

**THE RELATIONSHIP BETWEEN FINANCIAL INNOVATION  
AND EFFICIENCY OF COMMERCIAL BANKS IN KENYA**

**BY**

**GITONGA PAUL MIHIU**

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## DECLARATION

This research project is my original work and has not been submitted for any award in any other university.

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Paul Mihiu Gitonga

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Date

This research project has been submitted for examination with my approval as the University supervisor

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Mr. Herick Ondigo

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Date

Lecturer

Department of Finance and Accounting

School of Business

University of Nairobi

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## **DEDICATION**

I dedicate this study to my Dad, mom, twin sisters, brother and wife, for their love, support, encouragement they gave me to complete my postgraduate studies.

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## **LIST OF ABBREVIATIONS**

<b>ATM</b>	-	Automated Teller Machine
<b>CBK</b>	-	Central Bank of Kenya
<b>CCR</b>	-	Charnes, Cooper and Rhodes model
<b>DEA</b>	-	Data Envelopment Analysis
<b>DEAP</b>	-	Data Envelopment Analysis (Computer) Program
<b>DMU</b>	-	Decision Making Unit
<b>IT</b>	-	Information Technology
<b>M M</b>	-	Miller and Modigliani
<b>SMS</b>	-	Short Message Service

## **ABSTRACT**

This study examines the relationship between financial innovation and the efficiency of commercial banks in Kenya for the period between 2009 and 2012. The banking sector is one of the fastest growing sectors in the economy registering significance implementation of innovations. This study therefore seeks to establish the efficiency status with the view of establishing financial innovation types that can improve banks' efficiency levels. Relationship between relative efficiency score and total assets admitted, age and ownership is noted.

This study is designed as a descriptive study. The population comprised of 43 commercial banks out of which 21 were selected, forming the sample size. The DEA model was used using a DEA computer program. The objective of the study was to obtain the following information of each firm: Relative efficiency score, peer for each inefficient bank, objective output and input targets.

The mean relative efficiency score for the selected banks was found to be approximately 80%. Large banks in terms of assets were found to be relatively more efficient than small and medium sized banks. Foreign banks were found to have a higher efficiency score than public and private-domestic banks in terms of ownership.

Banks that had been operational more than 18 years were considered to be old. The old banks were found to be more efficient than the new ones. This paper concludes that lack of organizational innovation among banks is a major factor in inefficiency within the bank. Also, several recommendations both to the banks and researches are made.

Small and medium banks, new and old banks, public and private-domestic banks need to compare themselves with their peers in terms of innovation implementation and operation. This would lead improved efficiency score through introduction of new and improved innovations, better innovation combination and optimal usage of assets and capital.

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background of the Study

Innovation is normally defined as the introduction of a new product to a market or the production of an existing one in a new manner. Innovations occur because market participants are constantly searching for new ways to make greater profits (Merton, 1992).

Innovations can be grouped by a functional basis, “aggressive” or “defensive”. Aggressive innovation is the introduction of a new product or process, in response to perceived demand. A very large part of innovation since the late 1970’s is aggressive innovation in the literature. Defensive innovation is response to changed environment or transactional cost.

Financial innovations lower the transactional cost of transferring funds from lower yielding money balances to higher yielding alternatives. Therefore, with financial innovations market participants attempt to minimize risk and maximize return. While stakeholders and banks are central actors in the innovation process, there is a critical role for government in providing a legal infrastructure and supplying basic scientific knowledge (Gitau, 2011).

This study will evaluate the impact that the financial innovation based on the financial performance of commercial banks in Kenya. A research based away from the traditional profitability basis, needs to be carried out to establish if financial innovation implementation plays a part in the performance of commercial banks in Kenya.

### **1.1.1 Financial Innovation**

Financial innovation is the act of creating and then popularizing new financial instruments, as well as new financial technologies, institutions, and markets. This has been spurred by of I.T developments and aggressive expansion, coupled with innovative product launch in the market (Githakwa, 2011).

These innovations are created to curb resource costs such as labor, materials, and capital employed by banks. In response, commercial banks have changed their behavior of income sources by innovating products, processes, structures and services to reduce the costs and high risks created by future uncertainties (Montiel, 1995).

This income sources include Islamic banking, Agency banking, M-kesho, mobile banking products, SMS banking, e-banking and internet banking, debit and credit cards, mortgage financing and the automatic teller machine (Shakhala, 2012).

Banks work as the originators and channelize the innovations and facilitate the investors to accept the creativity. The basic underlying “physical” technologies of finance are those of telecommunication and data processing, which provide the gathering of information, its transmission, and its analysis easy and fast (Githakwa, 2011).

Increasingly, financial innovation allows financial market participants to measure and manage their risk exposure more efficiently and effectively. For example, with respect lending, asymmetric information problems imply that the lenders have difficulties determining who is a creditworthy borrower (adverse selection) and also have difficulties monitoring borrowers after a loan has been made (moral hazard) (Shakhala, 2012).

### **1.1.2 Efficiency**

Efficiency describes the extent to which time, effort or cost is well used for the intended task or purpose. It is often used with the specific purpose of relaying the capability of a specific application of effort to produce a specific outcome effectively with a minimum amount or quantity of waste, expense, or unnecessary effort (Hoque, 2012).

Lovell (1993) defines the efficiency of a production unit in terms of a comparison between observed and optimal values of its output and input. The comparison can take the form of the ratio of observed to maximum potential output obtainable from the given input, or the ratio of minimum potential to observed input required to produce the given output.

The efficiency measurement can be roughly organized into two groups according to the methodology that is used to construct the reference technology. Namely, parametric methods [including the stochastic frontier approach of Aigner, Lovell and Schmidt (1977) and the deterministic approach of Aigner and Chu (1968)] and non-parametric methods, such as data envelopment analysis (DEA) described in Charnes, Cooper and Rhodes (1978) and the Free Disposable Hull (FDH) approach used by Deprins, Simar and Tulkens (1984) (Coelli, 1996).

Data Envelopment Analysis (DEA) is widely used. The primary focus of DEA is to measure the production or performance function of DMUs (decision making unit). DEA evaluates the inputs consumed and outputs produced by DMUs and identify those units that comprise an efficient frontier and those that lie below this frontier. The standard DEA models have an input and output orientation (Coelli, 1996).

### **1.1.3 Effect of Financial Innovation on Efficiency**

If the world were free of all “imperfections”—such as taxes, regulation, information asymmetries, transaction costs, and moral hazard—and if markets were complete in the sense that existing securities spanned all states of nature, we could arrive at an M&M-like environment regarding financial innovation. Financial innovations would not benefit commercial banks and would simply be neutral mutations. Against this backdrop, commercial banks seek to establish how financial innovations respond optimally to various basic problems, such as incomplete markets that prevent risk shifting or asymmetric information (Tufano, 2002).

Financial innovations are now thought to hold the promise of a new commercial revolution by offering an inexpensive and direct way to sell or buy products and services. This revolution in the market place has set in motion a revolution in the banking sector for the provision of a payment system that is compatible with the demands of the electronic marketplace which reduce transactional costs and thereby improving financial efficiency (Tufano, 2002).

Therefore financial innovation contains new ideas which influence the behavior of economic agents in a previously unknown way. The introduction of new technology, human capital and the improvements in the financial process of banking increases firm’s efficiency and enables it to operate at lower costs than its rivals thus increasing its performance. This generates a proprietary competitive position that bestows on the Bank a competitive advantage and efficiency (Hornor, 1998).

Berger and Mester (2003), consistent with the results of other studies that support the hypothesis that the first mover advantage offers the institution better efficiency, the examination by Dos Santos and Peffers (1995) of the introduction of ATMs by American banks demonstrated that the competitive advantage that is associated with it were not realized by those who subsequently adopted the technology.

### **1.1.4 Commercial Banks in Kenya**

Commercial banks are licensed and regulated under the Banking Act, cap 488 and prudential Regulations issued there-under. There are currently 43 commercial banks in Kenya. Out of the 43 banks, 27 are local private financial institutions and 13 are foreign private financial institutions. The 3 public owned financial institutions comprise of Consolidated bank of Kenya, Development bank of Kenya and National bank of Kenya (Banks Supervision Annual Report, 2011).

Over the last few years, the banking sector in Kenya has continued to grow in Assets, deposits, profitability and products offering. The growth has been mainly underpinned by an industry wide branch network expansion strategy both in Kenya and in the East African community region and automation of a large number of services and a move towards emphasis on the complex customer needs rather than traditional “off-the - shelf” banking products. This has led to creative customization of financial products against the customers’ needs. Players in this sector have experienced increased competition over the last few years resulting from increased innovations among the players and new entrants into the market (Githakwa, 2011).

## **1.2 Research Problem**

There are several innovations which have taken place in the banking sector such as M-KESHO and a variety of mobile banking to distribution innovations such as agency banking. In particular, M-Shwari crossed the Sh1 billion mark at the close of 2012 barely when it was introduced on November 2012 by Safaricom and Commercial bank of Kenya. Innovations which have also been growing include use of credit cards and debit cards, real time processing of transactions as well as ATM’s. Indeed, the banking industry is one of the major consumers of IT and software products in Kenya (Shakhala, 2012).The intense competitive environment makes innovation become the key method for commercial bank to survive (Ruan & LI, 2009). Kenya Commercial Bank (KCB) signed a deal with MasterCard to introduce high security cards. This will help curb fraud at ATMs and point of sale terminals which will see 5 million chip and PIN debit and pre-paid cards in the Kenyan market.

They joined Standard Chartered which processes the new technology for its debit cards after embedding it in its credit cards. The Kenya Bankers Association (2013) has set March 2014 as the deadline by which all lenders should migrate to the chip-based technology for debit and credit cards. Together with Gulf African bank and First community bank, Standard chartered bank will offer Islamic banking by end of this year. This is due to the unreached 4 million Muslims in Kenya, 10% of Kenya population (Juma, 2013).

A number of studies on the role of financial innovation on commercial banks efficiency exist. For instance, Musara (2010) did a study on whether technological innovations has resulted in increased efficiency and cost savings for bank customers. Omar et al. (2006) did a study on the efficiency of commercial banks in Malaysia. Kablan (2010) did a study on Bank efficiency and financial development in Sub-Saharan Africa.

The banking sector in Kenya is one of the fastest growing sectors of the economy having registered significant growth in the past decades. However, most studies done to examine the impact of financial innovation on commercial banks in Kenya are based on profitability. It is suffice to note that the sector is one of the leading sectors in innovation together with the telecommunication industry.

Majority of local studies have sought to establish the impact of financial innovation on commercial banks in Kenya using profitability include; the relationship between financial innovations and the growth of commercial banks in Kenya in (Shakhala, 2012), The relationship between the level of Technological innovations and financial performance of commercial banks in Kenya (Nyawira, 2011), Challenges of implementing financial innovations by commercial banks in Kenya (Jepkorir, 2011), among others. Githakwa (2011) clearly did a project on the relationship between financial innovations and profitability of Kenyan banks. He identified his research gap to the fact that past studies did not exhaust such aspects as efficiency, risk and performance but rather centered on productivity.



Shakhala (2012) did a study to establish the effect of financial innovation on the growth of commercial banks in Kenya based on the banks' revenue, pretax profits, customer deposits, loan advances and number of innovations. This was based on profitability.

Past studies that have sought to establish efficiency of banks in Kenya include; Measuring operational efficiency of the insurance industry in Kenya using DEA (Mwangeti, 2012), Measuring bank efficiency using DEA analysis: A case of Kenya Commercial Bank LTD (Muthoni, 2011) and The effect of Financial liberalization on the efficiency of commercial banks in Kenya (Simiyu, 2009). Through this gap the research question derived is: Is there a relationship between financial innovation implementation and the efficiency of commercial banks in Kenya?

### **1.3 Research Objective**

To establish the relationship between the financial innovation and the efficiency of commercial banks in Kenya.

### **1.4 Value of the Study**

This study may be important to various different groups of people including:

The management and shareholders in the commercial banks in Kenya, to enable them identify appropriate and strategic type of innovation that can make their respective banks efficient.

Additionally, the study findings will be important to potential investors who will be able to understand efficient innovative financial operations of the banking sector.

Finally, researchers and scholars can use this proposed study to expand the academic knowledge of financial innovation and efficiency by identifying possible areas of further study.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter provides theoretical and empirical information from papers on topics related to the research problem. It examines what various authors and academic scholars have studied and written about financial innovation and financial efficiency for commercial banks in Kenya.

#### **2.2 Theories of Financial Innovation**

The theories to be reviewed include Diffusion theory, Constraints-induced financial innovation theory and Circumvention innovation theory. Diffusion theory seeks to establish why financial innovation evolution has led to improved financial efficiency. Constraint-induced financial innovation explains why innovation does not guarantee a definite financial efficient commercial bank. Circumvention innovation theory explains the increased financial innovation seen in Kenya.

##### **2.2.1 Diffusion Theory**

In his comprehensive book *Diffusion of Innovation*, Rogers (2003) defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system. Rogers' theory of diffusion contains four elements that are present in the diffusion of innovation process. The first is innovation which he defines as an idea, practice, or object that is perceived as new by an individual or other unit of adoption. The other is communication channel which is the means by which messages get from one individual to another.

Time is the other that encapsulates innovation-decision process, relative time (innovation is adopted by an individual or group) and innovation's rate of adoption. Last element is social system which is a set of interrelated units that are engaged in joint problem solving to accomplish a common goal.

It seeks to explain how, why and at what rate new ideas and innovations spread through cultures. This can explain how financial innovation has evolved over time over the commercial banks in Kenya. Banks efficiency due to innovations takes time as it involves transmission of new ideas and processes to its customers and employees. This new idea has to be accepted by all stakeholders, shareholders to the customer, so that the social systems can understand the importance of the innovation despite high costs and work towards streamlining the processes (Hornor, 1998).

### **2.2.2 Constraints – Induced Financial Innovation Theory**

American economist Silber (1983) advanced constraint-induced financial innovation theory points out that the purpose of profit maximization of financial institution is the key reason of financial innovation. There are some restrictions (including external handicaps such as policy and internal handicaps such as organizational management) in the process of pursuing profit maximization (Shakhala, 2012).

Through these restrictions innovation processes are slowed thus reducing the efficiency of financial institution; hence financial institutions strive toward casting them off. Constraint-induced innovation theory discussed the financial innovation from microeconomics, so it is originated and representative (Shakhala, 2012).

New innovations are usually faced with stiff oppositions from within and externally. This can explain inefficiencies that are experienced over the different process, service, and organizational and product innovations carried out by banks. Effects of restrictive policies that government and regulatory bank's bodies give on innovation can also be established.

### **2.2.3 Circumvention Innovation Theory**

American economist Kane (1981) is the pioneer of circumvention innovation theory. He proposed that many forms of government regulations and controls, which have the same property of implicit taxation, embarrass the profitable activity engaged by the company and the opportunity of earning profit, so the market innovation and regulation innovation should be regarded as the continuous fighting process between independent economic force and political force. Because financial industry is special, it has the stricter regulations. Financial institutions deal with the status such as the reduction of profit and the failure of management induced by government regulations in order to reduce the potential loss to the minimum.

Therefore, financial innovation is mostly induced by the purpose of earning profit and circumventing government regulations. Kane's theory can therefore be used to show if cost reduction has been achieved. This can explain which type of innovation (product, process, organizational and service) is mostly used to circumvent controls in Kenya.

## **2.3 Financial Innovation**

Frame and White (2004) define Financial innovation as "...something new that reduces costs, reduces risks or provides an improved product/service/instrument that better satisfies participants' demands..." within a financial system as noted in section 1.1.1. Innovations can emerge due to technological changes, as well as a response to increased risk or to new regulations. They noted that when defining financial innovations the usual approach is to categorize it into four groups, according to where innovations occur. These include process innovation (refers to new production processes that allow the provision of new institutions or organizational structure within institutions), organizational innovations (Affect the financial sector as a whole), service innovation (Relate to new customer service of payment and account access) and product innovations (new products or services created to meet market needs) (Gitau, 2011).

Mikwa (2011) determined that regulation and innovation are intricately linked. Innovations are created by financial intuitions as an incentive to evade already existing regulations as to earn profits. Kane (1982) describes this process of evasion as “loophole mining”. This can occur when authorities change operational rules of the financial markets so as to permit activities previously forbidden. IT has spurred financial innovations that have altered financial products and services and production processes. For example, the ability to use applied statistics cost-effectively via software has markedly altered the process of financial intermediation (Korgar, 1995).

Allen and Santomero (2001) suggest that the release of financial innovation process undertaken by banks in the United States appears to be a response to intensified competition in financial market. Competitive advantage and efficiency can be maintained with permanent innovation and improvement of the product and process (Mikwa, 2011).

Unstable macroeconomic conditions e.g., fluctuating prices, interest rates, exchange rates create uncertainties and risks and thus are likely to spur more innovation than would be true in a stable macroeconomic environment. Greater instability is likely to be associated with a faster pace of innovation that would reduce costs and risks through provision of improved and efficient services and processes (Mikwa, 2011).

The innovation process refers to the transformation process in an innovation trajectory. In most studies, the innovation process is modeled as influencing the innovative input and output. The crucial inputs must be available for innovation to occur, and the exact nature of those inputs differs depending on the desired outputs and outcomes. Those inputs can be both tangible and intangible. Tangible inputs have a physical embodiment and cost. Intangible inputs do not have a physical embodiment. Tangible inputs may include production materials and intangible ones may include knowledge and skills of labor force (Stone, 2008).

Innovation involves the application of knowledge in creative activities. Innovation cannot take place without an understanding of the resources, tools, technologies, materials, markets, and needs in the situation at hand. Stone (2008) underscores the tremendous importance of the innovative process knowledge.

## **2.3.1 Types of Innovation**

### **2.3.1.1 Product Innovation**

Product innovation can be defined as “first of its kind” or improvement to a range of products in a market. This might include a new product’s invention; technical specification and quality improvements made to a product; or the inclusion of new components, materials or desirable functions into an existing product (Stone, 2008).

Airtel and Safaricom mobile phones transfer services M-pesa and Zap to tap the potential for transactions at reasonable costs serves as an example. Equity bank partnering with Safaricom to introduce the M-kesho service, products tailored to suit specific status groups such as Excel, Priority, Premier and Executive banking services bank accounts tailored for specific age groups as Barclay’s bank’s junior eagle account for children, premier and premier life banking for the affluent (Gitau, 2011).

### **2.3.1.2 Organizational Innovation**

Organizational innovation refers to new ways work can be organized, and accomplished within a bank to encourage and promote competitive advantage and independence of creativity in overcoming risks and costs thus increasing efficiency. It encompasses how organizations and individuals specifically, manage work processes in such areas as customer relationships, employee performance and retention, and knowledge management. Therefore, organizational innovation requires a culture of innovation that supports new ideas, processes and generally new ways of "doing business" (Shakhala, 2012).

Credit Reference Bureaus which collect manage and disseminate customer information to lenders within a provided regulatory framework serve as an example of organizational innovations.

NIC bank, Equity bank and CFC bank are offering insurance services on behalf of Insurance companies. Islamic banking is also been offered by Gulf African bank and First Community bank (Gitau, 2011).

### **2.3.1.3 Process Innovation**

The past 25 years has witnessed important changes in bank's production processes. The use of electronic transmission of bank-to-bank retail payments, which had modest beginnings in the 1970's, has exploded owing to greater retail acceptance, online banking and cheque clearing. Cheque clearing is the process between banks that takes place at the Clearing House. Kenya Bankers Association (KBA) owns the Clearing House and works with the Central Bank of Kenya (CBK) to operate it. Through the use of technology, cheque clearing is now image-based. This has drastically improved the time from a high of 21 days to today when it takes banks just 2 days in the Clearing House (Gitau, 2011).

Real Time Gross Settlement (RTGS) system is a fund transfer mechanism where transfer of money takes place from one bank to another on a-real time and gross basis. Real time means the transactions are processed as they are received while gross means they are settled on one to one basis without batching with any other transaction. RTGS systems are primarily for large value transactions

### **2.3.1.4 Service Innovation**

Service innovation primarily relate to enhanced account access and new methods of payment, each of which better meets customer demands for convenience and ease. ATMs have diffused rapidly through the 1980's, significantly enhancing retail bank account access and value by providing customers with around the clock access to funds (Githakwa, 2011).

ATM cards were replaced with debit cards which gives the ability to make payment from a bank account at the point of sale. Online banking which allows customers to monitor accounts and originate payments using "electronic bill payment" is now widely used. Gitau (2011) notes that prepaid cards have also become popular.

## 2.4 Efficiency

The word 'Efficiency' refers to the ability to accomplish a job with a minimum expenditure of time and effort. In border sense, efficiency refers to the optimal usage of a given resources or time needed to complete a task measured against preset standards of accuracy, completeness, cost, and speed. In other words, it refers to the conversion rates and cost reduction to which an achievement is being or has been accomplished (Mikwa, 2011).

Profitability measures the extent to which a business generates a profit from the factors of production: labor, management and capital. Profitability analysis focuses on the relationship between revenues and expenses and on the level of profits relative to the size of investment in the business. This study seeks to use efficiency by measuring the relationship between the input and out of financial innovation ran in banks (Cresswell, 2004).

Performance is generally conceptualized as the bank's ability to generate transaction by effective utilization of its resources. Economically efficiency refers to the ratio of outputs to inputs. Primarily, the performance is measured through an analysis using different accounting ratios like; return on assets (ROA), return on investments (ROI), return on equity (ROE) (Quereshi, 2007).

In view of banking activity as a transformation of particular set of inputs (e.g. capital, labor, and financial innovations) into a particular set of outputs (e.g. loans, securities), the relative efficiency of the banks can be analyzed by using DEA. Relative efficiency is the weighted average of the efficient units that act as a comparator for the inefficient unit (Vujcic, 2001).

Compared to the regression analysis, DEA provides an alternative approach. While regression relies on central tendencies, the DEA is based on extreme observations; while in the regression approach a single estimated regression equation is assumed to apply each observation vector, DEA analyze each DMU separately; producing individual efficiency measures relative to the entire set under evaluation (Vujcic, 2001).



## 2.5 Data Envelopment Analysis Model

The DEA technique was first developed by Charnes, Cooper and Rhodes (CCR) in 1978 and the concept of efficiency of frontier analysis was introduced by Farrell (1957). Charnes et al.'s (1978) DEA model estimates efficiency under the assumption of return to scale while Banker, Charnes and Cooper (1984) assumed variable returns to scale.

The CCR model assumes that there are N numbers of DMU's to be studied, using m-inputs which will produce n-outputs. Therefore, for any given DMU  $B_k$ ,  $1 \leq k \leq N$  inputs for  $B_k = \{X_{k1}, X_{k2}, X_{k3}, \dots, X_{km}\}$ , the output matrix will be  $B_k = \{Y_{k1}, Y_{k2}, Y_{k3}, \dots, Y_{kn}\}$ ; Therefore the relative efficiency of DMU  $B_k$ , denoted  $E_k$ , would be

Maximize the ratio  $\frac{\text{Virtual output}}{\text{Virtual input}}$

$$\text{Maximize } E_k = \frac{\sum_{j=1}^N U_j Y_{kj}}{\sum_{i=1}^m V_i X_{ki}} \quad \text{Where } k=1, 2, 3, 4, \dots, N$$

Subject to

$$\sum_{i=1}^m V_i X_{ki} - \sum_{j=1}^n U_j Y_{kj} \leq 0, \quad 1 \leq k \leq N$$

$$\sum_{i=1}^m V_i X_{ki} = 1$$

The weights  $V_i, U_j, Y_{kj}, X_{ki} > 0$

This model is normally referred to as CCR model.

DEA is a non-parametric mathematical linear programming that measures the production or performance functions of DMU's (Decision Making Units). DEA evaluates the inputs consumed and outputs produced by DMUs and identify those units that comprise an efficient frontier and those that lie below this frontier. The standard DEA models have an input and output orientation.

An input orientation identifies the efficient consumption of resources while holding outputs constant. An output orientation identifies the efficient level of output given existing resource consumption. The output orientation provides estimates of the amount by which outputs could be proportionally expanded given existing input levels (Hoque, 2012).

Since introduction of the basic CCR model, it has attracted attention of various researchers and different modifications have been developed from the first model. The first variation involved the standard constant return to scale (CRS) and variable return to scale (VRS) models that involved the standard calculating technical and scale efficiencies. The second model considered the extension of these models to account for allocative efficiencies and cost. Finally, the third option considered applying Malmquist DEA methods to calculate indices of total factor productivity (TFP) changes, technological changes, technical efficiencies changes and scale changes (Mwangeti, 2012).

### **2.5.1 Choice of Inputs and Outputs variables**

The most important step in using DEA to examine the relative efficiency of any type of firm is the selection of appropriate inputs and outputs. This is partially true for banks because there is considerable disagreement over the appropriate inputs and outputs for banks. Previous applications DEA to banks generally have adopted one of two approaches to justify their choice of inputs and outputs Qureshi (2012).

The first “intermediary approach” views banks as financial intermediaries whose primary business is to borrow funds from depositors and lend those funds to others for profit. The banks’ outputs can include loans and their inputs include the various costs of these funds (including interest expense, labor, capital and operating costs). The second “production approach” views banks as institutions that use capital, operating costs, interest expense and labor to produce loans and deposit account services (Qureshi 2012). My study will use the both intermediary and production approach where the input will be the number of different types of innovation used, operating expense and total deposits received. The output will include the loans, operating income and net profit which could be influenced by the use of the innovation.

Inappropriate choice of variables can give inaccurate results and will not reflect the true relative efficiency. Great care must be taken to include all inputs and outputs that have impact on each commercial bank. Omitting an input may disadvantage those banks that are efficient in allocating them whereas omitting output may disadvantage those that are efficient in producing them. Alirezaee (1998) concluded that average DMU relative efficiency score is directly proportional to the number of DMU's. Therefore quality and appropriateness of the data used are important as this can cause failure (Mwangeti, 2012).

Banks have many variables that can be as input and output variables both qualitative and quantitative. Some quantitative variables include interest income, pool interest, commission and fee revenues, foreign exchange income, other income, staff cost, depreciation, other operating expenses, deposits, loans granted and extended, number of customers, number of innovations, market share and profit before tax. Qualitative variables may include customer index and quality service index (Muthoni, 2011).

### **2.5.2 Advantages and Disadvantages of Data Envelopment Analysis**

DEA uses actual sample data to derive the efficiency frontier against which each bank in the sample can be evaluated. As a result, no explicit functional form for the production function has to be specified in advance. Instead, the production frontier is generated by a mathematical programming algorithm which also calculates the optimal DEA efficiency score for each bank (Simiyu, 2009). Unlike Statistical method, it compares the efficiency not with average bank, but with the best in a class called peers. It can therefore be a method of benchmarking variables of banks against the best in the class.

However, like any other scientific method it has a number of disadvantages which need to be acknowledged when interpreting results of the study. Firstly, it is a deterministic method rather than statistical thus producing results that are sensitive to measurement error of variables. It measures efficiency relative to the best in the sample and it's not important to compare scores between two different studies. Lastly, the linear program formulations obtained for each DMU under the study makes manual solving very tedious and time consuming (Mwangeti, 2012).

### **2.5.3 Data Envelopment Analysis Computer Programs**

As stated as a limitation, manual evaluation of the relative efficiency of the DMU's can be tedious. Luckily, many software tools have been developed over time to compute DEA efficiency scores. While most are for commercial use, some have been designed as free distribution. These include DEAP (Coeli, 1996), Onfront (Fare & Grosskopf, 2000), among other commercial and non-commercial distributions.

## **2.6 Empirical Review**

### **2.6.1 Global Empirical Study**

Vujcic (2001) did a study on Efficiency of Banks in Transition: A DEA approach using CCR model. Both operating and intermediating approach were used in estimating the relative efficiency for the Croatian commercial banks for the period 1995-2000. The two approaches were used to reflect the two different ways in evaluating the banks efficiency; Cost/revenue management perspective and the mechanical perspective that takes banks as entities which use labor and capital to transform deposits into loans and securities. The banks were segmented into four criteria that included bank size, ownership structure, date of establishment and quality of assets. Different sets of input/output data were used for the two approaches in estimating the relative efficiency.

For operating approach, data was obtained from the banks' financial statements. Sample data that were bankrupt were excluded for the analyzed period. In terms of size, small banks were globally efficient while large banks were locally efficient. State owned banks rose from 32% to 81 % efficiency from 1995-2000. Result also showed that technically more efficient banks are also banks that have, on average, less performing loans.

Omar et al. (2006) did a study on the efficiency of commercial banks in Malaysia to investigate the change in the productivity of banking industry during the period of 2000 to 2004. The data consisted of a panel of 11 commercial banks in Malaysia.

Productivity was measured by the Malmquist index, using a Data Envelopment Analysis (DEA) technique using efficiency change; technical and scale efficiency.

In the year 2003 to 2004 the highest technical and efficiency changes at a rate of 5.5 and 3.9%, respectively was recorded. Total Factor Productivity growth in the commercial banking industry in Malaysia had been largely due to the efficiency change (1.6%) compared to the technical component which contributed a negative change (-0.3%) to the overall Total Factor Productivity growth.

Enyih et al. (2007) did a study on Measuring Commercial Bank Performance and Efficiency in Sub-Saharan Africa and determined input and output factors on two fronts. They applied the first front; Data Envelopment Analysis (DEA) for assessing efficiency level. Secondly, the banks ratio analysis measuring banks performance through returns volatility for each bank, asset utilization and provision for bad and doubtful debts over the study period were used as tools for the analysis. The estimated scores efficiency for banks in Sub-Saharan Africa was on the average 98.35% efficient for output maximization. These inputs/outputs include; shareholders equity (Input), loans (output) and Deposit with other banks. Their research work indicated that banks had very high provision for bad and doubtful debts for the banks in consideration on average in 2007.

### **2.6.2 Local Empirical Study**

Gitau (2011) longitudinal study from January 1<sup>st</sup> 2006 to December 31<sup>st</sup> 2010, 5 years, on the relationship between financial innovation and financial performance of commercial banks in Kenya was based on a quasi-experimental research design.

It had a target population of all 44 commercial banks in Kenya where primary data was collected from the questionnaires and secondary data about financial innovation collected from the bank's financial results and publications.

The study found that 70% of the institutions had adopted process innovations, 16% product innovations and 14% institutional innovations. The study also conducted that there was a positive relationship between financial innovation and financial performance of commercial banks in Kenya.

He noted that process innovations adopted include RTGS, mobile banking and internet banking. Product innovations strategies adopted include credit cards, business club and unsecured loans. Institutional innovations adopted are insurance services, credit references bureau and Islamic banking. The study found out that efficiency of financial innovation affected the financial performance through a mean of 3.9 by answering the question that to what extent did financial innovation affect financial performance of banks in Kenya. Out of 35 firms analyzed, 23 firms were found to be operating efficiently. He concluded that within Kenyan insurance industry, operational efficiency does not depend on the size of the firm.

Muthoni (2011) did a case study on Kenya Commercial bank on measuring banks operational efficiency using DEA analysis. The study population consisted of 168 branches of the bank that were in operation within Kenya throughout the year 2010. Secondary data was obtained from the bank's database for each branch. The inputs used were: Interest payable, staff cost, other operating expenses and depreciation costs. The selected outputs that were used included: Interest receivable, fees and commissioned earned and other operating income.

The variables were selected after performing input-output correlation analysis that established that they all have strong positive correlation. Other qualitative inputs that could have been used such as customer satisfaction index were excluded since not all branches conducted the measures and such do not differ significantly among branches.

The CCR model was used to compute the relative operational efficiency for each branch. Deap version 2.1 (Coelli, 1996) was used to solve linear programs. For each branch, the output file contained: constant return to scale, variable return to scale, relative operational efficiency scores, peers for each branch, slack variable measures and optimal input and output targets for each branch.

Muthoni (2011) classified the branches into geographical location, size category (small, medium and large) in terms of total asset. The average operational efficiency for the whole bank was found to be 65%. Only 25 branches out of 168 were found to be relatively efficient with a score equal to 1. Small and large branches in terms of total assets were found to be more efficient than middle sized branches. The results revealed that the cause of inefficiency was the staff cost variable with only 41 out of 168 branches having surplus staff cost units.

Mwangeti (2012) did a descriptive census study of the operational efficiency of the insurance industry in Kenya using DEA. Qualitative information was obtained from the Insurance Regulatory Authority report 2010. The study population consisted of all insurance companies operating in Kenya as at 31<sup>st</sup> December 2010. 47 Insurance companies were studied as it was considered to be manageable. The study employed the following inputs: incurred claims, commission expenses, management expenses and total assets. The outputs used included; net income premiums, market share and investment income.

Data collected was analyzed using the CCR model to calculate the relative operational efficiency for each DMU which computes the ratio of relative operational efficiency as the maximum weighted sum of the outputs to inputs used for each of the DMU under the study. The study used a DEA computer program DEAP version 2.1 (Coelli, 1996) to solve the linear problems. The mean operational efficiency score of the insurance industry in Kenya was found to be 91%, thus, implying efficient usage of available resources by Kenyan insurance industry.

A correlation study conducted by Shakhala (2012) on the relationship between financial innovations and the growth of commercial banks in Kenya over 2002 to 2011 used a population of 43 commercial banks registered and operating in Kenya. He noted that given the nature of his study, it was prudent that all the banks formed the sample size, thus a sample size of 43 commercial banks. He observed that financial innovation had a positive but insignificant effect on all the measures of banking growth. He found out that financial innovation accounted for 18% of the variance in pre-tax profit growth but the F statistics of 3.072 was insignificant at 5%.

## **2.7 Summary of Literature Review**

The literature review has clearly introduced the concept of financial innovation input and output concept. Definition of the concept, its importance and the factors that lead to financial innovation were reviewed in the theoretical literature. Past studies on financial innovation have also been reviewed. It is clear from the empirical review that little if any has been done by the local study of the effect of financial innovation on efficiency as a measurement of Kenya's overall bank performance.

Shakhala (2012) attempted used pre-tax profit, revenue, customer deposits and loan advances as a measurement of effect of financial innovation on bank's performance. He did not use efficiency as measurement of performance but rather profitability. Muthoni (2011) used the DEA model and determined that the operational efficiency of KCB bank was at 65%. His input-output model for the case study did not include financial innovation as a variable and was carried out for one annual period, 2012. My study will therefore seek to merge the two aspects, financial innovation as a variable in the input-output model and DEA as methodology for efficiency measurement and focus on a four year period.



## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This section presents an overview of the methods to be used in the study. Areas covered include the research design, population, sample and sampling techniques, data collection and analysis.

#### **3.2 Research Design**

Research design refers to the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in the procedure (Babbie, 2002). In addition Kothari (2004) observed that research design is a blue print which facilitates the smooth sailing of the various research operations, thereby making research as efficient as possible hence yielding maximum information with minimal expenditure of effort, time and money (Shakhala, 2012).

The research used a descriptive research study. Descriptive research portrays an accurate profile of persons, events, or situations. Surveys allow the collection of large amount of data from a sizable population in a highly economical way. It allows one to collect quantitative data, which can be analyzed quantitatively using descriptive and inferential statistics. Therefore, the descriptive survey was deemed the best strategy to fulfill the objectives of this study. Robson (2002) points out that descriptive study portrays an accurate profile of persons, events or situation. Furthermore, Chandran (2004) states descriptive study describes the existing conditions and attitudes through observation and interpretation techniques.

### **3.3 Population and Sample**

In line with the subject matter of the study, the target populations of the study were all the 43 commercial banks in Kenya as of May 2013 (CBK, 2013). The accessible population were all commercial banks which operated at an uninterrupted period of not less than 5 years (that is, from January 1<sup>st</sup> 2008 to December 31<sup>st</sup> 2012). The study was a census survey owing to the number of commercial banks in Kenya. This included all 44 commercial banks registered with the CBK. A census of all the banks with their headquarters was done.

### **3.4 Data Collection**

Primary data was obtained through a structured questionnaire administered personally by the researcher. The questionnaire was administered through a “drop and pick later” approach. Primary data on financial innovation was sourced from the questionnaires. Secondary data on the other inputs (operating expense and total deposits received) and the outputs (operating income, loans given out and net profit) of the commercial banks was sourced from the financial publications and banks’ websites. According to Chandran (2003), it is relatively quick to collect information using questionnaires. However in some situations they can take a long time not only to design but also to apply and analyze. Potentially information can be collected from a large portion of a group. This potential is not often realized, as returns from questionnaires are usually low.

For the purpose of this study, the following inputs were used: Financial innovations, total deposits received and operating expense. The selected outputs that are to be used include: loans borrowed by customers, operating income and net profit. The variables are selected after performing an input-output correlation analysis that establishes that they all have a strong positive correlation. Intensive review of literature of similar studies such as Memet & Kale (2010) and Berger & Humphrey (1997) reveals that the chosen variables have been successful in measuring relative efficiency.

### 3.5 Data Analysis

DEA is incapable of handling negative data variables. Therefore, for consistency on all data variables the first step was to ensure that they were not null or negative by adding a constant to all variables for all the DMU's (Mwangeti, 2012).

The data collected was analyzed using CCR model to calculate the relative efficiency for each DMU which computes the ratio of relative efficiency as the maximum weighted sum of outputs to inputs used for each of the DMU under the study. Using the CCR model which was introduced earlier, assuming that there are N number of DMU's to be studied, using m-inputs and n-outputs. Therefore, for any given DMU  $B_k$ ,  $1 \leq k \leq N$  inputs for the outputs  $B_k = \{X_{k1}, X_{k2}, X_{k3}, \dots, X_{kn}\}$ , matrix would be  $B_k = \{Y_{k1}, Y_{k2}, Y_{k3}, \dots, Y_{kn}\}$ . Therefore the relative efficiency of DMU  $B_k$ , denoted by  $E_k$  would be

$$\text{Maximize } E_k = \frac{\sum_{j=1}^N U_j Y_{kj}}{\sum_{i=1}^m V_i X_{ki}} \quad \text{Where } k=1, 2, 3, 4, \dots, N$$

Subject to

$$\sum_{i=1}^m V_i X_{ki} - \sum_{j=1}^N U_j Y_{ki} \geq 0, \quad 1 \leq K \leq N$$

$$\sum_{i=1}^m V_i X_{ki} = 1$$

The weights  $V_i, U_j, Y_{kj}, X_{ki} > 0$

Where  $V_i$  represents the weight or value of contribution of one unit of output and  $U_i$  represents the weight or values of contribution of one unit of input.

The constraints are added as follows,

a) The efficiency of all DMU's should not exceed 100% i.e.,  $E_k \leq 0$  this is mathematically expressed as

$$\sum_{i=1}^m V_i X_{ki} - \sum_{j=1}^N U_j Y_{kj} \geq 0, \quad 1 \leq K \leq N$$

b) The weights  $V_i, U_j > 0$ , for all  $i= 1, 2, 3, 4, \dots, n$

c) The fractional programming above can be converted into a linear programming problem by adding a constraint such that the denominator is equated to a unit i.e.

$$\sum_{i=1}^m V_i X_{ki} = 1$$

For each bank  $k$ , a linear programming problem need to be formed separately and evaluated to obtain a relative efficiency score. However, solving the problems manually is tedious and can lead to erroneous solutions. Therefore, the study used a DEA computer program DEAP version 2.1 (Coelli, 1996) to solve the linear programming problems. This program is a free distribution and has no maximum number of DMU's to be used.

The data obtained for the study was run with the specified format on the computer program and output results. The banks was segmented into three criteria that included bank size (small, medium and large), ownership structure (public, private domestic and foreign owned) and date of establishment (new and old) as was done by Muthoni (2011) and Vujcic (2001). Descriptive statistics for efficiency results obtained from the computer program was noted.

## CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSIONS

### 4.1 Introduction

This chapter presents the principle findings from data analysis after all inputs and output data provided by the banks' primary and secondary sources were run Through DEAP (Appendix 4). The chapter focuses on the findings of the study in relation to research objective that aim to answer the research question.

### 4.2 Correlation Analysis of Chosen Output and Input Variables

Successful studies are dependent upon objective choices of both output and input variables. Positive correlation between each selected input and at least one selected output is therefore of outmost importance (Murray & Rowse, 2006). For one to establish a definite relationship between the selected output variables and input variables, the analysis began by conducting an input-output correlation analysis. Correlation matrix table 1, table 2, table 3 and table 4 below summarizes the correlation findings from the analysis for the years 2012, 2011, 2010 and 2009 respectively.

**Table 4.1: 2012 Input-output correlation matrix**

<b>2012 CORRELATION MATRIX</b>			
<b>OUTPUTS</b>	<b>INPUT</b>		
	FINANCIAL INNOVATION	OPERATING EXPENSE	TOTAL CUSOTMER DEPOSITS RECEIVED
NET PROFIT	0.6543515	0.93984938	0.9396231
OPERATING INCOME	0.6176458	0.97513869	0.9528346
LOANS GIVEN TO CUSOMERS	0.5839673	0.94991676	0.98238

**Source: Research findings (2013)**

The results from the table 4.1 tables showed that the strongest correlation pair is the operating income and the operating expense with highest been 0.97513869. The correlation pair with the least values is financial innovation and loan given out to customers with lowest been 0.5839673.

**Table 4.2: 2011 Input-output correlation matrix**

2011 CORRELATION MATRIX			
	INPUT		
OUTPUTS	FINANCIAL INNOVATION	OPERATING EXPENSE	TOTAL CUTOMER DEPOSITS RECEIVED
NET PROFIT	0.61586222	0.9522944	0.9284895
OPERATING INCOME	0.59964106	0.9894894	0.9581796
LOANS GIVEN OUT TO CUSTOMERS	0.5774053	0.963293	0.9642415

**Source: Research findings (2013)**

The results from the table 4.2 tables showed that the strongest correlation pair is the operating income and the operating expense 0.9894894. The correlation pair with the least values is financial innovation and loan given out to customers with lowest been 0.5774053.

**Table 4.3: 2010 Input-output correlation matrix**

2010 CORRELATION MATRIX			
	INPUT		
OUTPUTS	FINANCIAL INNOVATION	OPERATING EXPENSE	TOTAL CUTOMER DEPOSITS RECEIVED
NET PROFIT	0.60251609	0.9291817	0.8745842
OPERATING INCOME	0.56135081	0.9893576	0.9577849
LOANS GIVEN OUT to Customers	0.48184905	0.9587025	0.9514147

**Source: Research findings (2013)**

The results from the table 4.3 tables showed that the strongest correlation pair is the operating income and the operating expense with 0.9893576. The correlation pair with the least values is financial innovation and loan given out to customers with lowest been 0.48184905.

**Table 4.4: 2009 Input-output correlation matrix**

2009 CORRELATION MATRIX			
OUTPUTS	INPUT		
	FINANCIAL INNOVATION	OPERATING EXPENSE	TOTAL CUSTOMER DEPOSITS RECEIVED
NET PROFIT	0.6237829	0.8517232	0.8592778
OPERATING INCOME	0.59997057	0.9653105	0.9475525
LOANS GIVEN OUT TO CUSTOMERS	0.54857059	0.9677975	0.9653229

**Source: Research findings (2013)**

The results from the table 4.4 tables showed that the strongest correlation pair is the loans given out to customers and the operating expense with 0.9677975. The correlation pair with the least values is financial innovation and loan given out to customers with lowest been 0.54857059.

The results from the 4 tables showed that all selected variables were strongly positively correlated and were suitable for the computation for the relative efficiency of commercial banks in Kenya. The strongest correlation pair is the operating income and the operating expense with highest been 0.9894 in the year 2011. The correlation pair with the least values is financial innovation and loan given out to customers with lowest been 0.4818 in the year 2009. Data for 2008 was not available for most banks hence was not considered.

### 4.3 Relative Operational Efficiency Scores

The results from the analysis carried out in section 4.2 confirmed that the data was suitable to measure relative efficiency for each commercial bank over the period 2012 to 2009. The variables were then run through DEAP software version 2.1. Appendix Column 4 summarizes the output results for the commercial banks. The average efficiency for the selected banks for 4 annual periods is summarized as table below

**Table 4.5: Average efficiency and the number of innovations for selected banks (2009-2012)**

BANK	EFFICIENCY	TOTAL INNOVATION	PRODUCT INNOVATION	PROCESS INNOVATIO	SERVICE INNOVATION	ORGANIZATION INNOVATION
Bank of Africa Kenya Ltd.	0.869	29	12	1	16	0
Bank of India	0.951	19	12	0	7	0
Barclays Bank of Kenya Ltd.	0.9145	48	20	4	16	8
Cfc Stanbic Bank Ltd.	0.8125	28	12	4	12	0
Chase Bank (K) Ltd.	0.808	39	16	7	12	4
Consolidated bank of Kenya Ltd.	0.64725	36	16	4	16	0
Co-operative Bank of Kenya Ltd.	0.804	42	20	6	16	0
Credit Bank Ltd	0.753	31	12	4	16	0
Diamond Trust Bank Kenya Ltd.	0.906	39	16	6	16	0
Ecobank Bank Kenya Ltd.	0.65675	30	12	6	12	0
Equatorial Commercial Bank Ltd.	0.46575	43	20	4	15	4
Equity Bank Ltd.	0.95475	42	16	6	16	4
Family Bank Ltd.	0.76375	36	16	4	16	0
Fina Bank Ltd.	0.36175	40	20	4	16	0
Imperial Bank Ltd.	0.8685	36	16	4	16	0
Kenya Commercial Bank Ltd.	0.95325	42	20	6	16	0
National Bank of	0.58725	28	12	0	16	0

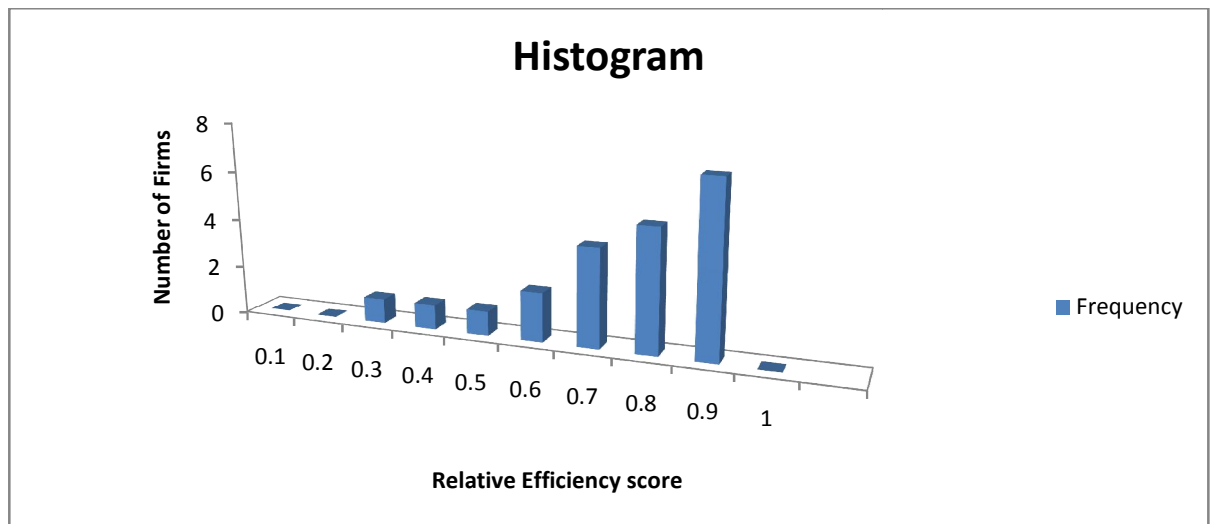


Kenya Ltd.						
NIC Bank Ltd.	0.91625	32	16	4	12	0
Oriental Commercial Bank Ltd	0.7815	31	12	4	15	0
Standard Chartered Bank Kenya Ltd.	0.949	44	20	4	16	4
Trans-National Bank Ltd.	0.7955	24	8	0	12	4

**Source: Research findings (2013)**

The range of relative efficiency scores was found to be 0.593 Table 1 and 0.711 for Appendix 4. This indicates that there was great disparity among usage of innovation that revealed that banks need to come up with innovation strategy to be used. Average efficiency for the 21 selected banks was established to be 0.78. This implies that innovations were contributing to efficient operations by commercial banks in Kenya of nearly 80%.

**Figure 4.1: Efficiency Histogram**



**Source: Research findings (2013)**

The Histogram (Figure 1) summarizes the result of relative efficiency scores obtained. It indicates the number of banks that obtained a score that is within the indicated range interval.

Only 7 banks out of 21 were found to be relatively efficient. 9 more banks were found to have efficient levels above 70%. These banks need to be investigated with a view to identify best practices that can be employed to other banks. However, 2 banks (10%) were found to be operating below 50% efficiency. This means innovations of such banks were not effective or did not attract enough customers.

**Table 4.6: Selected Banks with over 90% relative efficiency (2009-2012)**

Bank	Average Efficiency	product	process	service	organization	Total Innovation
Equity Bank Ltd.	0.95475	16	6	16	4	42
Kenya Commercial Bank Ltd.	0.95325	20	6	16	0	42
Bank of India	0.951	12	0	7	0	19
Standard Chartered Bank Kenya Ltd.	0.949	20	4	16	4	44
NIC Bank Ltd.	0.91625	16	4	12	0	32
Barclays Bank of Kenya Ltd.	0.9145	20	4	16	8	48
Diamond Trust Bank Kenya Ltd.	0.906	16	6	16	0	38

**Source: Research findings (2013)**

**Table 4.7: Selected Banks that are relatively inefficient (2009-2012)**

Bank	Average Efficiency	Product	Process	Service	Organization	Total Innovation
Fina Bank Ltd.	0.36175	20	4	16	0	40
Equitorial Commercial Bank Ltd.	0.46575	20	4	15	4	43

**Source: Research findings (2013)**

The efficiency score (1) of the efficient banks in appendix 4 indicates that they were using its available innovations 100% effectively. The efficient banks acts as benchmarks and peers of themselves, mainly because they have the best relative efficiency level and appear on the frontier line.

#### 4.4. Relative Efficiency between Banks Efficiency Score and Total Assets

According to CBK's annual report for the year 2012, the sector consolidated assets as at the end of the year 2012 was Kshs 2.5 trillion. In order to determine whether a bank was utilizing its total admitted assets to produce outputs, an analysis of the relative efficiency score was done to determine whether there was a relationship between the bank's total admitted asset and its efficiency score

The banks were divided into 3 categories (small, medium and large) in terms of total assets used in its operations. Transactional bank had very small admitted assets (4.7 Billion) while Cooperative bank had very large amount of assets compared to others (225 Billion). Table 8 summarizes the result between average admitted assets and average efficiency score per size category.

**Table 4.8: Mean score vs Mean Admitted Asset Distribution for selected banks**

<b>Bank Category</b>	<b>Admitted Assets Kshs 000' Million</b>	<b>Mean Admitted Assets Kshs 000' Million</b>	<b>Mean Efficiency Score</b>	<b>Number of Efficient Firms</b>	<b>Average Number of Innovations</b>
Small Sized	0-50	17.93	0.716075	1	32
Medium Sized	50-100	67	0.766125	1	33
Large Sized	100-above	168.86	0.899142	5	40

**Source: Research findings (2013)**

The result indicates that large banks appear to be more efficient than the small and medium sized banks in terms of assets. This may allude from the fact that large banks are able to utilize assets more efficiently due to economies of scale. Small and medium sized banks tend to have few assets at their disposal making them less efficient. The results confirm the findings of similar studies in the past including Murrey & Rowse (2006).

Out of 21 banks those that had over 90% relative efficiency, bank of India belonged to small sized category; NIC bank under the medium sized category, while Barclays, Diamond Trust, Equity, KCB, and Standard Chartered bank were under the large category. This clearly indicates that generally large sized banks are more efficient than the small and medium sized banks and confirm the economies of scale. According to the theory, a large bank will be efficient because of economies of scale (Vujcic, 2002).

#### **4.7 Relationship between Bank Relative Efficiency and Age**

In 1995 the exchange controls were lifted after the liberalization of the banking in Kenya whereby, exchange controls lifted. This included such measures as Interest rates liberalization, relaxation of foreign exchange controls, abolishment of currency declaration forms, abolishment of import licensing, introduction of foreign exchange bureaus and many other controls.

Banks that were operational in Kenya before 1995, 18 years ago from 2013 were considered to be old while those that were equal to or less than 18 years were considered to be new. Date of banks was based on operation basis and as a fully fledged commercial bank. Table 9 summarizes the result between average age and average efficiency score per age category.

**Table 4.9: Mean score vs mean age for selected banks**

<b>Bank Category</b>	<b>AGE</b>	<b>Age of Bank (Years)</b>	<b>Mean Age (Years)</b>	<b>Mean Efficiency Score</b>	<b>Number of Efficient Firms</b>
New	0-18	14	0.7293	1	
Old	18-More	50	0.83875	6	

**Source: Research findings (2013)**

The result indicates that old banks appear to be more efficient than the new banks. This may allude from the fact that old banks have more developed operational policies and processes and have enough capital bases to introduce new innovations. New banks tend to have few assets at their disposal making them less efficient. The results confirm the findings of similar studies in the past including Murrey & Rowse (2006).

Out of 21 banks those that had over 90% relative efficiency, NIC bank belonged to new category while Bank of India, Barclays, Diamond Trust, Equity, KCB and Standard Chartered banks were under the old category. This clearly indicates that generally old banks are more efficient than the new banks.

#### 4.8 Relationship between Bank Relative Efficiency and Ownership

Banks in Kenya are categorized in 3 basic types; foreign (incorporated or non-incorporated), private-domestic and government (influenced or non-influenced). Zhuang (1999) argue that ownership structure is one of the most important factors in shaping the corporate governance system of any country. This is because it determines the nature of the agency problem. That is, whether the dominant conflict is between managers and shareholders, or between controlling and minority shareholders.

As stated in section 1.1.4, 27 are local private financial institutions and 13 are foreign private financial institutions. The 3 public owned financial institutions comprise of consolidated bank of Kenya, Development bank of Kenya and National bank of Kenya. Table 10 summarizes the result of average efficiencies of different bank ownerships.

**Table 4.10: Mean score for ownership categories of selected banks**

<b>Bank Category</b>	<b>Mean Efficiency Score</b>	<b>Number of Efficient Firms</b>	<b>Total Innovations</b>	<b>Average Number of Innovations</b>	<b>% of banks that are efficient</b>
Public	0.750063	1	134	34	25
Private-domestic	0.752068	2	396	36	36
Foreign	0.874375	4	209	35	66

**Source: Research findings (2013)**

Out of 21 banks those that had over 90% relative efficiency, Bank of India, Barclays, Diamond Trust and Standard Chartered banks are owned by the foreign, Equity and NIC banks are private-domestic while KCB bank is public. This clearly indicates that generally foreign banks are more efficient than the other banks. This is shown in terms of numbers and percentage.

#### 4.9 Best Efficient Peers for each Inefficient Bank

A peer bank refers to one or more banks with relative efficiency to one that can be used as benchmark for a certain banks with relative efficiency less than one. A best peer is the closest that can be used as an example of a certain relatively inefficient bank. It can therefore be used to identify best practices and to set objective performance target for the inefficient bank.

The DEAP program computed peers for each bank with efficiency less than one. Appendix 3 Column 11 indicates the best peer branch for each branch under study. We noted that peers for each branch with relative efficiency score to 100% was the bank itself. This is because banks that are 100% efficient are considered as benchmarks since they lie in an efficient frontier line and are therefore best suited compared with themselves.

**Table 4.11: Peer count frequency summary**

Peer Bank (Year)	Standard chartered (2012)	Equity Bank (2012)	Ecobank (2012)	Bank Of Africa (2012)
Best Peer Frequency	36	32	25	21
Total Innovations (2012)	10	12	11	7
Number of years its Efficiency=100%	1	2	1	3

**Source: Research findings (2013)**

Table 5 indicates the top five best peer banks. These can be considered as models for the inefficient banks. It was found out that Standard bank was a best peer to 36 banks; this implies it can be used as ‘benchmark model bank’ for most inefficient banks and its practices can be studied and adopted in other branches.

#### **4.10 Interpretation of Findings**

Through financial innovation, efficiency is relatively high over the period the research was covered. All types of innovations; product, process, service and organization innovation were all used by the commercial banks. Process innovation was widely used by all banks while organizational innovation was used by only 6 selected banks, thus the least used. Due to competition that is in the industry, most banks have developed new products through modification of products and services of their competitors or improved on the features of the products or services that they are offering.

The study found out that small and medium sized banks tend to have few assets at their disposal making them less efficient than large banks in terms of size peering. In terms of efficiency over age, it was noted that old banks appear to be more efficient than the new banks. This may be due to the fact that old banks have more developed operational policies and processes and have enough capital bases to introduce new innovations. On ownership, foreign banks are more efficient than the public and private-domestic banks in terms of numbers and percentage. This may be due to the efficient management that the foreign banks employ.

It was found out that Standard bank was a best peer to 36 banks; this implies it can be used as 'benchmark model bank' for most inefficient banks and its practices can be studied and adopted in other branches. The range of relative efficiency scores was found to be 0.593. This indicates that there was great disparity among usage of innovation that revealed that banks need to come up with innovation strategies to be used. Average efficiency for the 21 selected banks was established to be 0.78. This implies that innovations were contributing to efficient operations by commercial banks in Kenya of nearly 80%.

From the study, only 2 banks out of 21 were found to be relatively inefficient; Fina bank (40%) and Equatorial Commercial bank (50%). Other banks were found to have efficient levels above 50%. This shows that banks were efficient in utilizing their innovations. Organizational innovations need to be adopted by most banks in Kenya as it not used by the inefficient banks.

## **CHAPTER FIVE: SUMMARY, RECOMMENDATIONS AND CONCLUSIONS**

### **5.1 Introduction**

This chapter concludes the research study by making brief summary findings of the entire study and its objectives. It also makes recommendations to the banking industry players and discusses the limitations encountered during the study. Finally, it concludes by making suggestions for further research.

### **5.2 Summary**

The objective of the study was to compute the relationship between the financial innovation and the efficiency of commercial banks in Kenya using DEA technique for the year 2012 to 2008. The method was selected as this could be used to determine how many units of financial innovations should be increased in order to improve efficiency of the banks. Traditional accounting ratios used by banks render them inadequate for making informed management decisions. This is attributed by the fact that the ratios use one input versus one output variable and cannot be used to determine best peer for benchmarking purposes in the banking sector.

A descriptive census survey for the banks was used. Out of 43 banks in Kenya 21 were selected for analysis. This was due to the unavailability of data for some banks for the years below 2012. Therefore, they were excluded from the analysis to enable unbiased results. This study used the following inputs: Financial innovation, operating expense and Customer's deposits while the output used included operating income, Loans borrowed by Customers and Net profit. The quantitative data for these variables were obtained from the annual reports and financial statements of the selected banks while data for financial innovations was through questionnaires handed out to the respective employees of selected banks. This was formatted and run through DEAP 2.1 computer program. The software produced an output file that contained all the information required to meet the study objective.



The average relative efficiency for the 21 selected banks was found to be 0.78 which shows a higher efficiency more than 0.65 which Muthoni (2011) established for one of the bank in Kenya. Only 7 banks out of 21 were found to have an average efficiency with a score more than 90%. Medium and large banks in terms of total assets were found to be more efficient than small sized banks. Large banks had an average of 40 innovations implemented while the rest had below 35 innovations. The result revealed that banks with larger asset base are utilizing their resource capacity to gain competitive advantage over smaller ones. This is evident by achieving the highest average efficiency score of above 80%. Asset management is therefore a key of concern within the small and medium banks as expected due to their economies of scale.

Out of 21 banks those were efficient included NIC bank under the new age category while Bank of India, Barclays, Diamond Trust, Equity, KCB and Standard Chartered banks were under the old category. This is due to the fact that of implementation basis of the innovation owned. Foreign Banks were observed to be more efficient due to the use of latest technology for implementation of the innovation. These banks had also embraced Islamic banking an organizational innovation.

Finally, the study established each bank inputs and outputs slacks and surplus which could be used in performance target setting. A bank utilizing the surplus or slacks proportion appropriately would be able to achieve maximum profitability hence high returns on investments implying.

### **5.3 Conclusion**

Among many methods of measuring relative efficiency ranging from accounting ratios, the DEA model employed in this study is a very superior method of measuring relative efficiency. This is because of the fact it can use more than one variable of the bank. It provides useful information that can enable a bank solve challenges like the type of innovation to implement and the number of innovations that are valuable through comparison to the best bank peers. This will enable a competitive edge over other banks (Vujcic, 2001).

## **5.4 Policy Recommendations**

During this research study, several business recommendation of interest to the banks' management was noted. The bank should adopt linear programming methods as DEA to measure impact of innovations away from accounting methods. Secondly, the banks needs to conduct an asset verification exercise to ensure that all innovations are still within the banks and are being put into productive use. Any redundant or obsolete innovation should either be disposed or redeployed to those bank branches that need them. Lastly, banks should employ organizational innovations (Islamic banking and insurance) to capture new markets. This could greatly increase the banks efficiency

## **5.5 Limitations of the Study**

This study faced a number of shortcomings. Data for the year 2008, for most of the banks was unavailable. This led for selection for the data for the years 2009, 2010, 2011 and 2012 to avoid unbiased analysis.

Secondly, the study was not able to use all input and output variables involved in banking operations, in particular qualitative variables were excluded from the study. More accurate results could have been obtained if more variables were used.

Lastly, results from the questionnaires cannot be relied as true and fair due to tendency of respective bank employees to portray their institutions in a positive light. The sample size used in the study could therefore be considered to be not representative enough.

## **5.6 Suggestions for Further Study**

This study focused on the relationship between financial innovation and the efficiency of commercial banks in Kenya banking industry. A researcher can adjust the variables and include qualitative variables such as customer satisfaction index to make the analysis more inclusive.

Secondly, efficiency categories such as geographical location, organizational structure and strategy need to be researched. A replicate study probably a case study/in-depth approach would uncover more.

Lastly, this study can be extended to other financial institutions such as insurance, co-operatives, micro-finance institutions, forex bureaus and others and comparison made.

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## APPEDICES

### Appendix 1: Research Questionnaire

Kindly answer the following questions by filling the spaces provided

#### The Relationship between Financial Innovations and Financial Performance of Commercial Banks in Kenya.

##### Section A: General Bank information

Name of the Bank.....

1. Which best describes your position for your bank?  
Management [ ]      Permanent staff [ ]      Contractual staff [ ]
2. How long have you been working for your bank?  
Less than 6 months [     ]  
Less than 1 year [     ]  
Less than 3 years [     ]  
More than 3 years [     ]

##### Section B: Types of Financial innovation

1. What financial innovations strategies have been adopted by your institutions

	<b>Innovation</b>		<b>Year Introduced</b>
a)	Agency Banking	[ ]	_____
b)	ATM	[ ]	_____
c)	Branch Network Expansion	[ ]	_____
d)	Change in core banking systems	[ ]	_____
e)	Credit cards	[ ]	_____
f)	Debit cards	[ ]	_____
g)	Internet banking	[ ]	_____
h)	Islamic banking	[ ]	_____
i)	Mobile banking	[ ]	_____
j)	Mortgage related products	[ ]	_____
k)	Insurance related products	[ ]	_____
l)	Personal Unsecured Loans	[ ]	_____
m)	SMS banking	[ ]	_____

**Appendix 2: Input-Output Data from the Selected Banks (2009-2012)**

		FINANCIAL INNOVATION	OPERATING EXPENSE	TOTAL CUSTOMER DEPOSITS RECEIVED	NET PROFIT	OPERATING INCOME	LOANS GIVEN OUT to Customers
			KSHs Million	KSHs Million	KSHs Million	KSHs Million	KSHs Million
Bank of Africa Kenya Ltd.	2012	7	3,120,266	1,909,644	761,548	4,013,504	37,587,836
	2011	7	1,350,316	2,303,203	432,725	1,904,866	21,639,691
	2010	7	1,010,993	1,682,524	355,258	1,495,470	14,122,485
	2009	8	1,405,400	18,796,143	192,439	1,021,527	13,730,002
Bank of India	2012	5	174,781	17,830,797	120,128	354,909	7,554,907
	2011	5	313,046	18,474,826	765,862	1,288,213	7,229,142
	2010	5	160,791	13,939,984	381,363	688,154	5,662,417
	2009	4	354,727	13,004,715	400,199	963,618	5,439,539
Barclays Bank of Kenya Ltd.	2012	12	14,404,643	137,915,391	8,740,703	27,424,387	104,204,295
	2011	12	14,267,534	124,207,289	8,112,637	26,338,089	99,072,495
	2010	12	15,248,327	123,826,442	10,598,982	26,023,681	87,146,982
	2009	12	14,394,870	125,868,585	6,091,040	23,397,336	93,542,609
Cfc Stanbic Bank Ltd.	2012	7	9,208,975	75,632,926	3,009,891	13,920,609	66,149,841
	2011	7	7,390,363	74,007,134	1,838,992	10,189,264	64,256,754
	2010	7	6,313,759	71,425,115	1,787,368	8,319,726	58,984,961
	2009	7	6,162,060	61,474,379	35,928	4,837,041	45,840,448
Chase Bank (K) Ltd.	2012	10	2,345,050	36,978,406	914,414	3,832,257	29,742,477
	2011	10	1,731,636	7,089,984	602,246	2,581,566	18,139,456
	2010	9	1,202,888	2,146,978	381,392	1,737,970	11,131,009
	2009	10	693,971	10,116,828	210,515	1,024,059	6,745,468
Consolidated bank of Kenya Ltd.	2012	9	1,346,914	13,324,851	139,249	1,522,852	10,077,068
	2011	9	1,159,305	12,010,250	149,824	1,487,838	9,197,024
	2010	9	873,730	8,008,438	172,478	1,249,067	6,047,276
	2009	9	689,536	4,881,920	80,938	908,999	3,868,472
Co-operative Bank of Kenya Ltd.	2012	11	14,171,860	162,267,227	7,707,986	23,759,696	119,087,748
	2011	11	11,903,056	142,704,593	5,186,343	18,070,824	109,408,815
	2010	10	9,844,520	124,012,039	4,379,230	15,403,548	86,618,311
	2009	10	7,982,490	91,552,508	2,967,962	11,718,185	62,274,421
Credit Bank Ltd	2012	8	457,162	4,781,147	47,074	508,444	3,112,099
	2011	8	457,162	315,294	47,074	508,444	2,883,261
	2010	8	440,120	249,341	33,791	473,732	1,926,918
	2009	7	259,740	77,441	57,803	342,298	1,880,943

Diamond Trust Bank Kenya Ltd.	2012	10	5,188,686	106,975,254	4,067,978	12,320,427	87,707,243
	2011	10	4,583,078	85,986,399	2,996,726	9,571,819	71,297,721
	2010	9	3,671,376	66,196,600	2,482,170	7,757,593	51,260,068
	2009	10	2,762,283	52,834,395	1,354,435	5,067,930	41,518,135
Ecobank Bank Kenya Ltd.	2012	8	263,369	4,908,898	1,055,754	229,934	13,968,266
	2011	8	646,254	16,566,403	202,106	70,662	11,380,592
	2010	7	655,032	16,493,841	125,122	70,109	9,693,275
	2009	7	1,330,595	10,818,797	-796,261	53,527	6,444,336
Equitorial Commercial Bank Ltd.	2012	11	1,017,983	12,962,765	481,940	494,327	7,538,422
	2011	11	664,632	9,833,985	72,341	725,702	6,635,194
	2010	11	734,969	8,036,584	68,064	634,086	4,792,435
	2009	10	268,682	3,522,174	51,306	353,630	2,749,529
Equity Bank Ltd.	2012	11	15815061	140285671	10996839	31874668	122,410,013
	2011	11	13,363,488	121,774,061	9,773,857	25,467,002	106,486,367
	2010	10	10,881,849	95,203,689	7,554,376	20,193,666	72,902,021
	2009	10	8,703,597	65,824,732	4,563,132	14,273,161	59,868,232
Family Bank Ltd.	2012	9	3,202,436	94,388	540,718	4,690,948	17,868,745
	2011	9	2,906,303	21,443,927	354,604	3,766,041	16,332,359
	2010	9	2,275,294	15,731,247	354,689	3,118,826	10,298,791
	2009	9	1,847,882	10,490,293	220,895	2,190,489	7,675,806
Fina Bank Ltd.	2012	10	1,648,882	21,450,141	134,557	214,720	14,180,269
	2011	10	1,493,811	19,205,790	311,033	66,715	11,835,689
	2010	10	1,391,327	16,888,926	134,073	236,368	10,165,285
	2009	10	1,148,233	14,738,232	109,426	58,356	9,291,539
Imperial Bank Ltd.	2012	9	2,219,822	30,703,750	1,342,354	4,210,382	21,292,362
	2011	9	1,778,082	19,244,702	1,197,382	3,409,773	14,903,789
	2010	9	1,493,971	13,678,340	885,246	2,726,389	11,152,828
	2009	9	1,027,266	12,269,906	555,878	1,887,627	9,676,110
Kenya Commercial Bank Ltd.	2012	11	24,753,160	288,037,367	12,203,531	44,059,338	211,664,226
	2011	11	21,828,228	259,308,849	10,981,046	36,504,645	198,724,919
	2010	10	18,412,941	196,974,651	7,177,973	29,328,808	148,113,364
	2009	10	15,575,491	163,029,350	4,083,871	22,593,773	122,659,082
National Bank of Kenya Ltd.	2012	7	5,737,284	55,191,425	729,752	1,263,721	28,346,668
	2011	7	5,351,289	56,728,163	1,546,113	7,795,139	28,068,218
	2010	7	4,402,093	47,804,607	2,021,919	7,099,916	20,844,636
	2009	7	3,433,677	41,995,446	1,462,955	753,412	13,156,455
NIC Bank Ltd.	2012	8	3,798,158	83,379,576	3,036,794	8,316,125	71,540,092
	2011	8	2,997,786	66,293,053	2,707,137	6,602,734	56,624,621
	2010	8	2,605,088	48,492,224	1,863,918	5,213,480	40,754,979
	2009	8	2,314,285	39,514,275	1,085,718	3,841,078	32,511,082

Oriental Commercial Bank Ltd	2012	8	113,567	4,806,223	94,468	354,708	3,452,899
	2011	8	261,259	3,694,362	152,004	453,853	2,798,853
	2010	8	235,540	3,266,148	155,770	418,469	2,450,600
	2009	7	159,091	2,011,798	38,210	192,151	1,518,545
Standard Chartered Bank Kenya Ltd.	2012	11	8,398,595	140,524,846	8,069,533	20,671,436	112,694,523
	2011	11	7,959,132	122,323,049	5,836,821	16,214,267	96,097,823
	2010	11	6,468,204	100,504,065	5,376,191	14,150,088	60,336,829
	2009	11	5,043,049	86,773,652	4,732,754	12,246,432	56,694,876
Trans-National Bank Ltd.	2012	6	539,952	6,451,636	213,393	966,669	4,238,908
	2011	6	482,302	5,241,741	202,580	841,454	3,308,068
	2010	6	438,074	3,010,470	142,342	658,201	1,937,580
	2009	6	362,625	1,844,938	90,156	483,802	1,688,664



**Appendix 3: Output and Input Data of Selected Banks from DEAP version 2.1**

SELECTED BANKS	Year	Bank Number	OUTPUT SLACK			INPUT SLACK			DEPOSITS RECEIVED	Best Peer bank	Peer Weight
			RELATIVE EFFICIENCY	NET PROFIT	OPERATING INCOME	LOANS GIVEN OUT TO CUSTOMERS	FINANCIAL INNOVATION	OPERATING EXPENSE			
Bank of Africa Kenya	2012	1	1.000	0.000	0.000	0.000	0.000	0.000	1	1	
	2011	2	1.000	0.000	0.000	0.000	0.000	0.000	2	1	
	2010	3	1.000	0.000	0.000	0.000	0.000	0.000	3	1	
	2009	4	0.476	468963.258	102540.663	0.000	0.000	0.000	1	0.082	
Bank of India	2012	5	0.964	455342.477	0.000	0.000	0.000	10449767.79	37	0.404	
	2011	6	1.000	0.000	0.000	0.000	0.000	0.000	6	1	
	2010	7	1.000	0.000	0.000	0.000	0.000	0.000	7	1	
	2009	8	0.84	87534.27	0.000	0.000	0.476	0.000	77	0.018	
Barclays Bank of Kenya Ltd.	2012	9	0.926	854197.585	0.000	5853686.798	1.101	0.000	77	0.142	
	2011	10	0.921	891677.506	0.000	2063919.855	1.394	0.000	45	0.815	
	2010	11	1.000	0.000	0.000	0.000	0.000	0.000	11	1	
	2009	12	0.811	1939883.269	0.000	0.000	0.000	0.000	45	0.712	
Cfc Stanbic Bank Ltd.	2012	13	0.888	1219282.592	0.000	0.000	0.000	540747.281	61	0.12	
	2011	14	0.853	1081709.104	0.000	0.000	0.000	0.000	62	0.213	
	2010	15	0.828	831390.134	473295.276	0.000	0.000	0.000	62	0.153	
	2009	16	0.681	1920470.019	1983552.977	0.000	0.000	0.000	62	0.121	
Chase Bank (K) Ltd.	2012	17	0.733	1109547.727	0.000	0.000	0.000	0.000	77	0.164	
	2011	18	0.897	120546.659	0.000	0.000	1.644	0.000	45	0.034	
	2010	19	0.95	0.000	0.000	0.000	3.328	0.000	37	0.039	
	2009	20	0.652	220182.013	0.000	0.000	5.305	0.000	37	0.048	
Consolidated bank of Kenya	2012	21	0.56	378873.367	0.000	0.000	2.268	0.000	45	0.002	
	2011	22	0.624	364841.985	0.000	0.000	3.355	0.000	45	0.007	
	2010	23	0.71	255563.437	0.000	0.000	5.288	0.000	3	0.096	
	2009	24	0.695	205282.826	0.000	0.000	5.513	0.000	45	0.024	
Co-operative Bank of Kenya Ltd.	2012	25	0.875	0.000	0.000	0.000	0.000	0.000	62	0.142	
	2011	26	0.857	486830.653	0.000	0.000	0.000	0.000	77	0.16	
	2010	27	0.792	779982.181	0.000	0.000	0.000	0.000	61	0.057	
	2009	28	0.692	1205583.482	0.000	0.000	0.000	0.000	1	0.284	
Credit Bank Ltd	2012	29	0.539	129331.929	0.000	0.000	3.561	0.000	77	0.015	
	2011	30	0.753	34251.79	0.000	0.000	4.599	0.000	45	0	
	2010	31	0.72	31119.716	0.000	0.000	4.847	0.000	45	0.001	
	2009	32	1.000	0.000	0.000	0.000	0.000	0.000	32	1	
Diamond Trust Bank Kenya Ltd.	2012	33	1.000	0.000	0.000	0.000	0.000	0.000	33	1	
	2011	34	0.924	119938.772	0.000	0.000	0.000	0.000	2	0.224	
	2010	35	0.886	791788.587	0.000	0.000	0.000	0.000	37	0.397	
	2009	36	0.814	822368.452	0.000	0.000	0.000	0.000	37	0.486	

Ecobank Kenya Ltd.	2012	37	1.000	0.000	0.000	0.000	0.000	0.000	0.000	37	1
	2011	38	0.563	513441.54	552218.19	0.000	0.000	0.000	17786 11.34	37	0.502
	2010	39	0.507	463306.148	523755.378	0.000	0.000	0.000	14045 34.10 6	37	0.382
	2009	40	0.557	0.000	1061723.063	3670522.5 55	0.000	0.000	0.000	11	0.032
Equitoria Bank Ltd.	2012	41	0.289	0.000	0.000	0.000	0.000	0.000	0.000	2	0.064
	2011	42	0.522	370798.195	0.000	0.000	3.728	0.000	0.000	2	0.037
	2010	43	0.427	175622.032	0.000	0.000	3.623	0.000	0.000	37	0.025
	2009	44	0.625	113152.203	0.000	0.000	5.579	0.000	0.000	37	0.037
Equity Bank Ltd.	2012	45	1.000	0.000	0.000	0.000	0.000	0.000	0.000	45	1
	2011	46	1.000	0.000	0.000	0.000	0.000	0.000	0.000	46	1
	2010	47	0.966	0.000	0.000	6070413.8 45	0.000	0.000	0.000	37	0.259
	2009	48	0.853	48006.584	0.000	0.000	0.000	0.000	0.000	45	0.395
Family Bank Ltd.	2012	49	1.000	0.000	0.000	0.000	0.000	0.000	0.000	49	1
	2011	50	0.678	858973.294	0.000	0.000	3.006	0.000	0.000	45	0.101
	2010	51	0.724	598660.806	0.000	1661970.8 16	4.599	0.000	0.000	45	0.081
	2009	52	0.653	388253.617	0.000	716568.53	4.113	0.000	0.000	45	0.049
Fina Bank Ltd.	2012	53	0.412	560099.173	905988.849	0.000	0.000	0.000	0.000	37	0.356
	2011	54	0.367	287024.824	818935.434	0.000	0.000	0.000	0.000	37	0.334
	2010	55	0.332	388381.829	487625.508	0.000	0.000	0.000	0.000	1	0.064
	2009	56	0.336	401615.724	531897.915	0.000	0.000	0.000	0.000	37	0.339
Imperial Bank Ltd.	2012	57	0.827	237083.213	0.000	0.000	5.153	0.000	0.000	3	0.044
	2011	58	0.903	22433.028	0.000	0.000	6.632	0.000	0.000	77	0.05
	2010	59	0.9	58493.309	0.000	0.000	6.856	0.000	0.000	3	0.041
	2009	60	0.844	128090.965	0.000	0.000	6.171	0.000	0.000	3	0.09
Kenya Commercial Bank Ltd.	2012	61	1.000	0.000	0.000	0.000	0.000	0.000	0.000	61	1
	2011	62	1.000	0.000	0.000	0.000	0.000	0.000	0.000	62	1
	2010	63	0.938	876430.274	0.000	0.000	0.000	450163.948	0.000	61	0.592
	2009	64	0.875	2251383.098	0.000	0.000	0.000	204063.292	0.000	61	0.255
National Bank of Kenya Ltd.	2012	65	0.444	438209.195	2848510.055	0.000	0.000	0.000	0.000	69	0.078
	2011	66	0.689	1233880.414	0.000	5087512.0 39	1.761	0.000	0.000	77	0.097
	2010	67	0.758	521824.103	0.000	9769170.2 82	2.466	0.000	0.000	45	0.158
	2009	68	0.458	0.000	2505656.209	4994285.4 92	0.000	0.000	0.000	46	0.071
NIC Bank Ltd.	2012	69	1.000	0.000	0.000	0.000	0.000	0.000	0.000	69	1
	2011	70	1.000	0.000	0.000	0.000	0.000	0.000	0.000	70	1
	2010	71	0.886	159581.827	0.000	0.000	0.000	0.000	0.000	2	0.135
	2009	72	0.779	355468.632	0.000	0.000	0.000	0.000	0.000	2	0.253
Oriental Commercial Bank Ltd.	2012	73	1.000	0.000	0.000	0.000	0.000	0.000	0.000	73	1
	2011	74	0.764	20017.397	0.000	0.000	5.695	0.000	0.000	2	0.026
	2010	75	0.78	0.000	0.000	0.000	5.827	0.000	0.000	37	0
	2009	76	0.582	50279.485	0.000	0.000	3.695	0.000	0.000	37	0.02
Standard Chartered Bank Kenya Ltd.	2012	77	1.000	0.000	0.000	0.000	0.000	0.000	0.000	77	1
	2011	78	0.903	190047.669	0.000	0.000	0.000	0.000	0.000	62	0.033
	2010	79	0.914	65512.669	0.000	13889925. 03	2.862	0.000	0.000	45	0.057
	2009	80	0.979	94467.465	0.000	10105540. 79	3.491	0.000	0.000	77	0.581
Trans-National Bank Ltd.	2012	81	0.817	139408.977	0.000	158873.15 6	4.492	0.000	0.000	45	0.017
	2011	82	0.82	98940.398	0.000	321793.64 5	4.581	0.000	0.000	77	0.012
	2010	83	0.795	58263.557	0.000	586554.26 6	4.359	0.000	0.000	45	0.017
	2009	84	0.75	37619.921	0.000	163999.15 2	4.063	0.000	0.000	45	0.01

