Productivity of Commercial Banks in Kenya: A Data Envelopment Analysis

MILLICENT WANJIRU GITAU
X50/71351/07

Research Paper Submitted in Partial Fulfillment of the Requirements for the Award of the Degree of Masters of Arts in Economics of the University of Nairobi.

SEPTEMBER, 2009

DECLARATION

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

NAME: MILLICENT WANJIRU GITAU

SIGNATURE.....

DATE..... 5th Sept. 2009 .....

APPROVAL

This research paper has been submitted for examination with our approval as University supervisors.

NAME: PROF PETER KIMUYU

SIGNATURE.....

DATE..... Sept. 13, 2009 .....

NAME: DR GOR SETH

SIGNATURE.....

DATE..... 09/09/2009 .....

DEDICATION

To my late parents: Mr. James Gitau Mwangi and Mrs. Rosemary Njeri Gitau.

ACKNOWLEDGMENT

This research work is the culmination of enormous support from various people. My foremost acknowledgement goes to the School of Economics, University of Nairobi for funding my graduate studies and for providing me with a favourable study environment. I am grateful to my project supervisors PROF Peter Kimuyu and DR Gor Seth who have seen me through my research process. Their advice, support, time and tireless effort cannot go unnoticed. DR Bamidele Adekunle, thank you for your assistance, comments and suggestions.

I appreciate the efforts of my parents Mr. and Mrs. James Gitau Mwangi for taking me to school and for sacrificing a lot for my sake. I also extend my gratitude to my brothers; Mwangi, Kareko, Mwaura, Kamande and sister Muthoni. As a family, your prayers, moral support and encouragement definitely helped me through this phase of my life.

I will not forget the intellectual and moral support from my classmates of the M.A. Economics 2007/2008 for their encouragements and cheers particularly Susan, Isaac and Nthabiseng.

The views expressed in this paper, however are my own and do not represent the views of any of the named person(s) or institution(s). I solely bear the responsibility for any errors and/ or omissions.

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

ASCAs	Accumulating Savings and Credit Associations
ATM	Automated Teller Machine
CBK	Central Bank of Kenya
CRS	Constant Returns to Scale
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
EFFCH	Efficiency Change
MFIs	Micro- Finance Institutions
MPI	Malmquist Productivity Index
NBFI	Non-Banking Financial Institutions
NSE	Nairobi Stock Exchange
PECH	Pure Efficiency Change
PPF	Production Possibility Frontier
ROSCAs	Rotating Savings and Credit Associations
SACCos	Savings and Credit Co-operatives
SFA	Stochastic Frontier Approach
SECH	Scale Efficiency Change
TECH	Technical Change
VRS	Variable Returns to Scale

Abstract

Starting from 1980s and early 1990s Kenya introduced a series of financial reforms to boost the efficiency and productivity of Kenyan banks. This study examines changes in commercial banks productivity in Kenya in the context of liberalization using Data Envelopment Analysis (DEA) method. The study is in two stages: the first stage measures the productivity growth and its components while the second stage examines the factors affecting Total Factor Productivity (TFP) growth. From a time series dataset consisting of information on commercial bank activities obtained from Central Bank of Kenya's publications supplemented by a banking survey, DEA method is used to measure Malmquist index of total factor productivity for a total of 34 banks for the period 1999-2008. A decomposition of TFP measures is done to establish whether the change in factor productivity is due to technological change or to change in technical efficiency over the period in question. The study further examines the effect of asset composition, market share in deposit market, ownership structure and number of branches on productivity growth. The results demonstrate that the TFP deteriorated over the period while Efficiency change (EFFCH) increased as Technical Change (TECH) declined implying that TFP deterioration was due to either technological innovations or shocks. Given that technology is the main driver of productivity, Central Bank of Kenya should design practicable protocol as a technological standards requirement.

CHAPTER ONE

1.0 Introduction

Modern market economies cannot function properly without an efficient banking system intermediating between savings and investments and providing other essential services to the public. yet proper and efficient functioning of the financial market payments and security transfer systems depends on banking services. An efficient banking system is also necessary for the conduct of monetary policy. The basic objective of any financial system is to facilitate and encourage intermediation between borrowers and lenders. and the resultant. transfer of funds occurs directly through money and capital markets and indirectly through the banking system. Therefore for any economy to prosper. an efficient and highly productive banking system is required.

Banks play a pivotal role in the process of financial intermediation by mobilizing the transfer of funds between the surplus units and the deficit units. As prime movers of economic life. banks occupy a significant place in the economy of every nation and it is therefore not surprising that their operations are perhaps the most heavily regulated and supervised of all businesses (Soyibo and Adekanye, 1991). Policy makers. economists and monetary authorities recognize that the ability of banks to achieve the desired results and to continue to play the role earmarked for them depends on the existence of an enabling environment and the number of operating banks and their performance from one financial year to another.

In 1980s and early 1990s, Kenya introduced an extensive economic reform and structural adjustment program to transform the economy from an inward and centrally planned one dominated by the public sector to an outward looking economy led by the private sector. (Were et al. 2005). Liberalisation and privatisation of the financial sector in general, and the banking system in particular, were crucial to the intended transformation of the economy. Kenya's move towards this transformational process of the economy was in response to the general globalisation process. The major objective was to enhance productivity and efficiency since productivity growth is key to sustainable economic growth in any society.

Within the context of globalisation, liberalisation of financial markets worldwide has led to deeper integration of financial institutions (Ragunathan, 1999). As a result, financial institutions today face a fast-paced, dynamic, and competitive environment on a global scale. Given such a competitive environment, financial sector supervisors, as well as financial institutions, are required to examine their performance as their survival is likely to depend on their productive efficiencies. Some earlier studies (Berger and Humphrey, 1991 and Berger, Hunter and Timme, 1993) had demonstrated that in the banking sector particularly, inefficiencies are more important than scale and scope issues. Consequently, banks have been trying to adapt and adjust themselves to improve their productivity in this changing and highly competitive environment (Harker and Zenios, 2000).

Advancement in Information and Communications Technology (ICT) in the banking industry has enhanced efficiency and improved customer service. This is reflected

particularly in the increased use of Automated Teller Machine (ATM) cards resulting from broadening of ATM network, including additional ATM and a wider network of merchants that accept payment through credit/debit cards (CBK, 2006). This progress has, however, been accompanied by increased operational risks related to card frauds. There is therefore need for well formulated ICT strategies and security policies to mitigate the possible attendant risks.

Players in this sector have experienced increased competition over the last few years resulting from increased innovations among the players as well as new entrants into the market. Automation of a large number of services and a move towards emphasis on the complex customer needs rather than traditional 'off-the-shelf' banking products is the current trend (Oloo, 2007). The recent development of mobile banking has the potential to offer low cost, easily accessible financial services to poor people in Kenya and other developing countries that do not have bank accounts. Today many banks have come up with new strategies of offering diverse services to their customers, including investment and corporate finance advisory services.

Financial sector reform in Kenya began in 1990, as a continuation of Structural Adjustment Programmes sponsored by the International Monetary Fund and The World Bank. Prior to liberalization, the financial system was highly repressed, with heavy government intervention in the banking sector through credit and interest rate controls (Brownbridge et al 1988). Financial sector reforms led to the removal of credit control and liberalization of interest rates and streamlining of the market trading system which opened the banking system to new competition and efficiency.

1.1 Overview of the Banking Industry

Development of banking industry in Kenya started with colonization and the influx of foreign banks, due to trade connections between Kenya and India in the late 19th century. As trade developed, finance was largely concentrated in international transactions and this stimulated the local economy greatly. Early banks established links with European, South African and Indian businesses. Local deposits grew mainly from pioneer traders and settlers in Kenya as well as from proceeds of trade in primary products. The bulk of these deposits were invested overseas because there were few investment opportunities in Kenya and customers of the banks were not adequately familiar with banking requirements to obtain loans.

The National Bank of India was the first bank in Kenya, established in 1896 followed by Standard Bank of South Africa in 1910. From then until the run up to independence in 1963, there were few significant entries in the industry. The fast pace of economic growth in the 1963-72 period was a boost to the banking sector, which expanded significantly. Other growth and diversification factors for the banking sector were the need for intermediation, government policies encouraging local participation by relaxing entry requirements, exploitation of loopholes in the regulatory framework that encouraged the growth of non-banking financial institutions (NBFI) and liberalization of the sector (Brownbridge et al, 1988).

The growth of Kenyan economy after independence was accompanied by expansion and diversification of the financial system in terms of numbers and range of financial

institutions and the depth of financial intermediation. At independence there were nine foreign-owned commercial banks. In the period following independence the government established the Central Bank of Kenya (CBK) and three parastatal commercial banks. During the 1970s, the non-bank financial institutions (NBFI) sector began to expand rapidly, stimulated by the differences in the regulatory treatment of banks and NBFI which created market opportunities for the NBFIs.

The growth of the locally owned financial institutions accelerated in the 1980s and began to include commercial banks, some of which were set up by the owners of existing NBFIs. During the mid-1980s the financial system suffered its first major episode of financial fragility with several locally owned financial institutions being closed down after encountering severe liquidity problems as a result of mismanagement and fraud (Brownbridge et el, 1988). This crisis led to a series of revisions to the banking laws, the strengthening of banking supervision, the creation of Deposit Protection Fund (DPF) and the formation in 1989 of a government-owned bank, the Consolidated Bank, which was given the task of restructuring a number of failed private sector financial institutions. During the 1980s and early 1990s the government introduced a number of policy reforms aimed at gradually liberalizing financial markets. These reforms, together with those aimed at strengthening institutional framework of the financial system, were supported by a financial sector adjustment credit (FSAC) from the World Bank (Brownbridge et al, 1988).

Financial markets in Kenya were afflicted by severe turbulence in the early 1990s. Rapid inflationary increases in the money supply accompanied widespread fragility and fraud in the banking sector. A major source of monetary growth at this time was irregular borrowing by politically connected financial institutions from the CBK. Under pressure from the International Monetary Fund, the World Bank and donors, the CBK put around 16 financial institutions into liquidation in 1993/94, while others including one of the government-owned commercial banks, were recapitalised by their shareholders.

Berks and Fuchs (2004) argue that Kenya is viewed by regional standards to have a relatively well developed and diversified financial system, but there are major structural impediments which prevent it from reaching its full potential. Cross-country comparisons show the importance of a well developed financial sector for long-term economic growth and poverty alleviation which is one of the objectives of the Millennium Development Goals (MDGs). Experience from other developing economies has shown the detrimental effect of government ownership and the positive impact that foreign bank ownership can have on the development of a market-based financial system. By analyzing and decomposing the high interest rate spreads and margins in Kenya, Berks and Fuchs (2004) identify structural impediments that drive the high cost of and low access to financial services. They concluded that the limited sharing of information on debtors, deficiencies in the legal and judicial system, the limited number of strong and reputable banks, and non-transparency and uncertainty in the banking market are major impediments to the development of Kenya's financial system.

By June 1994, the banking system consisted of 33 commercial banks and 55 NBFIs. Approximately 25 of the NBFIs were affiliated to, or shared common ownership with the commercial banks (CBK, 2000). Of the 33 commercial banks, 12 were foreign owned, 5 were in public sector and the rest were owned by the local private sector. The sector recorded relatively strong performance during the period 2003-2007 in terms of growth in assets, deposits and profitability. In the period 2006 to 2007 total deposits held by financial institutions grew by 25.2 percent; total assets recorded a growth rate of 33.8 percent, while non-performing loans declined by 20.4 percent. The sector also recorded impressive growth in pre-tax profits which rose by 34.3 percent during the period under review. The improvement could be explained by increased competition in the banking sector, adoption of new technology and introduction of innovative products targeting different customer segments.

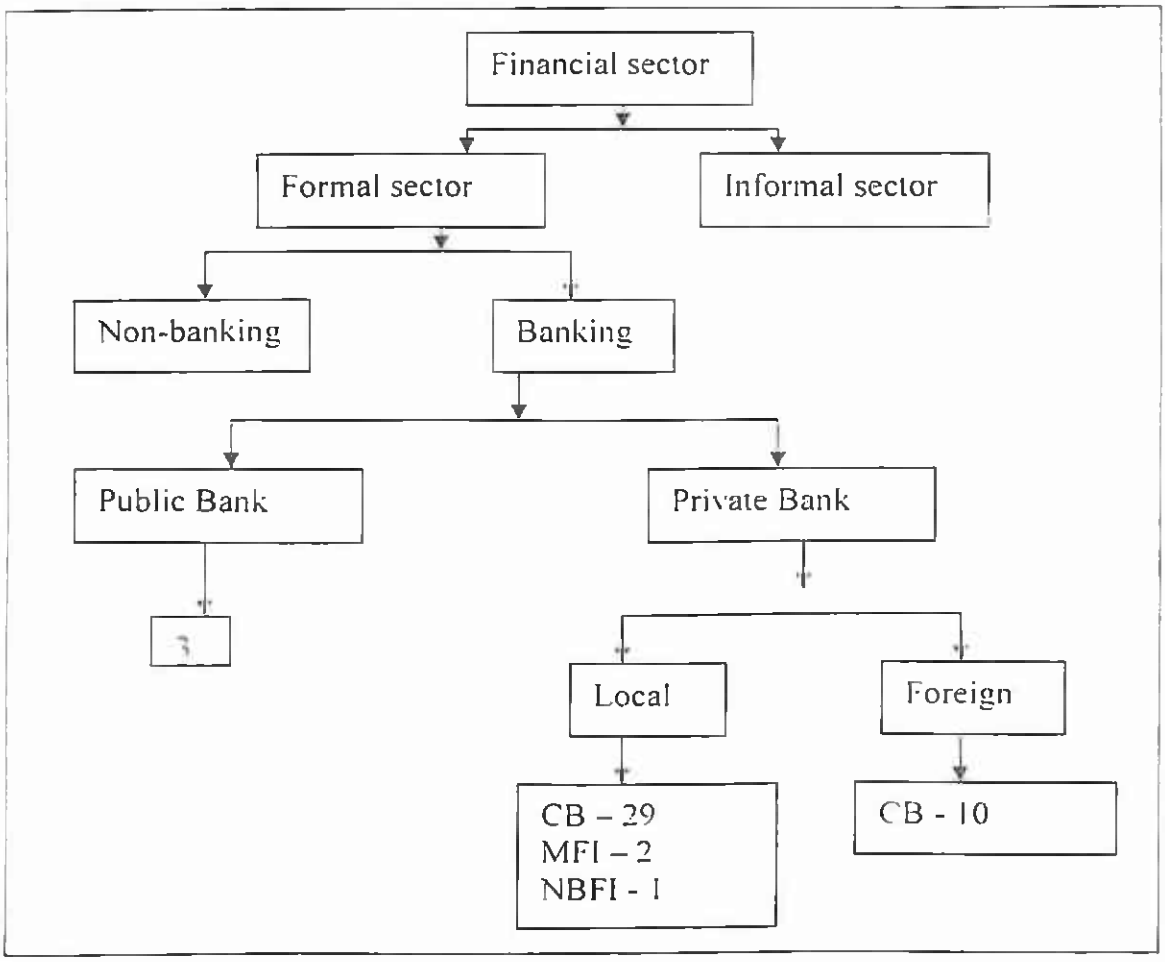
1.2 Structure of Financial Sector

Kenya's financial sector is probably the most advanced in East Africa, but to date, only an estimated 55% to 60% of the population have access to financial services. A strong financial sector is seen as a key element in a country's economic development, and this is one of the reasons why donors have long tried to support financial sector development. The financial structure in kenya can be divided into four categoies: formal financial services such as banks and the Post Office; semi-formal services such as microfinance institutions (MFIs) and savings and credit co-operatives (SACCos); and informal institutions such as rotating savings and credit associations (ROSCAs) and accumulating savings and credit associations (ASCAs).

Access to banking services is most frequent for waged employees, since an occupation in domestic services earns very low income, thus translating into fewer assets and the use of more informal savings and lending mechanisms. Informal financial services serve a third of the Kenyan population and hence it appears to be one of the most promising avenues to expand overall access to financial services.

According to CBK (2007) classification the banking sector comprised of 45 institutions, 42 of which were commercial banks, 2 mortgage finance companies and 1 non-bank financial institution as at 31st December 2007. Out of 45 institutions, 35 were locally owned and 10 were foreign owned as shown in figure 1. The locally owned financial institutions comprised of 3 banks with significant shareholding by the Government and State Corporations (public owned), 29 privately owned commercial banks, 2 mortgage finance institutions and 1 non-bank financial institution. Local private institutions constituted 71.1 percent of total institutions while local public institutions constituted 6.7 percent and foreign institutions 22.2 percent. The total net assets for local private institutions constituted 54.7 percent while the local public institutions and foreign institutions constituted 5.3 percent and 40.0 percent of the total net assets respectively.

Figure 1: Structure of Banking Industry in Kenya (2007)



Notes:
CB – Commercial Bank
MFI – Mortgage Financial Institutions
NBFI – Non-Bank Financial Institutions

Source: Central Bank of Kenya 2007 Annual Report

The existing structure of the banking sector is such that only eight (8) out of the forty-five (45) banks control 69% and 70% of the market share in terms of net assets and deposits respectively (CBK, 2007). Small and medium-sized banks that are the majority only in terms of numbers are not able to compete favourably with the few big banks in terms of offering a full range of products and services. This lack of an effective competitive environment has led to inefficiencies that translate to high interest rates.

The peer grouping (classification) criteria for institutions was reviewed in December 2005 resulting in the reduction of peer groups from 5 to 3 namely, large, medium and small in terms of net assets. Out of the 45 institutions, 13 were in the large peer group with aggregate net assets of over Kshs. 15 billion. The medium peer group comprise of 17 institutions with net assets ranging between Kshs. 5 billion and Kshs. 15 billion, whereas the small peer group had 15 institutions with net assets of less than Kshs. 5 billion. As at the end of 2007, 28.9 percent of the institutions were in the large peer group and accounted for 80.1 percent of the total assets, 80.7 percent of deposits, 79.9 percent of net advances, 77.1 percent of capital and reserves and 86.0 percent of profits in the banking sector (CBK, 2007).

Table 1 depicts the regional distribution of the branch network in the banking sector in the period 1998 to 2007. Between the year 2006 and 2007, Nairobi and Rift Valley Provinces had the highest number of new branches at 54 and 46 respectively, followed by Eastern and Coast Provinces with 25 and 18 new branches respectively. Central Province was the only province that reported an aggregate decrease of 2 branches in the year 2007.

Table 1: Branch Network for the Banking Industry

Province	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
Central	78	80	71	71	69	69	69	65	79	114
Coast	93	75	72	72	69	70	69	71	80	77
Eastern	61	36	39	39	36	34	35	31	36	60
Nairobi	293	239	214	212	204	186	192	179	189	199
N. Eastern	6	4	4	4	4	4	4	4	5	4
Nyanza	52	41	40	40	40	38	40	39	46	70
Rift valley	128	82	75	75	71	67	67	61	75	139
Western	29	18	19	19	19	18	18	15	20	28
Total	740	575	534	532	512	486	494	465	530	692

Source; authors compilation

Over the period 2000 to 2003. there was economic slow down mainly attributed to the severe drought that adversely affected the agricultural production and industrial output. As shown in Table 1. there was a decline in the total number of branches but with the economic rebound experienced after the year 2003 there has been an expansion in the number of branches up to a total of 740 as at December 2007. The branch expansion occurred also due to the many products and services that banks had introduced and thus different branches were set up to fit various characteristics of the products. Increased competition destroyed initial market forcing banks to pursue a super market strategy for which branch networking are crucial.

With the expanded growth in the banking sector. employment rose by 39.1 percent from 15,568 in 2006 to 21,657 employees by end of 2007 as shown in Table 2. The increase in staffing was largely attributed to the expansion in branch network in most institutions and the expansion in business volumes attributed to economic growth.

Table 2: Employment Trends in the Banking Industry

Category	2007	2006	2005	2004	2003	2002	2001	2000	1999
Management	4727	3981	3479	3165	3096	3104	3208	3408	3345
Supervisory	3865	3258	2978	2743	2564	2276	2109	2030	2108
Clerks	12773	7227	5902	5130	4862	5032	5329	5872	6747
Others	292	1102	230	903	809	928	1208	1512	1762
Total	21657	15568	12589	11941	11331	11340	11854	12822	13962

Source: authors compilation

The table shows a 73.5 percent decline in support staff in 2007 compared with 2006. This is attributed to the outsourcing of support services that most financial institutions adopted over the period 1999- 2007. Employment in the banking industry was on a downward trend in the period 2000 to 2003. Total staff complement decreased by 8.2 percent from 13,962 in December 1999 to 12,822 in December 2000. Reduction in employment in the banking industry was experienced in all categories except management. This trend continued up to a low of 11, 331 employees in 2003. As employment was decreasing the branches were expanding implying that banks were trying to increase efficiency and productivity by squeezing employees to get the best in them.

Central Bank of Kenya sits at the apex of Kenya's financial system as the custodian of monetary policy. The bank was established by an Act of Parliament in 1966, as a replacement of the former East African Currency Board. A decision was made in 1965 that each of the East African countries should have its own institution of monetary policy as a result of limited powers of the East African Currency Board. Since then the bank has been operating with the mission of maintaining price stability, fostering liquidity and creating a stable financial system in the country.

Although deregulation was expected to improve the competitiveness and efficiency of the banking sector and the financial system and given the fact that some new banks, mostly foreign owned and former building societies, were established and competed intensively with the existing banks for market share, over the period covered by the study several banks were put under statutory management after failing to meet cash reserve and liquidity requirements. This was due to huge non-performing loans and prolonged loss making periods which lead to gross under capitalisation.

The commercial banks have been experiencing a lot of changes and restructuring over the years, with a view of improving efficiency and profitability. One of the restructuring methods practised extensively is mergers. Kithinji and Waweru (2003) found out that the overall financial performance on average indicated an improvement after merger period compared to pre-merger period. Kenya's economic resurgence in the period 2004-2007 helped boost growth mainly in tourism and agricultural sectors, which in effect generated substantial incomes and hence created demand for banking services. In order to tap increased demand for banking services, a number of institutions put in place strategic programmes to expand their outreach to rural areas that are not adequately served. Consequently, the banking sector branch network increased by 7.7 percent from 534 branches in December 2005 to 575 branches in December 2006 and to 740 by 2007.

Financial institutions continue to utilise ICT as a tool to enhance operational efficiency, support newly developed products and improve the quality of customer service. For example, some banks are focusing on branch interconnectivity to facilitate branchless

banking and increasingly embracing E-banking to reduce long queues in banking halls. the mobile phone banking services provide several account enquiry tools (CBK, 2007). Besides, in today's competitive banking environment, exemplary customer service is one of the distinguishing characteristics that banks can exploit to establish a competitive edge. Since most banks offer comparable products and services, they continually search for a competitive advantage that will attract new customers and help them retain existing ones. Banks therefore must endeavour to develop innovative programs and initiatives to maintain superior customer service levels while remaining profitable.

In the liberalised and dynamic markets with constantly changing consumer preferences, new structures of production and work among others, there is need to rethink the concepts of productivity. Traditionally productivity was viewed mainly as an efficiency concept that is the amount of outputs in relation to inputs. Today productivity is increasingly being viewed as an efficiency and effectiveness concept, effectiveness being how well nations, sectors and organizations meet dynamic needs and expectations of their markets or how organizations, sectors or nations create and offer customer value.

At the enterprise level, productivity is measured in order to analyse and determine the levels of effectiveness and efficiency. Its measurement can stimulate operational improvement. Productivity indices can help an enterprise to establish realistic targets and check points for diagnostic activities during an enterprise development process, pointing to bottlenecks and barriers to performance.

1.3 Problem Statement

The efficiency and development of the financial system is instrumental in fostering investment and economic growth. An inefficient and weak financial market limits the efficient collection and allocation of resources and subsequently causes waste in those sectors. Inefficient and fragile banking systems are a major hindrance to economic growth.

A critical objective of any developing country is to enhance economic growth and development. The contribution of the banking industry towards the attainment of this objective cannot be gainsaid. Banks play a pivotal role in the process of financial intermediation by mobilizing the transfer of funds between the surplus units and the deficit units and they are prime movers of economic life. A banking system that efficiently channels available resources to productive uses is a powerful mechanism for economic growth. (Levine, 1997). The productivity level of commercial banks in Kenya is not known and hence we cannot ascertain the contribution of the banking sector to the critical process of economic growth. Therefore, this study seeks to fill the gap by measuring the productivity of commercial banks in Kenya.

The banking sector in Kenya has witnessed significant growth over time. Starting from 1990s Kenya introduced a series of financial reforms to boost the efficiency and productivity of the banks by limiting state interventions and enhancing the role of market forces. Enticed by the tremendous transformation of this industry the current study measures the productivity change of Kenyan commercial banks from 1999 to 2007 using

a non-parametric technique. Data Envelopment Analysis (DEA) by exploiting the strength of Malmquist Productivity Index to assess productivity change.

1.4 Objectives

The broad objective of this study is to assess the performance of the banking industry in Kenya in terms of its productivity. The specific objectives are:

i. To measure the productivity of commercial banks in Kenya and to investigate the factors that explain its growth.
ii. Use (i) above to analyze the performance of the industry.
iii. Use (i) and (ii) above to suggest policies of enhancing efficiency improvements in the industry.

1.5 Justification

The problem of soundness in banking and financial systems has become important in all countries in recent years and it is also relevant in Kenya, where the financial sector has been developing and growing rapidly in step with the whole economy. It is because of this that the monitoring and analysis of the performance of banks requires special attention, since productivity is fundamental to profitability and survival.

Since efficient banking systems tend to contribute extensively to higher economic growth in any country, studies of this nature are very important for policy makers, industry leaders and others who are reliant on the banking sector. This study should fill a gap in

this regard as it examines the performance of Kenyan commercial banks following deregulation. By so doing, we should be able to draw some indicative conclusions and make relevant policy recommendations, to facilitate and foster sound growth of the sector.

The outcome of this study will provide a comprehensive source of information to all players in the industry on the performance of commercial banks in terms of productivity and help to form a basis for suggesting policy changes necessary for the Kenyan banking sector. Besides, the deregulation process is still incomplete and remains highly challenging, any conclusion from this study will therefore inform policy makers on whether to deregulate or re-regulate.

CHAPTER TWO

2.0 Literature Review

This chapter reviews literature on productivity change and its application to the banking industry from both theoretical and empirical perspectives.

2.1 Theoretical Literature Review

Productivity growth is generally defined in terms of the improvement and technical change with which inputs are translated into outputs in the production process, (Shih-Hsun *et al.*, 2003). Indices of productivity can therefore be simply referred to as the ratio of aggregate output index to an index for total factor use. In assessing growth, sustainability and competitiveness in the banking sector, proper identification and measurement of banking productivity growth is important.

The productivity of a firm, organisation or nation is a gauge of the relationship between its production of goods and services and the factors of production used- labour, machinery and raw materials among others, thus productivity measures the ratio of outputs to inputs or a firm's productive efficiency. Productivity is a basic analytical tool used in economics and management, since any increase in its value indicates that scarce and expensive human and material resources are being used more efficiently

The performance of a firm, (conversion of inputs into outputs), can be defined in many ways. One possible way is to view it as a productivity ratio. By defining the productivity

of a firm as the ratio of outputs that it produces to the inputs used, the larger value of this ratio can be associated with better performance. Productivity is a relative concept. Therefore, the productivity of a company in the present year could be measured relative to its productivity last year, or it could be measured relative to the productivity of another company in the same year. It is even possible to compare the productivity of an industry over time or across countries.

According to Chambers (1988), productivity can be used to measure the rate of technical change in production and can be conceptualized as two main components namely partial factor productivity (PFP) and total factor productivity (TFP). Partial factor productivity is the ratio of output to a specific input. This only measures the contribution of one particular input to technical change, ignoring the effects from other factor inputs, while total factor productivity (TFP) is the partial product of all factor inputs. It is the ratio of output to an index of inputs. Productivity measurement is usually conducted from two perspectives – according to the level of productivity and according to the trends in the productivity.

Productivity is the quotient obtained by dividing output by the factors of production. The term 'productive efficiency' is commonly used to describe the level of performance of a production unit in terms of its utilisation of input resources in generating outputs while minimizing the wastage of resources in their production processes. Koopmans (1951) defined technical efficiency as a feasible input/output vector where it is technologically impossible to increase any output without simultaneously reducing another output. This

analogy holds for a reduction in any input or both a reduction in any input and an increase in any output.

Farrell (1957) demonstrated that for a production unit, economic efficiency is composed of two separate efficiency measures called technical efficiency and allocative efficiency. Economic efficiency is a term that refers to the optimal production and consumption of goods and services. This generally occurs when prices of products and services reflect their marginal costs. Farrell measured technical inefficiency as the maximum equi-proportional reduction in all inputs consistent with equivalent production of observed output. Allocative efficiency is based on cost considerations namely input prices. It is a situation where no one could be made better off without making someone else at least as worse off. This can be illustrated using a production possibility frontier (PPF) - all points that lie on the PPF can be said to be allocatively efficient because we cannot produce more of one product without affecting the amount of all other products available. The type of efficiency measured depends on the data availability and appropriate behavioural assumptions (Yin, 1999). When only quantities are available, technical efficiency can be calculated. When both, quantities and prices are available, economic efficiency can be calculated and decomposed into technical and allocative components.

Technical inefficiency arises in cases where more of each input is used than what should be required to produce a given level of output. Technical inefficiency is typically attributed to lack of strong competitive pressures, which allow bank managers to continue with less than optimal performance (Reda, 2006). Because it relies solely on the amounts

of inputs and outputs in its calculation and does not involve factor prices, which are mostly market or regulation driven, technical inefficiency is entirely under the control of bank management and thus results directly from management laxity and errors.

Technical inefficiency consists of two mutually exclusive and exhaustive components: pure technical inefficiency (PTE) and scale inefficiency (SE). Pure technical inefficiency is defined as managerial inefficiency devoid of scale effects. When the scale issues are dismantled, technical inefficiency (TE) and pure technical inefficiency (PTE) scores are the same, as the difference between them refers to scale inefficiency. Thus PTE refers to proportional reduction in input usage that can be obtained if the bank operates on the efficient frontier. As it results directly from management errors, it is considered one form of managerial inefficiency. Scale inefficiency refers to non-optimal choice of production scale in terms of cost control. A scale efficient firm will produce where there are constant returns to scale (CRS). Thus, when there are increasing returns to scale (IRS), efficiency gains could be obtained by expanding production levels. If decreasing returns to scale (DRS) exist, efficiency gains could be achieved by reducing production levels.

There are many different measures of productivity change, some of which are; growth accounting, stochastic frontier analysis (SFA) and data envelopment analysis (DEA). The choice between them depends on the purpose of productivity measurement and, in many instances, on the availability of data. Growth accounting is the most widely used method for measuring productivity, it assumes that output is produced using labour (L) and capital (K), and the relative contribution to output growth of L and K are β_L and β_K,

respectively. Productivity can be obtained as the residual of subtracting β_l*L + β_k*K from output change. While growth accounting is attractive on account of its simplicity it requires several restrictive assumptions to hold. Among them is that product markets must be perfect so that the factor shares reflect their respective marginal products, agents are assumed to be maximising and production equilibrium is reached under an optimal allocation of resources. However, the drawback from this approach is that the parameters are average values and if the features of the firms are heterogeneous then this approach will be an inappropriate tool.

To circumvent the averaging problem we rely on SFA. This approach constructs a frontier of efficient observations which envelops the relatively inefficient observations. An important advantage of the method is the ability to handle outliers and to allow for hypothesis to be tested. However, there are major drawbacks to this approach. The production function is assumed valid for all observations and technological change is the same for all observations. Besides, the distributional form of the error term as well as the functional form of the production function has to be specified

By contrast, DEA does not require any assumption about the functional form of the production function or economic agent's behaviour. Furthermore, there is no need to assume any specific distributional form of the error term and there is no need to assume perfect capital markets or optimal allocation of resources. This is not to imply that the above approaches should be ignored: in fact there is need for simultaneous techniques since results are sometimes sensitive to methodology.

DEA can either be input or output oriented depending on the objectives. The input-oriented method, defines the frontier by seeking the maximum possible proportional reduction in input usage while the output is held constant for each country. The output-oriented method seeks the maximum proportional increase in output production with input level held fixed. These two methods, that is, input-output oriented methods provide the same technical efficiency score when a constant return to scale (CRS) technology applies but are unequal when variable returns to scale (VRS) is assumed (Coelli et al. 2005). In this study, the output-oriented method is used by assuming that in banking, output maximization is obtained from a given set of inputs.

There are different methods for estimating the total factor productivity (TFP) for instance Malmquist and Tornquist indexes. The former has gained popularity in recent years since Fare et al., (1994) applied the linear programming approach to calculate the distance functions that make up the Malmquist index. According to Shih et al, (2003), since Data Envelopment Analysis (DEA) can be directly applied to calculate the index, the Malmquist index has the advantage of computational ease. Besides it does not require information on cost or revenue shares to aggregate inputs or outputs, and consequently it is less data demanding and allows decomposition into changes in efficiency and technology. This method does not attract any of the stochastic assumptions restriction. However, it is susceptible to the effects of data noise, and can suffer from the problem of unusual' shadow prices, when degrees of freedom are limited (Coelli and Rao, 2005).

2.2 Empirical Literature Review

Many empirical studies have been carried out to investigate the level of productivity both at the macro and micro level and mixed results have been obtained. Koutsomanoli-Filippaki et al (2009) employ the directional technology distance function to provide estimates of bank efficiency and productivity change across Central and Eastern European (CEE) countries and across banks with different ownership status for the period 1998–2003. Their results demonstrate the strong links between competition and concentration, with bank efficiency. They also show that productivity for the whole region initially declined but later improved with further progress on institutional and structural reforms. However, they find evidence of diverging trends in productivity growth patterns across banking industries. They also show that foreign banks outperform domestic private and state-owned banks both in terms of efficiency and productivity gains. In Overall they conclude that productivity change in CEE is driven by technological change rather than efficiency change.

Kaino and Meso (2008) conducted a study examining profit efficiency of commercial banks in Kenya after liberalisation. By utilising a stochastic frontier approach they estimated the annual profit efficiency scores for 17 commercial banks for the period, 1995-2004. They found an average of 65.6 percent profit efficiency over the study period. However, the mean profit efficiency declined from 67.9 percent in 1995 to 62.9 percent in 2000 and thereafter increased consistently to 68 percent in 2003. The initial decline in profit efficiency could be due to the oligopolistic nature of the Kenyan banking sector and the unfavourable macroeconomic environment that prevailed after the financial

sector reforms. The study further finds that bad debts were concentrated in banks that reported low levels of profit efficiency.

Anca and Jiri (2005) in their paper addressed the correlation between cost inefficient management and bank failure by carrying out a cost efficiency analysis and Cox proportional hazards model estimation. They employed three panel data parametric methods, namely Stochastic Frontier Approach (SFA), Random Effect Model (REM) and Distribution Free Approach (DFA)-in the form of Fixed Effect Model (FEM). The differences between particular parametric methods have been shown to stem from the way of disentangling inefficiency from the random part of the stochastic cost frontier. As for the construction of variables, demand deposits and total loans net of bad loans accounted for outputs, as the input prices were considered to consist of price of labour, price of physical capital and price of borrowed funds. The paper concludes that the risk of bank failure is closely correlated with cost inefficient management. They observed that the banks that failed tended to gradually descend in the relative ranking of efficiency to the bottom quartiles and one year prior to failure, all failed banks were placed in the least efficient quartile. Thus their findings validate the signalling effect of deteriorating efficiency for risk of bank failure.

Su wu (2004) in his paper categorized the sampled banks in Australia into 5 sub-groups; major banks, existing regional banks, newly established regional banks, foreign banks and specialised banks. Using Data Envelopment Analysis (DEA) and Malmqiust indices method he found out that, the major banks are the most inefficient group while foreign

banks performed far superior to existing regional banks and slightly inferior to newly established banks, but these three types of banks ended up with similar levels of high efficiency in the latter part of the sample period. He concluded that the major source of inefficiency in the industry is scale inefficiency arising from sub optimal size of operation, and that the low scale inefficiencies of the major banks group dominated and this could be improved if they reduced their operations size.

Reda (2006) in his study measured the efficiency and productivity change of Egyptian commercial banks from 1995 to 2003 using non-parametric techniques: Data Envelopment Analysis (DEA) and Malmquist Productivity Index. Results indicated that over the period covered by the study, Egyptian commercial banks' technical inefficiency was 22 percent, and in general, smaller banks were found to be least efficient. Malmquist results for a panel of 24 banks indicated that commercial banks productivity on average deteriorated by 4 percent per year during the study period.

Casu et al (2004) compared parametric and non-parametric estimates of productivity change in European banking between 1994 and 2000. They decomposed Productivity change into technological change, or change in best practice, and efficiency change. Their results suggest that productivity growth, where found, was mainly brought about by improvements in technological change and there were no 'catch-up' by non-best-practice institutions. However they conclude that competing methodologies sometimes identify conflicting findings for the sources of productivity. The two approaches generally do not

yield markedly different results in terms of identifying the components of productivity growth in European banking during the 1990s.

Angelidis and Lyroudi (2006) examined the productivity of the Italian banking industry for the period 2001-2002. To measure productivity they estimated Malmquist index and found it to be 1.035, implying that total factor productivity increased by 3.5%. Its two components, the technological change index was found to be 0.559 and the technical efficiency change index was 1.853 (in nominal values).

Berg, Forsund and Jansen (1992) introduced the Malmquist index as a measurement of the productivity change in the banking industry. They focused on the Norwegian banking system during the deregulation period covering 1980-1989. Their results indicated that deregulation creates a more competitive environment. The increase of productivity was faster for larger banks, due to the increased antagonism they faced.

Favero and Papi (1995) used the non-parametric Data Envelopment Analysis on a cross section of 174 Italian banks in 1991 to measure the technical and the scale efficiencies of the Italian banking industry. In implementing both the intermediation and the asset approach, the traditional specification of inputs was modified to allow for an explicit role of financial capital. In addition, regression analysis was used on a bank specific measure of inefficiency to investigate determinants of banks' efficiency. According to the empirical results, efficiency was best explained by productivity specialisation by bank

size and to a lesser extent by location (north-Italian banks were more efficient than south-Italian banks).

Allen and Rai (1996) estimated a global cost function using an international database of financial institutions for fifteen countries. Their sample was divided into two groups according to the country's regulatory environment. Universal banking countries (Australia, Austria, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, Italy, United Kingdom and Sweden) permitted the functional integration of commercial and investment banking, while separated banking countries (Belgium, Japan and US) did not. Large banks in separated banking countries exhibited the largest measure of input inefficiency and had dis-economies of scale. All other banks had significantly lower inefficiency measures. Moreover, small banks in all countries showed significant levels of economies of scale. Italian banks, along with French, UK and US ones were found to be less efficient than Japanese, Austrian, German, Danish, Swedish and Canadian ones.

Pastor, Perez and Quesada (1997) analysed the productivity, efficiency and differences in technology in the banking systems of United States, Spain, Germany, Italy, Austria, United Kingdom, France and Belgium for the year 1992. Using the non-parametric approach (DEA) together with the Malmquist index, they compared the efficiency and differences in technology of several banking systems. Their study used the value added approach. Deposits, productivity assets and loans nominal values were selected as measurements of banking output, under the assumption that these are proportional to the number of transactions and the flow of services to customers on both sides of the balance

sheet. Similarly, personnel expenses and no-interest expenses, other than personnel expenses were employed as a measurement of banking input. According to the results France had the banking system with the highest efficiency level followed by Spain, while UK presented the lowest level of efficiency.

Altunbas and Molyneux (1996) examined the banking systems of France, Germany, Italy and Spain for economies of scale and scope. They found differences among the four markets regarding economies of scale. However, the latter were significant only for the Italian banks, which gained as they succeeded in lowering costs.

2.3 Overview of the Literature

This chapter has provided a brief review of the theoretical and empirical literature on productivity studies, with special reference to the banking industry and DEA-based studies. Productivity studies on banks and other financial institutions have been conducted in developed and developing countries. However, the majority of studies conducted concentrated on financial sectors in US and Europe. The empirical studies have mixed evidence on the outcomes of financial liberalization. Some countries experienced productivity growth in the first years of the reforms but later there was deterioration while others have managed to reap the positive outcomes all through. Thus, it is difficult to derive a conclusion about the outcome of financial liberalization in a particular country based on studies made in other countries. The studies highlight the fact that the financial services sectors in developing countries have not been adequately researched. In-depth analysis of these markets is essential to formulate the required policies. The findings in other countries are probably irrelevant to a particular country since they have

demographic, social, political and economic differences. Therefore, it is essential to do a country specific analysis.

CHAPTER THREE

3.0 METHODOLOGY AND DATA

3.1 Introduction

This section describes the methodology employed in the present study. The study is done in two stages In the first stage we estimate total factor productivity (TFP) scores using DEA and in the second stage we assess the factors that influence TFP growth. In the first stage Malmquist index is constructed using the DEA based Malmquist approach which allows for calculation of technical progress and technical efficiency. This type of decomposition is important in facilitating a multilateral comparison that may help explain and characterize the differences and similarities in growth patterns of different banks. This study applies the method of Data Envelopment Analysis (DEA), a non-parametric technique which does not require specification of a particular form of the production function. Using a framework developed by Färe et al. (1992, 1994), Malmquist productivity index is computed and total factor productivity is decomposed into change in technical efficiency and technological change, the Malmquist index is used to measure Kenya's commercial banking sector productivity. In second stage an OLS regression is estimated to examine the determinants of TFP growth.

3.2 Data Envelopment Analysis

DEA has proven to be a popular technique for performance analysis in general and in the banking sector in particular. In this regard, the banking sector has a series of characteristics that make it particularly suitable for study through DEA. DEA technique defines productivity measure of a production unit by its position relative to the frontier of

the best performance established mathematically by the ratio of weighted sum of outputs to weighted sum of inputs. The estimated frontier of the best performance is also referred to as efficient frontier or envelopment surface.

Distance functions can be estimated by Data Envelopment Analysis (DEA). Grosskopf (1994) and Rao and Coelli (1998) explain clearly how the estimation can be done. Suppose there are K regions (indexed by k) using N inputs (indexed by n) to produce M products (indexed by m). x_n^k and y_m^k denote the n^{th} input and m^{th} output in the k^{th} region at time period i ($i=s, t$). We have to solve a linear programming problem to evaluate each of the distance functions in equation (6). Assuming a constant returns-to-scale technology, we have

$$\left[D^{i}(x^{k'i'}, y^{k'i'})\right]^{-1} = \max_{z,\theta} \theta^{i} \qquad (9)$$

$$\text{s.t.} \quad \theta^{k'i'} y_m^{k'i'} \le \sum_{k=1}^{K} z^{ki} y_m^{ki}, \qquad m = 1,\ldots,M,$$

$$\sum_{k=1}^{K} z^{ki} x_n^{ki} \le x_n^{k'i'}, \qquad n = 1,\ldots,N,$$

$$z^{ki} \ge 0, \qquad k = 1,\ldots,K,$$

where z^{ki} is a variable indicating the intensity at which a particular activity is employed in constructing the frontier of the production set. Note that when $i=i'=s$ (correspondingly, $i=i'=t$), solving the above linear programming yields the technical efficiency in period s (t).

Färe et al. (1994) also estimate the production frontier for a variable returns to scale (VRS) technology and separates the "scale effect" from productivity changes. However, literature shows that Malmquist index may not correctly measure total factor productivity (TFP) changes when VRS is assumed for the technology. Berg et al. (1992). contend that there may be confusion in the simultaneous use of CRS and VRS technologies within the same decomposition of the Malmquist index. In this study we confine our analysis to the use of CRS as the reference technology in computing the productivity indices.

There has been a growing literature applying this method to study productivity in various sectors. Färe et al. (1994) compute the Malmquist indices for 17 OECD countries and analyse the relationship between productivity growth. technical progress and efficiency change among them. Rao and Coelli (1998b) extend the analysis to a large data set and incorporate inequality into their analysis of social welfare. This study is an attempt to apply this technique to Kenyan commercial banking sector.

3.3 Malmquist Productivity Index

The study used Malmquist total factor productivity (TFP) index to examine productivity change in the banking industry. Malmquist firm-specific productivity indices were introduced by Caves, Christensen and Divert (1982). Assuming an output possibility set of the following type:

$$P(x) = \{y: x \text{ can produce } y\}. \qquad (1)$$

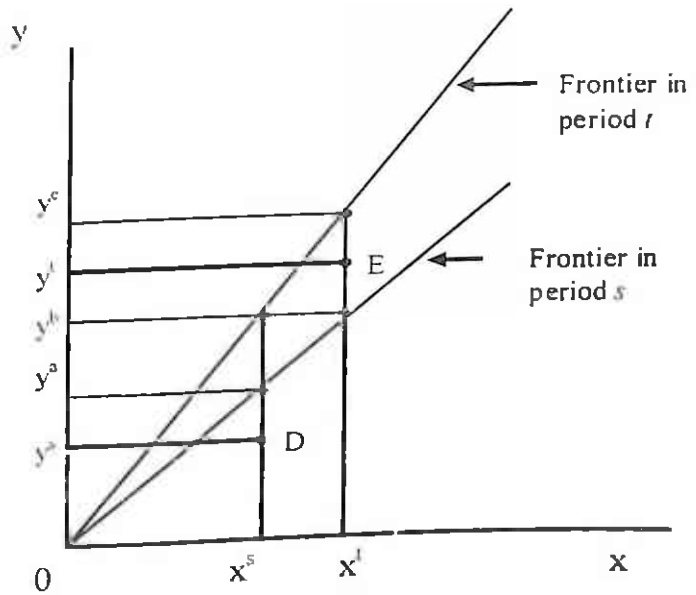
The output distance function with technology at time s, the initial period. can be defined as:

$$d^s(x, y) = \min\{\theta : \frac{y}{\theta} \in P(x)\} \qquad (2)$$

Note that when θ is minimised, y/θ is maximised. Thus this distance function measures the maximum possible output that a given amount of inputs can produce. Similarly, we can define a distance function in relation to technology in time t, the final period, as $d^t(x, y)$.

The idea can be shown graphically by a simplified one-input and one-output with constant returns to scale (CRS) technology case. Points D and E in Figure 2 represent the input-output combinations of a production unit in period s and t respectively. In both cases, the production unit is operating below the production possibility frontier. In period s (correspondingly, period t), with input x^s (x^t), it should be able to produce y^a (y^c) if it has full technical efficiency. The technical efficiency is then measured by y^s/y^a (y^t/y^c).

Figure 2: Decomposition of the Malmquist Productivity Index



Source: Yin (1999)

Productivity change can be measured by the part of output growth that is not contributed by input growth. In Figure 2, we can calculate a productivity index by $(y^t/y^s)/(y^b/y^a)$, where (y^t/y^s) is the output growth and (y^b/y^a) represents a movement along the production frontier in period s. This can be rewritten as $(y^t/y^b)/(y^s/y^a)$, where the numerator is a distance function for output in period t (y^t) with reference to the technology of period s and the denominator is the distance function representing technical efficiency in period s. This is precisely the Malmquist Productivity Index defined by Caves, Christensen and Diewert (1982a and 1982b; hereafter CCD), with reference to the technology of the initial period:

$$m^s_{CCD} = \frac{d^s(x^t, y^t)}{d^s(x^s, y^s)} \qquad (3)$$

However, we can also choose technology in period t as the reference in defining a productivity index. The Malmquist Productivity Index in relation to the technology of the final period can then be defined as:

$$m^t_{CCD} = \frac{d^t(x^t, y^t)}{d^t(x^s, y^s)} \qquad (4)$$

The two indexes appear to be identical in the simple case represented by Figure 2. However, they may or may not be the same in the case of multiple inputs and varying returns to scale (VRS) technology. To avoid the arbitrariness in choosing the benchmark, Färe et al. (1992 and 1994) specify the Malmquist Productivity Index as the geometric mean of the above two indexes:

$$m\ (x^{t}, y^{t}, x^{s}, y^{s}) = \left[\frac{d^{s}(x^{t}, y^{t})}{d^{s}(x^{s}, y^{s})} \times \frac{d^{t}(x^{t}, y^{t})}{d^{t}(x^{s}, y^{s})} \right]^{1/2} \qquad (5)$$

Fare et al. (1992) shows that this index is equivalent to:

$$m\ (x^{t}, y^{t}, x^{s}, y^{s}) = \frac{d^{t}(x^{t}, y^{t})}{d^{s}(x^{s}, y^{s})} \times \left[\frac{d^{s}(x^{t}, y^{t})}{d^{t}(x^{t}, y^{t})} \times \frac{d^{t}(x^{s}, y^{s})}{d^{t}(x^{s}, y^{s})} \right]^{1/2} \qquad (6).$$

In Figure 2, the two components of the Malmquist Index as in Equation (6) are represented by:

$$\text{Efficiency change} = \frac{y^{t}/y^{s}}{y^{s}/y^{a}} \text{ : and} \qquad (7)$$

$$\text{Technical change} = \left[\frac{y^{t}/y^{b}}{y^{t}/y^{s}} \times \frac{y^{s}/y^{a}}{y^{s}/y^{b}} \right]^{1/2}. \qquad (8)$$

The definition of a bank's function is one of the complications in bank productivity studies that affects variable selection and associated results. Two approaches in the banking literature discuss the activities of banks: the production approach and the intermediation approach. Both approaches apply the traditional microeconomic theory of the firm to banking and differ only in the specification of banking activities. In the production approach, banking activities are described in terms of production of services to depositors and borrowers. The intermediation approach describes banking activities as transforming the money borrowed from depositors into the money lent to borrowers. Similar to many studies on banking, the study adopts the intermediation approach. The use of intermediation approach in bank productivity presents fewer data problems than with the production approach and literature suggests that it is the most appropriate

approach for evaluating the entire banking industry as it is inclusive of interest expenses, which account for 50-66% of total costs of banks (Rao, 2002).

3.4 First Stage Estimation

Equation 6 is our estimable equation where the ratio outside the brackets measures the change in technical efficiency (EFFCH) between the years *s* and *t*. The geometric mean of the two ratios inside the square brackets captures the shift in technology (TECH) between the two periods evaluated at x^s and x^t. Note that TECH is larger than one, indicating that the production technology is progressive within two periods and that the technology level is depressive if the value of TECH is smaller than unity. If EFFCH is larger than one this means the efficiency improvement has occurred within the two periods, but if EFFCH were smaller than one, this would indicate that bank efficiency had become worse than before.

To estimate equation 6 we model commercial banks as multi-product firms, producing 3 outputs and using 3 inputs. The input vector includes; labour, capital, and loanable funds, which is the sum of deposit (demand and time) and non-deposit funds (value of total liabilities). Hence, the total cost includes both interest expense and operating costs and are proxied by the sum of labour, capital and loanable funds expenditures. The output vector includes: customer loans net of provisions, other earning assets, (loans to special sectors, interbank funds sold) and investment securities (treasury bills, government bonds and other securities). The time series data is entered in the Data Envelopment Analysis

Programme version 2.1 to generate Total Factor Productivity scores. The results are reported in Table 5a and 5b.

3.5 Second Stage Estimation Technique

The second stage of the study estimates an ordinary least square (OLS) regression of TFP scores on a vector of explanatory variables namely asset composition, share in local deposit market, structure of ownership and number of branches to explain the variation of the scores derived from first stage as well the source of the declining productivity. The general formula can be shown as:

$$y = f(x_i, \varepsilon)$$

Where y is the TFPCH index and x_i represents a vector of explanatory variables. The empirical equation takes the following form:

$$TFPCH = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 P_1 + \beta_5 N$$

Where x_1 is the asset composition calculated by the value of net loans as a share of total assets, x_2 is the concentration ratio in local deposit market, p_1 is a dummy variable for the ownership structure where 1=foreign banks, 2= local banks (in the model only one dummy is included to avoid dummy trap) and N is the number of bank branches. Using STATA 10 the results are summarised in Table 7.

3.6 Variable description and Data source

This study is based on annual data covering the period 1999-2008 for the commercial banks in Kenya. The data is collected from Central Bank of Kenya publications including Statistical Bulletin and Annual reports, International Financial Statistics (IFS) and

different annual financial reports of scheduled banks over the period. Table 3 shows a summarised description of the variables used in the study.

Table 3: Definition of Variables

Variable	Type	Description
Capital	Input	Net shareholders fund in Kshs. Million.
Labour	Input	Labour expenses in Kshs. Million.
Customer Deposits	Input	Value of total aggregate deposit by customers. in million of Ksh.
Investments	Output	Governments bonds and other securities.
Customer loans	Output	Value of total aggregate loans and advances to customers net of provisions. in million of Ksh.
Other earning assets	Output	Fees and commissions from loans to special sectors and interbank funds sold in million of Ksh.
Asset composition	Independent variable	Value of net loans as a share of total assets
Concentration in the local deposit market	Independent variable	Market share in the local deposit market
Ownership Structure	Independent variable	Dummy variable P1= foreign owned P2= locally owned
Number of Branches	Independent variable	Number of branches for each bank as at the end of 2008

Source: Author

The study used DEAP version 2.1 (Coelli. 1996) and STATA 10 econometric software.

The data availability made it possible for only 34 banks to be used in the study.

CHAPTER FOUR

4.0 ESTIMATION RESULTS

This chapter gives an account of research findings starting with the descriptive statistics of the variables used followed by the first stage DEA Malmquist index results then the second stage regression results.

Fare *et al.* (1984) made known that the output distance function is the equivalent of the inverse of Farell's measure of output efficiency. This study used malmquist index to measure the productivity growth of banking sector for 34 commercial banks in the period 1999–2008. The method used constructed the best – practice frontier in banking production for the sampled banks, Malmquist productivity indices as well as efficiency change and technological change components for each bank in the sample were calculated. Since this index is based on discrete time, each bank was given an index for every pair of years.

4.1 Summary of Descriptive statistics

Summary of descriptive statistics for the outputs and inputs used is shown in Table 4. DEA is able to integrate unlike multiple inputs and outputs to make simultaneous comparisons that would otherwise not be possible.

Table 4: Descriptive Statistics of the Variables

Variable	No. of Obs.	Mean	Std Dev	Min	Max
Shareholders Fund(Kshs. M)	340	2125.388	3193.597	0	21087
Administration Cost(Kshs. M)	340	630.4294	1213.361	11	8499
Customer Deposit(Kshs. M)	340	12507.44	20768.4	247	126691
Customer Loans(Kshs. M)	340	8432.376	15328.65	209	108086
Govt. securities(Kshs. M)	340	3315.194	5888.182	0	31940
Fees and Commission(Kshs. M)	340	455.6824	1052.547	0	6584
TFPCH	34	0.974	0.05	0.824	1.073
Asset Composition	34	0.509	0.115	0.21	0.7
Deposit Market Share	34	2.615	30944	0.13	16.86
Ownership Structure	34	1.853	0.61	1	2
Number of Branches	34	23.088	40.626	1	175

Source: Author

The dispersion of the variables across banks is very large, with the standard errors being nearly two times larger than the mean values and bank heterogeneity is therefore very significant.

4.2 Total Factor Productivity Growth

The first stage results are shown in Table 5a. 5b and Table 6. Table 5a presents Malmquist indices by annual means while Table 5b shows Malmquist indices means by firm for the period of study. Table 4b shows that 26 percent of the sample recorded productivity growth while the rest (74 percent) experienced a decline in productivity. In the sample the highest productivity growth experienced is 7.3 percent while the highest decline is 13.2 percent.

Table 5a: Malmquist Index Summary of Annual Means

year	EFFCH	TECH	PECH	SECH	TFPCH
1	0.0	0.0	0.0	0.0	0.0
2	1.042	0.981	1.022	1.019	1.022
3	0.982	0.951	0.99	0.992	0.935
4	0.978	1.045	1.01	0.969	1.023
5	1.039	0.994	1.001	1.037	1.032
6	0.94	1.005	0.975	0.964	0.944
7	0.967	0.957	1.02	0.948	0.926
8	0.984	0.992	0.985	0.999	0.977
9	1.086	0.853	1.01	1.075	0.926
10	1.044	0.941	1.037	1.006	0.982
mean	1.006	0.967	1.037	1.006	0.973

Source: Author

The average annual values of Total Factor Productivity Index (TFPCH), Technological Change (TECH), Technical Efficiency Change (EFFCH), Pure Technical Efficiency Change (PECH) and Scale Efficiency Change (SECH) for the years 1999 to 2008 are reported in Table 5a, while Table 5b shows the same but for average values across firms. Table 5a shows that there was total factor productivity growth in the first four years after which there was a decline in the following six years: the highest TFP growth was experienced in 5th year at 3.2 percent. On average there was decline of 2.7 percent in TFPCH which can be explained by the decline in TECH of 3.3 percent which is greater than the slight growth in EFFCH of 0.6 percent. TFPCH is a combination of TECH and EFFCH. The Malmquist Index cannot be constructed without a reference technology, which could be the technology of any year in a multi-period setting. We report the results relative to the technology fixed at the initial year 1999. Recall a value of the index greater than unity implies a positive growth of total productivity. An index equal to unity underlines no change in productivity level and a value less than one indicates decline in productivity from period t to period t+1.

Table 5b: Malmquist Index Summary of Firm Means

Firm	EFFCH	TECH	PECH	SECH	TFPCH
1	1.021	0.977	1.024	0.997	0.998
2	1.004	0.936	1.013	0.992	0.939
3	1.000	1.016	1.000	1.000	1.016
4	0.998	1.000	1.000	0.998	0.988
5	0.972	1.015	1.000	0.972	0.987
6	1.035	0.993	1.006	1.029	1.028
7	0.980	0.958	0.986	0.994	0.938
8	0.996	0.973	1.000	0.996	0.969
9	1.010	0.978	1.002	1.008	0.988
10	1.066	1.006	1.066	1.001	1.073
11	1.026	0.994	1.009	1.017	1.020
12	1.000	0.958	0.993	1.008	0.958
13	0.987	0.913	0.988	0.999	0.901
14	0.979	0.978	1.000	0.979	0.958
15	0.993	0.979	0.997	0.996	0.972
16	1.044	0.955	1.043	1.001	0.988
17	1.004	1.031	1.000	1.004	1.035
18	0.979	0.968	1.000	0.979	0.948
19	0.998	1.001	0.993	1.005	0.999
20	1.000	0.905	1.000	1.000	0.905
21	1.000	0.976	1.000	1.000	0.976
22	1.000	0.994	1.000	1.000	0.994
23	1.029	0.975	1.021	1.008	1.003
24	1.019	0.989	1.000	1.019	1.008
25	1.000	0.985	1.000	1.000	0.985
26	1.000	0.824	1.000	1.000	0.824
27	0.985	0.991	1.000	0.985	0.977
28	1.041	0.920	1.010	1.030	0.958
29	0.998	0.870	1.000	0.998	0.868
30	1.039	0.970	1.034	1.004	1.007
31	1.000	0.918	1.000	1.000	0.918
32	0.999	0.994	1.000	0.999	0.993
33	1.000	0.953	1.000	1.000	0.953
34	1.007	1.037	1.006	1.001	1.044
Mean	1.006	0.967	1.005	1.001	0.973

Source: Author

The mean values of TFP ranged from 1.073 and 0.868 for all the firms and the average TFP decline is 2.7 percent. 26 percent of the firms experienced TFP growth while 74 percent experienced TFP decline. 65 percent of the firms experienced EFF growth while 35 percent experienced a decline. On the other hand only 18 percent had a TE growth while 82 percent experienced a decline in TE growth. 12 percent had both EFF and TE growth. Thus the low number of firms that experienced growth in TE might have eroded the high number of firms that had growth in EFF leading to a decline in TFP.

Table 6: Summary of Malmquist Means by Sub-Sections

Sub- section of banks	Number of firms, Number of periods	EFFCH	TECH	PECH	SECH	TFPCH
Whole sample	34, 10	1.006	0.967	1.005	1.001	0.973
Small	9, 10	0.999	1.059	0.999	1.000	1.058
Medium	14, 10	1.002	1.004	1.001	1.001	1.006
Large	11, 10	1.002	1.011	1.001	1.001	1.013
Foreign owned	9, 10	1.003	0.978	1.002	1.001	0.981
Local owned	21, 10	1.008	1.030	1.001	1.000	1.039
Public owned	4, 4	1.000	0.935	1.000	1.000	0.935
Listed in NSE	4, 4	1.018	0.919	1.008	1.010	0.936
Not listed in NSE	30, 10	1.002	1.095	1.002	1.000	1.097

Source: Author

It is important to examine the main cause of low productivity. The level of TFP of the banking sector can be improved either by change in technical efficiency or a shift in production frontier (technological change). Table 6 shows the comparison between technical efficiency change and technological change for the various sub-sections of banks considered in the study. Among the 34 commercial banks, 9 foreign-owned and 4

public-owned banks recorded decline in productivity on average. The 4 listed banks had a decline in productivity while 30 non-listed banks recorded growth in productivity. For all the sub-sections only small banks had a decline in EFF while foreign-owned, publicly-owned and listed banks had a decline in TE. The sub-sections that experienced a decline in TE also recorded decline in TFP although they had recorded growth in EFF.

4.3 Regression Results of TFP Determinants

A second stage analysis was conducted to investigate other factors that affect total factor productivity from both bank specific characteristic and operating environment features. TFPCH scores was the dependent variable with asset composition, share in the deposit market, structure of ownership and number of branches as the explanatory variables. Table 6 presents the results of the analysis.

Table 7: Estimation Results

	Coefficients	P>|t|
constant	0.880	0.000
Asset composition	0.165	0.038
Deposit market share	0.003	0.214
ownership1= foreign	0.025	0.198
Number of branches	0.0001	0.021
R-squared	0.3236	
Prob > F	0.0492	
Number of obs.	34	

Source: Author

Asset composition, share in deposit market and number of branches are positively correlated with TFPCH. The results indicate that foreign ownership of banks increases

the productivity growth by 2.5 percent in comparison to local ownership of banks. Therefore, foreign-owned banks enjoy a higher productivity than that of locally-owned banks. The reasons could be that, foreign banks have easier access to imported new technology and expertise, which local banks may not have and publicly-owned banks- part of locally owned banks- do not run on sound management principles. For instance, personnel assignments to top management is a dominant policy and is also political in nature. Besides, Publicly-owned banks are at times additionally restricted to some specified political objectives, such as to stabilize the stock market, to cool down inflation, and to deduce business capital costs, among others.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study was motivated by the fact that even though the banking sector is the largest component of the financial system in Kenya accounting for more than 80 percent of the financial sector assets, there is not much quantitative literature on its general performance and productivity. Employing Data Envelopment Analysis (DEA) Malmquist Index approach, the study examined total factor productivity change in Kenyan commercial banks during the period (1999-2008) along with its mutually exclusive and exhaustive components: change in efficiency (catching up or falling behind) and change in technology (innovation or shock).Productivity was measured by the Malmquist index and was found to be equal to 0.973, which means that total productivity decreased by 2.7 percent. Its two components, the technological change index was found to equal 0.967 and the technical efficiency change index was 1.006.

This study presents some important findings on levels and trends in Kenya banking productivity both over time and across the banks. The findings revealed that the TFP decline was observed for all the banks except for 9 banks whose growth ranged from 0.3 percent to 7.3 percent. The sources of growth were found to be efficiency change rather than technological progress. In terms of sub-sections small banks had the highest productivity growth of 5.8 percent; large banks had a growth in TFP of 1.3 percent while medium banks experienced a 0.6 percent growth. Locally-owned banks experienced a 3.9 percent productivity growth while foreign-owned and publicly owned banks had a

decline in productivity of 1.9 percent and 6.5 percent respectively. Its only medium banks, large banks, locally owned banks and banks not listed in NSE that experienced both efficiency and technological growth.

The effect of asset composition, market share in deposit market, number of branches and structure of ownership was examined. It was found that all variables included in the model have a significant impact on the TFP except the share in deposit market and the number of branches.

The Central Bank of Kenya passed a motion for banks to increase their core-capital from the current 250million to 1 billion by 2012. Some of the reasons for this motion were to increase the productivity of the banks and adequately insulate banks in the event of failure. The findings of this study are in support of this initiative as the large banks are found to be more productive than medium banks. With the increase in core-capital the small and medium banks will be in the category of large banks thus making them more productive. As the banks capitalize, they can lend more and still be well insulated in the event of failure. Kenyan banks have not been productive with low productivity emanating from technology change (innovations/shocks). Given that technology is the main driver of productivity in the banking sector, Central bank supervision department should design practicable protocol as a technological standards requirement.

5.1 Limitations of the Study

The study encountered various limitations. First, output measures do not include quality-type measures, such as service quality and equipment quality, because such data is

unavailable. Second, due to limited data, the samples do not represent all the banks. As noted the sample included 34 banks whereas Kenya has 42 commercial banks. Lack of well organized data is a statistical problem in all developing countries. We may thus be unable to give the full picture of Kenya's banking sector. Third, it is not easy to convey the empirical results to the bank managers; also the evaluations of banks usually require on-site visits. More in-depth research is needed to combine such visits with DEA measurements. Finally, DEA does not suggest the cause or offer remedies for the identified declining productivity. Internal audits or follow-up review procedures are also needed to define the types of operating changes that can facilitate productivity improvement. It will be a significant achievement if such needs are met in future.

The same characteristics that make DEA a powerful tool can also create problems. To start with since DEA is an extreme point technique, noise (even symmetrical noise with zero mean) such as measurement errors can cause significant problems. DEA is good at estimating "relative" efficiency of a DMU but it converges very slowly to "absolute" efficiency. In other words, it only states how well a firm is doing compared to other firms but not compared to a "theoretical maximum."

5.2 Areas for Further Research

The results showed that when there was a decline in TECH growth (technological change) an increase in EFFCH growth would not offset the effect of TECH and more often there is a decline in TFP growth. Therefore, a critical area for further research is an investigation of technology uptake in the banking sector, the challenges involved in the adoption and whether the technology fits the environment in which the banks are

operating. Further research could be carried out to investigate the productivity of Central Bank of Kenya which regulates the operations in the finance sector and implements the monetary and fiscal policies. Its productivity might have major implications on the productivity of firms involved in the finance sector including commercial banks

As earlier mentioned productivity is one way of measuring performance. others are competitiveness and efficiency measures. Other studies can be conducted focusing on these areas for comparison purposes. Finally, cross country studies can give a broader idea on the productivity of commercial banks in comparisons with their counterparts in other countries.

References

Adekunle, B., (2007). The Impact of Cooperative Thrift and Credit Societies on Entrepreneurship and Microenterprise Performance. PhD Thesis, University of Guelph.

Allen L. and Rai A., (1996), Operational Efficiency in Banking: An International Comparison, *Journal of Banking and Finance*, 20: 655-72.

Altunbas Y. and Molyneux P., (1996) Economies of Scale and Scope in European Banking, *Applied Financial Economics*, 6: 367-75.

Anca Podpiera and Jiri Podpiera, (2005). Deteriorating Cost Efficiency in Commercial Banks Signals Increasing Risk Failure, unpublished seminar paper Czech.

Angelidis, D. And Lyroudi, K., (2006). Efficiency in the Italian Banking Industry: Data Envelopment Analysis and Neural Networks. *International Research Journal of Finance and Economics*. 5:155-165.

Banker, R.D., Charnes, A. and Cooper, W.W., (1984). Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis, *Journal of Management Science*, 30(9):1078-1092.

Bates, W., (2001). How Much Government? The Effects of High Government Spending on Economic Performance, unpublished seminar paper NewZealand.

Berger, A.N., Hunter, W.C. and Timme S.G., (1993). The Efficiency of Financial Institutions: A Review of Research Past, Present and Future. *Journal of Banking and Finance*, 17:221-49.

Berg S.A., Forsund F. and Jansen E., (1992). Malmquist Indices of Productivity during the Deregulation of Norwegian Banking, 1980-89. *Scandinavian Journal of Economics*, 94:211-228.

Berger, A.N. and Humphrey, D.B., (1991). The dominance of Inefficiencies Over Scale and Product Mix Economies in Banking, *Journal of Monetary Economies*, 28:117-148.

Berks, T. and Michael J. Fuchs, (2004). Structural Issues in Kenyan Financial System: Improving Competition and Access, *World Bank policy research*, working paper No. 3363.

Brownbridge, M., Harvey, C. and Gockel F. A. (1988). Banking in Africa. Africa World Press. 1988.

Casu B. and Girardone C. and Molyneux P. (2004) Productivity Change in European Banking: A Comparison of Parametric and Non-Parametric Approaches. *Journal of Banking and Finance*. 28 (10): 2521-40.

Caves, D.W., Christensen, L.R. and Diewert, W.E. (1982). The Economic Theory of Index Numbers and Measurement of Input, Output and Productivity, *Econometrica*, 50: 1393-1414.

Central Bank of Kenya, Annual Reports, 2000.

_____, Annual Reports, 2001.

_____, Annual Reports, 2002.

_____, Annual Reports, 2003.

_____, Annual Reports, 2004.

_____, Annual Reports, 2005.

_____, Annual Reports, 2006.

_____, Annual Reports, 2007.

Chambers, R.G. (1988). Applied Production Analysis: A Dual Approach, Cambridge University Press, New York.

Charnes, A., Cooper, W., Lewin, A., Morey, R., and Rousseau, J., (1984). Sensitivity and Stability Analysis in DEA, *Annals of Operations Research*, 2:139-56.

Coelli, T.J., Prasada Rao, D.S., O'Donnell, C.J. and Battese, G.E. (2005). An Introduction to Efficiency and Productivity Analysis, 2nd Edition, Springer, New York.

Coelli, T., D.S., Prasada Rao and G.E. Battese, (1999). An Introduction to Efficiency and Productivity Analysis. 1st Edition, Kluwer Academic Publishers.

Coelli, Tim (1996) "A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program" *Center for Efficiency and Productivity Analysis*, Department of Econometrics, University of New England, Australia, Working Paper 96/08.

Diewert, W. E. (1992). The Measurement of Productivity, Bulletin of Economic Research, Blackwell Publishing, 44(3): 163-98.

Fare, R., Grosskopf, S., Lindgren, B. and Roos, P., (1992). Productivity Changes in Swedish Pharmacies 1980-89: A Non-parametric Malmquist Approach. *Journal of Productivity Analysis*, 3:85-101.

Fare, R., Grosskopf, S., Norris, M. and Zhang, Z., (1994). Productivity Growth, Technical Progress and Efficiency Change in Industrial Countries. *American Economic Review*, 84:66-83.

Farrel, M.J., (1957). The Measurement of Productive Efficiency, *Journal of the Royal Statistical Society*, Series A, 120(3):253-281.

Favero C. and Papi L., (1995) Technical Efficiency and Scale Efficiency in the Italian Banking Sector: A Non-Parametric Approach, *Applied Economics*, 27: 385-395.

Greene, H.W., (2008). Econometric Analysis, 6th ed. Pearson Education.

Harker, P.T. and Zenios, S.A., (2000). What Drives the Performance of Financial Institutions? In Harker, P.T. and Zenios, S.A. (eds.) Performance of Financial Institutions, Cambridge University Press, New York NY.

Humphrey, D., (1991), Productivity in Banking and Effects from Deregulation. *Economic Review*, 77(2):16-28.

Hunter, W.C. and Timme S., (1995), Core Deposits and Physical Capital: A Re-examination of Bank Scale Economies and Efficiency with Quasi-Fixed Inputs, *Journal of Money, Credit and Banking*, 27:165-185.

Kaino, Donatilla and Meso, Boaz, (2008), Financial Liberalization and Bank Efficiency: The Case of Commercial Banks in Kenya, *The icfai Journal of Applied Economics*, 7(3):7-22.

King, R.G. and Levine, R., (1993). Financial Entrepreneurship and Growth: Theory and Evidence. *Journal of Monetary Economics*. 32:513-542.

Kithinji, M. and Waweru, Nelson, (2003). Merger Restructuring and Financial Performance of Commercial banks in Kenya. Unpublished seminar paper, Kenya.

Koopmans T.C (1951). An Analysis of Production as an Efficient Combination of Activities in T C Koopmans, (Ed).

Koutsomanoli-Filippaki, Anastasia, Margaritis, D. and Staitkouras, C., (2009), Efficiency and Productivity Growth in the Banking Industry of Central and Eastern Europe, *Journal of Business and Finance*, 33(3):557-567.

Leightner, J. and Lovell, C., (1998), The Impact of Finance Liberalization on the Performance of Thai Banks, *Journal of Economics and Business*, 50(2):115-31.

Levine, R., (1997). Financial Development and Economic Growth: Views and Agenda, *Journal of Economic Literature*, 35: 688-726

Lovell, C. A. K., (1996). Applying Efficiency Measurement Techniques to the measurement of productivity change, *Journal of Productivity Analysis*, 7: 329-340.

Ncube, M. and Senbet, L.W., (1994), Perspective of Financial Regulation and Liberalization in Africa under Incentive Problems and Asymmetric Information, Unpublished Seminar Paper, Kenya.

Ndungu S. N & Ngugi R. W (2000), Banking Sector Interest Rate Spread In Kenya. KIPPRA Discussion Paper No. 5.

Ngugi, R.W. (2000). Financial Reform Process in Kenya: 1989-1996. *African Development Review* 12(1): 52-77.

Ngugi R and Kabubo J. (1998), Financial Sector Reforms and Interest Rate liberalization: The Kenyan Experience. AERC Research Paper No.72.

Nishimizu, M. and J. M. Page Jr. (1982). Total Factor Productivity Growth, Technological Progress and Technical Efficiency Change: Dimensions of Productivity Change in Yugoslavia, 1965–1978. *Economic Journal* 92: 920–936.

Oloo, Ochieng' (2007), Banking Survey, Think Business, Kenya.

Oloo, Ochieng' (2009), Banking Survey, Think Business, Kenya.

Pastor J. M., Perez F. and Quesada J. (1997) Efficiency Analysis in Banking Firms: An International Comparison. *European Journal of Operational Research*, 98:395-407.

Ragunathan, V., (1999), Financial Deregulation and Integration: An Australian Perspective, *Journal of Economics and Business*, 51:505-514.

Rao, A., (2002). Estimation of Efficiency, Scale and Scope and Productivity Measures in UAE Banks. Unpublished seminar paper, USA.

Rebelo, Joao and Mendes, Victor, (2000), Malmquist Indices of Productivity Change in Portuguese Banking: the Deregulation Period, *International Advances in Economic Reseach* (IAER), 6(3):531-543.

Reda, Malak, (2006). Empirical Study of Efficiency and Productivity of the Banking Industry in Egypt. Unpublished Seminar Paper, Egypt.

Soyibo, A. and Adekanye, F., (1991). The Nigerian Banking System in the Context of Policies of Financial Deregulation. African Economic Research Consortium (AERC) Research paper 17.

Shih-Hsun H. Ming-Miin Yu and Ching-Cheng Chang (2003): Analysis of Total factor Productivity Growth in China's Agricultural Sector. Unpublished Seminar Paper, Canada.

Su Wu (2004). Productivity and Efficiency Analysis of Australia Banking Sector under Deregulation, Unpublished Seminar Paper, Australia.

Were, M., Ngugi, R., Makau, P., Wambua, J. and Oyugi L., (2005). Kenya's Reforms Experience: What Have we Learnt? KIPPRA Working Paper 12.

Wheelock, D.C. and Wilson, P.W., (1995), Explaining Bank Failures: Deposit Insurance, Regulation, and Efficiency, *Review of Economics and Statistics*, 77: 689-700.

Yin, R., (1999), Production efficiency and Cost Competitiveness of Pulp Producers in the Pacific Rim, *Forest Products Journal*, 49: 43-49.

Appendix

List of Banks

1 African Bank Corporation
2 Bank of Africa
3 Bank of Baroda
4 Bank of India
5 Barclays Bank of Kenya
6 CFC Stanbic
7 Chase Bank
8 Citibank
9 Commercial Bank of Africa
10 Consolidated Bank
11 Co-operative Bank of Kenya
12 Credit Bank
13 Development Bank of Kenya
14 Diamond Trust Bank
15 Ecobank
16 Equatorial Commercial Bank
17 Fidelity Commercial Bank
18 Fina Bank
19 Giro Commercial Bank
20 Guradian Bank
21 Habib A. G. Zurich
22 Habib Bank
23 Imperial Bank
24 Kenya Commercial Bank
25 Middle East Bank
26 National Bank of Kenya
27 NIC Bank
28 Oriental Commercial Bank
29 Paramount Commercial Bank
30 Prime Bank
31 Southern Credit Bank
32 Standard Chartered Bank
33 Transnational Bank
34 Victoria Commercial Bank