THE EMPIRICAL ANALYSIS OF THE COMMERCIAL BANKS' EFFICIENCY AND STOCK RETURNS IN KENYA

BY

NJUGUNA CHARLES KIMANI
REG NO: D61/P/7119/04

A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION, SCHOOL OF BUSINESS, UNIVERSITY OF NAIROBI

DECEMBER 2007
Declaration

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

Signature

Date: 18/11/2008

NJUGUNA CHARLES KIMANI

This management research report has been submitted for examination with my approval as the University Supervisor.

Signature

Date: 19/11/2008

MR. KISAKA SIFUNJO

LECTURER

DEPARTMENT OF FINANCE AND ACCOUNTING

SCHOOL OF BUSINESS

UNIVERSITY OF NAIROBI
Dedication

I dedicate this research report to my dear wife and family, my employer, and colleagues at Fina Bank Limited for being supportive throughout my studies.
Acknowledgement

I would like to acknowledge the support, advice and tireless efforts of my supervisor Mr. Kisaka Sifunjo during my research work and in writing of this research report.

I would also like to acknowledge the assistance provided by the Head of Banks Supervision Department at the Central Bank of Kenya in securing the data for the commercial banks under study.

I also thank the Librarians at the University of Nairobi for allowing me the use of the library facilities.

Finally, I would like to acknowledge the assistance given by the staff at the School of Business, University of Nairobi.
Abstract

Concepts for measuring efficiency fall into three categories: revenue, cost and profit efficiency. These concepts are based on an economic foundation for analyzing bank efficiency because they focus on economic optimization in reaction to market prices, competition and other business conditions, rather than being based solely on the use of technology. The purpose of this study was to contribute further evidence on bank efficiency in Kenya by defining alternative efficiency measures which are linked to stock market returns of financial institutions. The study considered revenue, cost and profit efficiency for Kenyan banks between 1998 and 2006. Besides, the study sought to relate the changes in cost and profit efficiency to stock returns, using classical regression models.

Using the DEA methodology, the findings established that the banks exhibited declining cost efficiency over the sample period while the revenue efficiency was on a steady increase. Malmquist total factor productivity (TFP) index measures showed that technical efficiency and technological efficiency were the main drivers of profit efficiency in the banking industry. This study also established that there exists a significant relationship between stock returns and changes in both cost and profit efficiency for the listed commercial banks. Cost efficiency influence stock returns of banks since poor cost management lowers banks’ profits. Poor profits lead to low future dividends to investors. Consequently, the share price will be bid down at the stock market. Conversely, a bank which efficiently mobilizes its deposits, other funds and staff earns high profits, translating into high dividends to investors and the share will be highly priced which implies high stock returns. The findings in this study are in agreement to empirical studies by Sakina (2006) and Joshua and Daehoon (2005).
Table of Contents

Title ................................................................................................................................... i
Declaration.......................................................................................................................... ii
Dedication .......................................................................................................................... iii
Acknowledgement ............................................................................................................ iv
Abstract .............................................................................................................................. v
Table of Contents .............................................................................................................. vi
List of Tables ..................................................................................................................... ix
List of Figures .................................................................................................................... x
List of Abbreviations and Acronyms ............................................................................... xi

CHAPTER ONE ............................................................................................................... 1

1.0 INTRODUCTION ..................................................................................................... 1

1.1. Background to the study ......................................................................................... 1

1.2. The Banking Sector in Kenya ................................................................................ 5

1.3. Problem Statement .................................................................................................. 6

1.4. Objective of the Study ............................................................................................ 8

1.5. Importance of the Study .......................................................................................... 8

CHAPTER TWO ........................................................................................................... 10

2.0 LITERATURE REVIEW ....................................................................................... 10

2.1. Introduction ............................................................................................................ 10

2.2. Commercial Banks’ Efficiency .............................................................................. 10

2.2.1. Cost Efficiency in Commercial Banks .............................................................. 11

2.2.2. Profit Efficiency in Commercial Banks ............................................................ 15

2.2.3. Application of DEA technique to Evaluate Cost and Profit Efficiency ........ 18

2.3. Banking Efficiency in Relation to Stock Returns .................................................. 21
List of Tables

Table 4.1 Model A - DEA Efficiency Scores for Yearly Averages .......................32
Table 4.2 Model A: Bank-specific DEA efficiency scores (1998-2006 averages) ......35
Table 4.3 Malmquist Index Summary of Annual Means (Model A) ......................36
Table 4.4 Malmquist Index Summary of Bank-specific Means (Model A) ..............37
Table 4.5 Model B: DEA Efficiency Scores for Yearly Averages .........................40
Table 4.6 Malmquist Index Summary of Annual Means (Model B) ......................42
Table 4.7 Malmquist Index Summary of Bank-specific Means (Model B) ..............43
Table 4.8 Descriptive Statistics on Excess Stock and Market Returns .................45
Table 4.9: Test of Relationship between Banks’ Efficiency and Stock Returns .......47
List of Figures

Figure 4.1: DEA Cost Efficiency Curves for Yearly Averages..............................32
Figure 4.2 Malmquist Index Curves for Annual Means (Model A)......................37
Figure 4.3 Model B - DEA Efficiency Curves for Yearly Averages.......................40
Figure 4.4 A Comparison of Cost (CE) efficiency and Profit (PE) efficiency.........41
Figure 4.5 Malmquist Index Curves for Annual Means (Model B).......................42
Figure 4.6 Trend of the Excess stock and Market returns (1998-2006).............45
## List of Abbreviations and Acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASX</td>
<td>Australian Stock Exchange</td>
</tr>
<tr>
<td>CAPM</td>
<td>Capital Asset Pricing Model</td>
</tr>
<tr>
<td>CBK</td>
<td>Central Bank of Kenya</td>
</tr>
<tr>
<td>CRS</td>
<td>Constant Returns to Scale</td>
</tr>
<tr>
<td>DEA</td>
<td>Data Envelopment Analysis</td>
</tr>
<tr>
<td>DMU</td>
<td>Decision-Making Unit</td>
</tr>
<tr>
<td>MPIs</td>
<td>Malmquist Productivity Indices</td>
</tr>
<tr>
<td>NBFIs</td>
<td>Non-Bank Financial Institutions</td>
</tr>
<tr>
<td>RoA</td>
<td>Return on Assets</td>
</tr>
<tr>
<td>SADC</td>
<td>South-African Development Community</td>
</tr>
<tr>
<td>VRS</td>
<td>Variable Returns to Scale</td>
</tr>
</tbody>
</table>
CHAPTER ONE

1.0 INTRODUCTION

1.1. Background to the study

1.1.1. The Concept of Efficiency and its Measurement

Banks, as financial intermediaries, provide various services for depositors and borrowers. They provide liquidity and safekeeping for savings, which allows depositors to smooth consumption over time. They also conduct credit analysis, disburse loans and monitor outstanding credits for borrowers who require more financing than they can generate from internal sources or from alternative sources of finance such as financial markets (Berger & Humphrey, 1993). In addition to this, they provide payment services, trade finance, leasing and factoring solutions that finance the inventory and fixed asset needs of borrowers. The efficiency of individual banks in providing these services and conditions in the external environment determine the efficiency of the overall banking sector, which influences the effectiveness of the domestic financial intermediation mechanism.

A banking sector’s efficiency can be represented by the average efficiency of its individual banks. Efficiency in the banking sector is recognized by central as a precondition for macroeconomic stability (Ngalande, 2003) and important for effective monetary policy execution (Hartmann, 2004). In addition, a banking sector’s ability to allocate credit efficiently is expected to have positive implications for economic growth (Galbis, 1977). Luccheti, Papi & Zazzaro (2000) empirically justified this fact in a study on the Italian banking sector. Concepts for measuring
efficiency fall into three categories: revenue, cost and profit efficiency. These concepts are based on an economic foundation for analyzing bank efficiency because they focus on economic optimization in reaction to market prices, competition and other business conditions, rather than being based solely on the use of technology.

Revenue efficiency measures the change in a bank’s revenue adjusted for random error, relative to the estimated revenue obtained from producing an output bundle as efficiently as the best-practice bank in a sample facing the same exogenous variables. It is not usually directly measured but is inferred from measurements of an output distance function, which measures output efficiencies (Adongo, Stork and Hasheela, 2005). Revenue efficiency occurs when banks charge higher prices for higher quality services, which result in higher revenues if these banks have the market power to extract some of the consumer surplus that arises. Empirical studies have found that revenue inefficiency can be attributed primarily to technical inefficiency as opposed to allocative inefficiency (Berger, Humphrey & Pulley, 1995). The main shortfall of the revenue concept is that it does not take into account the increased costs of producing higher quality services and thus focuses on only one side of the overall financial picture of a bank (DeYoung & Nolle, 1996).

Cost efficiency measures the change in a bank’s variable cost adjusted for random error, relative to the estimated cost needed to produce an output bundle as efficiently as the best-practice bank in a sample facing the same exogenous variables, which include variable input prices, variable output quantities and fixed netputs (inputs and outputs). It arises due to technical inefficiency, which results in the use of an excess or sub-optimal mix of inputs given input prices and output quantities. Ikhide (2000)
argues that costs are less vulnerable than revenues and profits to extraordinary factors that can affect different banks or categories of banks disproportionately such as variations in open-market interest rates.

One accounting measure of profit efficiency is the percentage change in a bank's headline earning relative to assets i.e. ROA. This measure may understate profit efficiency because variable profits are measured before taxes and fixed costs while the numerator used in the accounting ratio measures earnings after tax and fixed costs (DeYoung & Nolle, 1996; and KPMG, 2004). Profit efficiency also uses book values obtained from financial statement data available in banks’ annual reports. These values vary with factors such as accounting conventions, capital structures of different banks, market power and macroeconomic conditions in the markets in which the bank operates (Hughes, Lang, Moon & Pagano, 1997). The use of standard profit efficiency is justified as long as the assumptions on which it is based hold. Where this is not the case, alternative profit efficiency is adopted.

Farrell (1957) laid the foundation to measure efficiency and productivity studies at the micro level. His contribution highlighted new insights on two issues: how to define efficiency and productivity, and how to calculate the benchmark technology and efficiency measures. The fundamental objective is not to depart from the assumption of perfect input-output allocation but to allow for inefficient operations. Inefficiency is defined as the distance of a firm from a frontier production function accepted as the benchmark. The basis for this measure is the radial contraction/expansion connecting inefficient observed points with (unobserved) reference points on the production frontier. If a firm’s actual production point lies on the frontier it is perfectly efficient.
If it lies below the frontier then it is inefficient, with the ratio of the actual to potential production defining the level of efficiency of the individual firm (Decision Making Unit, DMU).

Farell proposed efficiency consists of two components: technical efficiency and allocative efficiency. The former reflects the ability of a DMU to minimize input use as to produce a given amount of output. The latter reflects the ability of a DMU to use inputs in optimal proportions, given their respective prices and the production technology. Together, these two measures represent a total efficiency measure (Coelli et al., 1997). Efficiency ratios take on a value between zero and one, where one indicates that the DMU is fully efficient and zero indicates that it is fully inefficient. For example, an efficiency score measured against a cost frontier of 90% signifies that the DMU could have reduced costs by 10% without altering its output vector.

In their study, Berlamino and Fernando, (1997) argued that while efficiency in financial markets is measured by the amount and speed with which information is incorporated into prices, firms’ efficiency depends upon the way they produce output from inputs. Producing more outputs than competitors for the same amount of inputs, or consuming less input for the same amount of output is a sign of relative efficiency.

Firm efficiency measures vary depending on the cost definitions and the estimation methodology. Emphasis has been given to the comparison of alternative frontier cost efficiency methodologies (Cummins and Zi, 1997; Resti, 1997) which can be classified into econometric studies and mathematical techniques. In Cummins and Zi (1997) multiple econometric and mathematical techniques are compared. It is shown
that while for absolute values there are significant differences among econometric techniques, the rankings obtained are quite similar among econometric estimates. More disparity is observed when comparing the mathematical techniques. However, Resti (1997) finds that econometric and mathematical techniques are similar in results and that differences can be accounted for by the underlying assumptions of the models.

When investigating efficiency, standard input-output analysis considers an indirect revenue function where firms are assumed to maximize revenue for a given (fixed) vector of output prices and input quantities while varying output quantities (Berlamino and Fernando, 1997). However, according to Berger, Humphrey and Pulley (1996) investigating efficiency considers an indirect revenue function where firms are assumed to maximize revenue for a given (fixed) vector of output quantities and input prices varying output prices. In the first case, the capacity of the firms to fix output prices is assumed to be non-existent, and in the second case firms have no capacity to expand output. As it has been briefly described, there are many open issues in efficiency. This controversial issue is the selection of inputs and outputs to be included in the estimation function. The existing alternatives for defining and approximating input and outputs are diverse.

1.2. The Banking Sector in Kenya

The Banking Sector in Kenya comprises of the commercial Banks and Non-Banking Financial Institutions (NBFIs). The various institutions in this sector are registered under the Banking Act, Chapter 488 of the laws of Kenya. The Central Bank of Kenya, which is established under CBK Act Chapter 491 of the laws of Kenya, is the main regulatory body in this sector. The CBK is the principal banking institutions to
exercise monetary control, supervision of financial institutions and assistance to commerce, trade and industry. It supervises, monitors, guides and advises the bank financial institutions so that the government's monetary policy objectives are fulfilled in the interest of the Nation.

According to Oloo (2007), the Kenyan banking industry has improved tremendously over the ten-year period, 1996 to 2006. Improvements had been evidenced in terms of size, profitability, product offerings, and quality of service. The industry has also seen the emergence of micro-finance banking institutions such as K-Rep Bank, Equity Bank, and Family Bank; all of which have targeted small traders and rural small-scale farmers. According to Central Bank of Kenya (2006), the key performance indicators of the Kenyan Banking sector maintained an upward trend between 2005 and 2006. Within the period, assets grew by 22%, capital increased by 29% due to enhanced profitability and injections by some institutions, and total profitability improved by 32% from Kshs. 19 billion in 2005 to Kshs. 24 billion in 2006. In addition, there have been enhanced level of investment by Kenyan banks in Information Communication Technologies (ICTs) in the recent past. This was principally due to competitive pressure and increased demands from customers. This has seen implementation of modern core banking solutions that provide a cost-effective platform for provision of banking services (Ndung'u, 2007).

1.3. Problem Statement

In instances where banks provide additional or higher quality services, costs rise but revenues may increase by more than the cost increase. Looking at efficiency from either the cost minimization or revenue maximization perspective fails to capture the goal of banks to maximize profits by raising revenues as well as reducing costs and
does not account well for unmeasured changes in output quality (Berger & Mester, 1999). This shortfall is overcome by the profit efficiency concept. Standard profit efficiency measures the change in a bank’s variable profits adjusted for random error, relative to the estimated profit needed to produce an optimal output bundle as efficiently as the best-practice bank in a sample, facing the same exogenous variables, which include variable input prices, variable output prices and fixed net-puts.

Mutanu (2002) used a sample of eight quoted commercial banks in Kenya to compare efficiency scores of highly capitalized banks with those of low capitalized banks for the period 1999 to 2001. He found out that the low capitalized banks were more efficient than the highly capitalized banks. Furthermore, Musyoki (2003) sought to establish if there is any link between quality and bank profitability. He established that quality improvement has a short-term effect on financial performance. Two years later, Njihia (2005) used a sample of 36 commercial banks in Kenya from 1998 to 2004 to find out the determinants of profitability of commercial banks in Kenya. He identified these as non performing loans and advances, interest expense on customers’ deposits, operating expenses, provision for doubtful debts and total assets. However, these studies do not answer the question: “Are the changes in cost and profit efficiencies of commercial banks reflected in their stock prices?”

This study contributes further evidence on bank efficiency by defining alternative efficiency measures which are linked to stock market returns of financial institutions. The study hypothesized that there exists a positive relationship between stock returns and changes in cost and profit efficiency of commercial banks (Joshua and Daehoon, 2005).
1.4. Objective of the Study

The objectives of this research were:

1. To determine the cost and profit efficiency scores of commercial banks listed at the Nairobi Stock Exchange between 1998 and 2006.

2. To investigate the relationship between stock returns and cost and profit efficiency of commercial banks listed at the Nairobi Stock Exchange.

1.5. Importance of the Study

1.5.1. The Policy Makers

This research investigated the nature of relationship between changes in efficiency and stock returns in Kenyan Banks. The findings from this study stand to inform the policy makers especially at the Ministry of Finance in formulation of the necessary regulations to guide the Central Bank of Kenya in drafting a regulatory framework for guiding commercial banks in enhancing their operational efficiency.

1.5.2. The Nairobi Stock Exchange

The findings of this study will also help the management of the Nairobi stock exchange, investment banks, and fund managers with information to guide investors who are interested in buying shares of commercial banks listed at the bourse.

1.5.3. To Bank Managers

The findings of the study provide the banking industry’s general trend for both the cost and profit efficiency scores for the period 1998-2006. This forms a basis for bank managers to structure various strategies to mitigate declining cost or revenue efficiency.
1.5.4. Investors in Financial Markets

The findings of the study stand to inform investors in the banking industry on the relationship between banks' stocks prices and their efficiency. This will enable them to make sound decisions while investing at the stock markets, and also to diversify their investments based on expected returns vis-à-vis the level of cost and profit efficiency.
CHAPTER TWO

2.0 LITERATURE REVIEW

2.1. Introduction

This chapter presents a review of the literature on the relationship between commercial banks' efficiency and stock returns. The chapter is organized as follows: Section 2.2 focuses on commercial banks’ efficiency, Section 2.3 focuses on banking efficiency in relation to stock returns, Section 2.4 reviews banking efficiency in Kenya. Finally, section 2.5 is the chapter summary.

2.2. Commercial Banks' Efficiency

Estimating efficiency involves defining a set of inputs which are linked to another set of outputs. Inputs and outputs are included and calculated based mainly on theoretical grounds. Defining partial measures of efficiency implies that a given bank will be more efficient than another (even though globally it may be less efficient) because a given input or output has not been considered, so that the ranking may be reversed when it is included. In their study, Berlamino and Fernando (1997) considered the following measures to link and weight efficiency estimates with stock performance in banking firms: production costs, systematic risk, specific risk and branch network distribution. In estimating production costs, they selected flow variables instead of stock variables such as stock prices for inputs. They however applied different approaches to measure outputs.
2.2.1. Cost Efficiency in Commercial Banks

According to Fiorentino, Karmann, Koetter (2006), in measuring the cost efficiency of banks, one should compare observed cost and output-factor combinations with optimal combinations determined by the available technology (efficient frontier). The method to implement this analysis could be either stochastic or deterministic. The former allows random noise due to measurement errors. The latter, on the contrary, attributes the distance between an inefficient observed bank and the efficient frontier entirely to inefficiency. A further distinction is made between parametric or non-parametric approaches. A parametric approach uses econometric techniques and imposes a priori the functional form for the frontier and the distribution of efficiency. A non-parametric approach, on the contrary, relies on linear programming to obtain a benchmark of optimal cost and production-factor combinations.

According to Rudi (2000), it is asserted that there may be differences between specialized and non-specialized banks with respect to the degree of operational efficiency. To test this conjecture, Rudi (2000) estimated a cost function for the different types of banks. Cost efficiency provides a measure of how close a bank's actual cost is to what a best-practice institution's cost would be for producing an identical output bundle under comparable conditions. The measure is usually derived from a cost function in which costs ($C$) depend on the prices of inputs ($p$), the quantities of outputs ($y$), risk or other factors that may affect performance ($z$), and an error term $\varepsilon$. The function can be algebraically written as shown in equation (1)

$$C = f(p, y, z) + \varepsilon$$  \hspace{1cm} (1)

In equation (1), $\varepsilon$ is treated as a composite error term represented as shown in equation (2);
\[ e = \mu + v \]  \hspace{1cm} (2)

Where \( v \) represents standard statistical noise and \( \mu \) captures inefficiency.

In the parametric methods, a bank is labeled inefficient if its costs are higher than a best-practice bank after removing random error. The methods differ in the way \( \mu \) is disentangled from the composite error term \( e \).

Aigner, Lovell, and Schmidt (1977) proposed stochastic cost frontier in analysis of cost efficiency of commercial banks. In general, the non-parametric methods are less suitable because they assume away noise in the data and luck. But for the purpose of this study, the most important drawback is that these methods generally ignore prices and, thus, can only account for technical inefficiency related to using excessive inputs or producing suboptimal output levels. As Berger and Mester (1997b) observed, these methods cannot compare firms that tend to specialize in different inputs or outputs because it is impossible to compare input and output configurations without the benefit of relative prices. Moreover, Berger and Mester (1997b) used the distribution-free approach as well as the stochastic frontier approach for both the translog and the Fourier specification of the cost and profit function. They concluded that the empirical findings in terms of either average industry efficiency or ranking of individual bank are similar across methods.

In equation (2), the random error term \( (v) \) is assumed to be normally distributed and the inefficiency term \( (\mu) \) is assumed to be one-sided. Either of the approaches (the half-normal and the exponential distribution approaches) can be used with similar results being reported in both cases. The model below has focused on the half-normal
distribution. The inefficiency factor ($\mu$) incorporates both allocative inefficiencies from failure to react optimally to changes in relative input prices, and technical inefficiencies from employing too much of the inputs to produce the observed output bundle. The log-likelihood function is given arithmetically by equation (3). The model can be estimated using maximum likelihood techniques.

$$\ln L = \frac{N}{2} \ln \left( \frac{2}{\pi} \right) - N \ln \sigma - \frac{1}{2\sigma^2} \sum_{i=1}^{N} \varepsilon_i^2 + \sum_{i=1}^{N} \ln \left[ \phi \left( \frac{\varepsilon_i}{\lambda} \right) \right]$$  \hspace{1cm} (3)

Where:

$$\varepsilon_i = \mu_i + \nu_i$$

$$\sigma^2 = \sigma_\mu^2 + \sigma_\nu^2$$

$$\lambda = \frac{\sigma_\mu}{\sigma_\nu}$$

$N$ = the number of banks and

$\Phi(.)$ = the standard normal cumulative distribution function.

Inefficiency measures are calculated using the residuals after the model is estimated. For the half-normal case, an estimate of the mean inefficiency is given by

$$\hat{E}(\mu_i) = \left( \frac{2}{\pi} \right)^{\frac{1}{2}} \hat{\sigma}_\mu$$  \hspace{1cm} (4)

Where: $\hat{\sigma}_\mu$ is the estimate of $\sigma_\mu$. Since the distribution of the maximum likelihood estimates is known, the approximate standard error of $\left( \frac{2}{\pi} \right)^{\frac{1}{2}} \hat{\sigma}_\mu$ can be easily computed. Previously, Jondrow et al. (1982) had showed that a bank-level measure of inefficiency is usually given by the mean of the conditional distribution function of $\mu$, given $\varepsilon_i$. For the normal-half-normal stochastic model, the conditional distribution
of \( \mu_i \) given \( \epsilon_i \) is a normal distribution \( \mathcal{N}(\mu_i, \sigma^2_i) \) truncated at Zero, where 
\[ \mu_i = \frac{\epsilon_i \sigma_i^2}{\sigma_i^2} \quad \text{and} \quad \sigma^2_i = \frac{\sigma^2 \sigma^2_i}{\sigma_i^2}. \]
This can be seen by adapting for the cost function the equation for the production function derived in Jondrow et al. (1982). The density function is algebraically illustrated in Equation (5)

\[
f(\mu_i/\epsilon_i) = \frac{1}{\sigma \sqrt{2\pi}} \phi \left( \frac{\mu_i/\epsilon_i - \phi(\epsilon_i/\sigma) - \phi(\epsilon_i/\sigma)}{\sigma^2 \sqrt{2\pi}} \right), \quad (\mu_i/\epsilon_i) > 0 \quad \text{........................................ (5)}
\]

As Mester (1996a, 1996b) and Greene (1991) observed, the conditional mean \( E(\mu_i|\epsilon_i) \) is an unbiased but inconsistent estimator of \( \mu_i \) since regardless of the number of observations, the variance of the estimator remains non-zero. The mean of the conditional distribution of Equation (5) is as shown in equation (6).

\[
E(\mu_i/\epsilon_i) = \left( \frac{\sigma_i \sigma_i \sigma_i}{\sigma} \right) \left[ \phi \left( \frac{\epsilon_i \lambda}{\sigma} \right) + \epsilon_i \lambda \left( \frac{\epsilon_i \lambda}{\sigma} \right) \Phi \left( \frac{\epsilon_i \lambda}{\sigma} \right) \right] \quad \text{........................................ (6)}
\]

A Farrell-type measure of operational efficiency can then be calculated as \( CEFF = e^{-r} \). A CEFF score of 0.8 would mean that the bank is using 80% of its resources efficiently or alternatively wastes 20% of its costs relative to a best-practice bank. For the functional form of \( C = f(p,y,z) \) a standard translog or the Fourier-flexible specification (McAllister and McManus 1992; Mitchell and Onvural 1996; Berger and Mester 1997) may be applied. The Fourier functional form augments the translog by including Fourier trigonometric terms. It is a global approximation because the sine and cosine terms are mutually orthogonal, so that each term aids in fitting the function closer to the true path of the data. But while formal tests indicate that the Fourier terms are jointly significant, the statistical fit, and both the average
levels of measured efficiency and their dispersion are very similar for both functional forms.

2.2.2. Profit Efficiency in Commercial Banks

According to Rudi (2000), profit efficiency measures how close a bank comes to generating the maximum obtainable profit given input prices and outputs. Berger and Mester (1997) used the concept of alternative profit efficiency to relate profit to input prices and output quantities instead of output prices. Alternative profit efficiency compares the ability of banks to generate profits for the same level of outputs and thus reduces the scale bias that might be present when output levels are allowed to vary freely. If customers are willing to pay for high-quality services, the offering banks should be able to earn higher revenues that compensate any excess expenditure and remain competitively viable.

In evaluating profit efficiency, the profit function uses essentially the same specification as the cost function. The dependent variable is now $\ln(\pi + |\pi_{\text{min}}| + 1)$, where $|\pi_{\text{min}}|$ is the absolute value of the minimum value of $\pi$ in the appropriate sample. In practice, the constant term $|\pi_{\text{min}}| + 1$ is added to every bank's profit so that the natural log is taken of a positive number. This adjustment is necessary since a number of banks in the sample period. The dependent variable is $\ln(1)=0$ for the bank with the lowest value of $\pi$. $\pi$ is calculated as all interest and non-interest earnings minus interest and operating costs. The explanatory variables remain unaltered. In this case, $\pi$ is based on the output-mix combining traditional and non-traditional bank activities. This produces a measure of profit efficiency denoted by PE. A PE of 0.8 would mean that a bank is actually earning 80% of best practice
profits or that the bank is losing 20% of possible profits due to excessive costs, deficient revenues, or both (Rudi, 2000).

In their study, Fiorentino, Karmann, Koetter (2006) investigated the consistency of efficiency scores derived with two competing frontier methods in the financial economics literature namely: Stochastic Frontier and Data Envelopment Analysis. They sampled 34,192 observations for all German universal banks and analyzed whether efficiency measures yield consistent results according to five criteria between 1993 and 2004: levels, rankings, identification of extreme performers, stability over time and correlation to standard accounting-based measures of performance. They found that non-parametric methods are particularly sensitive to measurement error and outliers. Furthermore, their results showed that accounting for systematic differences among commercial, cooperative and savings banks is important to avoid misinterpretation about the status of efficiency of the total banking sector.

Olena (2004) investigated the efficiency of Polish banks during the period of 1998-2000. A Data Envelopment Analysis (DEA) methodology was applied which allowed for distinguishing between five different types of efficiency namely: cost, allocative, technical, pure technical, and scale. Additionally, Olena performed a number of parametric and non-parametric tests to test whether foreign and domestic banks come from the same population. Finally, univariate and multivariate regression analysis was employed in order to detect the determinants of banking efficiency in Poland. The tests performed rejected the null hypothesis that all banks come from the same population and thus all the results were reported under the assumption of separate efficiency frontiers for foreign and domestic banks. Over the study’s sample period, it
was established that average efficiency was 44.62% and 69.70% for domestic and foreign banks, respectively. Foreign banks exhibited higher productivity of their inputs (technical efficiency) and were superior in choosing the right mix of inputs in light of given prices (allocative efficiency). The study concluded that foreign banks managed to utilize their comparative advantage and showed a higher level of efficiency. This superiority should not be attributed to foreign ownership per se. Instead, it is explained by better output quality, higher skilled personnel, and more advanced technology. Thus, Olena (2004) added to the evidence that opening banking markets to foreign capital fosters competition and adds to the efficiency of the banking industry.

Berger and Mester (1997a) studied the sources of differences in bank efficiency by applying different efficiency concepts, different measurement methods, and different potential correlates of efficiency to the same data set. They compared bank efficiency and productivity change between the last six years of the 1980s and the first six years of the 1990s. Their data set included annual information from 1984 through 1995 on virtually all U.S. commercial banks—totaling to over 145,000 annual bank observations in all. Their findings suggested that each of three efficiency concepts—cost, standard profit, and alternative profit efficiency—adds some independent informational value. The efficiency results were remarkably robust to the different measurement techniques, different functional forms, and various treatments of output quality used. Treatment of equity capital was found to be an important consideration.
2.2.3. Application of DEA technique to Evaluate Cost and Profit Efficiency

Data Envelopment Analysis (DEA) is a linear programming technique where the set of best-practice or frontier observations are those for which no other decision making unit or linear combination of units has as much or more of every output (given inputs) or as little or less of every input (given outputs). Developed by Charnes, Cooper, and Rhodes (1978), DEA was originally intended for use in public sector and not-for-profit settings where typical economic behavioral objectives, such as cost minimization or profit maximization, may not apply. Thus, DEA could be used even when conventional cost and profit functions that depend on optimizing reactions to prices could not be justified. The DEA frontier is formed as the piecewise linear combinations that connect the set of these best-practice observations, yielding a convex production possibilities set. As such, DEA does not require the explicit specification of the form of the underlying production relationship.

DEA involves the use of linear programming methods to construct a non-parametric piecewise surface (or frontier) over the data, so as to be able to calculate efficiencies relative to this surface. Coelli (1996) developed a DEAP® computer programming for performing DEA. The computer program can consider a variety of models. The three principal options are: 1) Standard constant returns to scale (CRS) and variables return to scale (VRS) DEA models that involve the calculation of technical and scale efficiencies (where applicable). These methods are outlined in Fare, Grosskopf and Lovell (1994); 2) the extension of the CRS and VRS models to account for cost and allocative efficiencies. These methods are also outlined in Fare et al (1994); and, 3) The application of Malmquist DEA methods to panel data to calculate indices of total factor productivity (TFP) change; technological change; technical efficiency change.
and scale efficiency change. These methods are also discussed in Fare, Grosskopf, Norris and Zhang (1994).

The Malmquist index is the geometric mean of two productivity indices that use output distance functions for the alternative base periods $t$ and $(t + 1)$ as indicated by the $D$-superscripts in equation (7) below.

$$M(x_{i,t+1}, y_{i,t+1}; x_{i,t}, y_{i,t}) = \left[ \frac{D'(x_{i,t+1}, y_{i,t+1})D''(x_{i,t+1}, y_{i,t+1})}{D'(x_{i,t}, y_{i,t})D''(x_{i,t}, y_{i,t})} \right]^{\frac{1}{2}}$$

The first index relates the input - output combinations observed in the two time periods ($t$ and $t + 1$) to the period $t$ technology frontier, and the second index relates the same input - output combinations to the period $(t + 1)$ technology frontier. The terms in the numerator are the inputs used and outputs generated by firms $i$ in period $t + 1$, and those in the denominator represent the corresponding quantities observed for period $t$.

Following Fare et al. (1995), manipulation of the Malmquist index makes it possible to distinguish between efficiency changes and productivity changes:

$$M = \frac{D'(x_{i,t+1}, y_{i,t+1})}{D'(x_{i,t}, y_{i,t})} \left[ \frac{D''(x_{i,t+1}, y_{i,t+1})}{D''(x_{i,t}, y_{i,t})} \right]^{\frac{1}{2}} = \Delta E \times \Delta T \quad \ldots \quad (8)$$

The first term represents the change in technical efficiency ($\Delta E$), and the expression in square brackets represents technological change ($\Delta T$). Values greater than one for the Malmquist index indicates an improvement in productivity, and values less than one signal deterioration. The same interpretation applies to the numerical values obtained for the efficiency and technology indices. Formally, there is no presumption that the three indices must always move in the same direction. For instance, an
improvement in productivity is entirely compatible with opposite improvement in
technical efficiency or technology, provided the deterioration in one component is
more than offset by an improvement in the other to generate a value of $M$ greater than
1.

DEA methodology requires solving a series of linear programming problems.
Consider the input and output vectors represented by equations (9) and (10)
respectively, where $s$ banks are producing $m$ outputs by using $n$ inputs.

$$x_{i,t} = (x_{1i,t}, \ldots, x_{ni,t}) \in \mathbb{R}^n $$ ....................................... (9)

$$y_{i,t} = (y_{1i,t}, \ldots, y_{mi,t}) \in \mathbb{R}^m $$ ....................................... (10)

The CRS output distance functions for bank $k$ can be calculated as algebraically
represented by the system of equation (11)

$$[D^*(x_{k,t}, y_{k,t})]^{-1} = \text{Max} \theta $$ ....................................... (11)

Such that:

$$\theta_{y_{m(k,t)}} \leq \sum_{i=1}^{s_s} \lambda_{i,t} y_{m(k,t)} \quad m = 1, \ldots, M $$ ....................................... (12)

$$\sum_{i=1}^{s_s} \lambda_{i,t} x_{n(i,t)} \leq x_{n(k,t)} \quad n = 1, \ldots, N $$ ....................................... (13)

$$\lambda_{i,t} \geq 0, \quad i = 1, \ldots, s_s $$ ....................................... (14)

Where $t$ indexes the time period. $\lambda$ is a column vector of intensity variables
($\lambda \in \mathbb{R}^n$). The output distance functions required for constructing the VRS frontier
can be calculated by including $\sum_{i=1}^{s_s} \lambda_{i,t}$ as an additional constraint to the linear
programming problem represented by the system of equations (11). Distance functions must be calculated for all banks in the sample for each period \((t \text{ and } t + 1)\) separately. The remaining distance functions needed to compute Malmquist indexes require the solving of mixed period linear programming problems (Coelli et al., 1998).

2.3. Banking Efficiency in Relation to Stock Returns

In a semi-strong, efficient market where most of the information is incorporated into prices, stock value performance is, as it is widely accepted the best measure of estimating whether firms are creating value for shareholders or not (Brealey and Myers, 1991). It may be expected that efficient firms perform better than inefficient firms and this fact will be reflected in market prices (directly through lower costs or higher output or indirectly, through higher customer satisfaction and higher stock returns). However, there may be efficiency criteria that are not important or relevant to the market, that is to say, the firm may be more efficient in a particular criterion than its competitors but the market does not value this efficiency. Hence, the firm is not creating value by being efficient in this particular criterion. Alternatively, all firms within an industry may be efficient in a particular criterion and, though highly valued by the market, it is not a distinctive factor among firms and hence there would not be stock performance differences due to this criterion.

In their study, Joshua and Daehoon (2005) focused on ten domestically owned retail banks listed on the Australian Stock Exchange (ASX). They analyzed the cost and profit efficiency of ten Australian banks between 1995 and 2002. Their results indicated that the major banks had experienced improvements in cost and profit efficiency, while the regional banks’ cost efficiency remained relatively unchanged.
and their profit efficiency had declined. The regional banks had relatively high cost efficiency initially, and up until 2000 the majors and regional bank cost efficiency scores converged. By combining the results of a cost efficiency model and a profit efficiency model, the findings inferred that revenue efficiency had declined for the regional banks, but improved for the major banks. It was also shown that changes in profit efficiency were statistically significant in determining the stock returns of banks, particularly the regional banks, in their sample. Previous studies have calculated efficiency scores without reference to market judgements of efficiency. The implication of the results of Joshua and Daehoon (2005) is that the Australian equities market (ASX) appeared to be semi-strong form efficient. That is, all publicly available information regarding the prospects of a firm was reflected in the stock price.

2.4. Banking Efficiency in Kenya

Empirical studies conducted in Kenya have expressed mixed views and opinions on efficiency within the banking sector. In a study conducted by Mutanu (2002), it was established that low-capitalized banks are more efficient than highly-capitalized banks. Mutanu (2002) argued that low-capitalized banks increase their efficiency by taking more risks while the highly capitalized banks feel that taking more risks would be too much risk for their capital and thus increases their inefficiency. Mutanu (2002) found out that in the Kenyan context, capital cannot be used to discriminate efficient banks from inefficient banks because the highly capitalized banks can increase their capital through reevaluation of the assets and not through the injection of fresh capital or retained earnings (Mutanu, 2002).
Musyoki (2003) compared quality improvement with financial performance in an attempt to establish if there is any link between quality and bank profitability. Using a sample of 46 commercial banks for the period 1998 to 2002, he found out that quality improvement has a short term effect on financial performance and that there are undoubtedly other benefits gained from improved quality, but they may be difficult to measure (Musyoki, 2003). Two years later, Njihia (2005) sought to determine the determinants of profitability of commercial banks in Kenya. The sample data was comprised of 36 banks over a period of six years, from 1998 to 2004. Using multiple regression analysis technique, established that the critical variables affecting profitability of commercial banks in Kenya are: non performing loans and advances, interest expense on customers’ deposits, operating expenses, provision for doubtful debts and total assets (Njihia, 2005). Efficiency in expense management was one of the most significant determinants of commercial bank profitability.

Finally, Sakina (2006) sought to investigate on the X-efficiency of commercial banks in Kenya and to establish whether the X-efficiency of these banks is affected by economies of scale. X-efficiency is defined as the general efficiency of a firm judged on managerial and technological criteria in transforming inputs at minimum costs into maximum profits. It includes intra-bank economic efficiency; intra-bank motivational efficiency - individual personality; and external motivational efficiency - arising from management incentives and the environment (Adongo et al., 2005; Leibenstein, 1978). The data set consisted of annual operation costs of banks including interest expense. Deposits and borrowed funds were treated as the inputs while the loans to customers, investments, and other incomes were treated as outputs. The sample comprised of 33 banks for the period 2000 to 2005. A stochastic econometric cost
frontier was used to measure X-efficiency level of commercial banks in Kenya. The empirical results obtained established that X-efficiency existed in the Kenya’s commercial banks industry at 18% and it was found to be affected by economies of scale. In a bid to establish whether the persistence of X-efficiency was related to bank size, Sakina (2006) further found out that average large banks tend to be more persistent than average small banks at the level of 23%. Besides, bank size affects X-efficiency for large banks.

2.5. Chapter Summary

Different types of approaches have been employed in the literature in evaluating the efficiency of financial institutions and branches. These methods differ primarily in the assumptions imposed on the data in terms of (a) the functional form of the best-practice frontier (a more restrictive parametric functional form versus a less restrictive nonparametric form), (b) whether or not account is taken of random error that may temporarily give some production units high or low outputs, inputs, costs, or profits, and (c) if there is random error in the probability distribution assumed for the inefficiencies (e.g., half-normal, truncated normal) used to disentangle the inefficiencies from the random error. Thus, the established approaches to efficiency measurement differ primarily in how much shape is imposed on the frontier and the distributional assumptions imposed on the random error and inefficiency. Empirical studies in Kenya (Mutanu, 2002; Musyoki, 2003; Njihia, 2005; and Sakina, 2006) have focused on the efficiency in the Kenya banking industry whilst establishing that commercial banks are efficient from different perspectives. However, none of these studies have established the link between banks’ efficiency and their respective stock returns. The present study sought to provide further insight to the Kenyan banking industry in the light of the findings obtained. The pursuit of efficiency has become
more important in the current more competitive banking environment since the inefficient institutions are less likely to survive. Hence, it is essential for managers to be knowledgeable about inefficiencies in the banking industry and their causes. It is of no doubt that the same information will be useful to the regulators as well.
CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1. Introduction

This chapter presents the research methodology used in this study. Section 3.2 describes the study population; Section 3.3 describes the sample; Section 3.4 outlines the data collection procedures and sources; and Section 3.5 describes the data analysis tools and the research model to be applied.

3.2. Population

The commercial banking sector in Kenya is comprised of 42 banks (see Appendix I). These banks formed the population of the study.

3.3. Sample

The sample comprised of 9 commercial banks. These included Barclays Bank of Kenya (BBK), C.F.C Bank (CFC), Diamond Trust Bank Kenya (DTK), Equity Bank (EQUITY), Housing Finance (HF), Kenya Commercial Bank (KCB), National Bank of Kenya (NBK), National Industrial Credit Bank (NIC), and Standard Chartered Bank (SCBK). The rationale for this sample was threefold. First, data on non-listed banks is difficult to obtain. The second reason is that these nine banks are listed at the NSE. Third, availability of data over the sample period. On the basis of the third criterion, Equity Bank (EQUITY) was eliminated from the sample. Equity bank was transformed into a commercial bank in 2004 and it was subsequently listed at the bourse in 2006 hence continuous data for the bank over the sample period could not be obtained.
3.4. Data Collection

The study applied secondary data which was extracted from the banks’ annual reports and financial statements for the nine-year period commencing 1998 up to 2006. The period was selected because continuous financial data was available for the eight banks over the entire period. These were obtained from the Banks Supervision Department at the Central Bank of Kenya. The data extracted from the financial statements included the following: interest expenses, non-interest expenses, net interest income, non-interest income, funds and deposits, total staff expenses, and the profit earned before tax.

3.5. Research Model

In assessing the relationship between changes in profit efficiency and stock returns for commercial banks in Kenya, this study used a Data Envelopment Analysis (DEA) model.

3.5.1. Conceptual Model

The study conceptualized that a bank’s stock returns is a function of changes in cost and profit efficiency as represented by equation (15) below.

\[ R_{it} = f(CE_{it}, PE_{it}) \]

Where:

- \( R_{it} \) Denotes the stock returns of the \( i^{th} \) bank
- \( CE_{it} \) Denotes the changes in cost efficiency of the \( i^{th} \) bank
- \( PE_{it} \) Denotes the changes in profit efficiency of the \( i^{th} \) bank
3.5.2. Empirical Models

3.5.2.1. Measuring Cost Efficiency

To measure efficiency as directly as possible, that is, management's success in controlling costs and generating revenues (that is, X-efficiencies), two input and two output variables, namely, interest expenses (IE), non-interest expenses (NIE) (inputs) and net interest income (NI) and non-interest income (NII) (outputs) were used (hereafter referred to as Model A and algebraically denoted by equation 16).

\[
CE_{it} = f(IE_{it}, NIE_{it}, NI_{it}, NII_{it})
\] ..........................(16)

3.5.2.2. Measuring Profit Efficiency

A second DEA analysis was run with deposits and staff numbers (proxied by staff expenses) as inputs and net loans and non-interest income as outputs (hereafter referred to as Model B and algebraically denoted by equation 17). In the Model B, where a less direct approach was taken to measure efficiency, Funds & Deposits (FDE) replaced interest expenses, staff expenses (STAFF) replaced non-interest expenses and profit before tax (PBT) replaced both the net interest income and non-interest income. Model B was thus a representative model of bank profit efficiency, indicating how well a bank transforms its inputs into profit.

\[
PE_{it} = f(FDE_{it}, STAFF_{it}, PBT_{it})
\] ..............................................(17)

3.5.2.3. Measuring Productivity Change

Efficiency changes were calculated by means of the Malmquist Index, following the approach proposed by Asmild et al. (2004). The index measures changes in efficiency between two successive periods. The Malmquist index is decomposed into two factors, one showing technical change and the other changes in efficiency change,
which can be interpreted as “catching up” effect. Equations (7) and (8) represent the algebraic expressions of computing the Malmquist index. According to Coelli (1996), the selection of the VRS or CRS option in computation of Malmquist indices has no influence on the Malmquist DEA because both are used to calculate the various distances used to construct the Malmquist indices. However, the output file indicates whether the sample assumes a VRS or a CRS approach.

In addition, all indices were relative to the previous year. Hence the output began with year 1999. Five indices were presented for each firm in each year. These are technical efficiency change (relative to a CRS technology); technological change; pure technical efficiency change (i.e., relative to a VRS technology); scale efficiency change; and total factor productivity (TFP) change.

3.5.2.4. Measuring Stock Returns

The stock returns represent the percentage gain or loss of the value of the stock when compared to some previous period. Equation (18) represents the algebraic expression that was used to compute the banks stocks returns.

\[ R_i = \left( \frac{P_i - P_{i-1}}{P_{i-1}} \right) \]  

\[ (18) \]

Where \( P_i \) denotes the price of the stock of the \( i \)th bank at the close of the year under study and \( R_i \) denotes the stock returns of the \( i \)th bank over the same year.
3.5.2.5. Linking Cost and Profit Efficiency to Stock Returns

After computing bank efficiency scores using publicly available information (accounting data), the next step was to link the scores to market returns. The model assumed the algebraic form shown in equation (19).

\[ ER_{it} = \lambda + \beta_0 EM_t + \delta_1 CE_{it} + \delta_2 PE_{it} + \epsilon_{it} \]  

(19)

Where \( ER_{it} \) is the excess return on stock \( i \) at time \( t \), \( EM_t \) is the excess market return, and \( CE_{it} \) is the percentage change in cost efficiency and \( PE_{it} \). \( \epsilon_{it} \) is a random error term. The excess stock return \( ER_{it} \) consists of two components, namely, the stock return and the risk-free return. The stock return consists of the dividend return and the return from movements in the stock price. The average annualized monthly return on 91 day Treasury bill rate for the relevant banks’ financial year was used as a proxy for the risk free return. Again, \( EM_t \) is the excess return on the market and is composed of the market return less a risk-free component. The NSE 20-share price index was used as the market portfolio and the return on this portfolio is calculated in the same manner as for individual stock.

3.5.3 Diagnostic Tests

This study used the F-test, t-test, and the coefficient of determination \( (R^2) \) to measure the significance of the relationship between stock returns and efficiency.
CHAPTER FOUR

4.0 DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.1. Introduction

This chapter presents the data analysis, interpretation, and discussion of the research findings. The chapter is organized as follows: section 4.2 presents the analysis of cost efficiency estimates; Section 4.3 presents the analysis of profit efficiency estimates; Section 4.4 provides a link between efficiency scores and banks’ stocks returns; and Section 4.5 is a discussion of findings.

4.2. Analysis Cost Efficiency Estimates (Model A)

Cost efficiency (CE) measures the possible reductions in cost that can be achieved if a bank is technically and allocatively efficient (Elyasiani and Mehdian, 1990). A bank is said to have technical efficiency (TE) if it operates on the efficient frontier and allocative efficiency (AE) if it is properly choosing the correct mix of inputs given the input prices. TE can be decomposed into pure technical efficiency (PTE) and scale efficiency (SE). Pure technical inefficiency results from using more inputs than necessary (input waste), while scale inefficiency occurs if the bank does not operate at constant returns to scale. Table 4.1 indicates the yearly averages for TE, AE, and CE for the eight listed banks selected for the study based on pooled data.
Table 4.1 Model A - DEA Efficiency Scores for Yearly Averages

<table>
<thead>
<tr>
<th>Year</th>
<th>Technical Efficiency</th>
<th>Allocative Efficiency</th>
<th>Cost Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>0.701</td>
<td>0.970</td>
<td>0.693</td>
</tr>
<tr>
<td>1999</td>
<td>0.685</td>
<td>0.884</td>
<td>0.639</td>
</tr>
<tr>
<td>2000</td>
<td>0.671</td>
<td>0.865</td>
<td>0.612</td>
</tr>
<tr>
<td>2001</td>
<td>0.606</td>
<td>0.850</td>
<td>0.555</td>
</tr>
<tr>
<td>2002</td>
<td>0.533</td>
<td>0.880</td>
<td>0.510</td>
</tr>
<tr>
<td>2003</td>
<td>0.596</td>
<td>0.898</td>
<td>0.573</td>
</tr>
<tr>
<td>2004</td>
<td>0.605</td>
<td>0.927</td>
<td>0.589</td>
</tr>
<tr>
<td>2005</td>
<td>0.608</td>
<td>0.894</td>
<td>0.575</td>
</tr>
<tr>
<td>2006</td>
<td>0.565</td>
<td>0.886</td>
<td>0.537</td>
</tr>
</tbody>
</table>

Notes: Scale assumption: Variable Return to Scale (VRS)
Source: Field Data (2007)

Figure 4.1: DEA Cost Efficiency Curves for Yearly Averages

Notes: TE = Technical Efficiency, AE = Allocative Efficiency, CE = Cost Efficiency
Source: Field Data (2007)
In general, the CE efficiency scores in Table 4.1 were on a downward trend in the period between 1998 and 2002, falling from 0.693 to 0.510. However, a slight increase in CE was realized between 2003 and 2005 before falling back to 0.537 in year 2006. The improvement in cost efficiencies of commercial banks after year 2002 would be attributed to a number of factors. First, the measures undertaken by the Central Bank of Kenya in 2002 to streamlines operations and corporate governance in the banking industry. They included introduction of an effective legal and regulatory framework, development of prudential regulations, increased interaction with other regulatory authorities, directors and external auditors, and amendment of the Banking Act. Section 24 (5) of the Banking Act was amended to give the Central Bank mandate to arrange trilateral meetings with an institution and its auditors, Section 31(3) was amended to allow the sharing of information between institutions, Section 11 was amended to state that facilities to a director must be approved by the full board of directors and further empowered the Central Bank to remove directors from office if their loans are non-performing. The amendments also saw the inclusion of banking regulations that empower the Minister of Finance and the Central Bank to levy penalties for non-compliance with corporate governance principles and other violations of the Banking Act. All prudential regulations were also reviewed in the year 2000 to ensure enhanced corporate governance in the Banking Sector (Central Bank of Kenya, 2002; Republic of Kenya, 2002).

In addition, the mean reported TE scores in Table 4.1 were lower than the reported mean allocative efficiency (AE) scores for all the years over the entire study period. This scenario implies that the main source of cost inefficiencies in the listed banks is most likely attributable to a range of factors namely. First, it is attributable to
overstaffing. Secondly, the long learning curve of management on how to best use technology to reduce costs e.g. introduction of internet banking should lead to reliance on less staff because most customers would transact without necessarily visiting the banking halls. Thirdly, competition in the banking industry has led to deployment of more staff to assist in implementation of various competitive measures introduced by individual banks. Finally, lack of proper communication infrastructure in rural areas has hindered the banks’ efforts to roll out modern banking services such as the internet banking.

Table 4.2 presents the mean averages for the bank-specific efficiency scores for the sample period between 1998 and 2006, under model A. The findings indicates that NIC Bank, SCBK, and DTK featured as the most cost-efficient banks over the sample period, reporting 1.0, 1.0, and 0.9237 mean CE scores respectively. HF and CFC faired well above the 0.5 CE mark at 0.6791 and 0.5090 respectively. NBK reported an average score of 0.4225 over the sample period. KCB and BBK featured as the most cost inefficient banks by reporting average CE scores of 0.1070 and 0.0518 respectively. The latter result is attributed to the low mean TE scores reported for both banks. As reported in Table 4.1 above, all the banks in Table 4.2 reported high averages of AE scores as compared to the TE scores. Therefore, the findings in both tables reinforce each other. The yearly DEA efficiency scores (Model A) for each bank are presented in Appendix II.
Table 4.2 Model A: Bank-specific DEA efficiency scores (1998-2006 averages)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Barclays Bank of Kenya (BBK)</td>
<td>0.0660</td>
<td>0.7856</td>
<td>0.0518</td>
</tr>
<tr>
<td>CFC Bank (CFC)</td>
<td>0.5587</td>
<td>0.9111</td>
<td>0.5090</td>
</tr>
<tr>
<td>Diamond Trust Bank (DTK)</td>
<td>0.9484</td>
<td>0.9739</td>
<td>0.9237</td>
</tr>
<tr>
<td>Housing Finance (HF)</td>
<td>0.7209</td>
<td>0.9420</td>
<td>0.6791</td>
</tr>
<tr>
<td>Kenya Commercial Bank (KCB)</td>
<td>0.1501</td>
<td>0.7128</td>
<td>0.1070</td>
</tr>
<tr>
<td>National Bank of Kenya (NBK)</td>
<td>0.5069</td>
<td>0.8334</td>
<td>0.4225</td>
</tr>
<tr>
<td>National Industrial Credit (NIC) Bank</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Standard Chartered Bank (SCBK)</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Scale assumption: Variable Return to Scale (VRS)
Source: Field Data (2007)

4.2.1. Analysis of Productivity Improvement of Net Interest and Non-interest Income

Another useful metric within the DEA framework is the Malmquist index, which is the product of two elements: (i) change in technical efficiency or how close a bank can get to the efficient frontier (namely, the catching up index) and (ii) technological change (namely, the changes in best-practice index) or how much the benchmark production frontier shifts at each bank’s observed input mix (innovations or shocks).

A Malmquist index that is greater than 1 implies that total factor productivity progress occurred, while an index less than 1 means that total factor productivity declined. The Malmquist total factor productivity (TFP) index measures the TFP change between two data points by calculating the ratio of the distances of each data point relative to a common technology. The Malmquist indices were computed using DEAP® 2.1 applying the procedures outlined by Coelli (1996).
The Malmquist index summary of annual means is presented in the Table 4.3. All indices are relative to the previous year. The year 1998 is the base year, so the output begins with the year 1999. Table 4.4 presents the changes in productivity for each bank in the sample.

Table 4.3 Malmquist Index Summary of Annual Means (Model A)

<table>
<thead>
<tr>
<th>Year</th>
<th>ATE</th>
<th>TECH</th>
<th>PTE</th>
<th>SE</th>
<th>TFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>1.032</td>
<td>1.283</td>
<td>1.000</td>
<td>1.032</td>
<td>1.323</td>
</tr>
<tr>
<td>2000</td>
<td>0.949</td>
<td>1.303</td>
<td>1.000</td>
<td>0.949</td>
<td>1.237</td>
</tr>
<tr>
<td>2001</td>
<td>0.815</td>
<td>1.493</td>
<td>1.000</td>
<td>0.815</td>
<td>1.216</td>
</tr>
<tr>
<td>2002</td>
<td>0.894</td>
<td>0.996</td>
<td>1.000</td>
<td>0.894</td>
<td>0.890</td>
</tr>
<tr>
<td>2003</td>
<td>1.185</td>
<td>0.902</td>
<td>1.000</td>
<td>1.185</td>
<td>1.069</td>
</tr>
<tr>
<td>2004</td>
<td>1.056</td>
<td>0.907</td>
<td>1.000</td>
<td>1.056</td>
<td>0.958</td>
</tr>
<tr>
<td>2005</td>
<td>1.014</td>
<td>0.881</td>
<td>1.000</td>
<td>1.014</td>
<td>0.894</td>
</tr>
<tr>
<td>2006</td>
<td>0.852</td>
<td>1.037</td>
<td>1.000</td>
<td>0.852</td>
<td>0.884</td>
</tr>
<tr>
<td>Averages (1998-2006)</td>
<td>0.968</td>
<td>1.081</td>
<td>1.000</td>
<td>0.968</td>
<td>1.046</td>
</tr>
</tbody>
</table>

Notes: all Malmquist index averages are geometric means

ATE = Technical Efficiency Change; TECH = Technical or Technology change;

PTE = Pure technical efficiency change; SE = Scale efficiency change; and

TPF = Total factor productivity change

Source: Field Data (2007)
Figure 4.2 Malmquist Index Curves for Annual Means (Model A)

Notes: all Malmquist index averages are geometric means

\[ \Delta \text{TE} \] = Technical Efficiency Change; \[ \Delta \text{TECH} \] = Technical or Technology change;
\[ \Delta \text{PTE} \] = Pure technical efficiency change; \[ \Delta \text{SE} \] = Scale efficiency change; and
\[ \Delta \text{TFP} \] = Total factor productivity change.

Source: Field Data (2007)

Table 4.4 Malmquist Index Summary of Bank-specific Means (Model A)

<table>
<thead>
<tr>
<th>Bank</th>
<th>( \Delta \text{TE} )</th>
<th>( \Delta \text{TECH} )</th>
<th>( \Delta \text{PTE} )</th>
<th>( \Delta \text{SE} )</th>
<th>( \Delta \text{TFP} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barclays Bank of Kenya (BBK)</td>
<td>1.002</td>
<td>1.261</td>
<td>1.000</td>
<td>1.002</td>
<td>1.264</td>
</tr>
<tr>
<td>CFC Bank (CFC)</td>
<td>0.894</td>
<td>1.235</td>
<td>1.000</td>
<td>0.894</td>
<td>1.104</td>
</tr>
<tr>
<td>Diamond Trust Bank (DTK)</td>
<td>0.950</td>
<td>1.139</td>
<td>1.000</td>
<td>0.950</td>
<td>1.082</td>
</tr>
<tr>
<td>Housing Finance (HF)</td>
<td>1.063</td>
<td>1.085</td>
<td>1.000</td>
<td>1.063</td>
<td>1.153</td>
</tr>
<tr>
<td>Kenya Commercial Bank (KCB)</td>
<td>1.036</td>
<td>1.029</td>
<td>1.000</td>
<td>1.036</td>
<td>1.065</td>
</tr>
<tr>
<td>National Bank of Kenya (NBK)</td>
<td>0.843</td>
<td>0.990</td>
<td>1.000</td>
<td>0.843</td>
<td>0.835</td>
</tr>
<tr>
<td>National Industrial Credit (NIC) Bank</td>
<td>0.974</td>
<td>0.984</td>
<td>1.000</td>
<td>0.974</td>
<td>0.958</td>
</tr>
<tr>
<td>Standard Chartered Bank (SCBK)</td>
<td>1.002</td>
<td>0.964</td>
<td>1.000</td>
<td>1.002</td>
<td>0.966</td>
</tr>
<tr>
<td>Average 1998-2006</td>
<td>0.968</td>
<td>1.081</td>
<td>1.000</td>
<td>0.968</td>
<td>1.046</td>
</tr>
</tbody>
</table>

Notes: all Malmquist index averages are geometric means

\[ \Delta \text{TE} \] = Technical Efficiency Change; \[ \Delta \text{TECH} \] = Technical or Technology change;
\[ \Delta \text{PTE} \] = Pure technical efficiency change; \[ \Delta \text{SE} \] = Scale efficiency change; and
\[ \Delta \text{TFP} \] = Total factor productivity change.

Source: Field Data (2007)
Following Coelli et al. (1998), productivity changes reflect the product of changes in technological progress and technical efficiency. The above results indicate that the average level of the Malmquist index ($\Delta TFP$) had dropped significantly from 1.323 in year 1999 to 1.046 in year 2006, meaning that the TFP had lost gains over the study period. This was attributed to the significant drops experienced in the TFP-linked indices namely the technical efficiency index ($\Delta TE$) and the technological change index ($\Delta TECH$). The technical efficiency change index ($\DeltaTE$) and technological change index ($\DeltaTECH$), respectively, decreased from 1.032 and 1.283 in 1999 to 0.968 and 1.081 in 2006 (or decline of 6.2% and 15.7%).

In general, the laxity in technological progress by the banks under study contributed to a decrease in TFP because of the decline in the rate of mean technological progress by 15.7% over the study period. These results suggest that the total factor productivity change was more attributable to the technical efficiency change ($\Delta TE$) than technological change ($\Delta TECH$). Also, during the study period it was found that the total factor productivity in years 2003 and 2006, respectively increased by 6.9% and 4.6% after a decline of 11% in 2002 and 11.6% in 2005. This might suggest that the institutional reforms in banking system by the Central Bank and Capital Markets Authority in 2002 and 2005 were indeed successful. These developments occurred despite the technological change index ($\Delta TECH$) declining by 9.8% to 0.902 in 2003 and the technical efficiency change ($\Delta TE$) declining by 3.2% to 0.968 in 2006. This implies that the increases of TFP in 2003 and 2006 were driven by technical efficiency (as a result of institutional reforms in the banking industry) and the technological efficiency realized after the banks adopted the modern core banking
technologies that support internet banking, ATM network expansion and ATM service outsourcing; SMS-banking, and management of lending services.

4.3. Analysis of Profit Efficiency Estimates (Model B)

Model B was designed to assess a bank's ability to transform inputs of borrowed funds and deposits and labour into profit. Table 4.5 indicates the yearly averages for TE, AE, and PE for the eight listed banks selected for the study based on pooled data. The findings indicate a sharp contrast to the allocative efficiency results presented in Table 4.1 (Model A - cost efficiency). In Table 4.5, the allocative efficiency scores have declined. This indicates that the most cost efficient bank is not necessarily the most revenue efficient. The overall profitability of the banking sector declined between 1998 and 2002 but it exhibited an upward trend thereafter (Figure 4.3). The growth in profitability can be attributed to the general economic growth experienced after 2002 which has led to improved lending, growth in branch and ATM networks, and growth in customer deposits. In addition, the regulatory reforms introduced by the CBK have improved the profit-maximizing behaviour of some commercial banks.

The allocative efficiency and the profit efficiency scores were significantly different in 1998, 2000, 2002 and 2003 and the variables appeared cyclical. The dip in 1998 and 2002 can be attributed to the reduced business activity by commercial banks in response to the political situations before and after the respective electioneering periods. The staff who are responsible for bringing new business are not able to generate revenues to offset their expenses which are fixed and this reduces both the allocative efficiency and profit efficiency. Commercial banks also reduce their lending to the private sector during the electioneering period and opt for the lower risk
government securities which have a lower yield thus reducing the allocative efficiency.

Table 4.5 Model B: DEA Efficiency Scores for Yearly Averages

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean Efficiency Scores</th>
<th>Technical Efficiency</th>
<th>Allocative Efficiency</th>
<th>Profit Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td></td>
<td>0.639</td>
<td>0.125</td>
<td>0.125</td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td>0.672</td>
<td>0.250</td>
<td>0.229</td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td>0.673</td>
<td>0.375</td>
<td>0.313</td>
</tr>
<tr>
<td>2001</td>
<td></td>
<td>0.669</td>
<td>0.250</td>
<td>0.208</td>
</tr>
<tr>
<td>2002</td>
<td></td>
<td>0.690</td>
<td>0.125</td>
<td>0.125</td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td>0.692</td>
<td>0.384</td>
<td>0.303</td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td>0.680</td>
<td>0.318</td>
<td>0.258</td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td>0.667</td>
<td>0.288</td>
<td>0.234</td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td>0.665</td>
<td>0.296</td>
<td>0.241</td>
</tr>
</tbody>
</table>

Constant Return to Scale (CRS) assumed
Source: Field Data (2007)

Figure 4.3 Model B - DEA Efficiency Curves for Yearly Averages

Notes: Constant Return to Scale (CRS) assumed
Source: Field Data (2007)

The comparison of trends in the CE (Model A) and PE (Model B) curves is presented in Figure 4.4 below. The findings indicate that over the sample period, the CE was
exhibiting a declining trend while PE was exhibiting an upward trend. That is, cost efficiency was declining despite the gains in revenue efficiency.

This has important implications for revenue efficiency. Although these banks are less efficient in transforming the specified inputs into interest earning assets and non-interest income (Model A outputs), they are more efficient in transforming those outputs into revenue.

**Figure 4.4 A Comparison of Cost (CE) efficiency and Profit (PE) efficiency**

![Graph showing the comparison between Cost (CE) and Profit (PE) efficiency over years from 1988 to 2006.](image)

*Note: Trend curves are lines of best fit*

*Source: Field Data (2007)*

**4.3.1. Analysis of Productivity of Deposits, Borrowed Funds and Labour**

The Malmquist indices were used to analyze the productivity of deposits, borrowed funds and labour. The summary of annual means is presented in the Table 4.6. All
indices are relative to the previous year (Asmild et al., 2004). The year 1998 is the base year, so the output begins with the year 1999.

### Table 4.6 Malmquist Index Summary of Annual Means (Model B)

<table>
<thead>
<tr>
<th>Year</th>
<th>(\Delta T E)</th>
<th>(\Delta T E C H)</th>
<th>(\Delta P T E)</th>
<th>(\Delta S E)</th>
<th>(\Delta T F P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>1.052</td>
<td>0.515</td>
<td>1.052</td>
<td>1.000</td>
<td>0.542</td>
</tr>
<tr>
<td>2000</td>
<td>1.001</td>
<td>0.679</td>
<td>1.001</td>
<td>1.000</td>
<td>0.679</td>
</tr>
<tr>
<td>2001</td>
<td>0.998</td>
<td>0.762</td>
<td>0.998</td>
<td>1.000</td>
<td>0.760</td>
</tr>
<tr>
<td>2002</td>
<td>1.033</td>
<td>0.765</td>
<td>1.033</td>
<td>1.000</td>
<td>0.790</td>
</tr>
<tr>
<td>2003</td>
<td>1.000</td>
<td>0.723</td>
<td>1.000</td>
<td>1.000</td>
<td>0.740</td>
</tr>
<tr>
<td>2004</td>
<td>0.978</td>
<td>0.894</td>
<td>0.978</td>
<td>1.000</td>
<td>0.875</td>
</tr>
<tr>
<td>2005</td>
<td>0.976</td>
<td>0.884</td>
<td>0.976</td>
<td>1.000</td>
<td>0.862</td>
</tr>
<tr>
<td>2006</td>
<td>0.995</td>
<td>0.844</td>
<td>0.995</td>
<td>1.000</td>
<td>0.840</td>
</tr>
<tr>
<td>Averages (1998-2006)</td>
<td>1.004</td>
<td>0.824</td>
<td>1.004</td>
<td>1.000</td>
<td>0.860</td>
</tr>
</tbody>
</table>

Notes: All Malmquist index averages are geometric means

\(\Delta T E\) = Technical Efficiency Change; \(\Delta T E C H\) = Technical or Technology change;
\(\Delta P T E\) = Pure technical efficiency change; \(\Delta S E\) = Scale efficiency change; and
\(\Delta T F P\) = Total factor productivity change

Source: Field Data (2007)

### Figure 4.5 Malmquist Index Curves for Annual Means (Model B)

Source: Field Data (2007)
Table 4.7 Malmquist Index Summary of Bank-specific Means (Model B)

<table>
<thead>
<tr>
<th>Bank</th>
<th>( \Delta T E )</th>
<th>( \Delta T E C H )</th>
<th>( \Delta P T E )</th>
<th>( \Delta S E )</th>
<th>( \Delta T F P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barclays Bank of Kenya (BBK)</td>
<td>1.000</td>
<td>0.764</td>
<td>1.000</td>
<td>1.000</td>
<td>0.764</td>
</tr>
<tr>
<td>CFC Bank (CFC)</td>
<td>0.996</td>
<td>0.776</td>
<td>0.996</td>
<td>1.000</td>
<td>0.772</td>
</tr>
<tr>
<td>Diamond Trust Bank (DTK)</td>
<td>0.990</td>
<td>0.739</td>
<td>0.990</td>
<td>1.000</td>
<td>0.732</td>
</tr>
<tr>
<td>Housing Finance (HF)</td>
<td>1.072</td>
<td>0.724</td>
<td>1.072</td>
<td>1.000</td>
<td>0.776</td>
</tr>
<tr>
<td>Kenya Commercial Bank (KCB)</td>
<td>0.996</td>
<td>0.711</td>
<td>0.996</td>
<td>1.000</td>
<td>0.743</td>
</tr>
<tr>
<td>National Bank of Kenya (NBK)</td>
<td>0.979</td>
<td>0.753</td>
<td>0.979</td>
<td>1.000</td>
<td>0.737</td>
</tr>
<tr>
<td>National Industrial Credit (NIC) Bank</td>
<td>1.000</td>
<td>0.770</td>
<td>1.000</td>
<td>1.000</td>
<td>0.770</td>
</tr>
<tr>
<td>Standard Chartered Bank (SCBK)</td>
<td>1.000</td>
<td>0.770</td>
<td>1.000</td>
<td>1.000</td>
<td>0.770</td>
</tr>
<tr>
<td>Average 1998-2006</td>
<td>1.004</td>
<td>0.824</td>
<td>1.004</td>
<td>1.000</td>
<td>0.860</td>
</tr>
</tbody>
</table>

Notes: All Malmquist index averages are geometric means
\( \Delta T E \) = Technical Efficiency Change; \( \Delta T E C H \) = Technical or Technology change; \( \Delta P T E \) = Pure technical efficiency change; \( \Delta S E \) = Scale efficiency change; and \( \Delta T F P \) = Total factor productivity change

Source: Field Data (2007)

The above results indicate that the average level of the Malmquist index \( \Delta T F P \) had increased significantly from 0.542 in year 1999 to 0.860 in year 2006, meaning that the TFP had made gains over the study period even though it oscillated below the 1.0 mark. This was attributed to the significant gains experienced in the TFP-linked indices namely the technical efficiency index \( \Delta T E \) and the technological change index \( \Delta T E C H \). The average technical efficiency change index \( \Delta T E \) for the sample period was found to be 1.004, indicating a marginal gain of 0.4%. The technological change index \( \Delta T E C H \), increased tremendously from 0.515 in 1999 to 0.824 in 2006 (or a gain of 60%). The net result of technical efficiency and technological change increased the TFP index by 58.7 percent, from 0.542 in year 1999 to 0.860 in year 2006. Considerable progress in technical efficiency changes was realized by most banks in the years 1999 (5.2%), year 2000 (0.1%), year 2002 (3.3%), year 2006 (0.4%). However, the fact that the Malmquist Productivity Indices (MPIs)
for technological efficiency change were below 1.0 for the entire sample period indicates that banks are still yet to realize full technological advancement. A 60% gain in the technological change index (ΔTECH) between 1999 and 2006 indicates that the Kenyan banks have since considered technological innovations as one of their growth strategies.

It therefore appears that technical efficiency and technological change were the dominant causes of improvements in (profit) efficiency over the period. Again scale efficiency change is 1.0 for the entire sample period, indicating it is unlikely that the bias noted by Grifell-Tatje and Lovell (1995) is significant. Grifell-Tatje and Lovell (1995) showed there is a systematic bias when the Malmquist index is calculated in the presence of variable returns to scale. The bias overstates true productivity change when input growth occurs in the presence of increasing returns to scale, and when input contraction occurs the bias is reversed. Further, the bias arises no matter whether the MPI is calculated using parametric or nonparametric approaches.

4.4. Linking Efficiency to Stock Returns

4.4.1. Summary Statistics on Excess Stock and Market Returns

Table 4.8 presents descriptive statistics for both excess stock and market returns. The mean value of $ER_{it}$ over the sample period was found to be 0.394 while the mean value for $EM_{it}$ was found to be 0.048. Positive values of kurtosis indicate that the observations of both returns were clustered around some central points, with the $ER_{it}$ clustering more. Positive values of skewness indicate that both distributions are non-symmetric at the mean points.
Table 4.8 Descriptive Statistics on Excess Stock and Market Returns

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>$ER_{it}$</th>
<th>$EM_{it}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>-0.187</td>
<td>-0.428</td>
</tr>
<tr>
<td>Maximum</td>
<td>1.976</td>
<td>0.994</td>
</tr>
<tr>
<td>Mean</td>
<td>0.394</td>
<td>0.048</td>
</tr>
<tr>
<td>Standard Error of the Mean</td>
<td>0.226</td>
<td>0.149</td>
</tr>
<tr>
<td>Skewness</td>
<td>1.885</td>
<td>1.148</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>3.667</td>
<td>1.511</td>
</tr>
</tbody>
</table>

Source: Field Data (2007)

The excess stock return consists of two components namely the stock return and the risk-free return. The stock return consists of the dividend return and the return from movements in the stock price. The excess return on the market on the other hand is composed of the market return less a risk-free component. Figure 4.6 presents a comparison in the trend movements of both the excess stock returns ($ER_{it}$) and Excess market return ($EM_{it}$)

Figure 4.6 Trend of the Excess stock and Market returns (1998-2006)

Source: Field Data (2007)
The trend curves (dotted lines) in Figure 4.9 indicates that both the stock returns and the market returns were on an upward trend over the sample period. The average growth in excess stock return was found to be 39.36%. The average growth in excess market return was found to be 4.82%.

4.4.2. Regression Analysis

The regression of equation (16) was performed to establish whether or not there existed a link between cost/profit efficiency and banks' stocks returns. The model was first subjected to F-Test to establish whether the variables were jointly significant. T statistics for the individual parameters' coefficients were examined to determine their significance in the model. Using the excess stock returns as dependent variables, the F-Test yielded $F_{(3,5)} = 35.753$; (P-value < 0.01). This value of F-statistic is statistically significant at 95% and 99% levels of confidence. This implies that the independent variables ($EM_t$, $CE_u$ and $PE_v$) were jointly significant to the model. Adjusted $R^2$ value of 0.929 was obtained implying that 93% of variations in the excess stock returns could be explained jointly by excess market return, change in cost efficiency, and change in profit efficiency of the listed banks. T-test was further used to ascertain the significance of each independent variable in the model by testing the null hypotheses that their respective coefficients are equal to zero (i.e. each of $\lambda_0$, $\beta_0$, $\delta_1$, $\delta_2 = 0$). The test yielded that the absolute values of the t-statistics were greater than the critical values at 95% level of confidence hence the null hypotheses were rejected for all coefficients. The findings are presented in Table 4.8.
Table 4.9: Regression estimates on the test of relationship between commercial banks’ efficiency and stock returns

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Coefficients</th>
<th>t-ratios</th>
<th>P-values</th>
<th>T-Tests on restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_0$</td>
<td>0.1900</td>
<td>2.4034*</td>
<td>0.0413</td>
<td>Reject H0</td>
</tr>
<tr>
<td>$\beta_0$</td>
<td>1.5917</td>
<td>7.518**</td>
<td>0.00065</td>
<td>Reject H0</td>
</tr>
<tr>
<td>$\delta_1$</td>
<td>-3.0459</td>
<td>-2.1694*</td>
<td>0.03220</td>
<td>Reject H0</td>
</tr>
<tr>
<td>$\delta_2$</td>
<td>0.3151</td>
<td>2.3643*</td>
<td>0.03440</td>
<td>Reject H0</td>
</tr>
</tbody>
</table>

* denotes significance at 5% level (P-values < 0.05); Critical values = 1.96 (at 5%)
** denotes significance at 1% level (P-values < 0.01); Critical values = 2.57 (at 1%)

Dependent Variable = Excess stock returns from pooled data; $ER$ = Excess stock returns; $EM$ = Excess market returns; $CE$ or $PE$ = % change in either profit or cost efficiency

The findings in Table 4.9 (in addition to the F-Test results) indicate that there exists a significant relationship between stock returns and changes in both cost and profit efficiency for the listed commercial banks. All the parameters had the expected positive signs. The banks exhibited a decline in CE over the sample period. Conversely, a revenue efficient bank is anticipated to yield high returns on stocks from the stock exchange markets. This means that poor management of costs affects banks’ profits. Poor profits would mean low dividends to investors. Consequently, the share price will be bid down at the stock market. Conversely, a bank which efficiently mobilizes its deposits, other funds and staff earns high profits. This translates into high dividends to investors. Thus, the share will be highly priced.

4.5. Summary

In regard to cost efficiency, CE efficiency scores were on a downward trend over the sample period (1998-2006). Allocative efficiency was found to be the major driver of the improvement in cost efficiency of commercial banks. It was therefore prudent to conclude that the main source of cost inefficiencies in the listed banks is most likely attributable factors such as overstaffing, the long learning curve of management on
how to best use technology to reduce costs, and lack of proper communication infrastructure in rural areas which has hindered the banks’ efforts to roll out modern banking services such as the internet banking and ATMs.

The findings on profit efficiency established that the PE scores were on an upward trend over the sample period (1998-2006). Technical efficiency and technological change were found to be the dominant causes of improvements in (profit) efficiency over the period. This is in agreement to the findings of Sakina (2006) that Kenyan banks are X-efficient (on managerial and technological fronts) in transforming inputs at minimum costs into maximum profits. Furthermore, commercial banks in Kenya are able to continue to realize profits against declining cost efficiency and relatively low allocative and profit efficiency because they are key players in lending to the government through the low risk treasury bonds and bills, from which they realize good returns.

Results from the regression analysis indicated that there exists a significant relationship between stock returns and changes in both cost and profit efficiency for the listed commercial banks. All the parameters except the one linked to change in cost efficiency had the expected positive sign. This implies that the stock market would respond negatively to a cost inefficient bank. A positive sign of the change in revenue efficiency coefficient implies that investors would expect a revenue efficient bank to yield high returns from the stock markets. The findings are in agreement to empirical findings by Joshua and Daehoon (2005) that changes in profit efficiency were statistically significant in determining the stock returns of banks.
CHAPTER FIVE

5.0 SUMMARY AND CONCLUSIONS

5.1. Introduction

This chapter presents the summary, conclusions and recommendations derived from the findings of the study. Section 5.2 is a brief summary of the study. Section 5.3 provides the conclusions. Section 5.4 presents the limitations of the study. Section 5.5 provides the recommendations.

5.2. Summary

The objective of the study was to investigate the relationship between banking efficiency and stock returns of commercial banks listed at the Nairobi Stock Exchange. The study hypothesized that there is a positive relationship between cost & profit efficiency and stock returns. The hypothesis was based on the assumption that stocks of a cost efficient or a revenue efficient bank would necessarily yield high returns in the stock markets. Empirical evidence shows that changes in profit efficiency are statistically significant in determining the stock returns of banks. In achieving the above objective, the study applied secondary data obtained from the audited financial statements of the commercial banks for the period 1998-2006. Data were obtained from the Banks Supervision Department at the Central Bank of Kenya. In order to measure the cost and profit efficiency of the listed banks, the study employed the Data Envelopment Analysis (DEA) technique.

The key findings of the study are as follows. First, the banks exhibited declining cost efficiency over the sample period while the revenue efficiency was on a steady
increase. Malmquist total factor productivity (TFP) index measures showed that technical efficiency and technological efficiency were the main drivers of profit efficiency in the banking industry. Secondly, there exists a significant relationship between stock returns and changes in both cost and profit efficiency for the listed commercial banks. The findings were in agreement to previous studies (Joshua and Daehoon, 2005; Berlamino and Fernando, 1997; Sakina, 2006).

5.3. Conclusions

The study has established that the efficiency of a bank’s operation has significant impact on its excess returns. Cost efficiency was on a declining trend while profit efficiency was on an upward trend. This indicates that commercial banks are able to return profits despite exhibiting increased cost inefficiency. This has been possible due to the economic growth realized which has resulted to improved borrowing by both the government and the ‘banked’ public. In addition, banks have put in place measures to clean their balance sheets of non-performing loans and advances net of provisions. Growth of asset base, customer deposits, and technological innovations has further contributed to improved profitability in the sector. Cost efficiency influence stock returns of banks. Poor management of costs affects banks’ profits. Poor profits would mean low dividends to investors. Consequently, the share price will be bid down at the stock market. Conversely, a bank which efficiently mobilizes its deposits, other funds and staff earns high profits. This translates into high dividends to investors. Thus, the share will be highly priced which implies high stock returns.
5.4. Limitations of the Study

The computation of cost and revenue efficiency did not put into consideration other determinants of efficiency other than the financial variables specified as inputs and outputs in the key models applied. Previous studies have indicated that the structure of regulation and organization, risk management practices, and competition may affect efficiency by influencing a financial institution's ability to transform inputs to maximum profits at minimal costs. These and other determinants of banks' efficiency were excluded from key models due to the associated measurement. Secondly, the study covered a 9-year period due to inadequate documentation of financial variables for the years prior to 1998. Thirdly, this study only examines the cost of producing services for a commercial bank but not the cost implication to the consumers of banking services. Both affect the allocation of resources, especially from the development perspective. Finally, the computer program DEAP® Version 2.1 is programmed to compute the MPIs with respect to the previous years hence it was not possible to compute MPIs with respect to 1998 as the base year.

5.5. Recommendations

In the long run, the success and soundness of the financial institutions and the entire banking sector in Kenya depends on the achievement of operational efficiency through the application of prudential practices, good corporate governance and robust risk management frameworks. Further research is recommended to establish whether regulatory reforms and liberalization have been effective in improving the efficiency of commercial banks in Kenya.
References


Appendices

Appendix I: List of commercial banks in Kenya

1. African Banking Corporation Ltd
2. Bank of Africa Kenya Ltd
3. Bank of Baroda (K) Ltd
4. Bank of India
5. Barclays Bank of Kenya Ltd
6. CFC Bank Ltd
7. Charterhouse Bank Ltd
8. Chase Bank Ltd
9. Citibank NA Kenya
10. City Finance Bank Ltd
11. Co-operative Bank of Kenya Ltd
12. Commercial Bank of Africa Ltd
13. Consolidated Bank of Kenya
14. Credit Bank
15. Development Bank of Kenya
16. Diamond Trust Bank Ltd
17. Dubai Bank Kenya Ltd
18. EABS Bank Ltd
19. Equitorial Commercial Bank Ltd
20. Equity Bank Ltd
21. Family Bank Ltd
22. Fidelity Commercial Bank
23. Fina Bank Ltd
24. Giro Commercial Bank Ltd
25. Guardian Bank Ltd
26. Habib Bank A.G. Zurich
27. Habib Bank Ltd
28. Imperial Bank Ltd
29. Investments & Mortgages Bank Ltd
30. K-Rep Bank Ltd
31. Kenya Commercial Bank Ltd
32. Middle East Bank Ltd
33. National Bank of Kenya Ltd
34. National Industrial Credit Bank Ltd
35. Oriental Commercial Bank Ltd
36. Paramount Universal Bank Ltd
37. Prime Bank Ltd
38. Southern Credit Banking Corporation Ltd
39. Stanbic Bank Kenya Ltd
40. Standard Chartered Bank (K) Ltd
41. Transnational Bank Ltd
42. Victoria Commercial Bank Ltd

Source: Central Bank of Kenya (2007)
Appendix II: DEA efficiency Scores (Model A)

<table>
<thead>
<tr>
<th>Year</th>
<th>TE</th>
<th>AE</th>
<th>CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998 (Means)</td>
<td>0.701</td>
<td>0.97</td>
<td>0.693</td>
</tr>
<tr>
<td>BBK</td>
<td>0.0740</td>
<td>0.8390</td>
<td>0.0620</td>
</tr>
<tr>
<td>CFC</td>
<td>0.5200</td>
<td>0.9400</td>
<td>0.7710</td>
</tr>
<tr>
<td>DTK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>HF</td>
<td>0.6140</td>
<td>0.9940</td>
<td>0.6100</td>
</tr>
<tr>
<td>KCB</td>
<td>0.1010</td>
<td>0.9910</td>
<td>0.1000</td>
</tr>
<tr>
<td>NBK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>NIC</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>SCBK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td><strong>Year 1999 (Means)</strong></td>
<td><strong>0.585</strong></td>
<td><strong>0.884</strong></td>
<td><strong>0.639</strong></td>
</tr>
<tr>
<td>BBK</td>
<td>0.0720</td>
<td>0.7610</td>
<td>0.0550</td>
</tr>
<tr>
<td>CFC</td>
<td>0.9560</td>
<td>0.9880</td>
<td>0.9440</td>
</tr>
<tr>
<td>DTK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>HF</td>
<td>0.6430</td>
<td>0.9080</td>
<td>0.5840</td>
</tr>
<tr>
<td>KCB</td>
<td>0.1320</td>
<td>0.7880</td>
<td>0.1040</td>
</tr>
<tr>
<td>NBK</td>
<td>0.6790</td>
<td>0.6290</td>
<td>0.2700</td>
</tr>
<tr>
<td>NIC</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>SCBK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td><strong>Year 2000 (Means)</strong></td>
<td><strong>0.671</strong></td>
<td><strong>0.865</strong></td>
<td><strong>0.612</strong></td>
</tr>
<tr>
<td>BBK</td>
<td>0.0650</td>
<td>0.7530</td>
<td>0.0490</td>
</tr>
<tr>
<td>CFC</td>
<td>0.7210</td>
<td>0.9410</td>
<td>0.6780</td>
</tr>
<tr>
<td>DTK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>HF</td>
<td>0.5460</td>
<td>0.9160</td>
<td>0.5000</td>
</tr>
<tr>
<td>KCB</td>
<td>0.1440</td>
<td>0.8650</td>
<td>0.0950</td>
</tr>
<tr>
<td>NBK</td>
<td>0.6920</td>
<td>0.6440</td>
<td>0.5750</td>
</tr>
<tr>
<td>NIC</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>SCBK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td><strong>Year 2001 (Means)</strong></td>
<td><strong>0.606</strong></td>
<td><strong>0.85</strong></td>
<td><strong>0.555</strong></td>
</tr>
<tr>
<td>BBK</td>
<td>0.0440</td>
<td>0.7810</td>
<td>0.0340</td>
</tr>
<tr>
<td>CFC</td>
<td>0.4630</td>
<td>0.9310</td>
<td>0.4310</td>
</tr>
<tr>
<td>DTK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>HF</td>
<td>0.6520</td>
<td>0.8190</td>
<td>0.5340</td>
</tr>
<tr>
<td>KCB</td>
<td>0.1280</td>
<td>0.6250</td>
<td>0.0800</td>
</tr>
<tr>
<td>NBK</td>
<td>0.5600</td>
<td>0.6420</td>
<td>0.3600</td>
</tr>
<tr>
<td>NIC</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>SCBK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td><strong>Year 2002 (Means)</strong></td>
<td><strong>0.533</strong></td>
<td><strong>0.88</strong></td>
<td><strong>0.51</strong></td>
</tr>
<tr>
<td>BBK</td>
<td>0.0550</td>
<td>0.7390</td>
<td>0.0410</td>
</tr>
<tr>
<td>CFC</td>
<td>0.2710</td>
<td>0.9900</td>
<td>0.2680</td>
</tr>
<tr>
<td>DTK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>HF</td>
<td>0.4860</td>
<td>0.8990</td>
<td>0.4370</td>
</tr>
<tr>
<td>KCB</td>
<td>0.1780</td>
<td>0.5640</td>
<td>0.0990</td>
</tr>
<tr>
<td>NBK</td>
<td>0.2730</td>
<td>0.8480</td>
<td>0.2310</td>
</tr>
<tr>
<td>NIC</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>SCBK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td><strong>Year 2003 (Means)</strong></td>
<td><strong>0.596</strong></td>
<td><strong>0.898</strong></td>
<td><strong>0.573</strong></td>
</tr>
<tr>
<td>BBK</td>
<td>0.0600</td>
<td>0.7930</td>
<td>0.0480</td>
</tr>
<tr>
<td>CFC</td>
<td>0.5440</td>
<td>0.8860</td>
<td>0.4820</td>
</tr>
<tr>
<td>DTK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>HF</td>
<td>0.7260</td>
<td>0.9810</td>
<td>0.7130</td>
</tr>
<tr>
<td>KCB</td>
<td>0.1750</td>
<td>0.6450</td>
<td>0.1130</td>
</tr>
<tr>
<td>NBK</td>
<td>0.2620</td>
<td>0.8770</td>
<td>0.2300</td>
</tr>
<tr>
<td>NIC</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>SCBK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Year 2004 (Means)</td>
<td>0.605</td>
<td>0.927</td>
<td>0.589</td>
</tr>
<tr>
<td>------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>BBK</td>
<td>0.0700</td>
<td>0.8650</td>
<td>0.0610</td>
</tr>
<tr>
<td>CFC</td>
<td>0.4820</td>
<td>0.9770</td>
<td>0.4710</td>
</tr>
<tr>
<td>DTK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>HF</td>
<td>0.8210</td>
<td>0.9610</td>
<td>0.7890</td>
</tr>
<tr>
<td>KCB</td>
<td>0.1850</td>
<td>0.6890</td>
<td>0.1270</td>
</tr>
<tr>
<td>NBK</td>
<td>0.2830</td>
<td>0.9220</td>
<td>0.2610</td>
</tr>
<tr>
<td>NIC</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>SCBK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 2005 (Means)</th>
<th>0.608</th>
<th>0.894</th>
<th>0.575</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBK</td>
<td>0.0790</td>
<td>0.7680</td>
<td>0.0610</td>
</tr>
<tr>
<td>CFC</td>
<td>0.4370</td>
<td>0.8440</td>
<td>0.3690</td>
</tr>
<tr>
<td>DTK</td>
<td>0.8750</td>
<td>0.8690</td>
<td>0.7600</td>
</tr>
<tr>
<td>HF</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>KCB</td>
<td>0.1620</td>
<td>0.7220</td>
<td>0.1170</td>
</tr>
<tr>
<td>NBK</td>
<td>0.3110</td>
<td>0.9470</td>
<td>0.2940</td>
</tr>
<tr>
<td>NIC</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>SCBK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 2006 (Means)</th>
<th>0.565</th>
<th>0.886</th>
<th>0.537</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBK</td>
<td>0.0750</td>
<td>0.7710</td>
<td>0.0580</td>
</tr>
<tr>
<td>CFC</td>
<td>0.3340</td>
<td>0.7030</td>
<td>0.2350</td>
</tr>
<tr>
<td>DTK</td>
<td>0.6610</td>
<td>0.8960</td>
<td>0.5920</td>
</tr>
<tr>
<td>HF</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>KCB</td>
<td>0.1480</td>
<td>0.7260</td>
<td>0.1070</td>
</tr>
<tr>
<td>NBK</td>
<td>0.3020</td>
<td>0.9920</td>
<td>0.3000</td>
</tr>
<tr>
<td>NIC</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>SCBK</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Source: Researcher's Computations