S. (2010). *Banking efficiency and financial development in Sub-Saharan Africa* (No. 10-136). International Monetary Fund.
- Kader, H. A., Adams, M., Hardwick, P., & Kwon, W. J. (2014). Cost efficiency and board composition under different takaful insurance business models. *International Review of Financial Analysis*, 32, 60-70.
- Karim, M. Z. A., Chan, S. G., & Hassan, S. (2010). Bank efficiency and non-performing loans: Evidence from Malaysia and Singapore. *Prague Economic Papers*, 2(2010), 118-132.
- Kasman, A., & Turgutlu, E. (2009). Cost efficiency and scale economies in the Turkish insurance industry. *Applied Economics*, 41(24), 3151-3159.
- Keeley, M. C. (1990). Deposit insurance, risk, and market power in banking. *The American Economic Review*, 1183-1200.

- Kiyota, H., (2009). “Efficiency of commercial banks in Sub-Saharan Africa: a comparative analysis of domestic and foreign banks”, Asian Development Bank Institute.
- Koetter, M., Kolari, J. W., & Spierdijk, L. (2012). Enjoying the quiet life under deregulation? Evidence from adjusted Lerner indices for US banks. *Review of Economics and Statistics*, 94(2), 462-480.
- Koetter, M., Kolari, J., & Spierdijk, L. (2008, February). Efficient competition? Testing the quiet life of US banks with adjusted Lerner indices. In *Proceedings 44th Bank Structure and Competition Conference, Federal Reserve Bank of Chicago* (pp. 234-252).
- Koopmans, T. C. (1951). Efficient Allocation of Resources, *Econometrica*, 12(10), 455-465.
- Kouki I. and Al-nasser A. (2017), The implication of banking competition: Evidence from African countries. *Journal of Research in International Business and Finance*, 39 (1), 878-895.
- Kosmidou, K., Pasiouras, F., Tsaklanganos, A., (2007). Domestic and multinational determinants of foreign bank profits: The case of Greek banks operating abroad. *Journal of Multinational Financial Management* 17(1), 1-15.
- Kumbhakar, S. C., & Lovell, C. K. (2003). *Stochastic frontier analysis*. Cambridge University Press
- Kwan, S., & Eisenbeis, R. A. (1997). Bank risk, capitalization, and operating efficiency. *Journal of financial services research*, 12(2-3), 117-131.
- Laeven, L., & Levine, R. (2007). Is there a diversification discount in financial conglomerates? *Journal of Financial Economics*, 85(2), 331-367.
- Leibenstein, H. (1966). Allocative Efficiency versus “X-Efficiency”. *American Economic Review*, 56(3), 392-415.
- Leon, F. (2014). *Bank competition in Africa: three essays* (Doctoral dissertation, Université d'Auvergne-Clermont-Ferrand I).
- Leon, F. (2015). What do we know about the role of bank competition in Africa ? What do we know about the role of bank competition in Africa ?
- Léon, F. (2016). Does the expansion of regional cross-border banks affect competition in Africa? Indirect evidence. *Research in International Business and Finance*, 37, 66–77.
- Lensink R., Meesters A. & Naaborg I. (2008). Bank efficiency and foreign ownership: Do good institutions matter? *Journal of banking & finance*, 32, 834-44.
- Lerner, A. P. (1934). The concept of monopoly and the measurement of monopoly power.
- Levine, R. (2005). Finance and Growth: Theory and evidence. In Aghion Philippe, & Steven N. Durlauf (Eds.), *Handbook of economic growth* (pp. 865-934). Amsterdam: Elsevier.

- Louzis D. P, Vouldis A. T, and Metaxas V. L. (2012). Macroeconomic and Bank-Specific Determinants of Non-performing Loans in Greece: A Comparative Study of Mortgage, Business and Consumer Loan Portfolios. *Journal of Banking & Finance*, 36(4), 1012-1027
- Luo. (2003). Evaluating the profitability and marketability efficiency of large banks: An application of data envelopment analysis. *Journal of Business Research*, 56(8), 627-635.
- Mamatzakis, E., Staikouras, C., & Koutsomanoli-Fillipaki, N. (2005). Competition and concentration in the banking sector of the South Eastern European region. *Emerging Markets Review*, 6(2), 192-209.
- Martin, S. (1996). R & D joint ventures and tacit product market collusion. *European Journal of Political Economy*, 11(4), 733-741.
- Marquez, R. (200). Competition, adverse selection and information dispersion in the banking industry. *Review of Financial Studies*, 15(3): 901.
- Mason, E. S. (1939). Price and production policies of large-scale enterprise. *The American Economic Review*, 29(1), 61-74.
- Mathisen, M. J., & Buchs, T. D. (2005). *Competition and efficiency in banking: Behavioral evidence from Ghana* (No. 5-17). International Monetary Fund.
- Mathieson, D. J., & Roldos, J. (2001). Foreign banks in emerging markets. *Open doors: Foreign participation in financial systems in developing countries*, 15-55.
- Maudos, J., & de Guevara, J. F. (2007). The cost of market power in banking: Social welfare loss vs. cost inefficiency. *Journal of Banking & Finance*, 31(7), 2103-2125.
- Maudos, J., & Pastor, J. M. (2003). Cost and profit efficiency in the Spanish banking sector (1985–1996): a non-parametric approach. *Applied Financial Economics*, 13(1), 1-12.
- Maudos, J., & Nagore, A. (2005). *Explaining market power differences in banking: a cross-country study*. Instituto Valenciano de Investigaciones Económicas.
- McDonald, C., & Schumacher, L. (2007). “Financial Deepening in Sub-Saharan Africa: Empirical Evidence on the Role of Creditor Rights Protection and Information Sharing.” IMF Working Paper, 07/203(Washington: International Monetary Fund).
- Mlambo, K., & Ncube, M. (2011). Competition and efficiency in the banking sector in South Africa 2 . A brief review of the literature, 23(1), 4–15.
- Mirzaei A. & Moore T. (2014), What are the driving forces of bank competition across different income groups of countries? *Journal of International Financial Markets, Institutions & Money* 32(1), 38-71.

- Mokhtar, H. S. A., Abdullah, N., & Al-Habshi, S. M. (2006). Efficiency of Islamic banking in Malaysia: A stochastic frontier approach. *Journal of Economic Cooperation*, 27(2), 37-70.
- Molyneux, P., Lloyd-Williams, D. M., & Thornton, J. (1994).). Competitive conditions in European banking. *Journal of Banking & Finance*, 18(3), 445-459.
- Molyneux, P. and M. Iqbal, 2005. *Banking and Financial Systems in the Arab World*, Palgrave Macmillan, New York, USA.
- Moyo, J., Nandwa, B., Council, D. E., Oduor, J., & Simpasa, A. (2014). Financial sector reforms, competition and banking system stability in Sub-Saharan Africa. *New perspectives*.
- Mukherjee, K., Ray, S. C., & Miller, S. M. (2001). Productivity growth in large US commercial banks: The initial post-deregulation experience. *Journal of Banking and Finance* 25, 913-939.
- Mwega, F. (2011). The competitiveness and efficiency of the financial services sector in africa: A case study of kenya. *African Development Review*, 23(1), 44-59.
- Mugume, A. (2007, July). Market structure and performance in Uganda's banking industry. Paper presented to the African Econometrics Society. Cape Town.
- Nahm, & Vu. (2013). Profit Efficiency and Productivity of Vietnamese Banks: A New Index Approach. *Journal of Applied Finance & Banking*, 3(1), 45-65.
- Ncube, M. (2009). Efficiency of the banking sector in South Africa. University of the Witwatersrand, 1-44.
- Ohene-Asare, K. (2011). *Nonparametric efficiency and productivity change measurement of banks with corporate social responsibilities: the case for Ghana* (Doctoral dissertation, University of Warwick).
- Oluitan, R. (2014). Bank efficiency in Africa. *The Journal of Developing Areas*, 48(2), 205-221. *Operational Research* 145, 301–319.
- Panzar, J. C., & Rosse, J. N. (1987) Testing for monopoly equilibrium. *The Journal of Industrial Economics*, 35, 443-456.
- Park, K. H. (2009). Has bank consolidation in Korea lessened competition?. *The Quarterly Review of Economics and Finance*, 49(2), 651-667.
- Pasiouras, F. (2008). Estimating the technical and scale efficiency of Greek commercial banks: the impact of credit risk, off- balance sheet activities, and international operations. . *Research in International Business Finance*, 22(3), 301–318.
- Pasiouras, F. & Kosmidou, K. (2007). Factors influencing the profitability of domestic and foreign commercial banks in the European Union. *Research in International Business and Finance*, 21 (2), 222-237.

- Pasiouras, F., Sifodaskalakis, E., & Zopounidis, C. (2007). C. (2007). Estimating and analysing the cost efficiency of Greek cooperative banks: an application of two-stage data envelopment analysis. *Working Paper, School of Management, University of Bath*, available at: <http://www.bath.ac.uk/management/research/papers.html>.
- Patti, E. B., & Hardy, D. C. (2005). Financial sector liberalization, bank privatization, and efficiency: Evidence from Pakistan. *Journal of Banking & Finance*, 29(8), 2381-2406.
- Petersen, M. A., & Rajan, R. G. (1995). The effect of credit market competition on lending relationships. *The Quarterly Journal of Economics*, 110(2), 407-443.
- Poshakwale, S. S., & Qian, B. (2011). Competitiveness and efficiency of the banking sector and economic growth in Egypt. *African development review*, 23(1), 99-120.
- Pruteanu-Podpiera, A., Schobert, F. & Weill L. (2008): Banking Competition and Cost Efficiency: A Micro-Data Analysis on the Czech Banking Industry, *Comparative Economic Studies*, 50(2), 253-273.
- Reinhart, C. M., & Rogoff, K. S., (2009). The aftermath of the financial crisis. *American Economic Review*, 99(2), 466-72.
- Resti, A. (1997). Evaluating the cost-efficiency of the Italian banking system: What can be Retrieved(www.abc.net.au/news).
- Saab, S. Y., & Vacher, J. (2007). Banking Sector Integration and Competition in CEMAC. IMF Working Paper WP/07/3. International Monetary Fund.
- Sahoo, B. K., Mehdiloozad, M., & Tone, K. (2014). Cost, revenue and profit efficiency measurement in DEA: A directional distance function approach. *European Journal of Operational Research*, 237(3), 921-931.
- Sathye, M. (2003). Efficiency of banks in a developing economy: The case of India. *European Journal of Operational Research*, 148(3), 662-67.
- Schaeck, K., & Čihák, M. (2008). How does competition affect efficiency and soundness in banking? New empirical evidence.
- Schaeck, K., & Čihák, M. (2010). Competition, efficiency, and soundness in banking: An industrial organization perspective.
- Sealey, C. W., & Lindley, J. T. (1977). Inputs, outputs, and a theory of production and cost at depository financial institutions. *The Journal of Finance*, 32(4), 1251-1266.
- Seelanatha, L. (2010). Market structure, efficiency and performance of banking industry in Sri Lanka. *Banks and Bank Systems*, 5(1), 20-31.
- Senbet, L. & Otchere, I. (2005). 'Financial Sector Reforms in Africa: Perspectives on Issues and Policies', Annual World Bank Conference on Development Economics, Dakar, Senegal.
- Shaffer, S. (2004). Patterns of competition in banking. *Journal of Economics and Business*, 56(4), 287-313.

- Sherman, H. D., & Zhu, J. (2006). Benchmarking with quality-adjusted DEA (Q-DEA) to seek lower-cost high-quality service: Evidence from a U.S. bank application *Annals of Operational Research* 145, 301–319.
- Smith, A. C., Koper, N., Francis, C. M., & Fahrig, L. (2009). Confronting collinearity: comparing methods for disentangling the effects of habitat loss and fragmentation. *Landscape ecology*, 24(10), 1271.
- Soteriou, A. C., & Zenios, S. A. (1999). Using data envelopment analysis for costing bank products. *European Journal of Operational Research*, 114(2), 234-248.
- Staiger, D. and J. H. Stock (1997). Instrumental variables regression with weak instruments. *Econometrica* 65(3): 557-86.
- Staub, R. B., e Souza, G. D. S., & Tabak, B. M. (2010). Evolution of bank efficiency in Brazil: A DEA approach. *European journal of operational research*, 202(1), 204-213.
- Stiglitz, J. E. (1989). Principal and agent. In *Allocation, information and markets* (pp. 241-253). Palgrave Macmillan, London.
- Stock, J. and Yogo, M. (2005). Testing for weak instruments in IV regression. In *Identification and Inference for Econometric Models: A Festschrift in Honour of Thomas Rothenberg.*, P.80-108. Cambridge Univ. press.
- Sufian, F., & Habibullah, M. S. (2012). Globalizations and bank performance in China. *Research in International Business and Finance*, 26(2), 221–239.
- Sun, P. H. Mohamad, S. & Ariff, M., (2017). Determinants driving bank performance: A comparison of two types of banks in the OIC," *Pacific-Basin Finance. Journal*, Elsevier, vol. 42(C), pages 193-203.
- Taiwan's banking industry. *Contemporary Economic Policy*, 24(4), 634-648.
- Tan, Y., & Floros, C. (2012). Bank profitability and inflation: the case of China. *Journal of Economic Studies*, 39(6), 675-696.
- Tecles, P. L., & Tabak, B. M. (2010). Determinants of bank efficiency: The case of Brazil. *European Journal of Operational Research*, 207(3), 1587-1598.
- Thanassoulis, E., Boussofiane, A., & Dyson, R. G. (1996). A comparison of data envelopment analysis and ratio analysis as tools for performance assessment. *Omega*, 24(3), 229-244.
- Tregenna, F. (2009). The fat years: the structure and profitability of the U. S banking sector in the pre-crisis period. *Cambridge Journal of Economics*, 33(4), 609-632.
- Vives X. (2001). Competition in the Changing World of Banking. *Oxford Review of Economic Policy*, 17 (4), 535 – 547.
- Wansbeek, T., & Bekker, P. (1996). On IV, GMM and ML in a dynamic panel data model. *Economics Letters*, 51(2), 145-152.

- Weill, L. (2003). Banking efficiency in transition economies: The role of foreign ownership. *Economics of transition*, 11(3), 569-592.
- Weill, L. (2004). On the relationship between competition and efficiency in the EU banking sectors. *Kredit und Kapital*, 329-352.
- Wooldridge, J. M. (2013). Introductory econometrics: a modern approach 5th edition. *Mason, OH: South-Western*.
- Xiaogang, C., Skully, M., & Brown, K. (2005). Banking efficiency in China: Application of DEA to pre-and post-deregulation eras: 1993–2000. *China Economic Review*, 16(3), 229-245.
- Yildirim, C. (2002). Evolution of banking efficiency within an unstable macroeconomic environment: the case of Turkish commercial banks. *Applied Economics*, 34(18), 2289-2301.
- Yildirim, H., & Philippatos, G. C. (2007). Efficiency of banks: recent evidence from the transition economies of Europe, 1993–2000. *European Journal of Finance*, 13(2), 123-143.
- Zainal, N. S., & Ismail, M. (2010). Concept and Measurement of Efficiency: A Review. *Voice of Academia*, 5(1), 17-26.

APPENDICES

Appendix A: Model Diagnostic Test

Breusch and Pagan	chibar2(01) = 522.65
	Prob > chibar2 = 0.0000
Hausman $(b-B)'[(V_b-V_B)^{-1}](b-B)$	chi2(18) 73.72
	Prob>chi2 0.0000

Source: Research data.

Appendix B: Estimation of translog cost function

VARIABLES	Dependent variable: Total cost
lny	0.9041*** (0.0399)
lny2	0.0081 (0.0068)
lnw1	0.7141*** (0.0488)
lnw2	0.2075*** (0.0422)
lnw12	0.0545*** (0.0156)
lnw22	-0.0194* (0.0109)
lnylnw1	0.0058 (0.0091)
lnylnw2	0.0036 (0.0074)
lnw1lnw2	-0.0298*** (0.0103)
t	0.0355** (0.0166)
t2	-0.0059* (0.0035)
tlny	-0.0019 (0.0020)
inflation	-0.0941 (0.0696)
gdppc	-0.0000*** (0.0000)
equityta	-0.0035*** (0.0008)
Constant	1.4070*** (0.1545)
Observations	1,073
Number of id	235
R ²	0.81

Standard errors are reported in brackets while ***, ** and * denote significance level at 1%, 5% and 10% accordingly.

Appendix C: Tukey's multiple comparisons of means 95% family-wise confidence level

INCOME GROUP	difference	lwr	upr	p-value
LRMIC-LMIC	0.167	0.052	0.281	0.004
UMIC-LMIC	0.142	0.028	0.256	0.013
UMIC-LRMIC	-0.024	-0.139	0.089	0.847

Source: Author's Calculation.

Appendix D: Variance Inflation Factor

Variable	Lerner	Bsize	MS	lngdppc	Cap	Infl	Ag	Ag2	Crk	Mean VIF
VIF	1.07	2.13	1.74	1.58	1.29	1.21	1.15	1.13	1.11	1.38
1/VIF	0.931	0.468	0.573	0.632	0.773	0.828	0.867	0.882	0.902	

Source: Author's Calculation.

Appendix E: Regression results with OLS fixed effects model

	All Countries	Low income Countries(1)	LOWER income Countries(2)	Upper income Countries(3)
Dependent variable:	Coefficient	Coefficient	Coefficient	Coefficient
Cost efficiency				
Measure of competition:				
Lerner index	0.0040*** (0.0010)	0.0172*** (0.0500)	0.0232*** (0.0011)	0.0030 (0.0048)
Bank specific variables:				
Bsize	0.000 (6.000)	-0.0014 (0.0011)	-0.0006*** (0.0002)	0.0002*** (0.0000)
market share	-0.0510*** (0.0031)	-0.0034 (0.0040)	-0.0000 (0.0015)	-0.0312** (0.0157)
capitalisation	-0.0052** (0.0018)	0.0004 (0.0028)	-0.0087* (0.0052)	-0.0019 (0.0023)
credit risk	-0.0663** 0.0219	-0.072* (0.0367)	-0.0027 (0.029)	-0.0546 (0.0873)
Asset growth	-0.0090 (0.0105)	0.002 (0.0207)	0.006 (0.0047)	-0.0017 (0.0016)
Asset growth square	-0.0264 (0.0817)	-0.0005 (0.0001)	0.001 (0.0371)	-0.00090 (0.0012)
Macroeconomic variables:				
inflation rate	0.0007 (0.0012)	-0.0002 (0.0012)	0.008** (0.0041)	-0.0143*** (0.0044)
lngdppc	0.0019*** (0.0001)	0.0801*** (0.0084)	0.0002** (0.0001)	0.0038*** (0.0013)
constant	-0.0020** (0.0008)	-0.0225 (0.088)	0.1321*** (0.0073)	0.1649*** (0.0024)
No. of observation	1030	420	367	242
No. of banks	235	97	86	52
R-Square	0.61	0.117	0.372	0.678
F-Test model χ^2	12.64***	7.57***	8.03***	17.40***

Source: Author's Calculation. Standard errors are reported in parentheses, where the ***, ** and * represent significance level at 1%, 5% and 10% accordingly.