

AN ANALYSIS OF THE KENYAN NON-LIFE INSURANCE COMPANIES' TECHNICAL EFFICIENCY

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**A Research Thesis submitted to the School Of Management
and Commerce in partial fulfillment of the requirements
for the award of the degree in masters of commerce**

School of graduate studies

Strathmore University

Nairobi, Kenya

June 2013

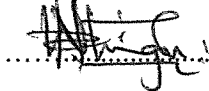
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Acknowledgement

First, I wish to thank the almighty God for giving me the will, knowledge and the energy to write this thesis. I also wish to thank Strathmore University staff and management for providing resources and a conducive environment to conduct the research. My sincere appreciation goes to Dr. Freshia Mugo Waweru for her guidance, dedication and positive contribution to the study. I cannot fail to appreciate all those who made their contributions to this study with special thanks to Dr. Wang'ombe, the Dean School of Management and Commerce Dr. Mboya and Dr, Dimba.

Lastly, I wish to thank my wife Joyce, my daughter Sharon my son Hilary, my niece Martha and my parents, brothers and sisters for their support and encouragement.

ABSTRACT

The main objective of this study is to analyze the technical efficiencies of the Kenyan non-life insurance companies during the period 2006 – 2010 the period that the Kenyan Insurance Industry saw many changes. Data Envelopment Analysis (DEA) a non-parametric method is used in evaluating the technical efficiencies of Non-life insurers in Kenya during the study period. The study uses Equity Capital, Debt Capital and Total Expenses as inputs in the DEA model, while Gross Premium and Investments Income are used as outputs. It was observed that Kenyan non-life insurers operated at an average overall technical efficiency of 84.7%, pure technical efficiency of 93% and scale efficiency of 90%. Further, the study tests the hypothesis relating to the roles played by each of the variable used in the technical efficiency analysis of the Kenyan non-life insurer. It was observed that Kenyan non-life insurers with higher market share measured by gross premium tend to have higher efficiencies, which implies that non-life insurers in Kenya could increase their efficiencies by increasing their market share.

This study adds to the knowledge of efficiency in the insurance industry in Kenya and on the knowledge of efficiency in the world. From an academic perspective, the particular contribution of this study lies in computing the technical efficiencies of the Kenyan non-life insurance companies by use of DEA model.

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CHAPTER ONE

INTRODUCTION

1.0 Background

The global insurance industry has been experiencing major structural changes in the last two decades (Mahlberg & Url, 2003).. Deregulation of the industry occasioned by the introduction of the Third Generation Insurance Directive in 1994 by the European Union notably changed the European market landscape in subsequent years. Japan similarly launched financial system deregulation in 1996, and the US took several steps to relax regulations, e.g., through the Gramm-Leach-Bliley Financial Services Modernization Act of 1999 (Mahlberg & Url, 2003).

A common goal of most of these deregulatory efforts has been to promote competition within and across national boundaries as well as to ensure fair prices and improved product offerings. In particular, Hussels & Ward (2006) observed that significant change was expected for previously highly regulated markets such as Germany, where results from deregulation were soon evident; strong competition ensued in the German property-liability market with new market entries, resulting in battles for market share and erosion of prices and margins (Hussels, Ward & Zurbruegg, 2005). As a result of the increased competition, triggered by the deregulation, firms and markets are also expected to become more efficient and more productive (Cummins & Rubio-Misas, 2006). Efficient firms, which previously could not exploit their advantages due to regulation, gained market share and realized economies of scale. Inefficient firms are forced to improve efficiency or they will be taken over by more efficient firms.

Moreover, measuring efficiency and factors affecting firm's efficiency can be used to identify and separate controllable and uncontrollable sources of performance variations and therefore assist in designing appropriate government policies and recommendations (Fried, Knox & Schmidt, 2008). For most firms the ultimate measure used to evaluate their business performance is a financial variable, but in fact this is just the bottom line performance indicator as it is influenced by efficiency and productivity performance of firms and price changes (e.g. input and product prices) (Fried et al, 2008). Therefore, a firm's efficiency and productivity performance is at the core of its financial success.

In measuring efficiency several methods have been used, with the traditional ratio method which involves calculating several ratios to explain a firm's performance, being the oldest. Infact, Arshinova, (2011) observed that although the traditional ratio measures are

attractive to analysts due to their simplicity, there are several limitations that must be considered. For example, the analysis assumes comparable units, which implies constant returns to scale. Each of the indicators yields a one dimensional measure by examining only a part of the organization's activities, or combining the multiple dimensions into a single, unsatisfactory number. Moreover, the seemingly unlimited numbers of ratios that can be created from financial statement data are often contradictory, thus ineffective for the assessment of overall performance. This overly simplistic analytical approach offers no objective means of identifying inefficient units and requires a biased separation of the inefficient and efficient levels.

Methods of frontier analysis ensure a principally different approach to the problem of efficiency measurement. They provide an opportunity of complex analysis of insurance efficiency level for a certain period of time and comparison of it among investigated insurance companies. This multidimensional approach meets the requirements of the insurance performance evaluation methodology. Two methods of frontiers analysis Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) are commonly used to measure efficiency. The two methods have been found to give almost similar results and none is superior to the other. For instance, Ben & Ross (2011) found that DEA and SFA produce similar efficiency rankings of farms, however, DEA rankings are more stable. A study conducted by Resti, (2000) concluded that neither DEA nor SFA models have an absolute advantage over their competitors. In this study the DEA model is used to calculate both technical and scale efficiency.

The study aimed to discuss the technical efficiency of the Kenyan non-life insurance companies, assess the growth rate of premiums in the industry and explore the reasons for such growth. This can help explain why premium growth in the Kenyan insurance industry is not directly related to the growth in profits and increase in insurance penetration. Further, the study also considered statistical tests of hypothesis on whether Scale of operation and Market share of an insurance company positively correlates with its efficiency. Scale of operation and market share being of importance to this study because they have been tested by other researchers and found to significantly contribute to the efficiency of insurance companies in different jurisdictions. For example Owusu, Dontwi, Seidu, Abudulai, & Sebil, (2010) in their study of Ghanaian general insurance technical efficiency tested the effect of scale of

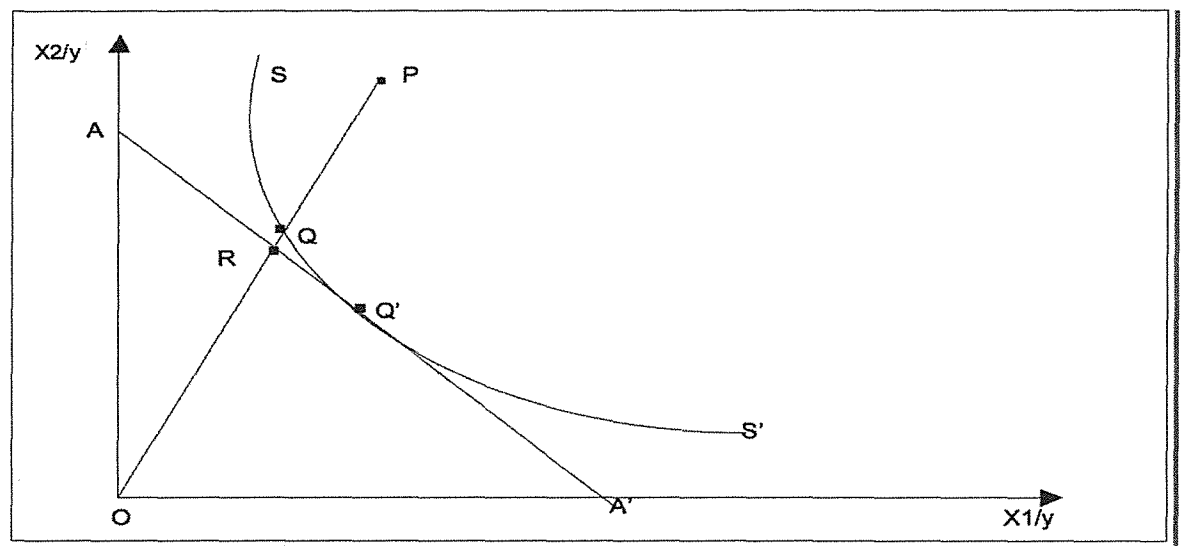
operation and market share using Mann-Whitney U-test model and found that large insurance companies in Ghana have a higher efficiency than small companies. Further, they found that companies that have a higher market share have a higher efficiency than companies with lower market share. Hao, (2007) while studying the efficiency of Taiwan life insurance industry found that size and market share contributes significantly to efficiency and profitability. Other researchers who have shown that size and market share have a significant impact on efficiency include Liargavas & Skandalis, (2008), Tarawneh, (2006), Kakani et al, (2005) and Chen & Wong, (2004).

The concept of measuring efficiency was first discussed by Farrell (1957), drawing inspiration from Koopmans (1951) and Debreu (1951). Farrell (1957) was the first to measure efficiency empirically. According to Farrell (1957), the concept of efficiency measurement can be divided into two components, technical efficiency (TE) and allocative efficiency (AE).

1.0.1 Technical Efficiency

This is the firm's ability to obtain maximal output from a given set of inputs (Farrell, 1957). Further Farrell, (1957) provided an explanation of efficiency using two factor inputs, X_1 and X_2 to produce output Y as shown in figure 1 below.

Figure 1: Overall Technical and Allocative Efficiency



Source: (Coelli et al.1995)

Assuming a firm, ABC, is using only two inputs, X_1 and X_2 to produce a single output (y) at point P. SS' slope shows the minimum combination of inputs the firm can produce if it is perfectly efficient. The various combinations of the two inputs along the isoquant line SS' are considered to be technically efficient, while the point which is located above the isoquant line SS' is considered to be technically inefficient.

The point P represents a combinations of the two inputs the firm uses to produce a unit of output, but this presents technical inefficiency since by moving to point Q through reducing inputs by the distance PQ the firm can reduce the inputs of production to produce the same outputs, this means that at point P the firm could reduce its inputs in order to achieve technical efficiency production which can be represented by the ratio QP/OP (Hamim, Naziruddin & AlHabshi, 2007). At point Q the firm can be technically efficient by producing the same unit of output as it produces at point P but using only OQ inputs, which can be defined as OQ/OP.

As a result, technical efficiency (TE) of a firm can be measured by the ratio $TE = OQ/OP$, this ratio lies between zero (i.e. a completely inefficient firm) and unity (i.e. a completely efficient firm), (Norma & Nur, 2011).

1.0.2 Allocative Efficiency

Farrell (1957) explains allocative efficiency (AE) when input price information is given. From figure 1 above, the slope AA' represents the input price ratio and it shows the various combinations of inputs that require the same level of expenditure. Allocative efficiency is measured by the ratio OR/OQ. The production of the firm is technically efficient at point Q, but it can be allocatively inefficient at this point, since production costs at the point Q are not efficient and can be reduced by distance RQ. At point Q' the firm's production is both technically and allocatively efficient.

1.0.3 Overall Efficiency

Since we have the ratio calculation for TE and AE and according to Farrell (1957), overall efficiency (OE) is obtained by multiplying TE by AE as shown below:

Overall Efficiency (OE) = Technical Efficiency (TE) x Allocative Efficiency (AE)

Technical Efficiency is given by point OQ divided by point OP in figure 1 above and Allocative Efficiency is given by point OR divided by OQ in figure 1 above in short overall efficiency is expressed as follows:

$$OE = TE \times AE = (OQ/OP) \times (OR/OQ)$$

$$\text{Thus } OE = OR/OP$$

1.1 The Kenya Insurance Industry

The concept of insurance and particularly the “social insurance programme” dealing with socio-economic problems has been around Africa for a long time (Rand & Graham, 2004). Members of a community pooled together resources to create a “social insurance fund”. The “premiums” ranged from material to moral support or other payments in kind. From the fund, “drawings were made out” to support the few unfortunate members exposed to perils (Rand & Graham 2004).

However, the history of the development of commercial insurance in Kenya is closely related to the historical emancipation of Kenya as a nation (Rand & Graham 2004). With the conquest of Kenya as a British colony complete, settlers initiated various economic activities, particularly farming, and extraction of agricultural products (Rand & Graham 2004). These substantial investments needed some form of protection against various risk exposures. British insurers saw an opportunity in this, and established agency offices to service the colony’s insurance needs. Prosperity in the colony soon justified expansion of these agencies to branch networks with more autonomy, and expertise to service the growing insurance needs. By 1963, most branches had been transformed to fully-fledged insurance companies (Rand & Graham, 2004).

Prior to 1978 the insurance industry operations in Kenya were governed by the Insurance Companies Act of 1960 which was based on the UK legislation. During this period there was no competent authority to supervise the industry. In 1978 the Minister for Finance issued an order stopping the operations of branch offices of international companies and all insurance companies were required to be locally incorporated. Thereafter in the early 1980’s the process of drafting a law to regulate the insurance sector was started by the Government with the support of UNCTAD (United Nations Conference for Trade and Development).

In 1984 the Insurance Act was enacted with the enforcement date being 1st January, 1987. The Insurance Act CAP 487 established the office of the Commissioner of Insurance as the regulator of the insurance industry and stipulated the mandate and functions of the office. The office of the Commissioner of Insurance was created as a Department in the Ministry of Finance known as the 'Department of Insurance'. Currently the industry is regulated by the Insurance Regulatory Authority (IRA) having been created by the amendment of the Insurance Act Cap 487, in 2006 and came into operation in May 2007. In Kenya the insurance industry is classified under the financial sector together with the banking industry.

Insurance business in Kenya is divided into two categories life or long term business and general or non-life insurance or short term business. The general insurance business contributes a larger portion of the total insurance business. According to the Association of Kenya Insurers (AKI) annual report for year 2010 non-life insurance has been contributing over 50% of total gross premium for the country since year 2006 (Appendix B). This study will focus on the efficiency of the non-life insurance business which controls a large part of the Kenyan insurance business and due to the fact that this line of business seems to be growing faster it can assist in meeting the goals stipulated in vision 2030.

Insurance in Kenyan is distributed through a number of channels which include independent agents, brokers and company direct sales through its employees. These methods of distribution are commonly known as the "traditional methods of insurance distribution". A modern and emerging form of insurance distribution is through banks' agencies, a very recent method of insurance distribution in Kenya. This channel of insurance distribution in Kenya has shown signs of tremendous and fast growth with many insurance companies partnering with banks to sell insurance to the bank customers. This form of insurance distribution is commonly known by the French term "Bancassurance" (Ianthi, 2005), it is one of the most important developments that have taken place in the Kenyan financial sector.

As at end of year 2010 there were 8 banks operating Bancassurance agencies (Appendix c). While insurance companies entering into agreements with banks agencies are attracted to the arrangement due to the low distribution costs, they also have the opportunity to access the banks' customers and cross sell their products through the large network of the banks' branches. Customers may also obtain financial products at more favorable rates than they would have obtained if they had approached the insurance company directly.

The introduction of new entrants and distribution channels in Kenyan insurance industry are some of the changes that have been experienced in the insurance industry since year 2006. Other events that have taken place include the changes in the regulatory regime. Before 2006 the government used to regulate the insurance industry directly through the Ministry of Finance but since 2006 the industry is being regulated by IRA, an autonomous body. Recapitalization of the insurance industry in 2010 to Kshs. 300million for non-life companies, Kshs 150 million for life companies and Kshs 450 for composite companies (writing both life and non-life), from Kshs. 100 million for non-life Kshs. 50 million for life and Kshs. 150 million for composite companies.

Other changes include, increase in communication between insurers and intermediaries due to development in information and communication technology, increase in customer sophistication (i.e. customers are more educated and enlightened on insurance matters) as such there has been an increased importance of insurance products such as 'family savings' and 'education' products". Also there has been an increase in the demand for life insurance products due to the growing inadequacy of social security pension systems. Finally the introduction of Bancassurance channel of insurance distribution and the introduction of M-Pesa mode of premium payment have been a major change that has occurred in the industry since 2006. The numerous events that have taken place in the Kenyan insurance industry since year 2006 have reduced the existing barriers among insurance companies and increased competitive pressure among the industry players.

In the forty eight years since independence, Kenya's insurance industry has flourished in terms of its members and premiums. As at the end of year 2010 the industry was composed of 47 insurance companies of which 10 wrote long-term insurance business, 21 wrote non-life insurance business, 16 were composite insurance companies and 2 reinsurance companies. During the same year there were 161 insurance brokers, 24 medical insurance providers and 3931 insurance agents (IRA, 2010). Gross direct premium written by the industry in 2010 was Kshs. 76.9 billion with life business contributing 35% while non-life business contributed 65%. This indicated a 117% growth from Kshs.36.42 billion written in 2005. However, insurance penetration ratio (premiums as a share to GDP) has remained low at 3% in 2010 (AKI, 2010); this being an improvement from 2.5% in 2005 as compared to the advanced economies like UK, Japan and Hong Kong with penetration ration of 8.1%,

11% and 11.4% respectively. Appendix A gives the comparative statistics of the advanced economies, emerging economies and whole of Africa penetration ratio from which it is evident that Kenya's penetration is low.

Despite the growth recorded in the industry there has been several challenges faced by the industry ranging from fraud, low capitalization, poor management and poor public perception of insurance (IRA, 2008). Another major challenge is the collapse of some insurance companies due to their inefficiency and thus inability to meet their obligations to the policy holders, these included Access Insurance Company of Kenya, Kenya National Assurance Company, Lakestar Insurance Company Limited, Liberty Insurance Company Limited, Stallion Insurance Company Limited, United Insurance Company Limited, Invesco Insurance Company Limited, Standard Insurance Company Limited and BlueShield Insurance Company Limited. These companies were placed under statutory management in 1997, 1996, 2003, 2005, 2002, 2008, 2008-2010, 2008 and 2011 respectively.

The insurance regulator has in the past introduced strict measure to address the above challenges which include raising the minimum capital requirements for insurers, requiring all insurance companies to be managed by qualified staff through approval of management staff (Insurance Act, cap 487), holding open day seminars in various regions of the country to educate the public on the need and importance of insurance. The insurance regulator in 2011 launched an anti-fraud unit to curb fraudulent activities in the industry as a way of addressing some of the challenges noted above.

Insurance companies in Kenya are classified in terms of their capital strength or size or scale. They are also classified in terms of the gross premium written or market share. The insurance sector in Kenya is well regulated and provides a wide variety of services to the public. However the industry is faced with the challenge of over-crowding and competition among the players with the 45 insurance companies competing for the slow growing insurance business with a growth of 17% in 2007, 9% in 2008, 16% in 2009 and 18% in 2010 (AKI, 2010). In terms of capital utilization the industry has performed poorly. In the period 2006 to 2010 the rate of return is low at 0.21, 0.13, 0.17, 0.15 and 0.19 respectively (AKI, 2010).

Further, the industry has over the years faced solvency problems that have led to the collapse of some insurance companies. The sector has maintained low level of development, compared with other sectors in the financial sector. For the period 2007-2010 the total assets of the insurance industry in billions of Kenya shillings was 134, 146,165 and 210 respectively (AKI, 2010) while that of the banking industry in billions of Kenya shillings for the same period was 951, 1184, 1354 and 1978 respectively (CBK, 2008 and 2010) indicating that the total insurance industry assets is on average 12% that of the banking industry.

As the insurance market in Kenya continues to evolve, although at a slow pace, it is imperative to find a tool to help identify the companies in this industry that are best positioned to respond to and thrive in a changing environment. In fact, efficiency evaluation and productivity improvement have become key factors for every insurance firm if they are to survive and compete effectively. Efficiency has been the focus of most research in insurance in the recent past (Owusu et al, 2010). Moreover, the increased market competition in the industry has equally placed insurance companies in a competitive environment. As a result Kenyan insurance companies are now under pressure to upgrade their efficiency relative to their competitors. Benchmarking analysis is one of the ways to drive insurance companies towards the frontier of best practices (Barros & Obijiaku, 2007).

1.2 Problem Statement

The Kenya insurance industry has traditionally been known for its high-cost of insurance distribution system. These trends however, are noted to be reversing with the industry now benefiting from low-cost non-traditional sources of insurance distribution such as banks and cooperative societies (Kirui, 2009). These non-traditional sources of insurance distribution are expected to capture a major share of the insurance market for asset accumulation products such as credit insurance and also medical insurance products (Kirui, 2009). As a result, competition among the insurance companies in Kenya is expected to increase, as insurance companies rush to look for strategic partnership in the banking industry, thus it is expected that the industry's profit margins will decrease. The decrease in profit margins will motivate insurers to seek ways to reduce their operational costs and efficiency (Cummins, Turcheti & Wess, 1996). Moreover, attainment of higher efficiency

level for any insurers is one of the main business objectives that an insurer would wish to achieve, the challenge being on how to achieve that efficiency.

In 2008 Kenya's long term economic blueprint, Vision 2030, was unveiled in which it was noted that for Kenya to transition to higher income and achieve growth in the longer term, measures to improve productivity and competition over the long term in all sectors of the economy were urgently needed. In the economic blueprint the insurance industry was noted as a key sector in achieving the envisaged growth of the economy, however the industry was identified as being under-capitalized with an asset base of just Kshs. 100 billion, that meant that the economy was under served and its assets by then being under-insured. The failure noted in the insurance industry in 2008 meant that the industry needed to improve in terms of capital and asset base. The major question by then being, 'if the improvement in capital and assets would lead to an improvement in the efficiency of the industry'.

Further, the goals envisioned in vision 2030 were expected to cause considerable expansion in the economy, thus leading to a huge amount of insurable assets and an increase in personal incomes, in effect Kenyans were expected to demand more insurance. The small size of the insurance industry, however, was identified in vision 2030 as facing significant institutional handicaps in extending the outreach and coverage of life and property insurance. Consequently, it was noted that there would be significant potential to strengthen the insurance industry in the interest of long-term savings and better coverage of risk, by addressing the several challenges that were a hindrance in achieving the goals set in vision 2030. To address the challenges faced in the industry some of the major steps envisaged included, strengthening of the industry by improving the efficiency and outreach of insurance service providers, through consolidation, public education campaigns and investment in new technologies (vision, 2030). Thus meaning that efficiency in the insurance industry is paramount.

Other challenges noted in the slow growth of the insurance industry were failures of 9 insurance companies since 1996 in Kenya (IRA, 2008). Failures of insurance companies in the industry may be attributed to inefficiency within the industry that has in effect lead to lower growth rate due the poor public perception of insurance. Knowledge of efficiency in management of insurance companies leads to insurers seeking to improve on the efficiency levels that lead to improvement in services offered and therefore growth in the industry.

One way of addressing the above challenges is by reducing the insurer cost of production through increasing the insurers output which can be achieved by increasing the insurer's technical efficiency. It is therefore, necessary to quantify the current levels of technical efficiency in the insurance industry so as to establish the industry efficiency level and to try and explain the causes and sources of inefficiencies noted in the industry. This study therefore, aimed to investigate the level of technical efficiency among the industry players with specific focus on the technical Efficiency of the Kenyan non-life insurance companies over the period 2006-2010, the period when many changes have occurred.

1.3 Research objectives

The main objective of this study was to measure the magnitude of the technical efficiency in 20 non life insurers operating in Kenya in the financial years 2006-2010. The study also intended to explore the most influential factors causing inter-company variations in technical efficiency.

The specific objectives for this study were:

1. To examine the level of technical efficiencies for the Kenya non-life insurance companies,
2. To examine the factors that determines the technical efficiency for the Kenya non-life insurance companies.
3. Investigate how each of the variables used in technical efficiencies analysis contributes to technical efficiency.

1.4 Significance of the study

A study on the technical efficiency of non-life insurance companies in Kenya will be of benefit to Insurance Regulatory Authority of Kenya. The knowledge will assist the regulator in identifying inefficient firms and factors contributing to the inefficiencies in the industry; formulating policies to improve the industry performance and determining which companies need to be subjected to thorough and strict supervision.

The study is also important to the management of insurance companies. This is because evaluating the performance of a company in relation to its competitors in the market enables the company compare its performance in relation to the best performers in the

industry, this will enable the management to formulate strategies aimed at improving efficiency and the overall performance of the company, in particular studies in efficiencies of companies will help the companies to optimize efficiency by maximizing outputs and minimize inputs.

Evaluating the efficiency of the non-life insurers will assist investors and analysts in the security markets make an assessment of a company's performance in relation to the best performers in the industry, enabling a more accurate valuation of the shares of the companies.

In general, a study on efficiency of insurance companies has important implications for the insurance operators who are always working to improve operating performance. For policy makers, an awareness of the determinants of insurance efficiency may help them in designing policies to improve the stability of the financial institutions and to enhance the effectiveness of the monetary system as a whole.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section gives a brief overview on the concepts of efficiency, and general description of the various tools used to measure technical efficiency. The chapter also outlines the various theories of efficiency measurements, studies that have measured technical efficiency of insurance companies in various jurisdiction of the world. Finally the choice of inputs and outputs used in the chosen model will be addressed.

2.1 Theoretical framework

Contemporary economic literature on the theoretical consideration of technical efficiency has emerged with two different notions of technical efficiency (Briec, 2000). Koopmans (1951) argued that a firm can be considered as technically efficient if a reduction in any input requires increasing at least one other input. This concept has been adopted by several authors such as (Farrell & Lovell, 1978). In economic theory, a production function is described in terms of maximum outputs that can be produced from a specified set of inputs given the existing technology available to the firm (Battese, 1992). Whilst Debreu (1951) and Farrell (1957) introduced the radial-based approach for measurement of technical efficiency as the maximum equi-proportionate reduction in all inputs consistent with equivalent production of observed output levels.

The free cash flow concept, developed by Jensen (1986), proposes that issuing large amounts of debt sets up the required organizational incentives to motivate managers and helps them overcome normal organizational resistance to retrenchment which the payout of free cash flow often requires. Rising of debt and the pressure on managers' incentives serves as an effective motivating force to make such organizations more efficient. Applied to the insurance sector, this concept suggests that insurers with higher debt obligations will be motivated to improve their efficiency in order to pay their financial obligations. Therefore, the free cash flow concept implies a positive relationship between technical efficiency and indebtedness.

The agency theory approach is based on Jensen & Meckling's (1976) agency cost concept. They defined an agency relationship as a contract under which one or more persons (the principal) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent. In most Agency/Principal relationships, the Principal and the Agent will incur positive monitoring and bonding costs and in addition there will be some divergence between the agent's decisions and those decisions which would maximize the welfare of the Principal.

Measuring a firm's degree of efficiency calls for the definition of a production (i.e. efficient) frontier. However, deducing the efficient frontier from theoretical considerations, especially in the insurance business, is unfeasible, thus making it necessary to induce it empirically (Croce & Bertoni, 2008). The efficient frontier is then formed by (best-practice) insurers which, when controlling for output volumes, exhibit the lowest costs. Efficiency thus concerns an insurer's ability to produce a given set of outputs (e.g. net premium), by means of a given set of input (e.g. operative costs and capital) (Croce & Bertoni, 2008). An insurer is considered to be technically efficient if it cannot reduce its resource use without a corresponding reduction in outputs, given the state of production technology in the industry. Efficiency is measured as the difference in inputs used between a firm and the production frontier (Leibenstein, 1966, as cited in Croce & Bertoni, 2008).

Inefficiency can arise from a variety of sources. First, companies might be operating at an inappropriate size (either too large or too small) and might thus display "scale inefficiencies". Second, companies may be utilizing their inputs (or producing their outputs) in the wrong proportions and might thus display "mix inefficiencies" (Croce & Bertoni, 2008). Both scale and mix inefficiencies can derive from environmental factors that may damage firm's ability to operate efficiently or simply by mismanagement, errors, lags between the adoption of the production plan and its implementation, human inertia, distorted communications and uncertainty cause deviations between firms actions and the production frontier (Croce & Bertoni, 2008).

2.2 The Efficiency Concept

Efficiency is the act of achieving good result with little waste of effort. It is the act of harnessing material and human resources and coordinating these resources to achieve better management goal (Oyewo & Isaac, 2011).

In the insurance industry the concept of efficiency concerns an insurer's ability to produce a given set of outputs (such as premiums and investment income) via the use of inputs such as administrative expenses, sales staff expenses and financial capital. It can also be thought as the degree to which the observed use of resources to produce outputs of a given quality matches the optimal use of resources to produce outputs of a given quality (Venkatesh, 1997). This can be assessed in terms of technical, allocative and cost efficiencies.

The most common efficiency concept is technical efficiency; which is the conversion of physical inputs (such as the services of employees and machines) into outputs relative to best practice. In other words, given current technology, there is no wastage of inputs whatsoever in producing the given quantity of output. An organization operating at best practice is said to be 100% technically efficient. If operating below best practice levels, then the organization's technical efficiency is expressed as a percentage of best practice. Managerial practices and the scale or size of operations affect technical efficiency, which is based on engineering relationships but not on prices and costs (Venkatesh, 1997).

Allocative efficiency refers to whether inputs, for a given level of output and set of input prices, are chosen to minimize the cost of production, assuming that the organization being examined is already fully technically efficient. Allocative efficiency is also expressed as a percentage score, with a score of 100% indicating that the organization is using its inputs in the proportions that would minimize costs. An organization that is operating at best practice could still be allocatively inefficient because it is not using inputs in the proportions which minimize its costs, given relative input prices (Venkatesh, 1997).

Finally, cost efficiency refers to the combination of technical and allocative efficiency. An organization will only be cost efficient if it is both technically and allocatively efficient. Cost efficiency is calculated as the product of the technical and allocative efficiency scores (expressed as a percentage), so an organization can only achieve a 100% score in cost efficiency if it has achieved 100% in both technical and allocative efficiency. Cost efficiency is also known as overall efficiency.

2.3 Measurement Tools

The measurement of insurance efficiency is mostly focused on two different frontier approaches, namely the parametric (statistical) or econometric approach and non-parametric (non-statistical) or mathematical programming approach. The most commonly used parametric approach is the Stochastic Frontier Approach (SFA), and most commonly used non-parametric approach is the Data Envelopment Analysis (DEA).

Researchers studying efficiency using the two approaches have no scientific basis to determine which one is better than the other, according to Norma, Shabri, Yusof, Duasa & Rahman (2006), there is an on-going debate as to which methodology is to be preferred for determining the best-practice frontier against which relative efficiencies are measured. Despite the debate, there seems to be an emerging consensus that it is not necessary to agree on a single frontier approach for measuring efficiency. Instead, there should be consistent conditions to be met for efficiency measures derived from various methodologies. Accordingly, if efficiency estimates are consistent across various approaches, these measures are therefore valid estimates. However, Cummins & Weiss (1998) explained modern frontier efficiency methodologies which were rapidly becoming the dominant approach for measuring a firm's performance. These methodologies estimate technical, cost, revenue and profit efficient frontiers by comparing each firm in the industry to a reference set consisting of all other firms. The frontiers can thus be considered "best practice" frontiers. A description of both the parametric and non-parametric approaches is given below.

2.3.1 Stochastic Frontier Approach (SFA)

The SFA, also known as the econometric frontier approach, is a parametric approach and specifies a functional form for cost, profit or production relationship among inputs, outputs, and environmental factors while allowing for random error. The basic idea behind the SFA, introduced by Aigner, Lovell & Schmidt, (1977) is to add to the production frontier an error term with two components, one that allows for technical inefficiency and another that allows for any random events that may affect individual firms.

The stochastic frontier analysis model as described in Kumbhakar & Lovell (2000) is

$$y_i = f(x_i; \beta) \cdot TE_i$$

where:

y_i is the observed scalar output of the firm i , $i=1, \dots, I$,

x_i is a vector of N inputs used by the firm i ,

$f(x_i, \beta)$ is the production frontier,

and β is a vector of technology parameters to be estimated.

TE_i denotes the technical efficiency defined as the ratio of observed output to maximum feasible output. $TE_i = 1$ shows that the i -th firm obtains the maximum feasible output, while $TE_i < 1$ provides a measure of the shortfall of the observed output from maximum feasible output.

A stochastic component that describes random shocks affecting the production process is added. These shocks are not directly attributable to the firm or the underlying technology. These shocks may come from weather changes, economic adversities or plain luck. We denote these effects with $\exp \{v_i\}$. Each firm is facing a different shock, but we assume the shocks are random and they are described by a common distribution.

The stochastic frontier approach model now becomes:

$$y_i = f(x_i; \beta) \cdot TE_i \cdot \exp \{v_i\}$$

We assume that TE_i is also a stochastic variable, with a specific distribution function, common to all firms.

We can also write it as an exponential

$$TE_i = \exp \{-u_i\},$$

where $u_i \geq 0$, since we required $TE_i \leq 1$. Thus, we obtain the following equation:

$$y_i = f(x_i; \beta) \cdot \exp \{-u_i\} \cdot \exp \{v_i\}$$

Researchers that have used stochastic frontier model have favored it due to its ability to typically permit assessment of maximal output subject to input levels; as such, it appears to be an output-oriented measure (Managing Fishing Capacity, 1999). The stochastic frontier is, in fact, a base or non-orienting measure. That is, the assessment of efficiency is not conditional on holding all inputs or all outputs constant. Utilizing the one-stage routine of Battese & Coelli, (1993), however, facilitates an assessment of maximal output from an input-based perspective. With this approach, the inefficiency error term, and subsequently the

maximal output, is specified as a function of inputs. Thus, it is possible to consider the input reduction coinciding with a fixed maximum or frontier output (Managing Fishing Capacity, 1999). However the SFA has been majorly criticized for its inadequacy to handle multiple outputs.

2.3.2 Data Envelopment Analysis

The DEA or mathematical programming approach is a non-parametric approach; it constructs the frontier of the observed input-output ratios by linear programming techniques. It estimates efficiency under the assumption of constant returns to scale (CRS) and variable returns to scale (VRS). DEA assumes that linear substitution is possible between observed input combinations on an isoquant.

DEA was introduced by Charnes, Cooper & Rhodes, (1978) and draws upon the efficiency concept in Farrell, (1957). According to Charnes et al., (1978), DEA estimates efficiency under the assumption of constant returns to scale, while Banker, Charnes & Cooper (1984) assumed variable returns to scale. This approach constructs the frontier of the observed input-output ratios by linear programming. It assumes that linear substitution is possible between observed input combinations on an isoquant. In other words, DEA is a model that combines all the input and output information on the firm into a single measure of productive efficiency that lies between zero (i.e. a completely inefficient firm) and unity (i.e. a completely efficient firm), (Norma & Nur, 2011). In addition, the DEA model effectively estimates the frontier by finding a set of linear estimates that bound (envelop) the observed data (Leong, Dollery & Coelli, 2003), as cited in Norma & Nur, (2011). Thus, this technique is a benchmarking technique in the sense that the “best practice” firms lie on the frontier and “envelop” other inefficient firms (Neal, 2004). DEA permits the use of multiple inputs and outputs and does not impose any functional form on the data nor does it make any distribution assumption. DEA assumes that the production function of the fully efficient firm/insurer or decision making unit (DMU) is known. In practice, this is not the case, and the efficient isoquant must be estimated from the sample data. Under such conditions, the frontier is relative to the sample considered in the analysis (Barros, Barroso & Borges, 2005).

The DEA model originally developed by Charnes, et al, (1978) with the assumption of constant returns to scale (CRS) is known as the CCR model. The model was as a result of the attempt by the authors to generalize the single-input, single-output measure of a DMU to a multiple input/output setting (Chansarn, 2008). DEA was further extended by Banker, et al, (1984) to include variable returns to scale (VRS); the model is known as the BCC model. To measure the technical efficiency of Kenyan non-life insurance companies we shall use both the CCR model and the BCC model. Copper, Seiford & Zhu, (2011) have shown that technical efficiency under the constant returns to scale divided by the technical efficiency under the variable returns to scale gives scale efficiency.

The CCR model is a ratio that measures the efficiency of each DMU. It is obtained as a maximum of a ratio of total sum of weighted outputs to total sum of weighted inputs, and is defined as follows:

$$\text{Efficiency} = \frac{\text{Weighted sum of outputs}}{\text{Weighted sum of inputs}}$$

The weights for the ratio are determined by the restriction that similar ratios for every DMU have to be less than or equal to unity, thus reducing multiple inputs and outputs to a single “virtual” input and single “virtual” output without requiring pre-assigned weights. Therefore, the efficiency score is a function of the weights of the “virtual” input-output combination Chansarn, (2008). The computational procedure used to implement the DEA CCR approach involves obtaining measures of technical efficiency as introduced by Charnes et al., (1978). Consider n non-life insurers each producing s different outputs using m different inputs. The $m \times n$ input matrix, X , and the $s \times n$ output matrix, Y , represent the data of all n non-life insurers, while for the individual non-life insurer outputs and inputs are represented by the vectors y_i and x_i . The purpose of DEA is to construct a non-parametric envelopment frontier over the data points such that all observed points lie on or below the production frontier. The technical efficiency of a specific non-life insurer o in ratio form is specified as follows:

$$\begin{aligned} & \text{Max}_{u,v} \sum_{r=1}^s U_r Y_{ro} / \sum_{i=1}^m V_i X_{io} \\ \text{Subject to} \quad & \sum_{r=1}^s U_r Y_{rj} / \sum_{i=1}^m V_i X_{ij} \leq 1 & j=1,2,\dots,n \\ & U_r, V_i \geq 0; & i=1,2,\dots,m \\ & & r=1,2,\dots,s \end{aligned}$$

.....(1)

u and v are such vectors of non-negative weights or multipliers that maximize the ratio of the weighted sum of outputs and the weighted sum of inputs of a non-life insurer o . u and v of non-life insurer o have to be such that if we use them for other non-life insurers being observed, the ratio of their weighted sum of outputs and the weighted sum of inputs is less than or equal to one (all efficiency measures have to be less than or equal to one), this problem has to be solved for all organizations, each unit is assigned a set of weights that are most favorable to them. One problem with the ratio form is that it has an infinite number of solutions (if u^* and v^* are solutions then u^* and v^* are also solutions), non-linear program can be converted to a dual pair of linear programs, to solve the problem of multiple solutions. This can be achieved by setting the denominator of equation (1) to equal 1 (copper et.al, 2011) which gives the following basic DEA model in the multiplier form:

$$\begin{aligned}
 & \text{Max} \sum_{r=1}^s U_r Y_{ro} \\
 & \text{Subject to} \\
 & \quad \sum_{i=1}^m V_i Y_{io} = 1 \quad j = 1, 2, \dots, n \\
 & \quad \sum_{r=1}^s U_r Y_{rj} - \sum_{i=1}^m V_i X_{ij} \leq 0 \quad i = 1, 2, \dots, m \\
 & \quad U_r, V_i \geq 0; \quad r = 1, 2, \dots, s
 \end{aligned}
 \tag{2}$$

The DEA multiplier form can then be used to derive the envelopment form by considering the duality of linear programming.

$$\begin{aligned}
 & \text{Min } \theta \\
 & \text{s.t.} \quad \sum_{j=1}^n \lambda_j X_{ij} - \theta X_{io} \leq 0 \quad j = 1, 2, \dots, n \\
 & \quad \sum_{j=1}^n \lambda_j Y_{rj} - Y_{ro} \geq 0 \quad i = 1, 2, \dots, m \\
 & \quad \lambda_i \geq 0 \quad r = 1, 2, \dots, s
 \end{aligned}
 \tag{3}$$

Where θ is technical efficiency score for any non-life insurer

λ_s are the Dual Variables

The model specified in (3) above has an assumption of constant returns-to-scale and is only appropriate where all non-life insurers are operating at an optimal scale. Where this assumption does not hold, scale effects will confound the measures of technical efficiency (*TE*). We would normally assume that many non-life insurers are not operating at an optimal scale (Worthington & Hurley, 2002). Following Banker et al.,(1984) as cited in Worthington and Hurley,(2002), the linear programming problem can be modified to account for variable returns-to-scale by adding the convexity constraint $\lambda = 1$ to (3). The measure of technical efficiency obtained in this instance is often referred to as pure technical efficiency (*PTE*). Dividing *TE* by *PTE* then provides a measure of scale efficiency (*SE*).

The variable return to scale DEA is thus given by:

$$\begin{aligned}
 &\text{Min } \theta \\
 &\text{s.t.} \\
 &\sum_{j=1}^n \lambda_j X_{ij} - \theta X_{i0} \leq 0 \quad j=1,2,\dots,n \\
 &\sum_{j=1}^n \lambda_j Y_{rj} - Y_{r0} \geq 0 \quad i=1,2,\dots,m \\
 &\lambda_j \geq 0 \quad r=1,2,\dots,s \\
 &\sum_{j=1}^n \lambda_j = 1
 \end{aligned}
 \tag{4}$$

Where θ is technical efficiency score for any non-life insurer

λ_j are the Dual Variables

Previous studies on the insurance industry's efficiency using DEA provided evidence to understand the performance of the insurance sector in certain countries, e.g. those studies which analyze insurance in national markets such as the case in the United States done by Cummins et al.,(1999), Meador, Ryan, & Schellhorn, (2000), Cummins & Weiss, (2002) Cummins et al. (2010) and the insurance industries in other countries like in Japan, Italy, United Kingdom, Australia, Spain and Germany have been studied by Fukuyama, (1997), Cummins et al.,(1996), Diacon, (2001), Worthington & Hurley, (2002) and Cummins & Rubio-Misas, (2001) respectively.

Cummins et al., (1996), in their paper examined technical efficiency and productivity growth in the Italian Insurance market. The study measured technical efficiency and productivity growth by estimating production frontier based on a sample of 94 Italian insurance companies for the period

1985 - 1993. To analyze these input-oriented distance functions, DEA was used and productivity growth was measured using malmquist indices which were decomposed into technical efficiency change and technical change. The study used benefits plus changes in reserves as output in life insurance and incurred losses plus invested assets as output in non-life insurance. The inputs used were acquisition labor expense, administrative labor expense, fixed capital and equity capital. The research concluded that technical efficiency in the Italian insurance industry ranged from 70 to 78 per cent during the study period. However, productivity declined significantly over the sample period, with a cumulative decline of about 25 per cent. It was implied that the insurers needed more inputs to produce their outputs at the end of the period than at the beginning. It was observed that in a dynamically changing environment many insurers might be adopting new approaches to produce their outputs. This provides more opportunities for firms to make mistakes in the choice of technology, perhaps leading to excessive consumption of inputs even by the "best practice" firms. An increase in the complexity of insurance products and markets could have a similar effect. The research concluded that the firms that fail to improve are likely to be penalized by the market.

Brown (2000), in his paper, outlined the rationale for applying methodologies developed to estimate different kinds of efficiencies of insurer. The data of 100 largest General insurers of UK for the year 1998 were taken. The data envelopment analysis (DEA) was used to analyze the data. The study used five models of input and output, and started with the simplest, where there was one output "net written premium" and one input "net operating expenses". In the second model, financial capital was added as the second input. The third model included reinsurance as input and gross premium as outputs. The fourth model used output as the net written premium, investment income and input as net operating expenses, capital and technical provisions. In the fifth model, output was taken as the gross premium instead of net premium and also used reinsurance as input. The results suggested that there were increasing return to scale for the smaller companies and decreasing return to scale for the larger companies, for their risk bearing/ risk pooling services taken as a whole.

Diacon (2001) explored the efficiency of UK specialist and composite insurer transacting general insurance business. The study uses the variable returns to scale, Farrell efficiency scores DEA model, to identify the locally efficient and inefficient insurers within each country. A comparison is then undertaken for all insurers after adjusting the impact of their local efficiency. This study uses four inputs namely, total operating expenses, total capital, total technical reserve, and total borrowing from creditors and three outputs namely, general insurance net earned premium, long-term insurance

net earned premium and total investment income. The results indicate that UK general and composite insurance companies have the potential to be among the most efficient in Europe.

Worthington & Hurly (2002) concluded that the cost frontier measures indicate that in 1998 a typical Australian general insurer's costs were 53.4 percent above what could be considered necessary based on observable best practice. The main source of this cost inefficiency would appear to be allocative inefficiency, rather than technical inefficiency; that is, the inability of the firm to use inputs in optimal proportions, given the respective prices, rather than the inability of the firm to minimize inputs for a given level of output. Notwithstanding the low average level of efficiency across the industry, the study also indicates that the industry is divided between a smaller number of relatively efficient insurers, and a larger number of relatively inefficient insurers. This would suggest that the gap, in terms of both market share and efficiency, between the largest general insurance groups and the remaining firms that opened with a wave of mergers and joint ventures in the last two years of the twentieth century is likely to continue into the new millennium. Such pressures for consolidation are only likely to intensify with the further liberalization of trade in insurance-related services negotiated by the world trade organization (WTO).

Besides the above studies, few studies have been conducted in Africa for example Barros & Obijiaku (2007) who sought to assess the efficiency of insurance industry in Nigeria. The study indicates that majority of Nigerian insurance companies are managed with pure technical efficiency and the inefficient ones have room for improvement, further, it found out that large companies in terms of assets are more efficient than small companies. It also reveals that the insurance companies which operate with bank branches are more efficient than those who use their own branches for distribution of insurance products. The study found out that companies with higher market share are more efficient than those with low market share. Similarly a study conducted in Ghana by Owusu-Ansah, Dontwi, Seidu, Abudulai & Sebil, (2010) found that a good number of Ghanaian general insurance companies operate with relatively high managerial skill and that large companies operate at higher efficiencies than small ones, the studies also observed that companies with higher market share in terms of earned premium tend to have high efficient scores. Finally, the study also found that companies with higher market share are more efficient than those with low market share. This study used the DEA model to measure efficiency while the Mann-

Whitney U-test is used to test the hypothesis “if scale or market share correlates to the efficiency”.

2.4 Determinants of Technical Efficiency

Lovell (1993), in a study on measurement and analysis of productivity efficiency states that it is highly plausible that a high level of competition will enhance the efficiency of firms, further, Caves & Barton (1990) while studying efficiency in the USA found that more intensive competition leads to more efficient technical choices. In the UK a study conducted on 19 manufacturing companies by Hay & Liu (1997) conclude that in a more competitive market environment firms have a relatively strong incentive to improve their efficiency. Gumbau-Albert & Maudos (2002) in their study conducted on 1,149 Spanish firms from 18 manufacturing sectors arrived at the conclusion that firm size and the amount of investment into physical assets is conducive to technical efficiency. Efficiency was also relatively high in firms that were subject to high competitive pressure on the market. In the study, the lowest levels of efficiency were found in the firms operating in more concentrated markets with a presumably low level of competition and in firms with public ownership participation.

Studies conducted on insurance industry concluded that size, capital, ownership, labor quality, liquidity, age and management quality are among the factors that have an influence on the company's efficiency. For example, Amal (2012) while studying the factors affecting the financial performance of listed insurance companies in Jordan identified leverage, liquidity, size, and management competency as significant factors that influenced the financial performance of the companies while company age was found to have no significant effect to performance. Size of the company and scale of operation were identified as significant factors that affected the efficiency of insurance companies in Ghana (see Owusu-Ansah, et al 2010).

In this study and based on the above literature the researcher was to examine the effect of size, market share, total management expenses and investment being the variables that have being used in computing the technical efficiencies of Kenyan non-life insurance companies, some of this factors have also been tested in other jurisdiction like Ghana by Owusu-Ansah et al, (2010) and in Jordan by Amal, (2012).

2.4.1 Size

Size as in Owusu-Ansah et al, (2010) is proxied by debt and equity capital. The size of the insurance company affects its efficiency in many ways. Large insurance companies can exploit economies of scale and scope and thus be more efficient than small insurance companies. Also, small insurance companies may have less power than large ones; hence they may find it difficult to compete with the large insurance companies particularly in highly competitive markets like Kenyan market. On the other hand, as insurance companies continue growing and becoming larger they might experience diminishing returns to scale and thus suffer from inefficiencies, leading to technical inefficiencies. The hypothesis developed therefore is:

H₁: A positive relationship exists between the size of an insurance company and its technical efficiency

2.4.2 Market Share

According to Pervan & Kramaric, (2012) market share is often used to describe the position and success of a company in the insurance (or any other) industry. From the generally accepted definition of the market share according to which it shows the relation between company performance (stated through revenue, employment, added value, etc.) and the total performance of the observed industry, in this paper the market share is given by the gross premium of a specific insurer. To explain the effect of a specific insurer market share to its efficiency the following hypothesis is developed:

H₂: A positive relationship exists between the market share of an insurance company and its technical efficiency.

2.4.3 Total Expenses

Insurer expenses are normally split into expenses accruing from management and those accruing from commissions paid to marketers. The effect of total expenses to efficiency is of paramount importance to an insurer since as the expenses grow the efficiency of an insurer is expected to decline. To test the effect of total expenses to the technical efficiency the following hypothesis is developed.

H₃: A positive relationship exists between the technical efficiency and total expenses.

2.4.4 Investment

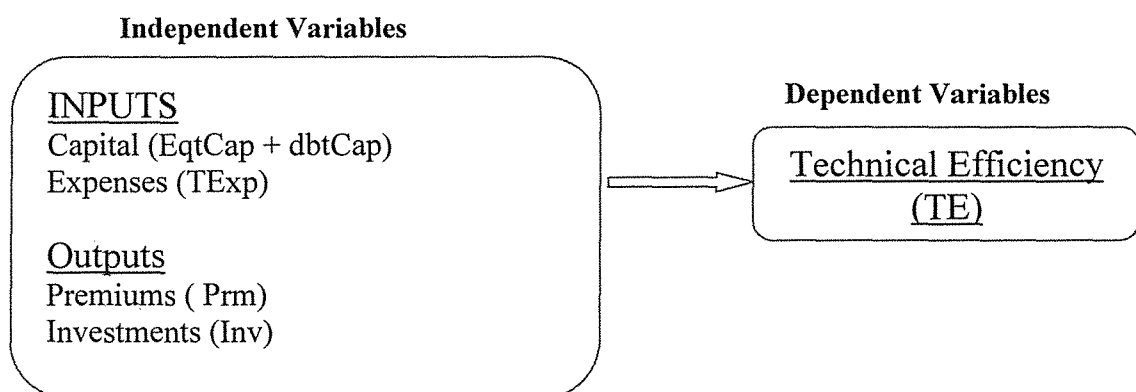
The economic system reform of Kenya is still in its development stage, and this has limited investment capability of the insurance industry. Investment vehicles are restricted by the immature capital market and stringent insurance regulation, which have significant impact on the insurance investment, to ensure the insurance companies are complying with the basic principles for insurance investment, such as diversification, maturity matching, liquidity and currency matching. Accordingly, Gumbau, (1998), proposes that a positive association is expected between gross capital formation and technical efficiency, this being to the fact that differences in efficiency are usually attributed to a higher ratio of investment to physical capital if it is assumed that new production technologies are incorporated into the new capital purchases, so that technological improvements stimulate the growth of efficiency in the industry. Therefore, the following hypothesis is developed.

H4: A positive relationship exists between investment of an insurer and its technical efficiency.

2.5 Conceptual Framework

The aim of this section is to discuss the conceptual framework of the Kenyan non-life insurance technical efficiency. The framework demonstrates what is needed and what one needs to know in analyzing the insurance technical efficiency. The conceptual framework in this case is divided into two phases, with phase one being on how to obtain the technical efficiency of non-life insurance companies in Kenya while in phase two we describe the model for testing the hypothesis on the effect of scale of operation and market share to efficiency.

Figure 2: Conceptual Framework of Insurance Efficiency



2.5.1 Research Model

Based on the conceptual framework above, the relationship between variables can be written in the form of a function as follows:

$$TE = f(EqtCap, DbtCap, TExp, Prm, Inv)$$

Where:

EqtCap: Capital given by the difference between assets and liabilities

DbtCap: Capital given by total liabilities

TExp: Expenses given by the sum of the total management expenses and total commissions in the year

Prm: Premium represented by the total or gross premium

Inv: Investments represented by the investment income

The resultant equation is as follows:

$$TE_i = \beta_0 + \beta_1 EqtCap + \beta_2 DbtCap + \beta_3 TExp + \beta_4 Prem + \beta_5 Inv + \varepsilon$$

2.5.2 Operationalization of Variables

From the above conceptual framework the input variables and output variables form the independent variables of the model while efficiency will be the dependent variable. A description of the variables and how they shall be obtained in this study is given below:

2.5.2.1 Technical Efficiency

Technical Efficiency concerns an insurer's ability to produce a given set of outputs such as premiums and investment income via the use of inputs such as administrative expenses, sales staff expenses and financial capital. It can also be thought of, as the degree to which the observed use of resources to produce outputs of a given quality matches the optimal use of resources to produce outputs of a given quality (Venkatesh, 1997). In this study technical efficiency will be the solution obtained in solving the linear programming (LP) equations.

2.5.2.2 Capital

Capital is subdivided into debt capital and equity capital. Debt capital is the capital that a business raises by taking out a loan. It is a loan made to a company that is normally repaid at some future date. Equity capital is capital raised from owners in the company also known as shareholders' funds, it is used as an input because insurers must keep capital

(Insurance Act, Cap 487) to prove their ability to pay claims even if more-than expected losses are incurred. Owusu et al. (2010), in their study “the efficiency of Ghanaian general insurance companies” use debt and equity capital. Debt capital is proxied by total liabilities whilst equity capital is proxied by capital and surplus (Represented as shareholders' funds in the IRA annual reports). In this study capital will mean both debt and equity capital, debt capital will be proxied by liabilities as per the insurance companies balance sheets, while equity capital will mean shareholders equity as shown in the insurance companies balance sheets.

2.5.2.3 Expenses

Commission expenses and management expenses have been used as inputs in studies that measured efficiency in the insurance industry, while applying the frontier models. Commission expenses refers to the amount of money paid to agents and brokers who distribute insurance products on behalf of the insurer as a token of appreciation for the service rendered, while management expenses refers to any other expense incurred by the insurer in the course of their business transaction and includes such items as traveling expenses, fuel expenses and telecommunication expenses. Norma & Nur, (2011) in the comparative study of efficiency of insurance companies in Malaysia and Brunei using DEA, used Commissions and management expenses as inputs. Owusu et al. (2010) while studying the Ghanaian general insurance company explains three types of inputs in the insurance industry as labor, business services and material, and capital. In this study expenses will mean both commission and management expenses and will be obtained from the insurers revenue accounts.

2.5.2.4 Premium

Premium in this study is an output variable and represents gross premium which will be obtained from insurer revenue accounts. Gross premium are used as output variables because of the difficult in identifying outputs and their measures in the insurance industry. Contemporary researchers have devised approaches of identifying outputs. Berger & Humphrey (1992) distinguish three alternative approaches to measuring outputs in the financial service industry: the intermediation approach, the user-cost approach, and the value-added approach. Cummins & Weiss (2000) argue that the value-added approach is the most appropriate for studying efficiency in the insurance industry, and specify three main

services produced by insurers as outputs: risk pooling/bearing services, intermediation, and financial services related to incurred losses. The most common proxies used in the literature for risk pooling/bearing services are either premiums or the present value of real losses incurred. From a theoretical point of view real losses are the more appropriate proxy for a theoretical derivation based on the Pratt-Arrow concept of the insurance premium (Cummins & Weiss, 2000). However, like most international research on efficiency, such a measure cannot be used due to data unavailability. Gross premiums are therefore used as a proxy for the risk pooling/bearing services.

2.5.2.5 Investments

Investments in this study is an output variable and refers to the amounts of invested assets as indicated in the insurers balance sheet. Invested assets are a good proxy for the intermediation function and are often used in literature (Cummins et al., 1999 and Berger et al., 2000).

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

The purpose of this chapter is to review the research design, define the population and sample of the study and describe how the data will be collected and analyzed using data envelopment analysis model.

3.1 Research Design

A descriptive type of research design was used to examine the level of technical efficiencies for the Kenya non-life insurance companies. Descriptive research is good in describing the characteristics of relevant groups such as insurance companies to estimate the percentage of units in a specified population exhibiting a certain behavior, to determine the perceptions of product characteristics, to determine the degree to which marketing variables are associated and or to make specific predictions (Malhotra, 2003). Descriptive research design was favored for this study because data collected was quantitative and the sample is representative of the whole population and efficiency predictions was made from the data using a Data Envelopment Analysis models. Descriptive research design was also favored in the study because it aims to test specific hypotheses and examine relationships as was the case in this study.

3.2 Population

The population of the study was all the insurance companies that transacted insurance business in Kenya in the 5 years period between 2006 and 2010, the period when many changes are deemed to have occurred in the Kenyan Insurance Industry. As at the end of year 2010, forty seven insurance companies transacted insurance business in Kenya. Three insurance companies were placed under statutory management within the period of study and therefore some data from the insurers in the study period was not available. The companies were therefore excluded in the computation of technical efficiency. Further one company was licensed to transact insurance business in Kenya towards the end of the study. The company was also excluded from the computation of technical efficiency due to unavailability of data in the study period. The population of the study after the filtration was brought to a total of forty four insurance companies.

3.3 Sample and Sampling Techniques

The sample drawn from the population was determined by the line of business transacted by an insurance company and availability of data. Insurance companies in Kenya are classified by line of business as either long-term, non-life or composite insurance business. For the purpose of this study only non-life insurance companies were considered. Complete data for the companies that transacted non-life insurance is required. Therefore, 20 insurance companies were sampled from the population. 2 non-life insurance companies lacked complete data in the study period and were therefore excluded from the sample, thus bringing the sample to a total of 18 companies.

3.4 Data Collection

Data from all the 18 non-life insurance companies was collected from the insurer's annual reports submitted and stored at the IRA library. Secondary data on shareholders paid up capital and reserves, total expenses, total liabilities, gross premium and investments was obtained from the 18 insurers audited financial statements for the years 2006-2010. Shareholders paid up capital and reserves and total liabilities were extracted from the statement of financial position, data on investment from statement of income while data on gross premium was obtained from the revenue accounts.

3.5 Data Analysis

To analyze the data collected, each year's data was arranged in tabular form with the inputs/outputs being represented in the columns while the 18 non-life insurers were represented in rows giving a table of 90 entries (18 companies x 5 inputs/outputs). The Max Dea 5.2 Basic Model a Data Envelopment Analysis model was applied to data for each year through the study period. The Max Dea 5.2 Basic Model computed the technical efficiency using both the constant return to scale (CRS) and variable returns to scale model (VRS) for each year by applying the output oriented model that aims to maximize outputs using a set of inputs.

The results of the technical efficiencies for each year were obtained and were entered in a table where the years under study were represented in the columns and the 18 non-life insurers were represented in the rows. Descriptive statistics were then obtained from the technical efficiency data. It is important to note that Max Dea 5.1 also computes the pure

technical efficiency and scale efficiency the product which forms the technical efficiency or overall technical efficiency. Data for pure technical and scale efficiency is treated the same as that of technical efficiency and the respective descriptive statistics obtained.

To explain the factors determining the technical efficiency for the Kenya non-life insurance companies, the data for technical efficiency score and the data for the variables (input/output) used in calculation of technical efficiency was transformed using natural logarithms to make it normal. Regression analysis was performed with the log of technical efficiency score as the response variables while the transformed data for each variable was used as the predictors. Minitab 14 was used to solve the regression equation.

To test the hypothesis on the effect of each variable to technical efficiency, the insurance companies were classified by the data of the variable being tested and the sample was divided into two, with one sample consisting of those insurers that have data greater than the median of the variable data of all insurers and the other sample consisting of those insurers that have data less than or equal to the median of the data of the variable being considered of all the insurers.

The Mann-Whitney test a non-parametric statistic was applied on the two samples to test the null hypothesis that two samples come from the same population (i.e. have the same median) or, alternatively, whether observations in one sample tend to be larger than observations in the other. Conclusion from Mann-Whitney test is drawn based on whether the p value (determined at $\alpha=5\%$ level of significance) of the test statistic is greater or less than the chosen α value. If the p value is greater than the chosen α level then there is no evidence to reject the null hypothesis otherwise the null hypothesis is rejected if the p value is less than α level. MINITAB 14 software was used to implement Mann-Whitney test.

CHAPTER FOUR

PRESENTATION OF RESEARCH FINDINGS

4.0 Introduction

This chapter presents the data obtained, the analysis done and the results of the study. Data was analyzed based on the objectives of the study which were: i) to obtain a measure of overall technical, pure technical, and scale efficiencies for individual non life insurance companies in Kenya, ii) to explain the factors determining the technical efficiency for the Kenya non-life insurance companies, iii) to investigate how each of the variables used in technical efficiencies analysis contribute to technical efficiency. The chapter is organized as follows; section 4.1 gives the sample selection, section 4.2 gives the technical efficiencies of the study. Section 4.3 gives the regression analyses of the variables used to compute technical efficiencies while section 4.4 analyses the effect of each variable used in computing technical efficiency to the technical efficiency.

4.1 Sample Selection

This section presents an analysis of the efficiency of the non-life insurers in Kenya during the period (2006–2010). The population of the study is presented in the previous chapter. The sample of 20 non-life insurers was selected for achieving the study purposes. Two insurers were excluded because of missing information. Data was collected from the annual reports of these insurers from IRA database. In computing the efficiencies of the non-life insurers in Kenya in the period (2006–2010), DEA model was used to evaluate the efficiencies of the non-life insurance companies during the period of study. One of the most important features of DEA is its ability to manage the multiple characteristics of an insurer, which use several inputs and outputs.

4.2 Technical Efficiencies of Kenyan non-life Insurers:

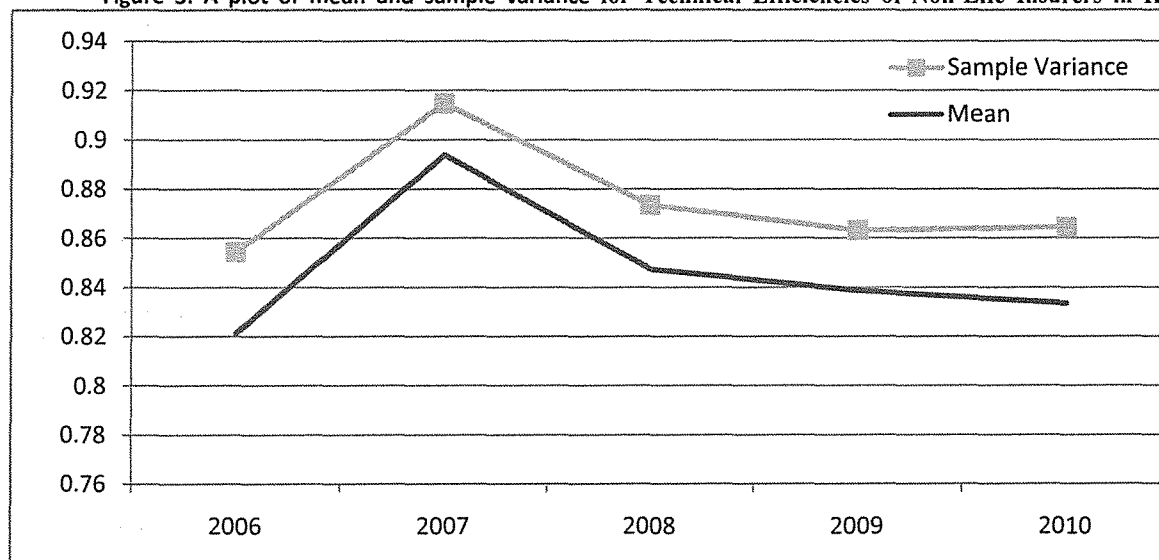
The descriptive statistics for technical efficiency values of the non-life insurers in Kenya from 2006 to 2010 were as illustrated in Table 1 below.

Table 1: Descriptive Statistics for Technical Efficiencies of Non-Life Insurers in Kenya

Year	2006	2007	2008	2009	2010
Mean	0.821333	0.893889	0.847389	0.838722	0.8335
Sample Variance	0.033303	0.020791	0.026088	0.02454	0.030992
Range	0.547	0.433	0.539	0.438	0.537
Minimum	0.453	0.567	0.461	0.562	0.463
Maximum	1	1	1	1	1

According to the research findings, the average technical efficiency value of the non-life insurers in Kenya was 84.7% this is observed on table 10 appendix D, indicating resources were not fully used or the inefficiency rate was 15.3%, implying that greater outputs can be obtained from the same resources environment. Table 1 also indicates that the lowest technical efficiency was recorded in 2006 at 45.3%, while the lowest average technical efficiencies were recorded in the same year at 82.1%. The highest technical efficiency was recorded in all the years at 100%; however, on average the highest technical efficiency was recorded in 2007 at 89.4%, figure 3 below shows the trends of the average technical efficiencies of the non-life insurers in Kenya for the period of study and the variations of the data from the averages.

Figure 3: A plot of mean and sample variance for Technical Efficiencies of Non-Life Insurers in Kenya



From figure 3 above, technical efficiencies rose sharply from 2006 to 2007 and decreased sharply between 2007 and 2008 and thereafter a gradual decrease up to the end of the study period was observed. The increase between 2006 and 2007 is consistent with the high economic growth rate recorded in Kenya between 2005 and 2007 that saw the

economy's GDP move from 5.9% to 7.0% Kenya National Bureau Statistics (KNBS 2010). The sharp decline between 2007 and 2008 is consistent with the sharp decrease in the Kenya economic growth rate that saw the GDP drop from 7.0% to 1.6% this was as a result of the post-election violence that erupted in Kenya after the 2007 general election. The gradual decrease in the technical efficiency figures after 2008 could be as a result of the increase in capital of insurance companies following a directive by the insurance regulator in Kenya to recapitalize the insurance companies as an increase in capital of an insurer implies increase in inputs that require a corresponding increase in output which in this case was gross premium that grew at a low rate. In terms of dispersion of data, the data was closest to the average technical efficiency in 2007 implying that most companies were efficient in 2007 than in any other year during the period of study.

4.2.1 Pure Technical Efficiencies (PTE) of Kenyan non-life Insurers

Presented here is the pure technical efficiency of the Kenyan non-life insurance companies under the period of study as obtained using DEA model. Pure technical efficiencies measure how a firm utilizes its resources under exogenous environments; a low PTE implies that the firm inefficiently manages its resources. Pure technical efficiencies are obtained when the variable returns to scale (VRS) assumption is used when computing the technical efficiencies. The results of the pure technical efficiencies of the Kenyan non-life insurers as determined using DEA model are shown in table 2 below:

Table 2: Descriptive Statistics for Pure Technical Efficiencies of Non-Life Insurers in Kenya

Year	2006	2007	2008	2009	2010
Mean	0.914667	0.923667	0.933667	0.929611	0.9645
Sample Variance	0.020134	0.014057	0.017371	0.009762	0.004889
Range	0.491	0.38	0.472	0.304	0.234
Minimum	0.509	0.62	0.528	0.696	0.766
Maximum	1	1	1	1	1

We observe from table 2 that the minimum pure technical efficiency of the Kenyan non-life insurers during the period of study was 50.9% in 2006, further the insurance companies within the period of study exhibited higher pure technical efficiencies (computed using VRS model) than they did for technical efficiencies (computed using CRS model)

since on average pure technical efficiency stood at 93% as observed in table 10 appendix D, this indicates that management of the companies was doing well to some extent and that probably inefficiency could be coming from the scales of operations. This indicates that management of the insurers did quite well during the study period and that there is room for the Kenyan non-life insurers to increase their efficiencies. This could be done by insurers studying their mode of operations at the times they performed at 100% and that of others replicate the same in their operation.

4.2.2 Scale Efficiencies of Kenyan non-life Insurers:

This section presents the scale efficiencies of the Kenyan non-life insurers. Scale efficiency is the potential productivity gain from achieving optimal size of a firm. The scale efficiencies as determined using the DEA model under the VRS assumption are as shown in table 3 below:

Table 3: Scale Efficiencies (VRS) by No. of Companies

Year	2006	2007	2008	2009	2010
Mean	0.897	0.964556	0.906389	0.898278	0.858278
Sample Variance	0.016397	0.003062	0.011131	0.012537	0.022361
Range	0.386	0.192	0.36	0.274	0.44
Minimum	0.614	0.808	0.64	0.726	0.56
Maximum	1	1	1	1	1

It is observed from table 3 that, the minimum scale efficiency of the non-life insurers under study during the period of study was 56% recorded in the year 2010. Further we observe from table 10 appendix D that the non-life insurers operated at an average scale efficiency of 90% for the period under study.

4.2.3 Summary of Technical efficiency

In examining the technical efficiencies of the non-life insurers in Kenya, the Max Dea 5.2 Basic Model was used to solve the linear programming problems that resulted from applying the DEA model on the Kenya non-life insurer's data. Max Dea 5.2 model computed technical efficiencies and classified the efficiencies as Technical Efficiency, Pure Technical Efficiency and Scale Efficiency. It is worth noting that pure technical efficiency is the component of technical efficiency that comes from management skills. The rationale for

interpreting the pure technical efficiency as management skills being based on the contrast between the constant-returns-to-scale (CRS) and variable-returns-to scale models (VRS). The CRS model identifies the technical inefficiency, whereas VRS model differentiate between pure technical efficiency and scale efficiency. It is computed using the variable-return-to-scale hypothesis. Under this hypothesis, it is assumed that firms do not necessarily increase their efficiencies by simply increasing inputs. The variable-return-to-scale hypothesis decomposes technical efficiency into pure technical efficiency and scale efficiency. That is, technical efficiency of a firm is a non-additive composition of scale and pure technical efficiencies. Thus, the scale efficiency of firms can be computed by dividing technical efficiency by pure technical efficiency.

The insurance companies exhibited higher pure technical efficiencies than they did for scale efficiencies. This indicates that management of the companies was doing quite well and that inefficiency could probably be coming from the scales of operations. The average scale technical efficiency of the insurers during the period of study stood at 90% as indicated in table 3 above. This indicates that the average Kenyan non-life insurer operated at decreasing-returns-to-scale. Further it was observed that on average Kenyan non-life insurers are managed with high technical efficiencies. It was also noted that the trends indicated in figure 3 above during the study period mirror the trends of the Kenyan GDP within the same period implying that technical efficiency for the Kenyan non-life insurers are directly affected by the country's economic performance.

4.2.4 Determination of the significance of the variables used to measure technical efficiency:

Presented in this section are the results of the regression analysis to explain the factors determining the technical efficiencies for the Kenya non-life insurance companies. Table 4 below gives the results obtained when the following regression equation is solved.

$$TE_i = \beta_0 + \beta_1 EqtCap + \beta_2 DbtCap + \beta_3 TExp + \beta_4 Prem + \beta_5 Inv + \varepsilon$$

Where:

EqtCap: Capital given by the difference between assets and liabilities

DbtCap: Capital given by total liabilities

TExp: Expenses given by the sum of the total management expenses and total commissions in the year

Prm: Premium represented by the total or gross premium

Inv: Investments represented by the investment income

Table 4: Regression Analysis Results

Panel A: Relationship between technical efficiency and variables used in its computation

Predictor	Coefficients	Standard Error	t Stat*	P-value*
Intercept	-0.684894108	0.379075921	-1.806746536	0.095923476
Total Expenses	-0.243076847	0.124559388	-1.951493592	0.074732963
Equity Capital	-0.190620625	0.073692597	-2.586699798	0.023802191
Debt Capital	0.071984176	0.085544276	0.841484427	0.416530918
Gross Premium	0.437931972	0.124728486	3.51108224	0.004293343
Investment Income	-0.009746439	0.021219541	-0.459314318	0.654217788

R- Sq = 72.3%

R- Sq (Adj) = 60.7%

*Values at 95% Confidence Interval

Source: Survey Data (2006 – 2010)

Panel B: Analysis of Variance

	Df	SS	MS	F	Significance F
Regression	5	0.137039245	0.027407849	6.261029886	0.004423305
Residual	12	0.052530365	0.00437753		
Total	17	0.18956961			

Source: Survey Data (2006 – 2010)

Table 4 presents the results of the regression analysis. The p-value in Panel B the Analysis of Variance table (0.004423305) shows that the model estimated by the regression procedure is significant at α -level of 0.05. This indicates that at least one coefficient is different from zero.

The p-values in Panel A, for the estimated coefficients of Equity Capital and Gross Premium are both less than 0.05, indicating that they are significantly related to Technical Efficiency. The p-values for Total Expenses, Debt capital and Investment Income are 0.075, 0.42 and 0.65, indicating that they are not significant in computing technical efficiency at α -

level of 0.05. Additionally, the coefficient of the variable gross premium (0.44) is large and positive indicating significant statistical impact to technical efficiency.

The R squared value indicates that the predictors explain 72.3% of the variance in Technical Efficiency. The adjusted R square is 60.7%, which accounts for the number of predictors in the model. Both values indicate that the model fits the data well.

4.2.5 Summary of Regression Analysis

The results of the regression analysis indicate that based on the p values, gross premium and equity capital are significantly related to the technical efficiency and are therefore the factors that determine the technical efficiency for the Kenya non-life insurance companies, this is consistent to Hay and Liu (1997) who in their study of 19 UK companies concluded that companies operating in competitive markets tend to have a relatively strong incentive to improve their efficiency. It is also consistent to Gumbau-Albert & Maudos (2002), who in their study of 18 manufacturing sectors, arrived at the conclusion that firm size and the amount of investment into physical assets is conducive to technical efficiency, they also found out that efficiency was also relatively high in firms that were subject to high competitive pressure on the market.

This implies that the technical efficiencies of Kenyan non-life insurers are significantly affected by the gross premium and equity capital thus; technical efficiency in this sector of the insurance industry in Kenya can be improved by increasing the variables gross premium written and equity capital in any one year.

4.3 Analysis of the effect of Variables used in computing technical efficiencies

The purpose of this section is to explain the factors determining the technical efficiency for the Kenya non-life insurance companies. The variables used are equity capital, debt capital, total expenses, gross premium and investment. To test the effect of Equity capital to technical efficiency is synonymous to testing the effect of size of an insurer to its efficiency since size of an insurer in this study is measured by equity capital. To test the effect of gross premium to technical efficiency is synonymous to testing the effect of market share of an insurer to its technical efficiency since market share in this study is measured by

gross premium. The effects of the other variables to technical efficiencies are tested using the variables as they are.

4.3.1 Effect of size on Insurer's Technical Efficiency:

Size as in other studies for example Owusu-Ansah, et al, (2010) is measured by equity and debt capital (which may be termed as total capital). To test the effect of size of an insurer to its technical efficiency the insurance companies are classified by the total capital with the corresponding technical efficiency score indicated. The sample is then arranged in ascending order. The median of the total capital is computed and the sample is then divided into two sample, with one sample consisting of those insurers that have total capital greater than the median and the other sample consisting of those insurers that have total capital less than or equal to the median of the total capital. The technical efficiencies scores of the samples are then used to carry out the test. The hypothesis tested is:

H1: Large insurers are more efficient than small insurers

Table 5 gives the result of the test of the hypothesis

Table 5: Effect of insurer size to technical efficiency

Data	Sample No	Median	95% CI difference in Medians	P- Value
Sample 1	9	0.6802	(-0.3756, -0.0001)	0.0322
Sample 2	9	0.9781		

From the above table the p value for the test statistic is less than the chosen α level of 0.05 implying that there is evidence to reject the null hypothesis the two medians are equal. Therefore, the conclusion is that 'large insurers in terms of size are more efficient than small insurers' meaning the size in terms of capital (equity and debt capital) of an insurer for the Kenyan non-life insurer contributes positively to technical efficiency, therefore size is a factor that determines efficiency of a non-life insurer in Kenya. The results obtained are consistent with other researchers who conducted similar studies for example Barros and Obijiaku (2007) & Owusu-Ansah, et al (2010) in the studies conducted in Nigeria and Ghana respectively, both of which found that large insurers are more efficient than small insurers.

4.3.2 Effect of Market share on insurer's Technical Efficiency:

This section seeks to test some hypotheses related to the technical efficiency scores of the non-life insurers. The Mann-Whitney test, which tests whether two samples are from the same population, is adopted. The Mann-Whitney test is recommended for the non-parametric analysis of DEA results. It is used here because the efficiency scores do not fit within a standard normal distribution. The technical efficiency scores are used for the tests since they adequately discriminate between the units being analyzed. The following hypothesis was tested:

H2: Insurers with higher market shares are more efficient.

To test the above hypothesis, the insurance companies were classified according to the estimated market share by gross premium. The sample was divided into two, with one sample consisting of those insurers that have premiums greater than the median of premium of all insurers and the other sample consisting of those insurers that have premiums less than or equal to the median of premiums. The respective technical efficiencies of the insurers in each sample were then used to carry out the test. The test was conducted using Minitab software and the results are as shown below:

Table 6: Relationship between Market Share and Technical Efficiency

Data	Sample No	Median	95% CI difference in Medians	P- Value
Sample 1	9	0.6978	(-0.3884, -0.0423)	0.016
Sample 2	9	0.9945		

Table 6 above presents the results as calculated using the Mann Whitney model. The sample medians of the ordered data are 69.8% and 99.5% respectively. The 95% confidence interval for the difference in population medians is between -0.3884 and -0.0423. The p-value is positive at 0.016. Since the p-value is less than the chosen α level of 0.05 then there is evidence that the population medians are different and therefore the null hypothesis is rejected, that is the medians come from same population. The conclusion drawn therefore is that non-life insurers with higher market share are more efficient than insurers with lower market share; therefore market share is a factor that determines the technical efficiency of a non life insurer in Kenya. The result is consistent with the studies conducted by Owusu-Ansah, et al (2010) which when studying the technical efficiencies of Ghanaian general insurers, found that a good number of Ghanaian general insurance companies operate with relatively high managerial skill and that large companies operate at higher efficiencies than

small ones. The result is also consistent with the study conducted on efficiency of insurance companies in Nigeria by Barros & Obijiaku (2007) that found out those companies with higher market share are more efficient than those with low market share.

4.3.3 Effect of total expenses, debt capital and investment income on Insurer Overall Technical Efficiency

Other variables that were used in the analysis of Kenyan non-life insurer's technical efficiencies and whose effect to the technical efficiencies was also tested are total expenses, Debt Capital and investment. In testing their effect to the technical efficiencies the following hypothesis were used:

H3: Insurers with high management expenses are not more efficient than insurers with low management expenses.

H4: Insurers with high Debt Capital are not more efficient than insurers with low Debt Capital.

H5: Insurers with high investment are not more efficient than insurers with low investment.

The results are indicated in table 6 below:

Table 7: Relationship between other variables and Technical Efficiency

Hypothesis	Data	Sample No	Median	95% CI difference in Medians	P- Value
H3	Sample 1	9	0.7070	(-0.2210,0.1399)	0.7239
	Sample 2	9	0.6900		
H4	Sample 1	9	0.8280	(-0.1380,0.1030)	0.7911
	Sample 2	9	0.8780		
H5	Sample 1	9	0.7950	(-0.1709,0.0819)	0.3314
	Sample 2	9	0.8900		

From table 6 above it is observed that each of the p values for the three tests are greater than the chosen α level of 0.05, implying that there is no evidence to reject any of the null hypothesis in each of the three hypothesis and the conclusion drawn is that the level of total expenses, debt capital and investment does not influence the technical efficiencies of Kenyan non-life insurers.

4.3.4 Summary of the effect of Variables used in computing technical efficiencies

The effect of variables used to compute technical efficiencies to the non-life insurers in Kenya technical efficiencies was tested using several hypotheses as outlined in the literature review and computed using the Mann Whitney a non-parametric model. Minitab 14 software was used to implement the Mann Whitney model. The results obtained indicate that there is a positive relationship between technical efficiencies of Kenyan non-life insurers and the size of the insurer measured by total of equity and debt capital. Also there is a positive relationship between the non-life insurer in Kenya technical efficiency and the insurer's gross premiums written.

CHAPTER FIVE

CONCLUSIONS, RECOMMENDATION AND LIMITATIONS

5.0 Introduction

This study computes the technical efficiencies, explains the factors determining the technical efficiency, and investigates the contribution of each variable used to compute technical efficiency of non-life insurers in Kenya in the period 2006 - 2010. This chapter therefore, presents a summary of the study and the implications of the findings based on the objectives of the study, conclusion, recommendation and finally the limitation. The chapter is organized as follows: first a summary of the findings is given in section 5.1, followed by the discussion of the findings in section 5.2, then the recommendation to the study is given in section 5.3 and finally the limitations to the study is presented in section 5.4.

5.1 Summary of the findings

This study aimed to examine the level of technical efficiencies for the Kenyan non-life insurers, to explain the factors determining the technical efficiency for the Kenya non-life insurance companies, and to investigate how each of the variables used in technical efficiencies analysis contribute to the technical efficiencies of Kenyan non-life insurers. The first objective was achieved by computing technical efficiency of the Kenyan non-life insurer using the DEA model which was implemented using the Max DEA 5.1 software, the second objective was achieved through regression analysis and the third objective was achieved by use of Mann Whitney model which was implemented using the Minitab 14 software. The key finding and implication of the study is discussed below:

5.2 Discussion of the findings

To attain the first objective that aimed at examining the technical efficiencies of Kenyan non-life insurers the insurers total expenses, equity capital, debt capital, gross premium and investments income were used as variables in the DEA model. Three inputs namely total expenses, equity capital and debt capital were used while two outputs gross premium and investments were used in the DEA model. This is consistent to the choice of inputs and output by researchers who used DEA like Brown (2000), Barros & Obijiaku (2007) and Owusu-Ansah, et al, (2010) used gross premium and investment income as outputs and operating expenses, capital and technical provisions as inputs, also Diacon

(2001) while studying the UK composite insurers used total operating expenses, total capital and technical reserves and borrowing from creditors as inputs and two out-puts, net earned premium and investment income. The key findings and implication of this study are presented below:

Based on the results of the technical efficiencies obtained for the 18 non-life insurer for the period 2006 to 2010 the technical efficiencies for Kenyan non-life insurers range from 45% to 100% during the period of study, further, a good number of Kenyan non-life insurers operate with relatively high technical efficiencies which averaged at 84.7% implying that Kenyan non-life insurer operate at technical inefficiencies of 15.3%. This therefore implies that the non-life insurers can increase their technical efficiencies to 100%, which can be achieved by observing periods when they operated at 100% technical efficiencies and implement the same during periods when they underperformed.

The average technical efficiency of Kenyan non-life insurers seems to be higher than most European countries in the study conducted by Martin and Michael (2008) on 3,555 insurers from 34 countries in the period 2002 to 2006 such as Australia where comparison of 276 countries indicated Australia technical efficiency was 66% on average, Bermuda with a comparison of 287 counties having average technical efficiency of 78% while Finland a comparison of 98 countries had average technical efficiency of 85%, comparing the average technical efficiencies of Kenyan non-life insurers with South Africa whose technical efficiency was compared with 72 countries by Martin & Michael (2008) shows that Kenya is more efficient than south Africa whose efficiency stood at 64% in the 2002 to 2006 study. However, the conclusion that Kenya's technical efficiency is higher than that of most developed countries contradicts Martin & Michael (2008) who asserts that developed countries in Asia and Europe achieve higher efficiency scores than do emerging market countries. It is important to note that the study conducted by Martin & Michael, (2008) in the period 2002 to 2006 was done earlier than this study which was conducted for the period 2006 to 2010 and therefore comparison made may not be accurate.

The results of technical efficiencies were further broken down to pure and scale technical efficiencies where pure technical efficiencies is interpreted as the contribution of managerial skills to technical efficiencies while the scale efficiencies is interpreted as the effect of scale to technical efficiencies. The results obtained from the DEA model indicates that 93% of the technical efficiencies are as a result of pure technical efficiencies or

managerial skills while 90% are as a result of scale. This implies that the Kenyan non-life insurers are managed with high technical efficiencies and that inefficiency could be as a result of scale associated factors.

To attain the second objective, a regression analysis was performed with the log of technical efficiency as response variable and the log of the average data for the five years period 2006 to 2010 for all the variables used in technical efficiency analysis was used as the predictor variables. Natural logarithms were applied to the data in order to transform the non-normal data into normal. The results of the regression analysis indicated that gross premium written and equity capital were significant variables in the measurement of technical efficiencies. The results are consistent to conclusions made by most researchers studying technical efficiency who concluded in various jurisdictions that size and market share measured by equity capital and gross premium respectively had a positive relationship to technical efficiency with examples from Nigeria and Ghana studied by Barros & Obijiaku (2007) and Owusu-Ansah, et al, (2010) respectively.

The third objective was attained using hypothesis which was tested to gauge how each of the variables used affect the technical efficiencies of non-life insurers in Kenya. The hypothesis was tested using the Mann Whitney model since the data was non parametric and therefore required a non-parametric model. The results obtained indicated that gross premium and the total of equity capital and debt capital have an effect on technical efficiencies implying that to improve the technical efficiency of a non-life insurer in Kenya the question of how much an insurer is writing is important and also the question of insurer's assets is also important.

5.3 Recommendation

Based on the findings of the study the following recommendations are made: In order to encourage the Kenyan non lifeinsurer write more premium, health competition in the industry need to be encouraged so that insurers can be encouraged to increase their marketing strategies which will in turn boost their gross premium income and thus increase their efficiencies. It is also recommended that insurers and all stakeholders identify untapped insurance market to attract more premiums so as to increase the technical efficiencies of the insurer. Insurers need also to increase their asset base to ensure that they are solvent and have large solvency margins or capital base.

5.3.1 Recommendation for further study:

- i. Further research can be conducted for validation of the results of this study.
- ii. Further research that eliminates or penalizes the use of claims as an input can also be conducted.
- iii. Research to test the effect of other economic/accounting factors to technical efficiency may also be conducted.
- iv. Research to test the effect of company ownership to technical efficiency is also recommended.

5.4 Limitation to the study

The limitation experienced in the course of the study was lack of data on some companies whose data at the beginning of the study was expected to be complete. However, some companies within the study period did not operate throughout the entire period of the study and therefore were eliminated in computing the technical efficiencies of the non-life insurers in Kenya due to lack of data. Lack of technical efficiencies studies for most of the African countries made comparison of results obtained to other African countries like Tunisia and Egypt difficult.

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Appendices

Appendix A: Selected World Insurance Market Gross Premium 2006 – 2010

Table 8: Selected World Insurance market and Kenya Gross Premiums for the Period 2006-2010

Region	Country	Life Premiums USD bn	Non-Life Premiums USD bn	Total Premiums USD bn	Insurance Penetration %
Advanced Markets	USA	538	667	1,205	8.1
	Japan	525	131	655	11.0
	UK	210	109	320	11.8
	France	175	98	273	9.5
	Germany	114	131	245	6.8
	Italy	105	55	161	7.0
	Hong Kong	25	3	28	11.4
Emerging Markets	Latin America	65	89	154	2.8
	Brazil	41	37	78	3.2
	Mexico	10	12	22	1.9
	Russia	1	42	43	2.4
	China	135	87	222	3.0
	Central and Eastern Europe	21	72	93	2.6
	India	60	13	93	4.1
	Middle East and Central Asia	10	30	40	1.5
	United Arab Emirates	2	5	7	1.8
	South and East Asia	228	119	347	3.0
Africa		46	22	68	3.6
World		2627	1970	4,597	6.6

Source: Swiss Re, Economic Research and Consulting

Appendix B: Gross Premium Written 2003 – 2011

Table 9: Kenya Gross Written Premium (GWP) for the Period 2003 – 2011

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Non- Life Insurance	19.4	22.78	25.39	29.2	32.95	36.89	43.11	52.35	60.67
%age of total GWP	69.5	69.6	69.7	70.1	68.5	66.8	66.9	66.2	66.23
Life insurance*	8.5	9.97	11.03	12.48	15.14	18.3	21.36	26.71	30.93
%age of total GWP	30.5	30.4	30.3	29.9	31.5	33.2	33.1	33.8	33.77
Total GWP	27.9	32.75	36.42	41.68	48.09	55.19	64.47	79.06	91.60

Source: AKI Insurance Industry Annual Report 2011

Figures in billions Kenya shillings.

Appendix C: Banks having insurance agencies

1. *Chase Bank*
2. *Commercial Bank of Africa,*
3. *Diamond Trust Bank,*
4. *Equity bank, NIC Bank,*
5. *Fidelity Bank.*
6. *First Community Bank,*
7. *Kenya Commercial Bank,*
8. *National Bank of Kenya,*

Appendix D: Average Technical, Pure and Scale Efficiency

Table 10: Average Technical, Pure Technical and Scale Efficiencies of Kenyan Non-life Insurers for the period 2006-2010

<i>Insurance Companies</i>	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Company A	0.999	1.000	1.000
Company B	0.889	0.920	0.960
Company C	0.888	1.000	0.890
Company D	0.844	0.950	0.880
Company E	0.748	0.780	0.950
Company F	0.950	0.950	0.990
Company G	0.693	0.810	0.840
Company H	0.879	0.940	0.930
Company I	0.673	0.850	0.790
Company J	0.904	0.940	0.950
Company K	0.920	1.000	0.920
Company L	0.768	0.980	0.780
Company M	1.000	1.000	1.000
Company N	0.786	1.000	0.790
Company O	0.646	0.780	0.830
Company P	0.897	0.930	0.970
Company Q	0.798	0.940	0.840
Company R	0.966	1.000	0.970
Average	0.847	0.930	0.900

Appendix E: Glossary of Terms

Allocative Efficiency:

This efficiency deals with the minimizing of cost of production with proper combination of inputs to a given level of outputs and a set of input costs. Allocative efficiency measures the DMU ability to minimize cost due to the proper combination of inputs.

BCC Model:

It is another DEA model put by Banker, Charnes and Cooper in 1984 to measure the relative efficiencies of *DMU's*, and it assumes variable returns to scale.

Bancassurance:

A French term referring to the selling of insurance through a bank's established distribution channels.

CCR Model:

It is the first Data Envelopment Analysis (DEA) model put forward by Charnes, Cooper and Rhodes in 1978 to measure the relative efficiencies of *decision making units (DMU's)*, and it assumes constant returns to scale

Constant Returns to Scale (CRS):

It means that, if inputs are increased or decreased, outputs will be increased and decreased by the same proportions (if inputs are doubled, output will also be doubled).

Data Envelopment Analysis (DEA):

It is a non-parametric quantitative model which is employed for measuring the relative efficiencies of DMU's, it was first put forward by Charnes, Cooper and Rhodes in 1978.

Decision Making Units (DMUs):

They are the economic entities or units whose efficiencies will be measured by the model; those units should be homogeneous, work in the same field and have the same inputs and outputs variables.

Economic Efficiency:

It means, producing the maximum value of output with a given value of inputs; or equivalently, using minimum value of inputs to produce a given value of output.

Efficiency: The DMU ability to produce the maximum amount of output with a given amount of inputs; or equivalently, using minimum amount of inputs to produce a given amount of output. The DMU is considered efficient if performances of other DMUs do not

show that some of its inputs or outputs can be improved without worsening other inputs or outputs. (Efficiency = weighted sum of outputs / weighted sum of inputs).

Insurance: Insurance has two fundamental characteristics. Firstly, transferring risk from one individual to a group and, secondly, sharing losses by all members of the group. “Insurance is a vital vehicle not just for transferring risk and sharing loss, but also for the development of the economy by increasing production, wealth protection, capital creation and reducing inflation” (Ajlouni et al, 2010).

Insurance Business:

“Insurance Business” means the business of undertaking liability by way of insurance (including reinsurance) in respect of any loss of life and personal injury and any loss or damage, including liability to pay damage or compensation, contingent upon the happening of a specified event (insurance act. 2010) in exchange of a specified payment known as premium.

Scale Efficiency (SE):

It measures the DMU’s ability to work at its optimal level of operation. This efficiency affects and contributes to the DMU aggregate technical efficiency.

Stochastic Frontier Analysis (SFA):

It is a parametric approach which is derived from parametric linear regression, and it is used to measure the relative efficiency of DMUs. The original model was proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977), and it requires a priori assumption about the shape of the efficiency frontier.

Solvency:

It is the total assets of a firm, minus its total liabilities.

Technical Efficiency (TE):

Technical efficiency means producing maximum output with given inputs; or equivalently, using minimum inputs to produce a given output.

Variable Returns to Scale (VRS):

It means that, if inputs are increased or decreased, outputs will not be increased or decreased by the same proportions (if inputs are doubled, outputs will not

Vision 2030:

The Kenya Vision 2030 is a vehicle for accelerating transformation of the country into a rapidly industrializing middle-income nation by the year 2030. The vision will be implemented through five year medium-term rolling plans, starting with the first one which will cover the period 2008-2012. Thus, the performance of the government should in future

be gauged on the basis of these medium term benchmarks. The Vision also aims at creating a cohesive, equitable and just society based on democratic principles and issue-based politics grounded on our rich and diverse cultures and traditions.