EFFECTS OF NON-PERFORMING LOANS ON TECHNICAL EFFICIENCY OF COMMERCIAL BANKS IN KENYA

FRANKLINE KIANYAGA ABUGA

A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMETRICS AND STATISTICS IN THE SCHOOL OF ECONOMICS IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER IN ECONOMICS (ECONOMETRICS) OF KENYATTA UNIVERSITY

MAY, 2022

DECLARATION

This project is my original work and has not been presented for a degree in any other university or any other award.

.

Signature: ……. Date……...

Frankline Kianyaga Abuga

(B. Econ & Stat, KU)

K102/38652/2017

I confirm that the work reported in this project was carried out by the candidate under my supervision.

Signature …… Date ……

Dr. Susan M. Okeri (PhD)

Senior Lecturer

Department of Economics and Statistics

School of Economics

Kenyatta University

DEDICATION

I dedicate this project to my parents- Richard Abuga and Colleta Abuga.

ACKNOWLEDGEMENTS

To God be the glory for His constant direction and provision of resources that enabled a smooth sail in my postgraduate studies, as well as getting this far.

Moreover, I would like to pour out my heart to thank my parents who emotionally, financially, physically and spiritually were with me during my studies. Thank you very much for believing in me and putting your money into my future. My siblings, classmates, and friends, I appreciate your advice and support.

Further, my heartily gratitude goes to Dr. Okeri for her enduring, constant and purposed supervision and leadership during the period of this research. I'd like to thank Dr. Njuguna, Dr. Diana, and Dr. Muniu for their valuable contributions to the comprehension and development of this project.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CBK	Central Bank of Kenya
CRB	Credit Reference Bureau
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
GOK	Government of Kenya
NPLs	Non-Performing Loans
TE	Technical Efficiency
SFA	Stochastic Frontier Analysis

DEFINATION OF TERMS

Commercial Banks: are financial institutions that are authorized to accept deposits and provide loans.

Data Envelopment Analysis: a non-parametric efficiency measuring methodology.

Financial Liberalization: This is the lessening or abolishment of government restrictions and regulations in the financial markets.

Financial Reforms: The process of enhancing efficiency and effectiveness of the financial organization by giving confidence to clients, ensuring stability and improving allocative efficiency.

Non-performing loans: these are credit advances that are un-serviced in more than 90 days.

Technical efficiency: the potential of a firm to optimize the yield for a certain amount of input.

ABSTRACT

With the formation of very large banks and increased interbank connectivity, the 1992 financial sector reforms resulted in a shift in market power. They also improved the banking sector's resilience and sustainability. The reforms aimed at doing away with regulatory and structured issues hindering efficiency of the sector. However, the increasing trend of Non-performing loans since 2008 as well as the commercial banks' decline in profitability since 2014, has been a cause of alarm and distress to customers and stakeholders. Although there exists an authority to monitor the operation of banks still their operations are sub-optimal. To improve operations of banks and create assurance to customers and stakeholders this study investigated the role of non-performing loans on technical efficiency of commercial banks in Kenya. The research was motivated by the enormous evidence that the Kenyan financial system is dominated by the banking sphere but little is known about efficiency statistics and determinants of efficiency scores. The study used Data Envelopment Analysis to measure efficiency scores in Kenya's 26 commercial banks; 9 in tier 1, 7 in tier 2, and 10 in tier 3, that existed over the study period (2014-2019); inputs as well as outputs variables were selected depending on the intermediation roles performed by banks. The variables were split into inputs and outputs. The income (a linear combination of non-interest income and interest income) was treated as output. The inputs were non-interest expenditure, equity capital and interest expenditure. The results revealed that there was inefficiency across all the banking categories. Tier one banks operated at 79.5 percent efficiency scores, tier 2 at 78.4 percent and tier 3 at 68.8 percent level. Tobit regression was utilized to examine the impacts of Non-performing loans on the technical efficiency of commercial banks in Kenya. The study regressed Non-performing loans, total loan to total assets ratio, total assets, equity to total assets ratio, and non-interest expenses to total assets ratio on technical efficiency level obtained in the first part. The findings indicated that Non-performing loans have -0.00000000262 effect on technical efficiency of the commercial banks, however the effect is not significant. This study concluded that if the commercial banks need to keep improving their efficiency indices, they need to minimize their non-performing loans by implementing the following recommendations; investing heavily on loan recovery a customer credit score monitoring, relying on private credit collection agencies, that look to solve disputes and seek to refer accounts to the credit reference bureau. This will avoid pilling of non-performing loans on the financial statement of commercial banks and other long term legal process such as court cases.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Banking can be termed as the economic activity of taking and safeguarding money belonging to other businesses and individuals, as well as lending it out for profit (Asmare, 2014). Banks are financial entities that facilitate the withdrawal and deposit of funds from the general public, as well as the provision of loans and advances for investment and other purposes. Adrian & Shin (2010) refers banks as financial intermediaries whose assets are loans to customers and businesses and whose liabilities are short term deposits.

Banks perform roles that include; accepting deposits from the general public, taking deposits in form of current deposits, fixed deposits and savings, provide loans and advances to entrepreneurs and business entities primarily to make profits: They also, provide credit cash; when banks provide loans or cash, they provide it in liquid cash, that's by opening and transferring money to customers' accounts. In the process they create money; They facilitate buying and selling of securities. They have locker facilities where customers store valuables and documents. According to Gabriel et al. (2019), the general function of banks is lending and borrowing, that is, transfer of funds from areas of surplus units to areas of deficit. Commercial banks' performance should be rigorously monitored in order to protect a country's interests. They are major economic growth drivers since they give financial services to citizens. Bank profitability translates to financial stability, which leads to economic affluence and stability (Ganic, 2014).

According to Sealey and Lindley (1977), banks' functions can be classified into two major approaches. First, the production viewpoint which gives an assumption that banks are service

providers to their account holders. They process documents such as advance and loan documents and conduct deposit account transactions. “Second, the intermediation approach, where the banks act as financial intermediaries, obtaining money from savers and converting it into loans to others in order to make profit” (Chu & Lim, 1998). In this approach, financial institutions buy materials, labor, and deposits to make loans and investments.

Neither of the above approaches is perfect because they do not wholly capture the two functions of any institution of finance, that is, financial intermediation and transaction provision. The production approach is best suited for analysis of bank branches because they process customer documents on behalf of the bank as a whole. In banking literature, the intermediation approach is commonly used (Flannery, Kwan & Nimalendran, 2013). The approach incorporates a view of the whole banking sector and it includes variables such as interest expenses (income to depositors) that account for two-thirds of the total cost (Gabriel et al., 2019).

1.1.1 Non-Performing Loans

Within the financial sector, banks take a lion share in the financial intermediation role; they greatly contribute to mobilization of investible resources. Loan assets dominate commercial banks' investible assets, accounting for approximately 55 percent to 75 percent of total assets. They expose banks to significant credit risks, which determine financial institution’s performance. The higher the exposure to credit risk, the more likely that bank will face financial difficulties (Al-Wesabi & Ahmad, 2013).

Loans become non-performing loans when they have more than 90 days and the repayment of the principal amount and interest have not been made. Banks are in trouble with non-performing loans. Originally Non-performing loans didn’t seem to have adverse effect on banks as they

remain liquid, assuring depositors (Njue, 2020). When banks are allowed to accumulate interest on Non-performing loans, then the scope of this problem expands.

Non-performing loans impact the feasibility and constancy of the banking sphere. They impact negatively on the pecuniary intermediation purpose of banks, which directly impacts on the main income generating channel of banks. The impact is passed to the financial dependability of the general economy (Alshebmi, et al., 2020). They have adverse and direct effect on the profit gain due to deliveries banks are required to record, therefore they affect the production performance of commercial banks (Ezeoha, 2011). Financial distress and poor bank in an economy, are solely associated with erratic changes in levels of loans that are deemed as non-performing (Otwori, 2013).

Non-performing loans put little pressure on revenue of effective banks as it does not drive them into making uncertain credit offering, but unproductive banks fall to problems due Non-performing loans. The rise in non-performing loans is a sign of a lack of credible credit policy (Muluwork, 2016). Incompetent management will suggest poor control on credit worth of clients and operating costs which will be accompanied with large credit loss. The bad administration hypothesis states that managers with poor skills, lack the capability to effectively estimate and regulate risks, when lending to new customers (Njihia, 2005).

1.1.2 Efficiency Assumption

In all businesses, efficiency is a general indicator of performance. Efficiency, according to Jurkonyte-Dumbliouskiene (2016), “can be defined as the maximum potential output-input ratio in the manufacturing procedure”. Allocative as well as technical efficiency are the two main types of efficiency considered.

Allocation efficiency is a firm's potential to utilize inputs optimally given their prices and productive technology. It is supported by microeconomic theory and its significant in many instances, however, when estimating allocative efficiency for banks one requires; the labour contracts which are often incomplete, the production function which normally is unknown or unspecified and the input prices despite the fact that not all inputs are marketed and if marketed they are not available in equal terms to all buyers (Kereta, 2007).

On the other hand, technical efficiency according to Farrell (1951), is the radian contraction of inputs given output and technology (input orientation) or radian augmentation of outputs given input and technology (output orientation). It is a managerial efficiency because the managers control the inputs and outputs. It is critical in tracking the growth process.

According to Chi, Kilduff & Gargeya (2009), firms are homogenous and some are more efficient than others. Those operating at the technological frontier earn high profits while others are barely able to survive. Efficiency enables banks to be more resilient to shocks, hence, significantly and positively affecting growth, bank efficiency ease credit constraints and enhances the growth of other economic sectors during crisis (Diallo, 2018). The financial sector's efficiency and economic growth are critical to the country's long-term growth (Zakaria et al., 2019).

1.1.3 Non-Performing Loans and Efficiency

When banks list loans that need to be collected, they incur additional costs from performing the non-value adding activity. The activities include being cautious on collateral value, tracking the monetary value of the debtor among other activities such as renegotiating the repayment (Ezeoha, 2011). According to Mwangi (2012), if management ignores the problem of asset quality, the costs are likely to increase in future hence deteriorating the efficiency of banks.

Hughes and Simpson (1993), as well as Berger and DeYoung (1997), show a linkage in Non-performing loans and efficiency. According to Hughes and Simpson (1993), banks fail to monitor and screen borrowers, which in the short-run lowers operating costs. However, in the long-run it results in higher non-performing loans which require more monitoring efforts that call for higher monitoring costs.

According to Berger and DeYoung (1997), bad-luck or external factors beyond the borrower's control can result in non-performing loans, leading to additional costs in the financial institution. The added costs are due to increased monitoring, contract renegotiation, and managers' efforts to reduce loan losses.

According to financial institution research, there is a positive linkage of operating costs and loans that are deemed as non-performing. Kwan and Eisenbeis (1995) investigated inefficiency of US banks using stochastic frontier analysis in relation to NPLs. The study found out that inefficient banks have higher non-performing loans. Efficiency has been a topic of discussion not because high costs endanger the financial sector's sustainability (Cull et al., 2009), but because high interest rates limit banks' potential to benefit their clientele, particularly the poor (Mersland and Strom, 2010).

1.1.4 Kenyan Commercial Banks

The central bank act, the Companies Act, the Banking Act, and other provident policies govern banking in Kenya. All commercial banks are regulated by central bank of Kenya. It articulates monetary policies and controls key elements such as solvency, liquidity and proper functioning of banks (CBK, 2019). The commercial banks have banded together to form the Kenya Bankers Association, which represents the interests of banks and the issues that their members face (KBA, 2012).

By 2021, there are 42 commercial banking institutions in Kenya, some being locally owned while others are foreign. They are grouped into tiers, a bank is classified under a certain tier using the weighted composed index, the index comprised of net assets, clientele capital, deposits as well as reserves, number of loaned accounts and number of deposit accounts. According to CBK (2019), a banking institution with 5 percent or more weighted composed index is classified into a tier 1 bank; large bank, the one whose weighted composed index lies between 1 and 5 percent is a tier 2 bank (medium bank) and one whose index is less than 1 percent is classified into tier 3 (small bank).

After the implementation of financial amendments in 1992, the banking sphere underwent significant policy and operational changes. The Kenyan banking sector has experienced numerous changes with 28mergers in the 1990s, 10 in the 2000s, 3 in the 2010s and 12 acquisitions in 2000s, 6 in 2010s. Consolidations occurred in all banking sector spheres, including tier 1, tier 2, and tier 3. Banks' profitability, asset quality, efficiency, and capitalization were expected to improve as a result of the consolidation. The amendments were also expected to trigger creation of strong banks that compete with lots of effectiveness among themselves, leading to the lowering of costs of products and services offered to customers (CBK, 2019).

Due to competition, new innovations, and product diversification for different market segments due to technological advancement the sector has experienced monumental expansion within the East-African region. Since there is increased utilization of information and communication technologies in the banking industry, there has been improved services' delivery and effected customer care services. With intensive use of ATMs, some banks have branch interconnections that enable branchless banking and E-banking. It is evident from reduced queues in banking facilities (CBK, 2018).

The banking sector contributes 7.7 percent (Bloom et al., 2018) to Kenya's gross domestic product providing over 1.5 million employment opportunity. Over the study period, commercial banks were able to increase the number of customer deposits, profitability, and loan books. However, the number of banks has not changed significantly, with 43 commercial banks in 2013 and 42 in 2019 (CBK, 2019). Several banks have been placed in receivership over the course of the period, including Dubai Bank on 14 August 2015, Imperior Bank Limited on 13 October 2015, as well as Chase Bank Limited on 7 April 2014.

Despite the growth and improvement in profitability, commercial banks continue to post a declining Returns on Assets (ROA). The pretax profit grew by 16.6 percent in 2013 from 2012. Over the period, the returns on assets were 4.7 percent (CBK, 2013). In 2014, pretax profit grew by 12.2 percent to Ksh. 141.1 billion from 125.8 billion in 2013.ROA declined to 4.5 percent (CBK, 2014). In 2015 the sector registered a decline in both pretax and ROA. The pretax declined by 5.03 percent to Ksh 134 billion from 141 billion the previous year, and ROA declined to 4.0 percent (CBK, 2015). In 2016, commercial banks registered a 10.91 percent growth in pretax profit to Ksh 147.4 billion, and Returns on Assets remained at 4.0 percent (CBK, 2016). In 2017, pretax profit declined by 9.6 percent to Ksh 133.2 billion at the period ROA declined to 3.4 percent (CBK, 2017).in 2018, banks experienced a 14.64 percent growth in pretax profits to Ksh 157.7 billion and slight growth in ROA to 3.5 percent (CBK, 2018). In 2019, pretax profit increased by 4.2 percent to Ksh 159 billion, and ROA declined to 3.3 percent (CBK, 2019).

Customer deposits over the study period grew by 82.4 percent; the growth is anticipated to the mobilization of deposits through Mobile Money and agent banking platforms. In 2013, the stakes grew by 13.34 percent to Ksh 1.935 trillion from 2012. In 2014, they grew by 18.42 percent to

stand at Ksh 2.681 trillion in 2016 (CBK, 2016). In 2017, they grew by 11 percent to Ksh 2.9 trillion; in 2018, they increased to Ksh 3.26 trillion, a 12.41 percent growth, and in 2019 they expanded to Ksh 3.53 trillion, an 8.26 percent growth (CBK, 2019).

In 2013, the net loans and advances for commercial banks stood at Ksh 1532.4 billion; a 12.75 percent increase grew the numbers to Ksh 1.881 trillion in 2014. At 2015, the loans and advances stood at Ksh. 2.091 trillion representing a 11.02 percent growth (CBK, 2015). The following year (2016) grew to Ksh 2.182 trillion a 4.36 percent (CBK, 2016). In 2017, the loans declined by 5 percent to Ksh 2.16 trillion (CBK, 2017). In 2018, the loans and advances grew by 3.07 percent to Ksh 2.49 trillion, and in 2019 they grew by 8.8 percent to Ksh 2.707 trillion (CBK, 2019).

Despite the growth in pretax profits, net loans and advances, and customer deposits, commercial banks' loan book quality has been declining. The sector is characterized with high interest rate spread, bank failures, high level of non-performing assets and low lending rates. Over the study period, non-Performing loans have been increasing. The non-performing loans condemn banks to risks of non-collection of funds advanced to borrowers.

In the first half of 2012, the high interest rate had a detrimental influence on loan and advance quality. The non-performing loans grew by 16.8 percent in 2012 from the previous year (CBK, 2012). During the year, the proportion of gross nonperforming loans to gross loans and advances hit 4.7 percent, up from 4.4 percent in 2011. (CBK, 2012).

Non-performing loans increased to Ksh 81.9 billion in 2013, bringing the gross NPLs to gross loans ratio to 5.2 percent. The non-performing loans grew to Ksh 108 billion in 2014, making the ratio of non-performing loans to gross loans 5.6 percent (CBK, 2014). As in 2015, NPLs grew to

Ksh 147.3 billion, growing the proportion of non-performing loans to gross loans to 6.8 percent. Due to the challenging business environment, delayed payments in the public and private sectors, and poor weather, the ratio of gross non-performing loans increased to 9.3 percent, putting non-performing loans at Ksh. 214.3 billion (CBK, 2016). In 2017, non-performing loans grew by 23.4 percent to stand at Ksh 264.6 billion, increasing the non-performing loans ratio to 12.3 percent (CBK, 2017).

In 2018, the challenging business environment and delayed payments grew Non-performing loans by 19.6 percent to Ksh 316.7 billion. During the same time period, the gross Non-performing loans to gross loans ratio was 12.7 percent. In the following year, non-performing loans increased by 6.3 percent to Ksh 335.9 billion, representing a 12.5 percent gross Non-performing loans ratio to gross loans, an improvement due to payment of pending bills and recovery efforts made by banks (CBK, 2019). To lessen the number of non-performing loans in 2013 there was introduction of Credit Reference Bureau (CBK, 2013).

1.2 Statement of the Research Problem

Banks are vital in any economy because they help channel resources from net savers to net spenders, they are used by the CBK to implement monetary policies, they act as trustees at the request of their customers, and they undertake investment projects. Since banks play a critical role in economic development and stabilization, they must be productive enough to ensure profitability and growth in order to carry out their roles effectively.

The Kenya vision 2030 provides gradualist reforms that have transform the banking sector to have few strong large banks, enact the credit reference bureau, and stabilizing the financial system and will keep transforming the sector. The transformations are expected to improve efficiency in the financial sector. Banks efficiency implies the development in profitability and

increased funding channels to provide better prices and service quality to customers, increased protection to improve the capital buffer and absorb financial institutions risks. The Kenya banking service efficiency is important as the banking sector is undergoing major structural changes in line with the development era.

Loans account for the majority of bank's outputs; however, lending entails risks. There is a risk that loans will not perform and thus, be deemed as nonperforming loans (Chang and Chiu, 2006). Non-performing loans in Kenya's commercial banks have been increasing since 2012. Non-performing loans had an increment of about Kshs.20 billion in 2013 from the previous year's Kshs. 61.9 billion. A record high of Kshs.147.3 billion was recorded in 2015 as compared to Kshs. 108 billion in 2014. The challenging business environment and delayed payment grew the NPLs to Ksh 214.3 billion 4.6 billion in 2017, Ksh 316.7 billion in 2018 and Ksh 335.9 billion in 2019. The upsurge in the number of non-performing loans led to an increment in the proportion of gross non-performing loans to total loans by about 8 percent in the period 2012-2019. The government established the credit reference bureau (CRB) in response to the rising number of NPLs. The CRB is supposed to provide a framework for borrowers' credit information exchange between commercial banks, SACCOs, Microfinance banks, and other credit providers licensed by the Kenyan central bank (CBK, 2020). Over the same period, the sectors profitability has been declining, measured in terms of returns on assets from 4.5 percent 2013 to 3.3 percent in 2020.

Non-performing loans are an unintended consequence of loan production. When credit advances are deemed as non-performing, they pose a risk on the banks' stability and also efficiency. Therefore, posing a threat to the following policy actions, the vision aims at revamping the financial sector. The actions include; raising the general saving rate from 17% to 30% of GDP,

increasing financial inclusion by reducing the population that cannot assess finance to about 20%, undertaking reforms that will transform the many small banks into few strong large banks and introduce institutional and legal reforms which would enhance transparency in transactions.

Early studies; Kiemo & Kamau (2020) on banking sector competition and intermediation efficiency. Macharia (2012) inquired into the influence of bank-specific characteristics on conduct and performance of financial organizations. The study took taken into account factors such as ownership, loan loss provisioning, bank strategy, and capital. Non-performing credit advances are one of the items that impact on a bank's growth and stability (Messai and Jouini, 2013).

In spite of the potential linkage of non-performing loans to banking efficiency (Barros et al., 2012), there is little research on this area compared to other spheres of the sector. This very research tries to bridge the gap by doing an inquisition into the influence of Non-performing loans on the technical efficiency of the commercial banking institutions in Kenya.

1.3 Research Questions

i. What level of technical efficiency do Commercial banks in Kenya operate in?
ii. What is the effect of non-performing loans on the technical efficiency level of the commercial banks in Kenya?

1.4 Objectives of the Study

To estimate the effects of non-performing loans on technical efficiency of commercial banks in Kenya. The specific objectives are:

i. To determine technical efficiency level of commercial banks in Kenya.
ii. To ascertain the effects of non-performing loans on the technical efficiency level of commercial banks in Kenya.

1.5 Significance of this Research

Efficiency refers to the employment of fewer resources whilst producing excellent results in terms of yield. The study is important to bank managers and supervisors in scheduling resources adequately to maximize outputs. Non-performing loans are by-products of loans; therefore, this study gives managers insights on the adverse effects in the overall spheres of banks.

1.6 Scope of this Research

The study assessed the efficiency scores of Kenyan commercial banking institutions then enquire the impact of non-performing loans on these efficiency scores. The period under study is 2014-2019, chosen as a result of policy changes in the sector during this period. Panel data was collected from 26 commercial banks that were operational over the study period. The sample size of 26 commercial banks is sufficient enough to yield credible results that can be generalized for the entire sector.

The data did not constitute all commercial banks since some banks lack information for the entire study period for example Jamii bora bank, Middle east bank of Kenya, Giro and Guaranty trust bank. Other banks including Chase bank Limited, Dubai bank limited and Imperior bank limited became insolvent and bankrupt. Other banks have secured their data for example M-oriented bank, Citibank and Habib bank A.G. While others have been absorbed while others are under acquisition.

1.7 limitations of the Study

As at 2020, there are 42 commercial banks operating in Kenya the study will analyze 26 of them, due to lack of data for some banks and, some banks have been placed under receivership since 2014 therefore, not included in the study.

1.8 Organization of the Study

There are five chapters in this project. The study was introduced in the first chapter. The second chapter explored the subject's theoretical and empirical literature. The third chapter tackled issues of model specification and estimation strategies that was used in the statistical analysis. Chapter four presents the study's findings and chapter gives the summary, conclusions and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

In this section, both theoretical and empirical analysis of the literature on technical efficiency as well as nonperforming loans are examined. Theoretical literature will be discussed in sub-section 2.2, empirical literature in sub-section 2.3, and a summarized review of the literature in sub-section 2.4 of this chapter.

2.2. Theoretical Literature

Efficiency measurement are discussed broadly in the production theory. The theory puts effort to explain how a business firm makes decisions on how much output to sell, how much produce to make and the number of inputs to employ. Firms are faced with a technological constraint as they maximize the profit objective. In economics, efficiency is how producers use scarce resources to produce economic output maximally. Under the theory of the firm efficiency, we are concerned with the performance of a firm that combines input to produce output. The firm's goal is to maximize profits; however, technological constraints prevent it from utilizing inputs to produce economic outputs. The production function best illustrates the combination of inputs at a given level of technology to produce a given amount of output (Greenlaw et al., 2018).

Non-performing loans do not affect the efficiency of firms directly. Non-performing loans are as a result of external factors. According to In Chesini, In Giaretta, & In Paltrinieri (2017), When banks realize these problematic loans, they incur expenses in trying to deal with them. On the process they may have a lower efficiency or not. The interconnection is discussed in the Bad-Luck hypothesis of Non-performing loans.

2.2.1. The Production Function

It provides a schedule of the highest yield that is produced given a certain combination of inputs and a given level of existing technology. Labour, capital, or other input resources are examples of inputs (factors of production).

Q = f (inputs)……. 2.1

Q = f (K, L, s) …… 2.2

Given that; Q is yield/output of the firm; L is labour force, K is capital and s represent other inputs resources that the firm employs in the production process (Shepherd, 2016).

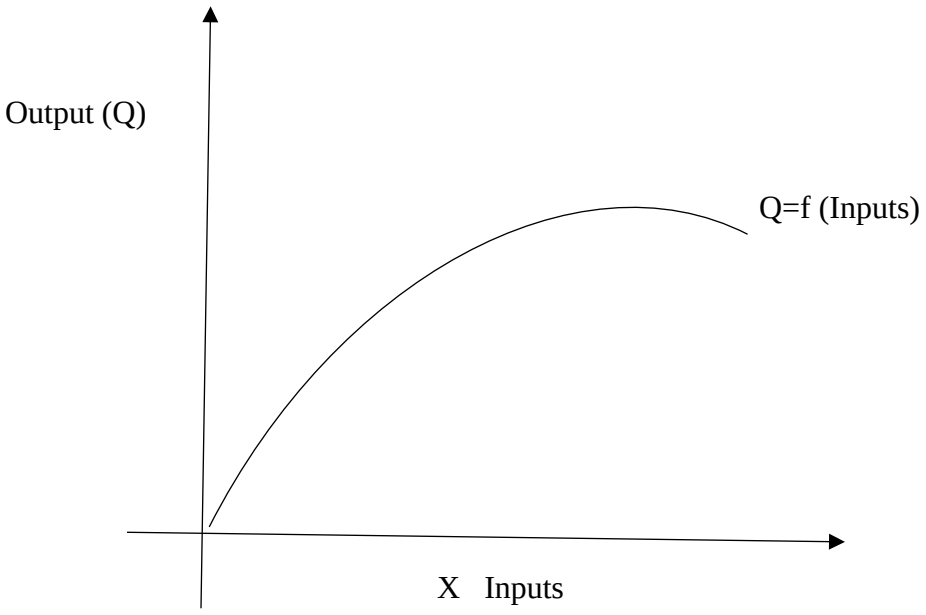

Figure 0.1: The production function

Source*: Varian (2011).*

According to Varian (2019), given an X vector of inputs, Q is the maximum vector of output that can be realized. However, there are other possible sets of output below the curve (Production

possibility set). The firm's goal is to maximize profits, which can be accomplished by increasing the firm's output Q or by lowering production costs. The two strategies depend on how the firm can effectively mix its inputs. Efficiency measurement aims at understanding if the firm give the optimal output given a set of input.

2.2.2. Bad-Luck Hypothesis of Non-Performing Loans

The hypothesis is deducted from the work of Berge and DeYoung (1997). In their argument external events such as closure of plants cause an increase in problematic loans for the banks. When the loan becomes due or non-accruing the bank looks forward to expand managerial efforts and their expenses in order to deal with these problem loans. The move increases the bank's administration expenses. As a result, non-performing loans will lower evaluated efficiency. In theory non-performing loans are associated with extra expenses that may result to a lower efficiency, but that is not necessarily the case. The study regressed non-performing loans and other factors on technical efficiency to justify the theory.

2.2.3. Asymmetric Information Theory

The theory is used mostly where information is flawed, situations whereby the knowhow about something differs between two parties. The theory was deducted from the work of Akerlof 1970 on "the market of lemons". It is the most relevant when evaluating information economics. Information sharing reduces detrimental selection in bank transactions through improved bank information on credit (Qamruzzaman, Karim & Wei 2019).

It is difficult to tell who is a good or bad borrower, the difference in information may lead to detrimental selection or moral hazard problem (Auronen, 2013). In financial transactions borrowing and lending utilizes asymmetric information. Since the borrower knows more about

his financial situation than the lender, they are better positioned or have an upper hand in negotiating a stipulated transaction.

2.3. Empirical Literature

A review of studies on bank efficiency and on the link between non-performing loans and the technical efficiency of commercial banking institutions, are included in this section.

2.3.1. Commercial Banks' Technical Efficiency

Following the financial liberalization of the 1990s, researchers shifted their focus to the efficiency of the finance world. The banking sphere has been the primary focus because it dominates the sector. Numerous studies have yielded inconclusive results.

Drake, Hall & Simper (2006) examined the technical efficiency of Hong Kong's banking institutions from 2000 to 2006. The slack-based measurement methodology was used in the study, and variables were chosen from environmental and market factors. According to the study, Hong Kong banking institutions experienced a downswing in technical efficiency in the year 2001, but regained in the period up until 2006. Both studies apply the non-parametric analysis however they differ in terms of variables selected this study chooses variables on the basis of intermediation approach.

Batchelor and Gerrard (2004) looked into how much technical efficiency as well as technological enhancements triggered production changes in three Singaporean commercial banking entities Between 1997 and 2001. MPI was used in the study on a data set that included labor, total deposits, total loans, and other investments. In terms of TFP, they discovered that the bank's performance improved by 11.7 percent. Technical efficiency remained constant over time. Both

the studies consider loans as variables however other variables differ as well the methodology of analysis differ.

Becks et al. (2010) examined productivity across banks in Kenya in terms of ownership and compared the results with banks from other sub-Saharan African countries and emerging countries. The study found out that Kenya banks are over staffed and the employees are less productive. Secondly state-owned banks have as twice as many employees, assets, loans and deposits as foreign owned banks. The high performance of foreign owned banks was as a result of high wages they paid. Private domestic banks were more staffed and less productive in comparison to foreign owned banks but they were more productive and less staffed than stated owned banks. The disparities across different banks in terms of ownership reflect a significant potential gain from increased competition and can improve efficiency. The current study employs variables other than Becks and Fuchs' no-interest expenses, interest expenses, equity capital, no-interest income, and interest income.

Between 1995 and 2003, Reda and Isik (2006) utilized DEA and MPI to analyze the efficiency and productiveness of Egyptian banks. The study revealed that banking entities were inefficient in terms of technology and that this inefficiency deteriorated with time. Data on labour, capital, loanable money, other earning assets, and off-balance-sheet entities are used in this study, which is unique. The influence of proprietorship structure and strict budget limitations on efficiency of Chinese banking institutions were explored by Yao et al. (2007). Between 1995 and 2001, the SFA studied a dataset of 22 banks and discovered that privately-owned banks were 8 to 18 percent more efficacious than those that the state had greater intervention in. The current study's most noticeable difference is the employment of output-oriented DEA technique.

Kamau (2009) employed the DEA technique to scrutinize the efficiency and productiveness of the banking sphere following liberalization in Kenya. Labour, capital, and deposits formed the study's inputs whereas loans and investments were used in the study as outputs. The enquiry revealed that most banking entities performed fairly well, with the bulk of the scores lying below 40Percent during the study period. Furthermore, foreign owned banks outperformed domestic owned banks, and local private banks outperformed local public banks. Both studies consider loans as output however they differ in that the current study will not categories banks in terms of ownership but in terms of their market share to tiers.

Henriques et al. (2018) evaluated the efficiency levels in the Brazilian banking entities between 2012 and 2016. The study used DEA technique and a 37-bank dataset to select variables using an intermediation approach. The average efficiency of the system was 51.4 percent, according to the study, which was influenced by technological and administrative concerns. The current study differs with the previous ones in that it pays attention to the role of banking entities in intermediation.

Kiemo and Kamau (2020) assessed the efficiency as well as competitiveness in the Kenyan banking industry between 2001 and 2017. In evaluating efficiency, the study used DEA methodology and data variables were selected to represent the production, intermediation and profit approaches of banks. The study established that banks operated at 69 percent on average technical efficiency. The difference is that the current study will evaluate technical efficiency for each tier of commercial bank, analysis at tier level gives a clear picture of each bank as opposed to evaluating all banks generally. Banks are not homogeneous in terms of NPLs (KBA, 2020). Large banks' loan books are growing faster therefore, even if loan defaulters increase the effect

is marginal as compared to small and medium banks with a double-digit ratio of gross NPLs to gross loans (KBA, 2020).

2.3.2. Non-Performing Loans and Technical Efficiency

Many researchers have used the Tobit model to assess if there is an association in variables with a limited dependent variable. In their study, Altumbas et al. (2000) looked into the effectiveness and riskiness of Japanese banking institutions. The study employed the Tobit regression techniques revealed a link between nonperforming loans and banks' inefficiencies.

Fan and Shaffer (2004) looked into the profit efficiency of significant US commercial banks. The study took into account non-performing loans. Non-performing loans indicated to be inversely associated to banks' efficiency, however the association is statistically negligible, according to the data.

In Singapore and Malaysia, Abd Karim et al. (2010) looked into the link in nonperforming loans and bank efficiency. The study employed the Tobit regression model. Non-performing loans yielded a statistically significant negative relationship with bank efficiency. Finally, higher Non-performing loans reduce bank cost efficiency and vice versa.

Boudriga, Taktak and Jellouli (2011) examined the cross-country determinants of non-performing loans and their likely impact on credit risk. The study employed environmental and economic data between 2002-2006 from 59 countries. The study found out that high non-performing loans reduce the loan assets that have severe consequences on financial performance.

Garza-Garcia (2012) analyzed the factors impacting the development and efficiency of Mexican banks between 2001 and 2009. Non-performing loans show a negative and considerable

influence on a bank's efficiency and development, according to the report. The study focused solely on Mexican banks.

Hassan and Wall (2014) investigated the determinants of bank loan loss for some US and Non-Us banks between 2003 to 2010. The determinants included non-performing loans and income before loan provision loss. The study revealed that high amount of non-performing loans is linked with huge loan reserve losses. However other variables included such as net charged off reflected some fundamental factors for US banks are not significant for non-US banks.

From 2005 to 2013, Alshatti (2015) looked into the impact of Non-performing loans ratio on Jordanian commercial banks' financial performance. For the study, 13 banks provided panel data. Credit risk has a positive influence on performance and effectiveness of banking entities in Jordan, according to the research's conclusions. There are many other elements that have no bearing on the profitability as measured by ROA.

Kamau (2015) examined the impact of defaulters listing on commercial banks' non-performing loan levels in Kenya. The study used secondary data considering unemployment, inflation rate, interest rate and bank size as the variables and, it employed multivariate regression analysis. It established an adverse correlation amid listing of loan defaulters and the levels of non-performing loans. Addition to that it realized that inflation lower the quality of Non-performing loans. Both studies considered bank size as a variable however, they differ in terms of methodology employed.

2.4. **Research Gap**

The Production theory puts effort to explain how a business firm makes decisions on how much output to sell, how much produce to make and the number of inputs to employ. Firms are faced

with a technological constraint as they maximize the profit objective. Efficient firms are able to account for all inputs used and they are reflected in their outputs. In terms of banks, they are profitable, stable and resilient to shocks.

Non-performing loans can have a great influence on efficiency, stability and effectiveness of a bank. According to the preceding literature, there are numerous types of literature concerning bank efficiency using various approaches. However, previous studies in Kenya have either examined only commercial bank efficiency or other aspects of banks such as ownership, loan loss provisioning, bank strategy, capital, and so on and their effects on bank performance. In Kenya, the effects of non-performing loans on bank technical efficiency are yet to be assessed.

Secondly, from the preceding literature it is evident that researchers have not agreed is on variables used in estimating efficiency, the current study will choose variables in relation to the intermediation role of banks. Since the approach incorporates the whole banking sector and it includes variables such as interest expenses (income to depositors) that account for two-thirds of the total cost.

The DEA approach was used to analyze technical efficiency because it does not require variable modification, that is, variables are used in their natural physical state. When several inputs are utilized in production of a certain number of yielding, DEA is employed to estimate TE scores (Badri and Mourad, 2013).

While assessing the effects of the non-performing loan ratio on commercial banks' technical efficiency levels. Since, there is lack of theoretical explanation of market related or bank specific characteristics that influence efficiency of banks. This study borrowed from the work of Muda et

al., (2013), “efficiency is influenced by non-performing loan, ratio of total loans to total assets, total assets, ratio of equity to total assets, and ratio of non-interest expenses to total assets.”

As the continuous variable, the bank’s technical efficiency ranged between 0 and 1. As a result, Tobit regression modelling was useful in analyzing the effects of the non-performing loans on technical efficiency.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

The chapter presents the research methodology adopted to evaluate the effects of non-performing loans on technical efficiency of commercial banks in Kenya for the period 2014 to 2019. It also, captures the research design, the theoretical model for the study; data collection and techniques employed to analyze collected data.

3.2. Research Design

The enquiry utilized a non-experimental design with a pooled blueprint, as similar data was collected from 26 commercial banks in Kenya between 2014 and 2019; 9 in tier 1, 7 in tier 2, and 10 in tier 3. Data envelopment analysis will be used to analyze the technical efficiency of commercial banks in Kenya.

3.3 Theoretical Model

In the production process the firm employs non-negative real factors of production (inputs) (x) to yield positive real output (y). Given the feasible input-output vector, the firm's production possibility set is expressed as;

$$u = \{(x, y): X \text{ produces } Y\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.1$$

The firm is free to choose any level of input-output combination from the PPS according to its production scheme. Considering the firm aims to produce g(x) output set that is specified as

$$g(x) = \{y: x \text{ can be able to produce } y\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.2$$

According to Varian (2006), the firm faces optimization problem, therefore, the technical relationship specifying the choice of inputs that produce the maximum output is a necessary. It can be defined as;

$$y_i = f(x_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.3$$

The production function gives the boundary, firms operating along it are efficient. From the theory it is right to conclude that the firm's efficiency depends on the technology available (Audretsch, 1995). Hence, efficiency can be defined as:

$$\text{Efficiency} = \frac{Output}{Inputs} \quad \text{----------3.4}$$

Firms employ numerous varieties of inputs to generate various outputs in real time. To measure efficiency in such cases we modify equation (3.4) to:

$$\text{Efficiency} = \frac{Sum\ of\ weighted\ Outputs}{Sum\ of\ weighted\ inputs} \quad \ldots\ldots\ldots\ldots\ldots 3.5$$

The DEA modelling was used to estimate technical efficiency scores, which is a traditional theory. The scores range from 0 to 1, with 0 indicating complete inefficiency and 1 indicating complete efficiency.

3.3.1The DEA Model

DEA is a common mathematical linear programming approach. It utilizes input and output amounts as data for a group of DMUs so as to create a pair-wise linear surface over datum (Coelli et al., 2005). The characteristics of the decision-making units guide the researcher in selecting either the constant returns to scale (CRS) DEA or the variables return to scale (VRS) DEA. DEA is either output- or input-oriented. If the researcher assumes CRS, the two give

similar results and different results if VRS is assumed. The characteristics of decision-making units also influence the choice of orientation.

In developing a frontier surface data envelopment analysis solves a series of linear programming problems, that help in establishing the input or output function necessary for estimating the technical efficiency scores for decision-making units. According to Färe, Grosskopf, Lovell & Yaisawarng (1993), the linear programming problem for establishing period s output distance function is given as:

$$\{d_0^s (y_{s,\, xs})\}^{-1} = \max {}_{\varphi}\lambda\gamma \; \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; 3.6$$

$$\text{Subject to: } -\gamma y_{is} + Y_s\lambda \geq 0$$

$$x_{is} - X_s\lambda \geq 0$$

$$I1'\lambda = 1$$

$$\lambda \geq 0$$

Where y_{is} is a M×1 output vector for the i^{th} firm in period s, x_{is} is a N×1 input vector at period s for the i_{th} firm. Y_s is a 1×M vector of output for all firms in period s. X_s is a 1×N vector of inputs for all firms at period s, λ is a 1×1 matrix of weights, γ is a scalar and I1'λ = 1 is a convexity condition provided for VRS (Charnes et al., 1985).

The outcomes are based on the best firm within the sample under consideration. Inclusion of a sample of other firms from the global market may reduce domestic firms' efficiency scores (Coelli et al., 2005). The choice of a representative sample is important, it should be as representative as possible and if possible, a population study is recommended (Zhung, 1998).

DEA has got advantages that made it appropriate for this study. It uses decision making units rather than averages therefore producing single efficiency scores for each DMU (Kirigia, 2013). The ability of using input and output data in its natural units without normalizing them is an added advantage (Ogada et al., 2014). Also, it is flexibility enables the researcher to take care of exogeneous variables that are beyond control in the DMUs under consideration.

3.4 Empirical Model

Researchers have not agreed on the bank inputs and outputs following the complexity of banking activities. There are several approaches to banking behavior that can support the input-output specifications, such as intermediation, value-added, production, and user cost. The intermediation technique is used to define inputs as well as outputs in this research.

Consider a situation of 26 banks, 9 in tier 1, 7 in tier 2 and 10 in tier 3 each producing income (y) (linear combination of non-interest income (y_1) and interest income (y_2)) while using non-interest expense (x_1), interest expenses (x_2) and equity capital (x_3). The i^{th} bank uses x_{ki} units of the k^{th} inputs to produce y_{mi} units of the m^{th} output. For each of the banks, a separate linear programming program will be solved. Solving the linear programming problem yields the Output-Oriented technical efficiency for the i^{th} bank in Tier 1:

Max φ_i …… 3.7

St: $\varphi_i y_{mi} - \sum_{j=1}^{9} \lambda j \text{ymj} \leq 0$ m = 1 output

$x_{ki} - \sum_{j=1}^{9} \lambda j$ xki ≥ 0 k = 1,2 & 3 inputs

$\sum_{j=1}^{9} \lambda j = 1$

$\lambda j \geq 0$ j = 1, … 9 banks

Solving the linear programming problem yields the Output-Oriented technical efficiency for the i^{th} bank in Tier 2:

Max φ_i …… 3.8

St: $\varphi_i y_{mi} - \sum_{j=1}^{7} \lambda j ymj \leq 0$ m = 1 output

$x_{ki} - \sum_{j=1}^{7} \lambda j$ xki ≥ 0 k = 1,2 & 3 inputs

$\sum_{j=1}^{7} \lambda j = 1$

$\lambda j \geq 0$ j = 1, … 7 banks

Solving the linear programming problem yields the Output-Oriented technical efficiency for the i^{th} bank in Tier 3:

Max φ_i …… 3.9

St: $\varphi_i y_{mi} - \sum_{j=1}^{10} \lambda j ymj \leq 0$ m = 1 output

$x_{ki} - \sum_{j=1}^{10} \lambda j$ xki ≥ 0 k = 1,2 & 3 inputs

$\sum_{j=1}^{10} \lambda j = 1$

$\lambda j \geq 0$ j = 1, … 10 banks

Where φ_i represents the proportional possible increment in output, λj is the weight variable for deriving the possible linear combination of all banks in the study. When φ_i = 1thus λj = 0,

therefore, the i^{th} bank rests on the frontier thus, making it technically efficient. For inefficiency $\varphi_i \geq 1$ and $\lambda j \neq 0$.

3.4.1 Tobit Regression

To determine the effect of non-performing loans on the technical efficiency level of commercial banks in Kenya, the results from equation 3.7, 3.8 and 3.9's technical efficiency will be regressed against a number of predictor variables (x). The predictor variables were obtained from past studies on efficiency in the banking industry. Since theoretical explanations of market-related or bank-specific characteristics that may affect efficiency are lacking; Karim et al. (2010), Garza-Garcia (2012) and Muda et al. (2013), "suggested use of non-performing loan (NPL), ratio of total loan total assets (LOTA), total assets (TA), the ratio of equity to total assets (EQTA) and ratio of non-interest expenses to total assets (NIE), as determinants of bank efficiency" expressed as:

$$TE = f(NPL, LOTA, TA, EQTA, NIE) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 3.10$$

Where TE is technical efficiency estimated in equation 3.7,38 and 3.9, NPL is non-performing loans, LOTA is total loans over total assets, TA is total assets, EQTA is ratio of equity to total assets and NIE is the ratio of non-interest expenses to total assets. Technical efficiency is a continuous variable, and it is censored between zero and one. Tobit regression is often used to analyze models with censored dependent variable; despite giving inconsistent results when the error term is not normally distributed, it gives unbiased coefficients for each explanatory variable (Heckman, 1979). Hence, Tobit regression model was utilized in investigating the effect of Non-performing loans on technical efficiency.

3.5. Measuring and Defining Variables

Table 3.1: Variables in the DEA Model: Description and Measurement

Variable		**Description**	**Measurement**
Input variables	Non-interest expenses;	operating expenses of a bank that are classified separately from interest expenses for example salaries, allowances, rent cost of information technology	Ksh. millions
	Interest expenses;	the total of payments made on fixed deposits, savings deposits, and demand deposits	Ksh. millions
	Equity Capital;	Portion of bank capital which is raised in exchange of bank shares	Ksh. millions
Output Variables	Non-interest income	sum of income to commercial bank from fees and activities not related to lending	Ksh. Millions
	Interest income;	amount received by banks for lending out money or other financial investment	Ksh. Millions

Table 3.2 Variables in the regression their description and Measurement

Variable	Description	Measurement
TE (Technical efficiency)	Refers to a bank's potential to optimize output, given a number of fixed inputs.	An Index
NPL	These are credit advances that are un-serviced in more than 90 days	Ksh. millions
TA	It is the proxy of bank size, given by total assets	Ksh. millions
LOTA	It is a proportion of total loaning to total assets that is a proxy for loan intensity.	A Ratio
EQTA	Represents a percentage of total shareholders' equity to total assets.	A Ratio
NIE	Represents the ratio of non-interest expenses to total assets.	A Ratio

Source: Karim et al. (2010), Garza-Garcia (2012) and Muda et al. (2013),

3.6 Data Collection

Study data was collected from 26 commercial banks in Kenya for a period of six years from the year 2014 to 2019. The data was sourced from World Bank indicators, and the Annual Supervision Reports of the Central Bank of Kenya

3.7 Data Analysis

After data collection, the data was keyed into an Excel spreadsheet. To meet objective one on evaluating the technical efficiency level of commercial banks in Kenya DEAP version 2.1 was

used and for objective two; determining the effects of non-performing loans on technical efficiency level of commercial banks in Kenya, STATA 16 was employed.

3.8 Diagnostic Tests

3.8.1 Panel Unit Test:

The study data takes a period of six years 2014 to 2019, the data required a unit root test to determine if it needed to be differenced to avoid giving biased and spurious results. Levin, Lin, and Chu's (2002) created a model called "LLC" that modified the "LL" model to allow for the use of the pooling approach. It was carried out in three stages. Step 1: using an Augmented Dickey Fuller regression as:

$$\Delta y_{it} = \rho_{iyit-1} + \sum_{j=1}^{\rho} \varphi ij \triangle yit - j\,it + Z_{it}\gamma + £_{it} \quad \ldots\ldots\ldots\ldots\ldots 3.10$$

The residuals will be calculated using the two auxiliary regression equations. Step 2: For each cross-section, the proportion of long-term to short-term standard deviation is estimated. Step 3: LLC test for pooling cross-section and time series is estimated:

$$e_{it} = ðv_{it} + £_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.11$$

Ho: ð = 1 (presence of unit root)

H_1: ð = 0 (No unit root)

If the results indicate ADF variable equals one, it implies the data is not stationary therefore, the data should be differenced to make it stationary for any further analysis.

3.8.2 Multicollinearity Test

Multicollinearity is where several explanatory variables in the model are correlated. When variables are highly correlated, they result in less reliable statistical inference. The variance

inflation factor (VIF) was used in this inquiry to examine the multicollinearity issues. VIF is used to assess the presence of collinearity among explanatory variables (Gujarati and Peter, 2009). When the VIF values are less than 10, there is no multicollinearity problem.

Ho: Coefficient of variables is zero

If the coefficient is zero no multicollinearity, the null hypothesis is not rejected and if the coefficient is different from zero, there is multicollinearity among explanatory variables therefore, dropping one of the highly correlated variables or having a linear combination of variables is required.

3.8.3 Normality Test

In any regression analysis, it is important to ensure that the error term is normally distributed, so that the results are consistent (Hopkins & Weeks, 1990). The Skewness/kurtosis test of normality of the residuals was used.

Ho: No skewness, no Excess Kurtosis

If the P value is less than 0.05, it implies that the error term is not normally distributed, therefore, some variables resulting into a negative error term should be dropped.

CHAPTER FOUR

EMPIRICAL FINDINGS

4.1: Introduction

The chapter gives the study's findings. Section 4.2 presents preliminary analysis and results for variable appropriateness. Technical efficiency indices are presented and discussed in section 4.3 and tobit regression results are included in section 4.4.

4.2: Description Statistics of Inputs and Outputs

Table 4.1(a) presents the mean and standard deviation of inputs and outputs used to generate efficiency scores for tier 1 commercial banks

Tables 4.1(a): Summary Statistics of Inputs and Outputs (Ksh. billions)

Variable	Mean	Standard deviation	Min	Max
Interest expenses	16.8	8.34	4.11	39.2
Non-interest expenses	8.36	3.81	1.09	15.1
Equity capital	47.4	18.9	21.8	97.8
Interest income	28.4	13.8	8.46	63.7
Non-interest income	9.86	5.14	2.10	23.5

Source: Author Calculations

Table 4.1(b) presents the mean and standard deviation of inputs and outputs used to generate efficiency scores for tier 2 commercial banks

Tables 4.1(b): Summary Statistics of Inputs and Outputs (Ksh. billions)

Variable	Mean	Standard deviation	Min	Max
Interest expenses	3.28	1.31	0.95	7.05
Non-interest expenses	3.75	2.95	0.42	11.1
Equity capital	11.3	4.63	6.08	24.5
Interest income	7.07	3.09	2.57	13.8
Non-interest income	1.18	0.93	0.21	3.08

Source: Author Calculations

Table 4.1(c) presents the mean and standard deviation of inputs and outputs used to generate efficiency scores for tier 3 commercial banks

Tables 4.1(c): Summary Statistics of Inputs and Outputs (Ksh. billions)

Variable	Mean	Standard deviation	Min	Max
Interest expenses	1.02	0.79	0.13	3.76
Non-interest expenses	2.92	1.86	0.93	8.5
Equity capital	1.57	1.12	0.30	5.4
Interest income	2.05	1.24	0.23	6.5
Non-interest income	0.58	0.47	0.04	2.36

Source: Author Calculations

From Table 4.1 (a), 4.1 (b) and 4.1 (c) above, the mean for each input and output used in the study is greater than the standard deviation. The small standard deviation shows data is clustered around the mean (Cheah, 2009).

Table 4.2 (a) presents the Pearson's correlation coefficient between inputs and outputs used in the DEA model to estimate efficiency scores. The inputs are non-interest expenses, interest expenses and equity capital and outputs are interest income and non-interest income.

Table 4.2 (a): The Correlation Coefficient Between Inputs and Outputs.

	Interest expenses	**Non-interest expenses**	**Equity capital**	**Interest income**	**Non-interest income**
Interest expenses	1.000				
Non-interest expenses	0.8060	1.000			
Equity capital	0.8940	0.9347	1.000		
Interest income	0.9076	0.9602	0.9642	1.000	
Non-interest income	0.7619	0.9628	0.9269	0.9183	1.000

Source: Author Calculations

From Table 4.2, there exists a positive correlation between inputs and outputs. This implies that variables under consideration move in the same direction. That is, commercial banks employ more resources in order to increase their lending. “Correlation is used to show the appropriateness of variables” (Avkiran, 1990), the high positive correlation between interest income and non-interest income implies presence of multicollinearity. To solve for multicollinearity the linear combination between Non-interest income and interest income was applied to yield income.

Table 4.2 (b) presents the Pearson’s correlation coefficient between inputs and outputs used in the DEA model to estimate efficiency scores, after the linear combination of interest and non-interest income.

Table 4.2 (b): The Correlation Coefficient Between Inputs and Outputs.

	Interest expenses	**Non-interest expenses**	**Equity capital**	**Interest income**
Interest expenses	1.000			
Non-interest expenses	0.8060	1.000		
Equity capital	0.8940	0.9347	1.000	
Income	0.7487	0.9203	0.8813	1.000

Source: Author Calculations

The high positive correlation between variables in the study implies variables are appropriate for estimating the technical efficiency of commercial banks. The findings collaborate with the findings by Bwana (2020), in the study, there was high correlation between inputs and outputs.

Section 4.3 presents the technical efficiency of commercial banks for each tier. Commercial Banks in Kenya are classified into tiers based on their market share.

4.3: Technical Efficiency

In accordance to objective one; to evaluate the technical efficiency of commercial banks in Kenya. Table 4.3(a) presents the technical efficiency results for tier 1 commercial banks. The tier 1 commercial bank is a bank that has a market share greater than 5 percent of the total banking sector market.

Table 4.3(a): Technical Efficiency Indices for Tier 1 Commercial Banks.

Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Equity bank	1.000	0.540	1.000	0.932	0.767	0.425
Cooperative bank	0.873	0.518	0.980	0.935	0.747	1.000
KCB	0.963	0.668	0.950	1.000	0.708	1.000
Absa	0.960	0.692	0.839	0.437	0.750	0.547
Standard Chartered bank	0.935	0.759	0.911	0.803	0.995	0.514
Diamond trust bank	1.000	0.754	1.000	0.928	1.000	0.602
Stanbic bank	0.510	0.749	1.000	0.632	0.806	0.501
NIC bank	0.627	0.914	0.719	0.693	0.805	0.614
I & M bank	0.660	1.000	0.933	0.794	0.638	0.912
Mean	**0.836**	**0.733**	**0.926**	**0.795**	**0.802**	**0.679**
Tier 1 Average = 0.795						

Source: Author Calculations

Table 4.3(a), shows that mean for tier 1 commercial banks in Kenya's technical efficiency for the year 2014 stood at 83.6 percent. It declined to 73.3 percent in 2015, then improved in 2016 to 92.6 percent, it declined again to 79.5 percent in 2017. It improved in 2018 then declined to 67.9 percent in 2019. To decline in 2015 corresponds with a 5.03 percent decline in pre-tax profits. Improved recovery efforts, safe lending and payment of pending bills, improved the technical

efficiency 2016, and 2018. The decline in 2017 is attributed to poor weather, inflation and political tension due to the general election. Due to banks down-sizing balance sheet and deleveraging, poor weather, the abolishment of interest rate cap in the end of 2018 and delayed payments from the public and private sectors in 2019, lowered return on equity and made funding difficult lowering technical efficiency to 67.9 percent.

On average, over the 6 years' period tier 1 banks operated at 79.5 percent efficiency level, reflecting that banks are inefficient since they haven't achieved a score of 1. Implies than the inputs can be reduced by 20.5 percent in order to achieve efficiency or increase outputs by 20.5 percent without any additional input to achieve efficiency. Efficiency improvement over the six-years and it can be attributed to regulatory compliance. These findings collaborate with the findings by Kiemo and Kamau (2020) which established that average efficiency score of the banking industry in Kenya was 69 percent. Indicating the industry could produce the same output with 31 percent few resources.

Table 4.3(b), presents technical efficiency scores for tier 2 commercial banks in Kenya. Tier 2 commercial bank is a bank whose market share lies between 1 percent and 5 percent of the total banking sector market.

Table 4.3(b): Technical Efficiency Indices for Tier 2 Commercial Banks

Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
National bank of Kenya	1.000	1.000	0.534	0.223	0.840	1.000
Family bank	1.000	0.737	1.000	0.227	1.000	0.889
Bank of Baroda	1.000	0.670	0.566	0.377	0.762	1.000
HFC limited	0.944	0.822	1.000	0.891	1.000	0.690
Prime bank	0.820	1.000	0.857	1.000	0.499	1.000
Eco bank	0.723	0.416	1.000	0.836	0.725	0.372
Bank of India	1.000	0.370	0.535	0.890	1.000	0.643
Mean	**0.934**	**0.716**	**0.785**	**0.635**	**0.832**	**0.799**
Tier 2 Average = 0.784						

Source: Author Calculations

The results in Table 4.3(b), show that in the year 2014, technical efficiency stood at 93.4 percent. Efficiency declined in 2015 to 71.6 and improved in 2016 to 78.5 percent. In 2017 it declined to 63.5 percent, it improved in 2018 to 83.2 percent before declining again to 79.9 percent in 2019. The improvement is attributed to policy compliance and safe lending with the introduction of interest cap Act that skewed lending in favour of government agencies. As a result of poor weather and political tension due to the general elections, technical efficiency declined to 63.5 percent in 2017. The improved recovery efforts and payment of pending bills increased efficiency to 83.2 percent in 2018 but in 2019 it dropped to79.9 percent, attributed to poor weather, abolishment of interest rate cap in end of 2018, poor general economic growth that declined from 6.3 percent in 2018 to 5,6 percent in 2017 and late payments in both the public and private sector.

On average tier 2 commercial banks operate at 78.4 percent efficiency levels, this implies that the banks are inefficient. 21.6 percent of inputs are not reflected in output. In order to achieve efficiency inputs can be reduced by 21.6 percent or increase outputs by 21.6 percent.

Table 4.3(c) presents the technical efficiency scores for tier 3 banks. Tier 3 commercial bank is a commercial bank whose market share is less than 1 percent of the total banking sector market.

Table 4.3(c): Technical Efficiency Indices for Tier 3 Commercial Banks

Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Bank of Africa	0.597	1.000	0.643	0.791	0.284	0.360
Gulf African bank	0.490	0.946	0.547	1.000	0.131	0.312
African Banking corporation	1.000	0.792	0.831	1.000	0.204	0.385
Sidian bank	0.929	0.754	1.000	0.626	0.282	0.360
First community bank	0.759	1.000	1.000	0.765	0.573	0.586
Guardian bank	0.519	0.906	0.526	0.760	0.741	1.000
Paramount universal	0.413	0.891	0.795	0.573	1.000	0.742
Credit bank	1.000	0.783	0.767	0.299	1.000	0.811
Uba Kenya bank	0.465	1.000	0.653	1.000	0.161	0.956
Consolidated bank	0.658	0.961	0.668	0.463	0.209	0.600
Mean	**0.683**	**0.903**	**0.743**	**0.728**	**0.458**	**0.611**
Tier 3 Average = 0.688						

Source: Author calculations

From Table 4.3(c), in 2014, efficiency stood at 68.3 percent. The efficiency improved to 90.3 percent in 2015, before dropping to 74.3 percent in 2016, 72.8 percent in 2017 and 45.8 percent in 2018. After which, the banks experienced an improvement in technical efficiency of 61.1 percent in 2019. The poor weather and political tension and late payments in both the public and private sector are attributed to the declines in efficiency. The growth in 2019 for the tier 3 is the reverse of happenings in tier 1 and 2, this is due to the fact that Kenya is well endowed and no severe credit rationing. Small banks are essential for countries that have low endowments and experience severe credit rationing (Hakenes and Schnabel, 2010).

Tier 3 banks operated at 68.8 percent efficiency level on average over the study period. The banks were inefficient implying that output can be increased by 31.2 percent without any additional cost on inputs.

From the finds Tier 1 and Tier 2 commercial banks experienced the same technical efficiency trend over the period 2014 to 2019. That is the efficiency level dropped in 2015, 2017 and 2019 while it improved in 2016 and 2018. On the other hand, tier 3 banks experienced an improvement in 2015 and 2019, but a consecutive drop in 2016, 2017 and 2018. Tier 1 commercial banks are more efficient at 79.5 percent followed by tier 2 commercial banks at 78.4 percent and then tier 3 commercial banks at 68.8 percent.

4.4: Tobit Regression Analysis

The second objective of the study to establish the effects of non-performing loans on the technical efficiency level of commercial banks in Kenya. Due to the number of observations regression was done for all commercial banks together.

Table 4.4 (a) gives the summary statistics for the variables in the regression model: Technical efficiency index, non-performing loans (NPLs), Total loans to total assets (LOTA), Total assets, Shareholders' equity to total assets (EQTA), Total Assets (TA) and non-interest expenses to total assets (NIE).

Table 4.4 (a): Summary Statistics of Variables in the Regression Model

Variables	**Mean**	**Standard deviation**	**Min**	**Max**
Technical Efficiency	0.7508846	0.2350994	0.131	1
NPLs	7980754	8766674	52000	39000000
LOTA	60.31653	13.29802	1.650547	86.21656
Total Assets	133000000	146000000	5601000	674000000
EQTA	15.21415	4.08843	2.39487	38.26102
NIE	2.575849	1.427364	0.3368597	7.047298

Source: Author calculations

From table 4.4 (a) the dependent variable; technical efficiency index is limited; it ranges from 0 to 1, therefore; Tobit regression is used.

The study used variance inflation factors (VIF) to examine the presence of multicollinearity problem among the explanatory variables (Gujarati and Porters, 2009).

Table 4.4 (b): The Variance Inflation Factors (VIF)

Variable	**VIF**	**1/VIF**
NIE	1.23	0.8156
Total Assets	2.67	0.3751
NPLs	2.43	0.4121
LOTA	1.11	0.9012
EQTA	1.12	0.8952
Mean VIF	1.71	

Source: Author Calculations

From the Table 4.4 (b), the results indicate that the VIF values for the variables in the model lie between 2.67 and 1.21. This means the model does not have any multicollinearity issues since the values are all less than 10.

"When the dependent variable is limited, in such cases the normality assumption of residuals is often violated" (Tobit, 1958). The study used skewness-kurtosis test of normality, to test the normality of residuals.

Table 4.4 (c), gives the skewness-kurtosis test of normality of the residuals.

Table 4.4(c): Skewness/Kurtosis test of Normality of the Residuals

Variable	Pr (skewness)	Pr (kurtosis)	Adj Chi2(2)	Prob > chi2
Residuals	0.8022	0.0358	4.54	0.1035

Source: Author Calculation

From Table 4.4 (c), it is noted that the probability value for skewness than 0.05. Therefore, fail to reject the null hypothesis and conclude there is no skewness. The overall probability is also 0.1035 which is also, greater than 0.05. The residuals have a normal distribution. Since the residuals have a normal distribution and the explanatory variables are not suffering from multicollinearity, regression analysis was carried on the data.

4.4.1 Regression Results

Table 4.4 (d), presents the regression results in line with objective two. The table presents the coefficient of each explanatory variable, the t- values and P-values.

Table 4.4 (d): Tobit Regression Results for Commercial Banks

Explanatory Variables	**Coefficient**	**(t)**	**P- value**
Total Assets	0.00000000195	1.09	0.278
Total Loans to Total Assets	0.0019161	1.47	0.146
Equity to Total Assets	0.00095225	1.82	0.072
Non-performing Loans	-0.00000000262	-0.96	0.338
Non-Interest Expenses to Total Assets	-0.0283118	-2.44	0.029
Constant	0.7806477	6.41	0.000
Observations = 85			
Pseudo R^2 = 0.7634			

Source: Author calculations

Dependent Variable: Technical Efficiency

From Table 4.4 (d) above, total assets (TA) coefficient is positive but not significant. The finding is consistent Garza-Garcial (2012), in his findings large banks are more efficient in comparison to small banks. Large banks have huge asset base that increase their stability and resilience. When the size of banks increase, they are able to control their costs.

Total loans to total assets (LOTA) coefficient are positive, however not significant. This indicates a positive and significant relationship between loans and technical efficiency. The findings show that the higher efficiency of commercial bank is reliable with the higher loan to total assets. Banks should have higher levels of liquidity to meet their daily obligations; "highly liquidity ratio means better managerial efficiency" (Boldbaatar, 2006).

Shareholders' equity to Total assets (EQTA) coefficient is positive and significant at 10 percent. This implies that when shareholder's equity to total assets is increased by 1 point the technical efficiency of commercial banks in Kenya increase by 0.0095225 points. The findings differ with the study by Sufian (2009), the study established that less efficient banks tend to engage in riskiest operations and hold more equity either voluntary or involuntary.

Non-performing loans (NPL) coefficient is negative but not statistically significant. This implies that non-performing loans increase technical inefficiency for commercial banks in Kenya. The results are consistent with the findings of Karim et al. (2010) and Garza-Garcia (2012). In the studies they established that inefficiency in the banking sector is increased by NPLs. High inefficiency is a sign of poor performance by top management in day-to-day bank activities. Guy (2011) established that 'banks with poor administration with deplorable skills in monitoring borrowers, appraising collaterals and credit scoring are likely to accumulate non-performing loans.

Non-interest Expenses to Total assets (NIE) coefficient is negative and significant at 5 percent. When non-interest income to total assets increases by 1 point the technical efficiency decline by 0.0283118 points. The findings are consistent with those by Garza-Garcia (2012), the study found out that expenses other than interest earning expenses reduce the overall efficiency of banks.

The constant term is positive and significant at 1 percent. Holding all factors constant, the overall efficiency of a commercial bank is 78.06 percent.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1: Introduction

The chapter contains the summary of the study findings, conclusion drawn from the study and policy recommendations as well as recommendations for further research.

5.2: Summary of the Study

This study evaluated the performance of commercial banks in terms of technical efficiency. The study also, established the effects of non-performing loan on the technical efficiency of commercial banks in Kenya. The output-oriented DEA was used to estimate the technical efficiency indices for commercial banks. DEA was perfect for the study as it does not require the predetermined production function. The study has multiple inputs and multiple outputs that needed to be worked out to obtain a single indicator per period per bank therefore DEA was applicable.

The dependent variable (technical efficiency) is limited that is it lies between 0 and one, in the second part it was regressed against total assets, overhead cost to total assets, total loans to total assets, non-performing loan, shareholder's equity to total assets and non-interest income to total assets.

The banks in Kenya are classified on the basis of ownership and further in terms of their market share; tier 1, tier 2 and tier 3. These categories of banks compete among each other disadvantaging small banks whose share is less than 1 percent. The study considered this argument, and evaluated technical efficiency of banks in each category. Banks in tier one had an overall average efficiency of 79.5 percent over the study period, implying than the inputs can be

reduced by 20.5 percent in order to achieve efficiency or increase outputs by 20.5 percent without any additional input to achieve efficiency. In 2016, the banks recorded the score of 92.6 percent the highest, and over the six years they recorded the lowest score in 2019, 67.9 percent.

Tier 2 operated at 78.4 percent and tier 3, 68.8 percent; this implies that the banks are inefficient. In both categories, 21.6 percent and 31.2 percent of inputs, respectively are not reflected in output. In order to achieve efficiency in tier 2 commercial banks inputs can be reduced by 21.6 percent or increase outputs by 21.6 percent. For tier 3 commercial banks to achieve efficiency inputs can be reduced by 31.2 percent or increase outputs by 31.2 percent. The efficiency changed from one year to another for each commercial bank over the study period across the three groups and the changes are as a result of policy compliance and safe lending, poor weather, political tension, late payments in both the public and private sector and policy implementations on the banking sector. In tier 2 banks the highest score was obtained in 2014 at 93.4 percent and the lowest score of 63.5 percent in 2017. For tier 3, the lowest record was 45.8 percent in 2018 and the highest of 90.3 percent in 2015.

In 2019, all the categories recorded the low average technical efficiency, because at the end of 2018, the implementation of interest rate cap was abolished. The cap skewed lending in favor of government institutions and over its implementation period banks recorded high efficiency levels.

In the second part the study evaluated the effect of technical efficiency on the technical efficiency level of commercial banks in Kenya. The results from revealed that non-performing loans have a negative but not significant effect on the technical efficiency of commercial banks. Commercial banks with high non-performing loans recorded low efficiency level. Other bank characteristics, such as the ratio of total loans to total assets, have a positive effect but not

significant effect on technical efficiency of commercial banks. Non-interest expenses to total assets have a negative and significant effect on technical efficiency of commercial banks at 5 percent. Shareholders' equity to total assets has a positive effect on technical efficiency of commercial banks at 10 percent significance level.

5.3. Conclusions

The study concludes that over the study period it was noted that technical efficiency changed from on year to another. The changes can be attributed to the changing business environment, changing weather conditions, political environment and policy implementations on the banking sector. In all the banking categories, changes were experienced where the banks performed best in the period 2016 to 2018 when the enactment of interest rate cap law was in place. In 2019, banks recorded the lowest efficiency across all categories, the year following the abolishment of interest rate cap act.

The study further revealed that the technical efficiency of banks depends on the total loans, the non-interest expenses and the shareholders 'equity. Non-performing loans low the efficiency of commercial banks, however the coefficient is not significant.

5.4. Policy Recommendations

The study findings indicate that across all banking categories, there is a degree of inefficiency. The inefficiency is brought about by accumulation of non-performing loans in commercial banks' financial statements. Therefore, the policies adopted on the sector should be in line with improving asset qualities. The banks should invest heavily on loan recovery and customer credit score monitoring. Relying on private credit collection agencies, that look into resolving disputes and refer accounts to the credit reference bureau. This will avoid piling of non-performing loans on their financial statements and other long term legal process such as court cases.

5.5. Limitations of the Study

The study limitations are based on heterogeneity of banks and assumptions of DEA. Despite the study assuming banks are homogenous groups, banks are heterogeneous. They differ in terms of asset size, different services offered, capital requirements and locations, these characteristics are incomparable. Secondly, DEA assumes a full efficiency isoquant is known, however in its application the efficient DMUs is estimated from within the samples. Finally, the assumptions that DEA model does not establish a predetermined distribution between the inputs and output it make Data envelopment analysis attractive and distinctive. However, it falls to show the relative importance between inputs and outputs.

5.6. Areas of Further Study

Banks are critical in any economy- their performance reflects the economic performance of a nation. Kenya has experienced an increasing trend in non-performing loans over the last decade. The non-performing loans are one of the items that impact on a bank's growth and stability. To understand more on the non-performing loans and their effect on stability and performance of banks a study to determine the efficiency scores of commercial banks should be done. The study should treat non-performing loans as one of the outputs although undesirable.

REFERENCE

Abd Karim, M. Z., Chan, S. G., & Hassan, S. (2010). Bank efficiency and non-performing loans: Evidence from Malaysia and Singapore. *Prague Economic Papers, 2*(1).

Adrian, T., & Shin, H. S. (2010). The changing nature of financial intermediation and the financial crisis of 2007–2009. *Annu. Rev. Econ., 2(1),* 603-618.

Akerlof, G. (1970). Quarterly Journal of Economics. Quarterly Journal of Economics, 84, 488.

Alshatti, A. S. (2015). The effect of credit risk management on financial performance of the Jordanian commercial banks. *Investment management and financial innovations*, (12, № 1 (contin. 2)), 338-345.

Alshebmi, A. S., Adam, M. H. M., Mustafa, A. M., & Abdelmaksoud, M. T. D. O. E. (2020). Assessing the Non-Performing Loans and their Effect on Banks Profitability: Empirical Evidence from the Saudi Arabia Banking Sector. *International Journal of Innovation, Creativity and Change, 11(8),* 69-93.

Al-Wesabi, H. A., & Ahmad, N. H. (2013). Credit risk of Islamic banks in GCC countries. *International Journal of banking and finance, 10(2),* 95-112.

Asmare, A. (2014). Determinants of Banks Interest rate spread: An Empirical Evidence from Ethiopian Commercial Banks. *Addis Ababa University Addis Ababa, Ethiopia.*

Audretsch, D. B. (1995). Firm profitability, growth, and innovation. Review of Industrial Organization, 10(5), 579-588.

Auronen, L. (2013). Asymmetric information.

Batchelor, V. B., & Gerrard, P. (2004). *The productivity growth of commercial banks in Singapore from 1997–2001*. Working Paper, available http://www. hicbusiness. org/biz2003proceedings/ValliPercent 20BoobalPercent 20Batchelo r. pdf.

Barros, C. P., Managi, S., & Matousek, R. (2012). The technical efficiency of the Japanese banks: non-radial directional performance measurement with undesirable output. *Omega, 40(1),* 1-8.

Beck, T., Cull, R., Fuchs, M. J., Getenga, J., Gatere, P. K., Randa, J., & Trandafir, M. (2010). Banking sector stability, efficiency, and outreach in Kenya. *World Bank Policy Research Working Paper*, (5442).

Berger, A. N., & DeYoung, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking & Finance, 21(6),* 849-870.

Bloom, N., Mahajan, A., McKenzie, D., & Roberts, J. (2010). Why do firms in developing countries have low productivity? *American Economic Review, 100(2),* 619-23.

Boudriga, A., Taktak, N. B., & Jellouli, S. (2009). Banking supervision and nonperforming loans: a cross-country analysis. Journal of financial economic policy.

Bwana, K. M. (2020, August). Decomposing Total Factor Productivity of Non-life Insurance Firms in Tanzania. In Applied Research Conference in Africa (pp. 363-372). Springer, Cham.

Central Bank of Kenya. (2013). Bank Supervision Annual Report. Nairobi, Kenya. Retrieved fromhttps://www.centralbank.go.ke/images/docs/Bank%20Supervision%20Reports/Annual%20Reports/bsd2012-r.pdf

Central Bank of Kenya. (2013). Bank Supervision Annual Report. Nairobi, Kenya. Retrieved fromhttps://www.centralbank.go.ke/images/docs/Bank%20Supervision%20Reports/Annual%20Reports/BSD2013AnnualReport.pdf

Central Bank of Kenya. (2014). Bank Supervision Annual Report. Nairobi, Kenya. Retrieved fromhttps://www.centralbank.go.ke/images/docs/Bank%20Supervision%20Reports/Annual%20Reports/2014BSAnnualReport.pdf

Central Bank of Kenya. (2015). Bank Supervision Annual Report. Nairobi, Kenya. Retrieved from https://www.centralbank.go.ke/uploads/399346751_2015%20Annual%20Report.pdf

Central Bank of Kenya. (2016). Bank Supervision Annual Report. Nairobi, Kenya. Retrieved fromhttps://www.centralbank.go.ke/uploads/banking_sector_annual_reports/323855712_2016%20BSD%20ANNUAL%20REPORT%20V5.pdf

Central Bank of Kenya. (2017). Bank Supervision Annual Report. Nairobi, Kenya. Retrieved fromhttps://www.centralbank.go.ke/uploads/banking_sector_annual_reports/873911276_2017%20Annual%20Report.pdf

Central Bank of Kenya. (2018). Bank Supervision Annual Report. Nairobi, Kenya. Retrieved fromhttps://www.centralbank.go.ke/uploads/banking_sector_annual_reports/1174296311_2018%20Annual%20Report.pdf

Central Bank of Kenya. (2019). Bank Supervision Annual Report. Nairobi, Kenya. Retrieved fromhttps://www.centralbank.go.ke/uploads/banking_sector_annual_reports/197965474_BSD ANNUALREPORT2019%20.pdf

Central Bank of Kenya. (2020). Bank Supervision Annual Report. Nairobi, Kenya. Retrieved fromhttps://www.centralbank.go.ke/uploads/banking_sector_annual_reports/1375903848_Bank%20Supervision%20Annual%20Report%202020.pdf

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.

Cheah, B. C. (2009). Clustering standard errors or modeling multilevel data. University of Columbia, 2-4.

Charnes, A., Cooper, W. W., Golany, B., Seiford, L., & Stutz, J. (1985). Foundations of data envelopment analysis for Pareto-Koopmans efficient empirical production functions. Journal of econometrics, 30(1-2), 91-107.

Chi, T., Kilduff, P. P., & Gargeya, V. B. (2009). Alignment between business environment characteristics, competitive priorities, supply chain structures, and firm business performance. *International Journal of productivity and performance management.*

Chu, S. F., & Lim, G. H. (1998). Share performance and profit efficiency of banks in an oligopolistic market: evidence from Singapore. *Journal of Multinational Financial Management, 8(2-3),* 155-168.

Coelli, T., Lauwers, L., & Van Huylenbroeck, G. (2005). Formulation of technical, economic and environmental efficiency measures that are consistent with the materials balance condition. *Centre for Efficiency and Productivity Analysis Working Paper*, *6*.

Cull, R., Demirgüç-Kunt, A., & Morduch, J. (2009). Microfinance meets the market. *Journal of Economic perspectives, 23(1),* 167-92.

Diallo, B. (2018). Bank efficiency and industry growth during financial crises. *Economic Modelling, 68,* 11-22.

Drake, L., & Hall, M. J. (2003). Efficiency in Japanese banking: An empirical analysis. *Journal of Banking & Finance, 27*(5), 891-917.

Drake, L., Hall, M. J., & Simper, R. (2006). The impact of macroeconomic and regulatory factors on bank efficiency: A non-parametric analysis of Hong Kong's banking system. Journal of Banking & Finance, 30(5), 1443-1466.

Ezeoha, A. E. (2011). Banking consolidation, credit crisis and asset quality in a fragile banking system: Some evidence from Nigerian data. *Journal of financial regulation and compliance.*

Fan, L., & Shaffer, S. (2004). Efficiency versus risk in large domestic US banks. *Managerial Finance*.

Färe, R., Grosskopf, S., Lovell, C. K., & Yaisawarng, S. (1993). Derivation of shadow prices for undesirable outputs: a distance function approach. The review of economics and statistics, 374-380.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society: Series A (General), 120*(3), 253-281.

Fiordelisi, F., Marques-Ibanez, D., & Molyneux, P. (2011). Efficiency and risk in European banking. *Journal of banking & finance, 35(5),* 1315-1326.

Flannery, M. J., Kwan, S. H., & Nimalendran, M. (2013). The 2007–2009 financial crisis and bank opaqueness. *Journal of Financial Intermediation, 22(1),* 55-84.

Gabriel, O., Victor, I. E., & Innocent, I. O. (2019). Effect of non-performing loans on the financial performance of commercial banks in Nigeria. American International Journal of Business and Management Studies, 1(2), 1-9.

Ganic, M. (2014). Bank specific determinants of Credit Risk-An Empirical Study on the banking sector of Bosnia and Herzegovina. International Journal of Economic Practices and Theories (IJEPT) ISSN, 2247-7225.

Garza-García, J. G. (2012). Determinants of bank efficiency in Mexico: a two-stage analysis. *Applied Economics Letters*, *19*(17), 1679-1682.

Gitau, C. M. W., & Gor, S. O. (2011). Measuring Factor Productivity of the Banking Sector in Kenya. *OIDA International Journal of Sustainable Development*, *2*(12), 11-18.

Greenlaw, S. A., Shapiro, D., Taylor, T., & OpenStax (Nonprofit organization). (2018). Principles of economics 2e

Hakenes, H., & Schnabel, I. (2010). Banks without parachutes: Competitive effects of government bail-out policies. Journal of Financial Stability, 6(3), 156-168.

Henriques, I. C., Sobreiro, V. A., Kimura, H., & Mariano, E. B. (2018). Efficiency in the Brazilian banking system using data envelopment analysis. Future Business *Journal, 4(2),* 157-178.

Hopkins, K. D., & Weeks, D. L. (1990). Tests for normality and measures of skewness and kurtosis: Their place in research reporting. Educational and psychological measurement, 50(4), 717-729.

Hughes, P. S., & Simpson, W. J. (1993). Production and composition of hop products. *Technical quarterly-master brewer's association of the Americas, 30*, 146-146.

In Chesini, G., In Giaretta, E., & In Paltrinieri, A. (2017). The business of banking: Models, risk and regulation. Cham, Switzerland: Palgrave Macmillan.

Kamau, A. W. (2009). *Efficiency in the banking sector: An empirical investigation of commercial banks in Kenya* (Doctoral dissertation, University of Nairobi).

Kamau, P. N. (2015). Effects of listing of loan defaulters by credit reference bureaus on non-performing loans of commercial banks in Kenya (Doctoral dissertation, University of Nairobi).

Karumba, M., & Wafula, M. (2012). Collateral lending: Are there alternatives for the Kenyan banking industry. *Nairobi: KBA Centre for Research on Financial Markets and Policy Working Paper Series*.

Kenya Bankers Association (2012). Kenya Bankers Economic Bulletins. Nairobi, Kenya. Retrieved from https://www.kba.co.ke/downloads/KBA%20Economic%20Bulletin%20v4.pdf

Kereta, B. B. (2007). Outreach and Financial Performance Analysis of Microfinance Institutions in.

Kiemo, S., & Kamau, A. (2020). Banking Sector Competition and Intermediation Efficiency In Kenya. *Kenya Bankers Association-KBA Centre for Research on Financial Markets and Policy Working Paper Series*.

Kiemo, S. M., Olweny, T. O., Muturi, W. M., & Mwangi, L. W. (2019). Bank-specific determinants of commercial banks financial stability in Kenya. *Journal of Applied Finance and Banking*, *9*(1), 119-145.

Kirigia, J. M., & Asbu, E. Z. (2013). Technical and scale efficiency of public community hospitals in Eritrea: an exploratory study. *Health economics review*, *3(1)*, 1-16.

Kwan, S. H., & Eisenbeis, R. A. (1995). An analysis of inefficiency in banking: A stochastic cost frontier approach. In *Working paper, Working Papers in Applied Economics*. Federal Reserve Bank of San Francisco.

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of econometrics*, *108*(1), 1-24.

Maudos, J. (2017). Income structure, profitability and risk in the European banking sector: The impact of the crisis. *Research in International Business and Finance, 39*, 85-101.

Mersland, R., & Strøm, R. Ø. (2010). Microfinance mission drift? *World development, 38(1)*, 28-36.

Messai, A. S., & Jouini, F. (2013). Micro and macro determinants of non-performing loans. *International journal of economics and financial issues*, *3*(4), 852.

Muda, M., Shaharuddin, A., & Embaya, A. (2013). Comparative analysis of profitability determinants of domestic and foreign Islamic banks in Malaysia. *International Journal of Economics and Financial Issues*.

Mung'aho, A. K., Ondiek, B. A., & Odhiambo, A. (2016). Non-performing loans and financial performance of Kenya women finance trust in Kenya. *International Journal of Multidisciplinary and Current Research*.

Muluwork, K. E. (2016). *The Relationship between Non-Performing Loans and Financial Performance of Commercial Banks in Ethiopia* (Doctoral dissertation, University of Nairobi).

Muriithi, J. W. (2014). *The effect of non-performing loans on liquidity risk of commercial banks in Kenya* (Doctoral dissertation, University of Nairobi).

Njihia, J. K. (2005). *The determinants of banks profitability: the case of Commercial Banks in Kenya* (Doctoral dissertation, University of Nairobi).

Njue, A. (2020*). Liquidity Management and Financial Performance of Microfinance Institutions in Kenya* (Doctoral dissertation, University of Embu).

Ntwiga, D. B. (2020). Technical efficiency in the Kenyan banking sector: Influence of fintech and banks collaboration. *Journal of Finance and Economics*, *8*(1), 13-22.

Ogada, M. J., Muchai, D., Mwabu, G., & Mathenge, M. (2014). Technical efficiency of Kenya's smallholder food crop farmers: do environmental factors matter? *Environment, development and sustainability, 16(5),* 1065-1076.

Otwori, C. K. (2013). *The relationship between credit referencing and the level of non-performing loans of commercial banks in Kenya* (Doctoral dissertation, University of Nairobi).

Qamruzzaman, M., Karim, S., & Wei, J. (2019). Does asymmetric relation exist between exchange rate and foreign direct investment in Bangladesh? Evidence from nonlinear ARDL analysis. The Journal of Asian Finance, Economics and Business, 6(4), 115-128.

Ramli, N. A., Mohammed, N. I., Hussin, S. A. S., & Khairi, S. S. M. (2018). Investigating the effect of non-performing loans on technical efficiency in Malaysian banking sector. In *AIP Conference Proceedings* (Vol. 1982, No. 1, p. 020008). AIP Publishing LLC.

Reda, M., & Isik, I. (2006, December). Efficiency and Productivity Change of Egyptian Commercial Banks 1995-2003. In *ERF 13th Annual Conference, Kuwait*.

Sealey Jr, 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.

Shepherd, R. W. (2016). Theory of Cost and Production Functions. Princeton: Princeton University Press

Varian, H. R. (2011). Intermediate microeconomics: A modern approach. New York: Norton.

Varian, H. R. (2019). *Intermediate microeconomics: With calculus*

Wheelock, D. C., & Wilson, P. W. (1999). Technical progress, inefficiency, and productivity change in US banking, 1984-1993. *Journal of Money, Credit, and Banking*, 212-234.

Yao, S., Jiang, C., Feng, G., & Willenbockel, D. (2007). WTO challenges and efficiency of Chinese banks. *Applied Economics, 39(5),* 629-643.

Zakaria, S., Saleh, M. S. M., Wahid, K. A., & Bakar, H. A. (2019). The Macroeconomic Determinants of Malaysian Stock Market Return. *AU ICBE 2019*, 241.