TOTAL FACTOR PRODUCTIVITY CHANGE IN THE NON-LIFE INSURANCE SECTOR, KENYA: 2005-2009.

A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF APPLIED ECONOMICS IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF ECONOMICS (FINANCE) DEGREE OF KENYATTA UNIVERSITY.

MAY, 2012

DECLARATION

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

Signature.. Date...

Mdoe Idi Jackson

BED (Arts)

K102/20091/2010

This project is submitted with our approval as supervisors:

Signature..Date..

Dr. Paul M. Gachanja

Department of Economic Theory

Kenyatta University

Signature...Date...

Dr. Dianah Muchai

Department of Econometrics and Statistics

Kenyatta University

DEDICATION

To Ruth Ongiri, Programme co-ordinator, Child Education Support and Development (CESAD) a great project that saw me through high school.

ACKNOWLEDGEMENT

Much appreciation goes to my God and Father for answering my prayers and granting me innumerable wishes. You will always be my God.

I am deeply and sincerely grateful to my supervisors for guiding me through this work and being patient with my repeated mistakes. In particular, I am grateful to Dr Gachanja for providing me with the necessary materials to handle this topic ranging from textbooks to his own office space. Equally, I am grateful to Dr Dianah for challenging me to go on with the topic even when things became difficult. Both of you have turned my potential to reality. I shall never forget that there is always a way around things.

Special thanks go to Dr. Omolo for the insightful comments that made my work easier. In addition, I acknowledge the assistance that I have received from the academic staff school of economics. They are a great motivation to me.

Importantly, this study was made possible by an incountry scholarship awarded to me by Germany Academic Exchange (DAAD), without which I would not have been able to pursue my master's course. Long live DAAD. Finally, I am grateful to Kenyatta University for providing me with an opportunity to work as a teaching assistant in the department of applied economics during the course of the study.

All errors and omissions in this work are solely mine.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AKI	Association of Kenya Insurers
AIG	American Insurance Group
CER	Commission Expense Ratio
DEA	Data Envelopment Analysis
DEAP	Data Envelopment Analysis Programme
DMU	Decision Making Unit
GDP	Gross Domestic Product
ICEA	Insurance Company of East Africa
IRA	Insurance Regulatory Authority
LP	Linear Programming
MER	Management Expense Ratio
PIN	Price based Index Numbers
ROC	Return on Capital
SFA	Stochastic Frontier Approach
UNCTAD	United Nations Conference on Trade and Development
UPR	Underwriting Profit Ratio

OPERATIONAL DEFINITION OF TERMS

Composite Insurer: An insurer who carries out life and non-life business

Non-life insurance: One of the sectors in insurance industry also known as property Insurance or general business.

Takaful: Insurance business that is in accordance with Islamic laws.

ABSTRACT

The Kenya Vision 2030 acknowledges that financial services will play a critical role by providing better intermediation between savings and investments. Among the financial service providers are non-life insurers. Non-life insurers contribute to economic growth through channelling resources from savers to investment projects, inducing consumption in risk averse individuals, reducing uncertainty and volatility of events as well as diversifying risk. To develop the insurance industry the government has intervened by creating IRA. To consolidate non-life insurers the government raised the paid up capital from Kshs. 150 million to Kshs 300 million and restricted individual ownership of an insurance company to less than 25 percent. The extent to which total factor productivity (TFP) for non-life insurers has changed with these reforms is yet to be determined. This notwithstanding, the actual levels of TFP change in the Kenyan non-life insurance sector is not known. The study sought to fill this gap by estimating and decomposing total factor productivity change for non- life insurance sector. The study used an output oriented Data Envelopment Analysis (DEA) to derive Malmquist total factor productivity change indices. The indices were then decomposed to identify the sources of productivity change. To achieve these objectives the study used data from 32 non-life insurance firms that existed during the study period (2005 to 2009).The results revealed that, there was 2.7 percent progress in TFP for the sector. This progress in TFP was sourced from innovations. The decomposition of efficiency change into scale efficiency change and pure efficiency change revealed that the 7.8 percent decline in efficiency for the entire sector was occasioned by 2.7 percent decline in scale efficiency and 5.3 percent decline in pure efficiency. The study concluded that for non-life insurers to continue improving their TFP they need to sustain the high innovations and improve efficiency by improving their level of resource utilization and product survival.

CHAPTER ONE

INTRODUCTION

1.1 Background

1.1.1 Insurance

Insurance is a form of risk management used to hedge against contingent loss, which is loss dependent on chance. It involves transfer of potential loss from one entity to another, in exchange for a risk premium (International Association of Insurance Supervisors (IAIS), 2002). Given this role, insurance fosters financial stability by enabling economic agents to undertake various transactions with the facility of transfer and dispersion of risks.

Globally, insurance is divided into two main broad categories namely life and non-life insurance (Swiss Re, 2003). Life insurance covers risks associated with death, terminal illness and accidents. Non-life insurance covers risks associated with loss of property (Swiss Re, 2003). The global insurance industry consists of life insurers, non-life insurers, re-insurers, composite insurers and *takaful* (Swiss Re, 2003). Re- insurance refers to insurance that is purchased by an insurance company from another insurance company (Swiss Re, 2003). On the other hand, composite insurance involves provision of both life and non-life business by the same insurance company (IRA, 2006). *Takaful* is a special type of insurance that is carried in accordance with Islamic laws.

In terms of the number of firms, the insurance industry in the East African region is less developed compared with the banking sector. The licensed banks are 117 whereas the insurance firms are 83. The Kenyan insurance industry is the leading with 43 insurance firms out of the 83 (price waterhouse coopers (PWC), 2011). Most insurance firms in East Africa focus on serving the formal sector and generally the high-income segment (PWC, 2011). Interestingly, there is only one *takaful* insurance firm in East Africa, which began operations in 2011. In addition, the insurance business in the East Africa relies on the Kenyan market for re- insurance services.

1.1.2 Insurance industry in Kenya

In Kenya, insurance is one of the products of colonization and the development of a modern economic sector (Muli, 2010). Its origin can be traced back to the protection offered to settlers' farms and agricultural products by insurance firms from Britain and India. As the economic activities in the colony increased, the insurers got a reason to establish branch networks with more autonomy, and expertise to service the growing insurance needs. Consequently, by independence the country's insurance market was dominated by branches of foreign insurance companies mainly from the UK and India (Rand, 2004).

Insurance operations then were governed by the Insurance Companies Act of 1960, which was based on the UK legislation (IRA, 2009). During this period, there was no competent authority to supervise the industry (IRA, 2009). As a result, there was frequent failure of insurance companies due to increasing competition for business, management incompetence and sometimes fraud resulting to the need for statutory regulation (supervision) of the insurance industry.

Eventually, to protect the interest of the public and that of the policy holder's the first reform in the form of a ministerial order was witnessed in 1978. It required all the branches of insurance companies to stop operations unless they were incorporated locally as insurance companies (Republic of Kenya, 1978). This reform aimed at domesticating insurance in the country as well curbing fraud. However, the companies were still regulated using UK's Insurance Companies Act of 1960. The ministerial order was successful in curbing fraud and reducing the frequent failures by insurance companies (IRA, 2009).

Thereafter in the 1980's the government with the help of United Nations Conference on Trade and Development (UNCTAD) began a process of drafting a law to regulate the sector. Consequently, the Insurance Act of 1986 came into force. The Act introduced the department of Commissioner of Insurance in the ministry of Finance (IRA, 2007). The department's core function was to supervise and regulate the insurance sector. Hence, its main role was to ensure the safeguard and protection of policyholder's interests and not the growth of the industry.

Under the department of the Commissioner of Insurance, the industry experienced many challenges, which hindered its growth (IRA, 2009). To begin with, the industry lacked innovation as insurance companies continued to sell similar products. This has caused unhealthy competition, which has mainly been characterised by price wars. As a result, most insurance firms have been relying on investments to make profits.

Secondly, due to poor claims payments practices by the industry the public has a negative perception of insurance business (Rand, 2004). The situation is worsened by insolvency of industry players, low profitability, inadequate customer handling processes and poor-quality customer service, low contract certainty and a lack of proper complaints monitoring and handling processes (PWC, 2011). Therefore, insurance agents find it hard to make sales especially on non compulsory business such as life insurance.

These challenges brought concerns that the department concentrated on safeguarding the policy holders' interest only at the expense of insurance industry development. Consequently, the need for the department to focus on both policy holders and insurance companies became evident. As a result, the Insurance Act of 1986 was amended in 2006 to create an independent commission with an additional role of developing the insurance industry (IRA, 2009).

Eventually, the insurance regulatory authority was established and began its operations on May 2007.

To consolidate the industry, the commission raised paid up capital from Kshs 150 million to Kshs 300 million for companies transacting in non-life insurance, Kshs 50 million to Kshs 150 million for companies transacting in life insurance and from Kshs200 million to Kshs 450 million for composite insurers (Association of Kenya Insurers (AKI), 2007). Further to this, ownership of insurance companies was restricted in that no single individual can own up to 25 percent of an insurance company. In case there is such a person, they are not entitled to appoint more than 25 percent of the Board of Directors of an insurer or receive more than 25 percent of the aggregate dividends of an insurer in any given financial year.

Though these measures were aimed at eliminating the challenges experienced by the industry, they were not successful as most insurance firms retained their earnings to raise the required capital while others transformed some balance sheet items to meet this requirement (IRA, 2009). Therefore, the industry is still bedevilled by unhealthy competition, overcapacity, lack of innovation and segmentation.

As of December 2009, there were 46 insurance firms, 10 carrying out life insurance, 20 carrying out general business insurance, 14 composite insurers and 2 reinsurers (IRA, 2009). All the holding firms owning insurance companies are domestic following the ministerial order of 1978.

Even though, the two sectors making up the insurance industry play an important role, non-life insurance has consistently provided more than half of the industry’s premiums for the period 2005 to 2009 (IRA, 2009). In addition, non-life insurance covers compulsory classes such as motor, marine, aviation and workmen compensation. Therefore, non-life insurance carries much of the risk in the industry (AKI, 2009). Several, authors (IRA, 2009; AKI, 2009; PWC, 2011) refer to non-life insurance as general business while others refer to it as property insurance. In this study therefore, the terms non-life insurance, general business and property insurance were used interchangeably.

1.1.3 Role of insurance in economic growth

Internationally, there has been much attention on other players in the financial industry such as banks and the stock market but with the growing share of insurance sector in the aggregate financial industry in almost every developing and developed country attention is beginning to shift on insurance (Haiss and Sumegi, 2006). This is driven by the realization of the important role that insurance is playing.

To begin with, the sector helps to channel resources from savers to investment projects (Wachtel, 2001). They do this by screening fund seekers, improving resource allocation, lowering cost of capital via economies of scale and specialisation and providing risk management services.

Secondly, by reducing uncertainty and volatility, insurance companies smoothen the economic cycle and reduce the impact of crisis situations on the micro and aggregate macro level (Haiss and Sumegi, 2006). First of all, there is demand for protection against loss of property caused by natural disaster, crime, violence, accidents, etc. Purchase, possession and sale of goods, assets and services are facilitated by the indemnification of the insurance. Therefore, the assured safety of the property enhances trade, transportation and capital lending. Therefore, many sectors are heavily reliant on insurance services.

Thirdly, the industry induces consumption in risk-averse individuals by relieving fears associated with expenditures on items such as cars, real estate or even travel hence impacting positively on national consumption which is an important determinant of GDP (Wachtel, 2001).

Fourthly, insurance companies add an additional competitor to the financial market, which enables the customer to diversify his portfolio or substitute different investments. Since the indemnification of possible losses is assured by insurance, the dependence on precautionary savings held by companies or households is reduced (Haiss and Sumegi, 2006). Consequently, offering insurance services can result in an increased consumption by the households and may increase market competition and hence market efficiency.

Lastly, at a first glance the setup of an insurance company seems to be quite simple. As an intermediary insurance aids the unfortunate who suffer losses by compensating them from funds collected from many policyholders. However, the premiums collected from the clients have to be managed in professional ways to prevent the company from liquidity bottlenecks and the reserves from deprecation. Illiquidity can occur because the receipt of the premiums and the payment of insurance liabilities are temporally independent and the sudden appearance of a disaster can cause a peak demand for financial coverage. The reserve deprecation can be neutralized by the insurers investment capabilities and hence by the yields obtained through the activities performed on the financial market, so insurance companies are major investors within the economy.

1.1.4 Non-life insurance in Kenya

In Kenya, the insurance industry falls under financial services and so is non-life insurance. As of December 2009 there were 34 non-life insurers carrying out business in 11 classes namely: aviation, engineering, fire domestic, fire industrial, liability, marine motor private, motor commercial, personal accident, theft and workman’s compensation (IRA, 2009).

The sector is important in economic development in three main ways. First, the sector helps in pooling and bearing of risks associated with fire, accidents liabilities and theft through the various non-life insurance policies. The claims that the sector incurred for the period 2005 to 2009 rose from Kshs 1.12 billion in 2005 to Kshs. 1.91 billion in 2009 (IRA, 2009). Through this compensation, the sector was able to reduce and smoothen uncertainty and volatility associated with crisis situations. As a result risk averse individuals are encouraged to spend on goods such as cars, real estate etc therefore increasing our national consumption which is an important component of GDP.

Secondly, the sector acts as an investor in the country, much of the premiums that non-life insurance companies receive may not be required immediately. Consequently, they invest such premiums in profitable ventures as allowed by law. The real investments carried out by non-life insurers for the period 2005 to 2009 is as shown in table 1.1

Table 1.1: Investment by non-life insurers (Kshs. 000)

	2005	2006	2007	2008	2009
Government securities	7,428,386	7,010,465	6,966,214	6,773,162	7,076,153
Other securities	69,954	96,157	79, 353	63,447	224,528
Ordinary shares	6, 422, 698	9,523,339	9,502,072	7,653,664	6,086,604
Bank deposits	4, 175, 310	4,903,925	6,092,081	6,268,867	7,459,583
Investment property	5, 135, 257	4,986,069	5,582,482	5,985,230	7,244,838

Source of data: IRA, 2009

These figures indicate that investments such as bank deposits and investment property have been on the rise throughout the period. However, investment in government securities declined from 7.4 billion in 2005 to a low of 6.7 billion in 2008 after which it increased in 2009 to 7.1 billion. This can be explained by the vulnerability of the stock market during the post election violence (PWC, 2011). Therefore, non-life insurance is important in channelling resources from savers to investment projects. Moreover, they help in screening fund seekers since in choosing the investment managers of insurance firms must consider how safe their investments will be. The overall impact of these investment activities is improvement in resource allocation.

The overall contribution of the sector to GDP is as shown in table 1.2

Table 1.2: Contribution of non-life insurance sector to GDP 2005 to 2009 (%)

	2004	2005	2006	2007	2008	2009
Contribution by life insurance	0.78	0.78	0.76	0.83	0.87	0.94
Contribution by non-life insurance	1.76	1.79	1.78	1.82	1.76	1.90
Contribution by entire industry	2.54	2.57	2.54	2.65	2.63	2.84

Source of data: AKI (2009)

These figures indicate that the contribution of non-life insurance sector to GDP is cyclical. However, the growth has been small compared to the 2 percent milestone that had been set by the industry players in their strategic plan covering 2006 to 2010 (AKI, 2004). In addition, this is not in the spirit of vision 2030, which envisages growth in GDP that will lead to increased demand for insurance services (IRA, 2007). Therefore, there is need to have a more productive non-life insurance sector in the country to be able to meet the expected increase in demand for insurance services.

1.1.5 Performance of non-life insurance sector

Performance of a firm or sector can be evaluated using several measures. One of these measures is financial soundness indicators (ratios). These ratios can be classified into three categories namely operations ratios, capital adequacy ratios and resource utilisation (profitability) ratios (IAIS), 2002).

For Kenyan non-life insurance only two categories of the ratios are used namely operations ratios and resource utilisation ratios (IRA, 2009). Operations ratios include management expense ratio (MER) which is obtained by dividing managerial and administrative expenses by gross premiums in that year and commissions expense ratio (CER) which is obtained by dividing commission expenses by gross premiums. The two ratios represent real figures as the price effect cancels out in division. The two ratios cannot exceed 100 percent and neither can they be 0 percent (IRA, 2009). These two ratios show the extent to which an insurer is engaging labour in administration of the company and distribution of insurance products (IAIS, 2002). Figure 1.1 shows management and commission expense ratios for non-life insurance sector for the period 2005 to 2009

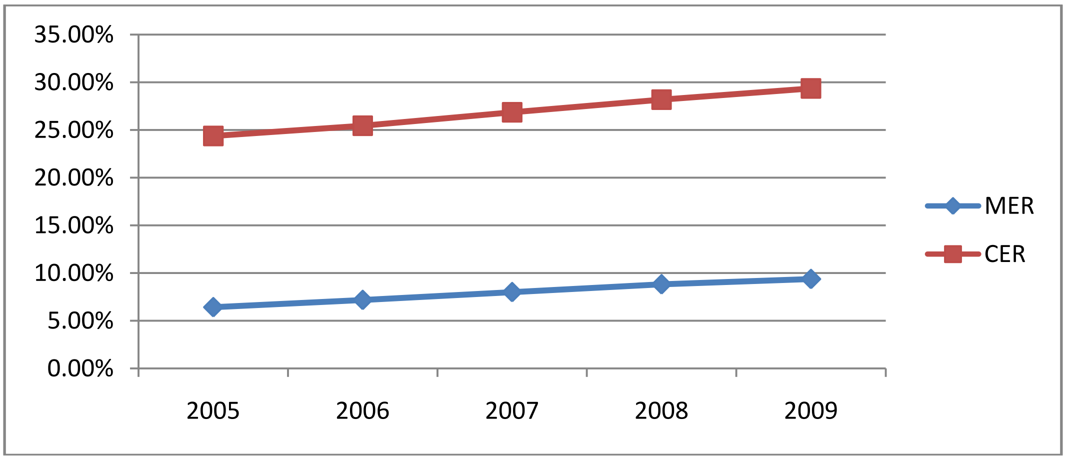

Figure 1.1: Operation ratios for non-life insurance for the period 2005 to 2009
Source: IRA, 2009

The figure indicates that there has been consistent improvement in the two ratios. Such a trend signifies continued engagement of labour in running the firms and distributing insurance products. Labour must be paid for in terms of salaries and wages thus the sustained increase in the use of labour means more expenses for the sector in terms of salaries and wages. This can be explained by increased competition, which has made it expensive for non-life insurers to make sales (IRA, 2007).

The impact of these expenses on the insurers' profitability is well captured by profitability ratios. They include underwriting profit ratio (UPR) which is obtained by dividing underwriting profit by gross premiums in that year and return on capital (ROC) which is obtained by dividing underwriting profits by capital. The two ratios are real and show the extent to which an insurer is efficient in utilising resources (IAIS, 2002). The trend for the two ratios for the period 2005 to 2009 is as shown in figure1.2.

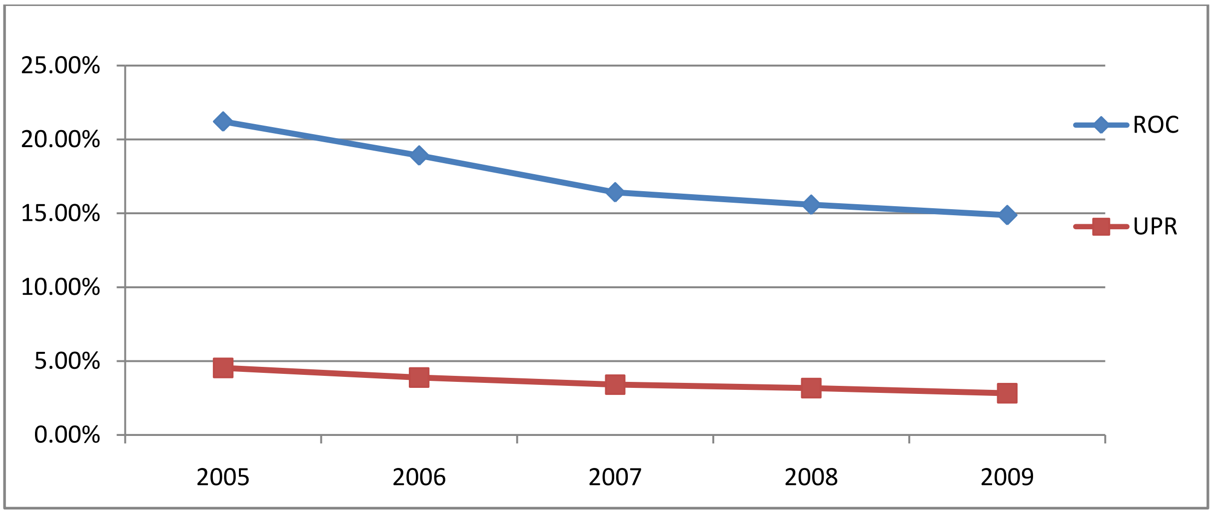

Figure 1.2: Resource utilisation ratios for non-life insurance for the period 2005 to 2009
Source: IRA, 2009

These figures indicate that profitability of non life insurers has been declining during the period. Therefore, non life insurers may be said to be inefficient as the improving operations ratios in figure 1.1 are accompanied by declining resource utilisation ratios in figure 1.2.

These trends may be explained by the poor perception, cut throat competition and price undercuts that the entire insurance industry is experiencing (PWC, 2011).Since the sector is further bedevilled by lack of innovation, its total factor productivity (TFP) change must have been affected as efficiency and innovations are the determinants of TFP change.

1.2 Problem statement

Non-life insurers are important in any economy as they help in channelling resources from savers to investment projects, reduce uncertainty and volatility of events, induce consumption in risk averse individuals and are a major investor (Haiss and Sumegi, 2006; Wachtel, 2001;

IRA, 2009). To perform these roles effectively, insurance firms must be productive enough to ensure growth and profitability.

The Kenya Vision 2030 recognises the critical role that financial services will play in mobilising investment funds that are required to implement the projects it envisages. Provision of non-life insurance services is one of these services. Therefore, the vision seeks to improve the efficiency and outreach of insurance service providers (Government of Kenya, 2007). To achieve this objective the government through the IRA sought to consolidate non-life insurers by raising their paid up capital from Kshs. 150 million to Kshs 300 million and restricting individual ownership of an insurance company to less than 25 percent (AKI, 2007; IRA, 2009). In addition, these reforms were meant to reduce competition and improve productivity of non-life insurers. However, the extent to which TFP for non-life insurers has changed with these reforms is yet to be determined. This notwithstanding, the actual levels of TFP change in the Kenyan non-life insurance sector are not known.

Previous studies (Muli, 2010; Rand, 2004) have focused on the efficiency of life insurers and the quality of services offered by Kenyan insurers. None of the studies has attempted to measure TFP change in the Kenyan non-life insurance sector. To bridge this gap, the current study focused on measurement of TFP change in the Kenyan non-life insurance sector using non-parametric DEA.

The study, therefore, sought to answer the following questions:

I. What is the total factor productivity change in the Kenyan non-life insurance sector for the period 2005 to 2009?

II. What are the sources of total factor productivity change in the Kenyan non-life insurance sector for the period 2005 to 2009?

III. What are the policy implications of the study findings?

1.3 Objectives of the study

The general objective of the study was to estimate the performance of non-life insurers in terms of productivity change. The specific objectives were to:

I. Measure total factor productivity change for non-life insurers for the period 2005 to 2009

II. Establish the sources of total factor productivity change in the Kenyan non-life insurance sector for the period 2005 to 2009.

III. Suggest policy recommendations based on the findings.

1.4 Significance of the study

This study is important in several ways. First, the levels of TFP change in the Kenyan non-life insurance sector are not known. Therefore, the findings will provide a benchmark for levels of TFP change in the Kenyan non-life insurance sector upon which future research can be undertaken.

Organisational structure influences the best practice procedures in non-life insurance management and therefore their total factor productivity. As a result, the study findings will inform non-life insurers whether they need to alter their organisation structure or sustain it in order to improve their total factor productivity.

Finally, stakeholders in the insurance industry such as IRA have implemented several reforms to consolidate non-life insurers, reduce their unhealthy competition and improve their efficiency, outreach and productivity. The study findings will reveal the extent to which these reforms have been successful.

1.5 Scope and organization of the study

The study focused on estimating the total factor productivity change in the non-life insurance sector in Kenya for the period 2005-2009 due the regulatory and policy change in the sector during the period. It used panel data on non-life insurance firms.

The study is organised into five chapters. Chapter one presents a general introduction to the study. Chapter two reviews the theoretical and recent empirical literature on the subject. Model specification, estimation procedures and data sources are discussed in chapter three. Chapter four presents the results of the study. Finally, chapter five gives the summary, conclusions, recommendations and areas for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this chapter, both the theoretical literature and empirical literature on productivity and productivity change are reviewed. Section 2.2 covers the theoretical literature on definition, measurement of productivity, measurement of productivity change, section 2.3 reviews the recent empirical literature and section 2.4 concludes with an overview of the empirical literature.

2.2 Theoretical literature

2.2.1 Concept of productivity and productivity change

To distinguish between productivity and productivity change let's consider a simple production process where a firm uses N inputs say labour, machinery, raw materials etc to produce a single output. The technological possibilities of this firm can be represented using the following production function:

$$y = f(X) \quad \ldots\ldots 2.1$$

Where y is a real non negative output and $X = (X_1, X_2, \ldots X_N)'$ is an N X 1 vector of inputs.

Productivity shows the relationship between inputs and outputs and is defined as the ratio of output(s) to input(s). That is

$$\text{Productivity} = \frac{f(X)}{X} \quad \ldots\ldots 2.2$$

On the other hand, productivity change is a ratio of productivity in period t+1 to productivity in period t. Therefore, a value greater than one shows an increase in productivity, a value of one shows stagnating productivity, whereas a value less than one shows declining productivity (Coelli et al., 2005). To increase productivity a firm may produce a similar level of output(s) using less input(s) or produce more output(s) using the same level of input(s) (Coelli et al., 2005).

Productivity can be divided into two broad concepts namely partial factor productivity (PFP) and total factor productivity (TFP). PFP estimates the ratio of total output to a single input, usually labour. In most studies, especially in economics, productivity is taken to be synonymous with labour productivity. This is because it is a simpler concept to estimate and it is a rough measure of the effectiveness with which labour is used as the most important factor of production (Coelli et al., 2005). However, it is worthy to note that productivity is not determined by the efforts of labour alone, but in combination with other factors especially land, capital, technology, management and the environment.

On the other hand TFP is the ratio of aggregate measure of output(s) to the aggregate measure of the input(s). Theoretically, this is the true measure of productivity as it incorporates the contribution of all the factor inputs (Coelli et al., 2005). There are however, some problems associated with measuring TFP. For example, it is difficult to construct an index number that will serve as the input. This is because this will mean adding hours done by labour to units of investments, the contributions of land, technology, among others to get a single index. Even to quantify them all in monetary terms would be very cumbersome. Even though this is the case some TFP estimation methods such as the frontier approaches have been put forward to overcome these challenges.

2.2.2 Set theoretic representation of a production technology and distance functions

Production technology maybe represented using set theory by defining the technology set, S, as (Coelli *et al.*, 2005).

S = {(**x, q**): **x** can produce **q**} ……….......……………………………. .2.3

where **x** and **q** denote an N-dimensional input vector of non-negative real numbers and a non-negative M-dimensional output vector, respectively. This set consists of all input-output vectors (**x, q**), such that **x** can produce **q** (Coelli *et al.*, 2005).

From the above set we can define the output set as follows

$P(\mathbf{x}) = \{\mathbf{q}: \mathbf{x} \text{ can produce } \mathbf{q}\} = \{\mathbf{q}: (\mathbf{x}, \mathbf{q}) \in S\}$. ……………………… ...2.4

On the other hand the input set is defined as

$L(\mathbf{q}) = \{\mathbf{x}: \mathbf{x} \text{ can produce } \mathbf{q}\} = \{\mathbf{x}: (\mathbf{x}, \mathbf{q}) \in S\}$...2.5

The output distance function is defined on the output set, **P**(x), and is minimum (infimum) scaling of the outputs, δ, such that the expanded output, **q**/δ , remains a member of the output set **P(x)** as well as technology set S. That is

$d_0(\mathbf{x}, \mathbf{q}) = \min\{\delta: (\mathbf{q}/\delta) \in P(\mathbf{x})\}$ ……………………...………………..2.6

Therefore, if $q \in P(x)$, then $d_0(\mathbf{x}, \mathbf{q}) \leq 1$; and if q is on the upper boundary (the frontier) of the output set, then $d_0(\mathbf{x}, \mathbf{q}) = 1$. This is possible since the set P(x) is closed (Coelli *et al.*, 2005).

This is well explained when one considers a production possibility curve obtained when two outputs q_1 and q_2 are produced using the input vector, x as shown in figure 2.1

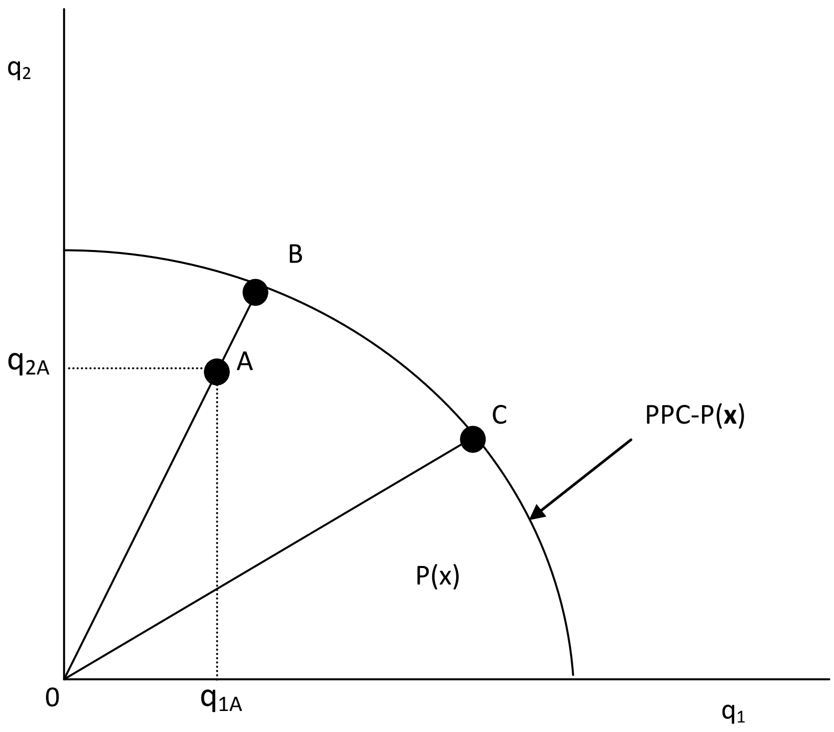

Figure 2.1 Output distance function and production possibility set
Source: Coelli *et al (*2005)

The production possibility set, p(**x**) is the area bounded by the production possibility frontier, PPC-P(**x**), and the q_1 and q_2 axis. The value of the distance function for the firm using input level **x** to produce the outputs, defined by the point A is equal to the ratio δ=OA/OB. The distance measure is the reciprocal of the factor by which the production of all output quantities could be increased while still remaining within the feasible production possibility set for the given input level. Points B and C are on the production possibility frontier denoted by PPC-P(**x**) (upper boundary of set P(x)), and hence would have distance function values equal to 1.

On the other hand input distance function is defined on the input set, **L(q),** and is maximum ss(supremum) scaling of the inputs , ρ , such that the contracted input, **x**/ ρ , remains a member of the input set **L(q)** as well as technology set S. That is

d_i (**x, q**) = max {ρ: (**x**/ρ) є L(**q**)} …………………………………………………..2.7

Therefore, if x ϵ L(q), then d_i (**x, q**) ≥1; and if q is on the lower boundary (the frontier) of the input set, then d_i (**x, q**) =1. This is possible since the set L(q) is closed (Coelli *et al.*, 2005).

This well demonstrated by a production technology that uses two inputs x_1 and x_2 to produce output vector **q**, as shown in figure 2.2

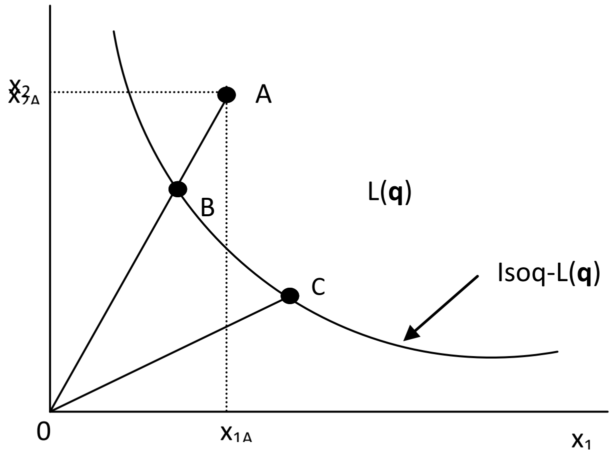

Figure 2.2 Input distance function and input requirement set
Source: Coelli *et al* (2005)

The input set L(**q**) is the area bounded from below by the isoquant, isoq-L(**q**). The value of the distance function from the point A which defines the production point where firm A uses x_{1A} of input 1 and x_{2A} of input to produce the output vector q, is equal to the ratio ρ=OA/OB.

2.3 Measuring total factor productivity change

For a firm producing multiple outputs using multiple inputs productivity change from one period to another is represented by a TFP index (Coelli *et al.*, 2005). In putting forward the various methods that can be used to estimate TFP index they consider the problem of measuring total factor productivity change for a firm from period, s, to period, t and assuming that the firm makes use of the state of knowledge, as represented by production technologies, $S_{s,}$ and ,$S_{t,}$ in period, s, and, t respectively.

Out of this problem various methods of estimating TFP index are put forward. These methods can be classified into broad categories namely price based index number methods and frontier methods. The two broad categories are reviewed below.

2.3.1 Price based index numbers methods (PIN)

Under this category there are two main approaches. First is the Hicks-Moorsteen approach. It represents a fairly simple TFP index that measures the growth in output net of growth in inputs. If output growth and input growth are measured using output and input quantity index numbers, then the HM TFP index is given by:

$$\text{HMTFP Index} = \frac{Growth\,in\,output}{Growth\,in\,input} = \frac{Output\;quantity\;index}{Input\;quantity\;index} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.2.8$$

The HM index can be made operational once appropriate measures of output and input growth are selected. A range of index numbers formulae are available for this purpose. Though this index is easy to measure and interpret, it is quite difficult to identify the main source of productivity growth.

The second approach is based on profitability ratio. Let R_s, R_t, C_s and C_t represent the observed revenue and cost of a given firm in period, s, and, t respectively. The data on input and output quantities and their prices are given by ($\mathbf{x}_s$, $\mathbf{q}_s$, $\mathbf{p}_s$) and ($\mathbf{x}_s$, $\mathbf{q}_s$, $\mathbf{w}_s$) for period s and ($\mathbf{x}_t$, $\mathbf{q}_t$, $\mathbf{p}_t$) and ($\mathbf{x}_t$, $\mathbf{q}_t$, $\mathbf{w}_t$) for period t. The TFP index that is based on the profitability ratio is measured using revenue and cost after adjusting for changes from period t to period s. Let R_s*, R_t*, C_s* and C_t* represent revenues and cost for the firm in period, s, and, t, respectively, after adjusting for price changes from period, s, to period, t. Then the TFP index is defined as:

$$\text{TFP index} = \frac{R_t^* / R_s^*}{c_t^* / c_s^*} = \frac{(R_t / R_s)/\,output\;\;price\;\;index}{(C_t / C_s)/\,input\;\;price\,index} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots...2.9$$

Since the TFP measure in equation 2.9 does not contain any price effects, the main sources of TFP change over periods, s, and, t, can be attributed to technical change and efficiency changes over this period (Coelli *et al* (2005).

Though this approaches are straightforward and easy to interpret. They are considered less useful since they assume that the firm is efficient yet this is not always the case. In addition, the two methods require price and quantity data which is not readily available especially for service firms.

2.3.2 Frontier approaches

Frontier approaches are used to estimate the Malmquist TFP index. To demonstrate the Malmquist TFP index due to Caves, Chritensen and Diewert (1982) input and output distance functions as put forward by Malmquist are used. The distance functions are as defined in section 2.2.2 of this study.

Malmquist TFP index is constructed by measuring the radial distance of the observed level of output and input vector in periods, s, and, t, relative to a reference technology. As the distance can be either output oriented or input oriented, the Malmquist TFP indices differ according to the orientation used.

The output oriented productivity measures focus on the maximum level of output that could be produced using a given input vector and a given production technology relative to the observed level of outputs. The output oriented period s Malmquist index (m_o^s) defined as a ratio of technical inefficiency in period s is be given by

$$m_o^s(q_s, q_t, x_s, x_t) = \frac{d_o^s(q_t, x_t)}{d_o^s(q_s, x_s)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.10$$

Assuming that the firm is technically efficient in both periods, then $d_o^s(q_s x_s) = 1$

and so;

$$m_o^s(q_s, q_t, x_s, x_t) = d_o^s(q_t, x_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.11$$

An output oriented Malmquist productivity index can be similarly defined based on period, t, technology

$$m_o^t(q_s, q_t, x_s, x_t) = \frac{d_o^t(q_t, x_t)}{d_o^t(q_s, x_s)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.12$$

If the firm is technically efficient in period t, then $d_o^t(q_t x_t) = 1$

Since the Malmquist productivity index can be defined using period, s, technology as well as period, t, technology, the Malmquist TFP index is defined as the geometric average of the two indices based on period-t and period-s technologies. Thus the output oriented Malmquist productivity index is given by:

$$m_o(q_s, q_t, x_s, x_t) = \left[m_o^s(q_s, q_t, x_s, x_t).m_o^t(q_s, q_t, x_s, x_t)\right]^{0.5} \ldots\ldots\ldots\ldots\ldots\ldots 2.13$$

It is noted that the Malmquist TFP index, defined in the equation 2.13 above requires the computation of four distance functions namely,

$d_o^s(q_s, x_s), d_o^t(q_t, x_t), d_o^s(q_t, x_t)$ and $d_o^t(q_s, x_s)$.

In order to compute these distance functions, the production technologies in periods, s, and, t, should be described. To describe the technologies data on a cross-section of firms in periods, s, and, t, should be accessible. The two main frontier methods used to estimate these production technologies as well as the distance functions are data envelopment analysis (DEA) approach and the stochastic frontier analysis (SFA). The methods are as reviewed below.

Data Envelopment Analysis (DEA)

DEA is a non parametric mathematical linear programming methodology, which uses data on the input and output quantities of a group of Decision Making Units (DMUs) to construct a piece –wise linear surface over the data points (Coelli *et al*, 2005).

Depending on the DMUs characteristics one can either choose to use the constant returns to scale DEA as put forward by Charnes, Cooper and Rhodes in 1978 or a variable returns to scale DEA as put forward by Fare, Grosskopf and Logan in 1983.

DEA can either be input or output oriented. The two orientations give similar results when constant returns to scale (CRS) assumption is made. However, the two orientation yield different results under the assumption of variable returns to scale. The choice of orientation is influenced by the characteristics of the DMUs under study (Coelli *et al*, 2005).

To construct the frontier surface DEA solves a sequence of linear programming problems, which help in estimating the output or input distance functions required for establishing technical efficiency scores for DMUs. The linear programming problem for estimating period t output distance function is as shown in equation 2.14

$$[d_0^t(\mathbf{q}_t, \mathbf{x}_t)]^{-1} = \max_{\theta\lambda} \theta \quad \ldots\ldots 2.14$$

s.t $\quad -\theta\mathbf{q}_{it} + \mathbf{Q}_t\boldsymbol{\lambda} \geq 0,$

$\mathbf{x}_{it} - \mathbf{X}_t\boldsymbol{\lambda} \geq 0,$

$\mathbf{I1}'\lambda = \mathbf{1}$

$\boldsymbol{\lambda} \geq \mathbf{0},$

Where $\mathbf{q}_{it}$ is a Mx1 vector of output values for the i-th firm in period t;

$\mathbf{x}_{it}$ is a Nx1 vector of input values for the i-th firm in period t;

$\mathbf{Q}_t$ is a IxM matrix of output values for all I firms in period t;

$\mathbf{X}_t$ is a IxN matrix of input values for all I firms in period t;

λ is a Ix1 vector of weights; and θ is a scalar.

$I1'\lambda = 1$ Is the convexity condition that provides for VRS.

Though this is the case, it is important to note that when one has a few observations and many inputs and outputs most of the DMUs will appear on the DEA frontier. That is to increase the technical efficiency scores an investigator needs to reduce the sample size and increase the number of inputs and outputs (Zhang, 1998). Therefore, it is conventional that the minimum number of DMUs is greater than three times the number of inputs plus outputs (Raab and Lichty, 2002).

In addition, efficiency scores obtained are only relative to the best firms in the sample under consideration. Therefore, the inclusion of extra firms from other countries may reduce efficiency scores of local firms (Coelli *et al*, 2005). To overcome this limitation the choice of the sample used becomes important. The sample should be representative as possible and where possible the entire population should be used in order to arrive at the true frontier (Zhang, 1998).

The Stochastic Frontier Approach

Unlike DEA that does not focus on the relationship between inputs and outputs the stochastic frontier approach SFA is a parametric methodology that imposes a priori functional form on the data. The Cobb Douglas stochastic model takes the following form:

$\ln q_i = \beta_0 + \beta_i X_i + V_i - U_i$...2.15

Where q_i output for the i th firm

X_i is a $k \times 1$ vector of containing logarithms of inputs

β vector of unknown parameters to be estimated

U_i non negative random variable associated with technical inefficiency

V_i random variable associated with measurement errors and noise

Therefore, according to the SFA firms may fail to be on the frontier because of measurement errors/ statistical noise and inefficiency. As a result, it has been criticised for confounding inefficiency with measurement errors (Coelli *et al*, 2005). From 2.15 the technical efficiency score for firm i will be given by

$\text{technical efficiency} = e^{-u}$..2.16

2.4 Overview of theoretical literature

Productivity can be measured using partial measures such as labour productivity, since labour is not the single factor that determines productivity it is advisable to estimate total factor productivity, which is the true theoretical measure of productivity. Therefore, the current study estimated productivity changes based on total factor productivity.

To measure TFP change one can use PIN methods or frontier methods. PIN methods are easy to interpret and estimate. However, these methods not only ignore inefficiency but also do not allow for the decomposition of the estimated TFP indices. In addition, PIN methods require quantity and price data that is seldom available especially for service industries such as insurance. Consequently, the current study used DEA since it incorporates inefficiency and allow for the decomposition of the obtained TFP index. Moreover, DEA does not require price data to estimate the production technology.

Frontier methods are characterised by DEA and SFA. SFA imposes a priori functional form over data and makes distributional assumptions about the error terms. On the other hand, DEA does not impose any functional form on the data nor make any distributional assumptions for the inefficiency term. As a result, SFA is computationally demanding compared to DEA especially when a study is not focusing on the algebraic relationship between inputs and outputs.

As observed in equation 2.15 SFA allows firms to deviate from the frontier due to purely random shocks and inefficiency. Contrary to this DEA allows firms to deviate from the frontier because of inefficiency only. Consequently, SFA has been criticised for confounding inefficiency with measurement errors. Therefore, the study used DEA.

2.5 Empirical literature

2.5.1 General Empirical Literature

Barbara and Claudia (2002) analysed the relevance of off balance sheet items in explaining productivity change in the European banking. The study was motivated by increased growth in bank income generated through non-traditional activities especially for large EU universal institutions. The study used non-parametric data envelopment analysis to estimate the Malmquist productivity change index with off balance sheet items as one of the outputs. The obtained total factor productivity index was decomposed to obtain the sources of the changes. The study found out that exclusion of off balance sheet items under estimate the Total factor productivity change for European banking. In addition, inclusion of off balance sheet items affects the technological component than the efficiency change component.

Our current study is similar to this study in that it seeks to estimate total factor productivity change for the Kenyan non-life insurance sector and decompose it to obtain its sources. More over, the study will use non-parametric data envelopment analysis to obtain the total factor productivity index. However, our current study differs from this study in terms of motivation as it seeks to estimate total factor productivity change to get productivity gains due to the reforms undertaken to develop the non life insurance sector.

Gachanja (2008) studied the total factor productivity change in the Kenyan manufacturing sector using a Malmquist index analysis. The study was motivated by the fact that many developing countries have embraced industrialization as a means of achieving structural transformation of their economies. This study estimated total factor productivity change and decomposed it into efficiency change and technological change using non-parametric data envelopment analysis. The study found out that there had been an overall decline in productivity of about 8.3 percent which was occasioned by a 17.8 percent decline in efficiency over the study period despite there being an overall technical progress of about 11.5 percent.

Our current study is quite similar to this study as it seeks to estimate total factor productivity change for Kenyan non-life insurance sector using non-parametric data envelopment analysis. In a similar way the current study will decompose the total factor productivity change indices obtained into efficiency and technological change to establish its sources. However, the current study differs in terms of the sectors under investigation. Gachanja focused on a goods sector whereas our current study focuses on a service sector.

Kamau (2010) investigated efficiency and productivity in the banking sector in the post liberalization period in Kenya. The study was motivated by the fact the banking sector constitutes a large part of the financial system in Kenya yet little is known about the efficiency status and factors that determine inefficiency. The study estimated efficiency scores and the productivity gains in the post liberalization period, X-inefficiency and the factors determining X-inefficiencies in the banking sector in Kenya.

The study used non-parametric Data Envelopment Analysis and parametric stochastic frontier approach to analyze measures of various aspects of efficiency in the banking sector. Later on, the study used the Malmquist Productivity Index to measure productivity gains of banks in Kenya. The study found out that though the banks were not fully efficient in all respects, they performed fairly well during the period under study. In addition, banks have reason and scope to improve performance by improving their technology, skills and enlarging their scale of operations to be fully efficient.

Our current study seeks to satisfy similar curiosity as little is known about total factor productivity change in the Kenyan non-life insurance. The current study differs with this investigation by focusing on both efficiency change and technological change. More over, the current study does not focus on estimating efficiency but total factor productivity change. Though this is the case, the current study will use non-parametric DEA just like the investigation.

2.5.2 Empirical Literature Specific to Insurance

Cummins *et al* (1996) studied the productivity and technical efficiency of Italian insurance industry for the period 1985-1993 using DEA to estimate Malmquist indices. The study found out that the cumulative productivity change for the period was 0.738 which is less than one. This implies that most firms experienced a decline in productivity during the study period. The study used the three main roles played by insurance firms to come up with the inputs and outputs. It used real claims incurred as the output for risk pooling and bearing as well as provision of real services whereas real total invested assets were taken to be the output for the intermediation role. Our current study adopts these functions in defining outputs for non-life insurers. Contrary to Cummins study that used a constant returns to scale technology assumption, our current study assumes a variable returns to scale technology which is a tenable assumption for insurance firms bearing in mind that they experience government interference through insurance regulators (Coelli *et al,* 2005). In addition the study did not focus on the sources of productivity change.

Barros *et al* (2005) evaluated the efficiency and productivity of insurance companies in Portugal for the period 1995 to 2001 using DEA and Malmquist indices. The study found out that some companies experienced productivity growth while others experienced a decline. The study used claims settled and profits as the outputs for non-life insurers. However, our current study will not use profits as an output since it considers the three roles played by non-life insurers. That is the output for risk pooling and bearing as well as provision of real services is claims incurred and that of intermediation is total investment assets. Following the same approach the study will not use investment income as an input, rather it will treat it as an outcome of investment activities whose input is capital. In addition, our current study does not use premiums used as inputs since premiums represent sales made by the insurance firms. These sales are backed up by capital which is a promise that they are able to pay losses that are larger than expected.

Cummins and Xie (2008) analyse productivity and efficiency effects of mergers and acquisitions in U.S property liability industry during the period 1993 to 2003 using DEA and Malmquist productivity indices. The study found out that acquiring firms achieved more efficiency than non acquiring firms. Further to this, the study used administrative labour, agent labour and financial equity as inputs for non-life insurers and incurred claims and invested assets as proxies for non-life insurers output. Our current study not only borrows their definition of inputs and outputs but also derives motivation from their work as the insurance sector has experienced change in regulation and a number of firms are currently separating their life and non-life business. However, this study did not focus on the sources of productivity change which our current study seeks to establish.

Managi *et al* (2008) studied productivity change of Nigerian insurance companies for the period 1994 to 2005 using non parametric Luenberger productivity model. The study found out that most firms experienced a decline in productivity during the period. The main drive for the study was to rank the companies analysed with a view of informing the ranked firms how their productivity could be upgraded. Our current study will rank non-life insurance firms according to their average productivity change and this will inform them of how well they are doing in terms of improving the productivity. Further, to this the study decomposed the estimated values of TFP index in order to gain a better understanding of the relative importance of each component of productivity change. The current study too will decompose the TFP indices obtained to identify the sources of TFP change in the Kenyan life insurance sector.

Martinez and Estrada (2009) studied the efficiency and productivity change in the Colombian insurance market for the period 1998 to 2007 using non parametric mathematical programming approach (DEA). They found out that there has been a significant gain in efficiency and productivity mainly driven by technological change. Our study seeks to satisfy similar curiosity on whether there has been an improving or declining productivity change in the Kenyan non-life insurance sector using DEA as it does not confound efficiency estimates with specification errors and does not require a priori specification of the functional form.

Muli (2010) studied the technical efficiency of the Kenyan life insurance sector for the period 2004-2009. The study found out that the sector is 57.9 percent efficient and therefore has a 47.1 percent potential to improve efficiency. The study used labour, business services, materials debt capital and equity capital as inputs whereas claims incurred and additions to reserves were used as outputs. The use of additions to reserves as an output for insurers has been put into questions as reserves change when policies age, regardless of whether new policies are sold. In addition reserves measure a change in liabilities rather than the productive effort of an insurer (Greene, 2004). Our current study avoids this error by taking investments by non-life insurers as the output for their intermediation role. Though this study did not have an objective of showing how efficiency has changed over time, the study estimated the productivity change for the life insurance sector and found out that productivity change for the period 2004-2009 was 0.831 which is less one. This implies that most life insurers experienced a decline in productivity over the period. Our current study seeks to fill the gap left on estimating productivity change for non-life insurers.

2.6 Overview of empirical literature

From the reviewed literature there appear to be no consensus on the choice of outputs for insurers. For instance, Barros *et al*, 2005 use profits and claims paid as outputs, Cummins et al, 1996; Greene, 2004; Cummins and Xie, 2008; Martinez and Estrada, 2009 use total investment assets and claims incurred as outputs. However, this task is simplified when one considers the main roles played by non-life insurance providers. Non-life insurers perform three main services namely: risk pooling and risk bearing, real financial services relating to risk management and insured losses, and financial intermediation services (Cummins and Xie, 2008). In keeping with these functions the current study measured output from risk pooling and bearing and real financial services relating to risk management with losses incurred which is proxied by claims incurred by non-life insurers in Kenya. For intermediation the output, is be proxied by investments assets by non-life insurers. To be consistent with this approach, the study used administrative expense, commission expense and capital as the inputs for non-life insurers.

The literature reveals that most studies such as Cummins et al, 1996; Barros *et al*, 2005 estimated productivity growth using DEA and decomposed the obtained TFP indices to obtain its sources. Our current study adopted this strategy as it sought to estimate and decompose TFP change for the Kenyan non-life insurance sector.

Further to this the reviewed literature reveals that most work is based on US and European firms. Previous studies on the Kenyan insurance industry have focused on efficiency (Muli, 2010) and quality of services offered by Kenyan insurers (Rand, 2004). None of the studies attempted to measure TFP change in the Kenyan non-life insurance sector. Therefore, the current study sought to fill this gap.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

Based on the reviewed theoretical and empirical literature, this section deals with the estimation of output distance functions required to estimate TFP change indices. The chapter is divided into five sections namely; research design, theoretical framework, the empirical model, definition and measurement of variables and data collection and analysis.

3.2 Research design

The study used non-experimental research design since it sought to examine non-life insurers as they are in terms of total factor productivity change. It adopted the panel design under non-experimental design, as it used panel data. Since the study used non-parametric DEA in the estimation of total factor productivity change quantitative data on inputs and outputs for non-life insurers was used.

3.3 Theoretical framework

Suppose a firm uses an N dimensional vector of non negative real input x, to produce an M dimensional output vector q. The production possibilities can be represented by the technology set S:

$S = \{(\mathbf{x}, \mathbf{q}): \mathbf{x} \text{ can produce } \mathbf{q}\}$ …………......……………………………. .3.1

The set consists of all input output vectors such that x can produce q. From 3.1 the output set is defined as:

$P(\mathbf{x}) = \{\mathbf{q}: \mathbf{x} \text{ can produce } \mathbf{q}\} = \{\mathbf{q}: (\mathbf{x}, \mathbf{q}) \in S\}$. ……………………… ...3.2

To know how the firm was efficient in the production process, the output distance function is used. It is defined as the maximum scaling $\frac{1}{\delta}$ (θ) such that θ defines the amount by which output could have been expanded given the inputs used, if technology for a certain period had been fully utilised. That is

$d_0(\mathbf{x}, \mathbf{q}) = \min \{\delta: (\mathbf{q}/\delta) \in P(\mathbf{x})\}$ ……………………..…..3.3a or

$[d0(\mathbf{x}, \mathbf{q})]^{-1} = \max \{\theta: (\theta\mathbf{q}) \in P(\mathbf{x})\}$……………..……3.3b

Suppose that we are measuring productivity change from period s to t with the associated input output vectors (x_s, q_s) and (x_t, q_t) respectively. The output oriented period s Malmquist index (m_o^s) defined as a ratio of technical inefficiency in period s will be given by:

$$m_o^s(q_s, q_t, x_s, x_t) = \frac{d_o^s(q_t, x_t)}{d_o^s(q_s, x_s)} \quad \text{………………………………………3.4}$$

where d_o^s is the output oriented distance function based on period s technology, similarly the Malmquist index based on period t technology is given by:

$$m_o^t(q_s, q_t, x_s, x_t) = \frac{d_o^t(q_t, x_t)}{d_o^t(q_s, x_s)} \quad \text{…………………………………………...3.5}$$

To avoid an arbitrary choice of the technology, the Malmquist TFP change index from period s to t is defined as the geometric mean of 3.4 and 3.5

$$m_o(q_s, q_t, x_s, x_t) = \left[m_o^s(q_s, q_t, x_s, x_t) . m_o^t(q_s, q_t, x_s, x_t)\right]^{0.5} \quad \text{…..............…..3.6}$$

To calculate 3.6 four distance functions namely $d_o^s(q_s, x_s)$, $d_o^t(q_t, x_t)$, $d_o^s(q_t, x_t)$ and $d_o^t(q_s, x_s)$ are needed. To obtain the sources of TFP change the Malmquist TFP index obtained in equation 3.6 is decomposed into efficiency change and technical change. Since most of the distance functions are less than or equal to one (there is technical inefficiency) equation 3.6 is equivalent to

$$m_0(q_s, x_s, q_t, x_t) = \frac{d_0^t(q_t, x_t)}{d_0^s(q_s, x_s)}\left[\frac{d_0^s(q_t, x_t)}{d_o^t(q_t, x_t)} \times \frac{d_0^s(q_s, x_s)}{d_0^t(q_s, x_s)}\right]^{1/2} \quad \text{...3.7}$$

The first ratio in equation 3.7 represents technical efficiency change from period s to t whereas the one in parenthesis represents technical change from period s to t. Therefore, from the decomposition efficiency and technical change are given by:

$$\text{Efficiency change} = \frac{d_0^t(q_t, x_t)}{d_0^s(q_s, x_s)} \quad \text{..3.8}$$

and

$$\text{Technological Change} = \left[\frac{d_0^s(q_t, x_t)}{d_o^t(q_t, x_t)} \times \frac{d_0^s(q_s, x_s)}{d_0^t(q_s, x_s)}\right]^{1/2} \quad \text{....................................3.9}$$

Under the assumption of variable returns to scale (VRS) the technical efficiency change (3.8) can further be decomposed into scale efficiency change and pure technical efficiency change..

3.4 Empirical model

In this study, TFP change was measured using two outputs (q_1 and q_2) and three inputs (x_1 , x_2 and x_3). Therefore, equation 3.6, 3.8 and 3.9 become

$$m_o\left(q_{1t}, q_{2t}, q_{1s}, q_{2s,} x_{1t}, x_{2t}, x_{3t}, x_{1s}, x_{2s}, x_{3s}\right) =$$

$$\left[\frac{d_o^t(q_{1t}, q_{2t}, x_{1t}, x_{2t}, x_{3t})}{d_o^t(q_{1s}, q_{2s}, x_{1s}, x_{2s}, x_{3s})} \; \frac{d_o^s(q_{1t}, q_{2t}, x_{1t}, x_{2t}, x_{3t})}{d_o^s(q_{1s}, q_{2s}, x_{1s}, x_{2s}, x_{3s})}\right]^{0.5} \quad \text{...3.10}$$

Where

q_{1t}, q_{1s} are real claims incured by a non life insurer in period t and s

q_{2t}, q_{2s} are real total investment assests by a non life insurers in period t and s .

x_{1t}, x_{1s} is real total paid up capital by a non life insurer in period t and s respectively

x_{2t}, x_{2s} are real administrative expenses incurred by a nonlife insurer in period t and s

x_{3t}, x_{3s} are real agent labour costs incurred by a non life insurer in period t and s

To obtain the sources TFP productivity change index obtained in 3.10. The index were to be decomposed into technical efficiency change (T.E) and technological change (T.C) using the following equations.

$$T.E = \frac{d_o^t(q_{1t}, q_{2t}, x_{1t}, x_{2t}, x_{3t})}{d_o^t(q_{1s}, q_{2s}, x_{1s}, x_{2s}, x_{3s})} \quad \text{...}3.11$$

$$T.C = \left[\frac{d_o^s(q_{1t}, q_{2t}, x_{1t}, x_{2t}, x_{3t})}{d_o^t(q_{1t}, q_{2t}, x_{1t}, x_{2t}, x_{3t})} \frac{d_o^s(q_{1s}, q_{2s}, x_{1s}, x_{2s}, x_{3s})}{d_o^t(q_{1s}, q_{2s}, x_{1s}, x_{2s}, x_{3s})}\right]^{0.5} \quad \text{..............................}3.12$$

To estimate 3.10, 3.11 and 3.12 the following four-output distance functions were required.

$d_o^t(q_{1t}, q_{2t}, x_{1t}, x_{2t}, x_{3t}), d_o^s(q_{1s}, q_{2s}, x_{1s}, x_{2s}, x_{3s}), d_o^t(q_{1s}, q_{2s}, x_{1s}, x_{2s}, x_{3s}), d_o^s(q_{1t}, q_{2t}, x_{1t}, x_{2t}, x_{3t})$

To estimate them, the following DEA linear programming problems were solved.

$[d_o^t(x_{1t,} x_{2t,} x_{3t,} q_{1t,} q_{2t,})]^{-1} = \text{Max}_{\theta\lambda}\ \theta$ 3.13

s.t.

$$-\theta q_{1ti} + (q_{1t1}\lambda_1 + q_{1t2}\lambda_2 + \cdots + q_{1t34}\lambda_{34}) \geq 0$$

$$-\theta q_{2ti} + (q_{2t1}\lambda_1 + q_{2t2}\lambda_2 + \cdots + q_{2t34}\lambda_{34}) \geq 0$$

$$x_{1ti} - (x_{1t1}\lambda_1 + x_{1t2}\lambda_2 + \cdots + x_{1t34}\lambda_{34}) \geq 0$$

$$x_{2ti} - (x_{2t1}\lambda_1 + x_{2t2}\lambda_2 + \cdots + x_{2t34}\lambda_{34}) \geq 0$$

$$x_{3ti} - (x_{3t1}\lambda_1 + x_{3t2}\lambda_2 + \cdots + x_{3t34}\lambda_{34}) \geq 0$$

$$I1'\lambda = 1$$

$$\lambda \geq 0$$

Where,

$\lambda = (\lambda_1, \lambda_2, \lambda_3, \ldots \lambda_{34})$

$I1'$ is a 34x1 vector of ones.

$\mathrm{i} = 1,2,3, \dots ,34$

q_{1ti} − real claims incured by non life insurer i in period t

q_{2ti} − real total investment assests by non life insurer i in period t.

x_{1ti} − real total paid up capital by non life insurer in period t

x_{2ti} − real administrative expenses incurred by non life insurer i in period t.

x_{3ti} − real agent labour cost incurred by non life insurer i in period t

θ − is a scaler providing information on technical efficiency score of firm i.

$d_0^s(x_{1s}, x_{2s}, x_{3s,}\ q_{1s,}\ q_{2s})$ is a variant of equation 3.13. Where a production point is compared to technologies from different time periods such as in $d_0^t(x_{1s}, x_{2s}, x_{3s,}\ q_{1s,}\ q_{2s})$. The linear programming problem were given by:

$[\mathrm{d}_\mathrm{o}^\mathrm{t}(\mathrm{x}_{1\mathrm{s},}\ \mathrm{x}_{2\mathrm{s},}\ \mathrm{x}_{3\mathrm{s},}\ \mathrm{q}_{1\mathrm{s},}\ \mathrm{q}_{2\mathrm{s},})]^{-1} = \mathrm{Max}_{\,\theta\lambda}\ \theta$ ………………………...................3.14

s.t.

$$-\theta q_{1si} + (q_{1t1}\lambda_1 + q_{1t2}\lambda_2 + \cdots + q_{1t34}\lambda_{34}) \geq 0$$

$$-\theta q_{2si} + (q_{2t1}\lambda_1 + q_{2t2}\lambda_2 + \cdots + q_{2t34}\lambda_{34}) \geq 0$$

$$x_{1si} - (x_{1t1}\lambda_1 + x_{1t2}\lambda_2 + \cdots + x_{1t34}\lambda_{34}) \geq 0$$

$$x_{2si} - (x_{2t1}\lambda_1 + x_{2t2}\lambda_2 + \cdots + x_{2t34}\lambda_{34}) \geq 0$$

$$x_{3si} - (x_{3t1}\lambda_1 + x_{3t2}\lambda_2 + \cdots + x_{3t34}\lambda_{34}) \geq 0$$

$$I1'\lambda = 1$$

$$\lambda \geq 0$$

The variables are as defined in equation 3.10 and 3.13. $d_0^s(x_{1t}, x_{2t}, x_{3t,}\ q_{1t,}\ q_{2t})$ is a variant of equation 3.14.

To know the number of LPs to calculate the following formula was used. If there is T time periods, then (3T-2) LPs must be solved for each firm in the sample. Hence, if there are I firms, then there are I×(3T-2) LPs to be solved. In our case we shall have 32 x (3x5-2)= 416. Each LP produced a θ and a λ vector. The θ parameter provides information on the technical efficiency score for the ith firm and the λ vector provides information on the peers of the (inefficient) ith firm. The peers of the ith firm are those efficient firms that define the facet of the frontier against which the (inefficient) ith firm was be projected.

3.5 Definition and measurement of variables

As guided by empirical literature outputs and inputs of non-life insurers are easily defined by considering their three roles namely; risk pooling and bearing, provision of real financial services and financial intermediation. Based on these roles table 3.1 summarizes the definition and measurement of outputs and inputs for non-life insurers. All the variables were measured in terms of Kenyan shillings. Deflation of these variables produced real figures based on 2001 prices. The nominal values for the variables were as reported in the IRA's annual reports.

Table 3.1 Measurement of variables

	Variable	Description
Outputs	q_1	Real claims incurred by a non-life insurer in a particular year.
	q_2	Real investment assets by a non-life insurer in a particular year
Inputs	x_1	Real total paid up capital by a non-life insurer in a given year
	x_2	Real administrative costs which are given by managerial expenses incurred by a non-life insurer in a given year
	x_3	Real agent labour costs which are given by commission expenses incurred in a particular year by a non-life insurer

Source: Author

Non-life insurers are unique in the sense that they have to increase some inputs such as paid up capital in order to cover more risks. Therefore, correlation analysis was used to show appropriateness of variables as observed by Avkiran (1990)

3.6 Data collection and analysis

To achieve the objectives of the study, secondary data on inputs and outputs for the 32 non-life insurers for the period 2005 to 2009 was obtained from IRA annual reports. The data was deflated using GDP deflators for the various years to obtain real figures. The data was arranged in panel form to fit data envelopment analysis programme (DEAP). DEAP simultaneously estimated and decomposed the TFP change indices.

CHAPTER FOUR

RESEARCH FINDINGS

4.1 Introduction

This chapter presents the study findings. Section 4.2 gives the preliminary analysis of the data and the test results for appropriateness variables; section 4.3 gives the TFP change indices for the non-life insurance sector whereas section 4.4 gives the sources of TFP change.

4.2 Descriptive statistics for outputs and inputs

Table 4.1 shows the mean and standard deviation for the output and input variables.

Table 4.1: Mean and Standard Deviation for Outputs and Inputs (000)

Year		2005	2006	2007	2008	2009
claims incurred	Mean	175750	196560	202446	215775	232063
	Standard deviation	223225	252199	312473	269758	295418
Total investments	Mean	333515	378586	391863	375332	434563
	Standard deviation	880067	693335	679527	649212	612466
Total paid up capital	Mean	116047	120941	128975	131953	167539
	Standard deviation	70222	77188	76985	64625	71044
Administrative Expense	Mean	104011	103695	124828	122485	111149
	Standard deviation	88083	96353	114512	118616	148975
Commission expense	Mean	49790	54669	58010	62606	59633
	Standard deviation	67176	67486	73335	120979	70581

Source: own calculation

The figures show that for all the outputs and inputs under consideration the standard deviation is higher than the mean. The finding implies that non-life insurers in Kenya have a high level of heterogeneity, since the variations are on inputs and outputs; the high standard deviation shows heterogeneity in the scale of operations by non-life insurers. Greene (2004) found similar results on the US life insurance industry. It should be noted that this will not pose a problem to our estimation method since DEA ignores the scale differences among decision-making units (Coelli et al, 2005).

Table 4.2 shows the correlation between inputs and outputs. Non-life insurers are unique in the sense that they have to increase some inputs such as paid up capital in order to cover more risk. Avkiran (1990) observes that correlation can be used to show appropriateness of variables.

Table 4.2: Correlation between outputs and inputs

	Claims incurred	total investments	Total paid up capital	Administrative expense
Claims incurred	1 0.000			
total investments	.587** 0.000	1 0.000		
Total paid up capital	.634** 0.000	.574** 0.000	1 0.000	
Commission expense	.558** 0.000	.299** 0.000	.413** 0.000	
administrative expense	.690** 0.000	.483** 0.000	.531** 0.000	1 0.000

**correlation is significant at 1% level of significance

Source: own calculations

Table 4.2 shows that there is positive correlation between the various inputs and outputs. That is the variables chosen as outputs and inputs move in the same direction. These results reinforce the fact that non-life insurers have to increase inputs such as capital in order to cover more risks. The high positive correlation shows that the variables chosen are appropriate for estimating the performance of non-life insurers in terms of TFP change.

4.3 Total factor productivity change

Table 4.3 shows the Malmquist TFP change indices for the entire non-life insurance sector.

Table 4.3: TFP change indices for the Kenyan non-life insurance sector

Period	Total factor productivity change
2005-2006	1.037
2006-2007	0.931
2007-2008	1.040
2008-2009	1.107
MEAN	1.027

Source: own calculations

The figures show that the TFP change index for the period 2005 to 2006 was 1.037, which is greater than one. Therefore, it shows that there was improvement in productivity from 2005 to 2006 of 3.7 percent. The table further reveals that it is only in the one period, 2006 to 2007, that the entire sector experienced a decline in TFP of 6.9 percent. The mean for the entire period is 1.027 implying that the sector experienced an overall improvement in TFP of 2.7 percent. This could be attributed to 11.4 percent technological progress whose gains were eroded by 7.8 percent deterioration in efficiency (see table 4.9). These results are contrary to Muli (2010) whose study shows that the life insurance sector in Kenya experienced a 16.9 percent decline in TFP over the same period and Cummins *et al* (1996) who found out that the Italian insurance industry experienced a 3.5 percent decline in TFP for the period 1985 to 1993.

Table 4.4 shows Mann Whitney test for equality of TFP change indices in the Kenyan non-life insurance sector.

Table 4.4: Mann Whitney test for equality of TFP change indices

Period	2005-2006	2006-2007	2007-2008
2005-2006			
2006-2007	0.368		

2007-2008	0.444	0.856	
2008-2009	0.502	0.289	0.629
Note: Probability values reported			

Source: Own calculation

From the test results in table 4.4, the null hypothesis of equality in the TFP change indices in the various periods was not rejected at the 5% level significance. This means that TFP change for the various periods are equal. This could be attributed to consistent organizational structure and resource utilization patterns by non-life insurers.

Figure 4.1 shows the K-S test comparison percentile plot for TFP change indices.

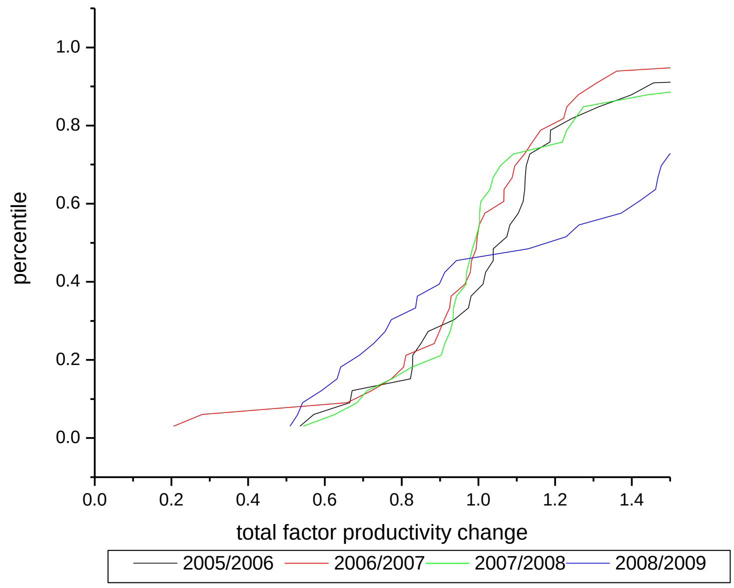

Figure 4.1: Kolmogorov-Smirnov test comparison percentile plot of TFP change indices
Source: own calculations

Figure 4.1 shows that there is no systematic difference in the TFP change indices since the distribution curves cross and overlap at different points. For example, the TFP change indices for the periods 2006-2006, 2006-2007 and 2007-2008 cross at the lower and upper ends of the curves. However, TFP change indices for the period 2008-2009 dominate the other periods at the upper end of the curves.

Table 4.5 shows K-S test for similarity of distribution in TFP change indices.

Table 4.5: Kolmogorov-Smirnov test for similarity of distribution in TFP change indices

PERIOD	2005-2006	2006-2007	2007-2008
2005-2006			
2006-2007	0.627		
2007-2008	0.27	0.964	
2008-2009	0.088	0.01	0.088
Probability values reported			

Source: own calculations

The results revealed that there was difference between the distribution for period 2008-2009 and any other at 10% level of significance. This means that the distribution of TFP change indices for the period 2008 to 2009 is different compared to the other periods. This could be attributed to the post election violence, which made non-life insurers shy away from making investments.

Table 4.1 shows that the standard deviations for inputs and outputs is higher than their mean implying that there is a high level of heterogeneity in the scale of operations for Non-life insurers. Therefore, non-life insurers can be classified according to their size. There is no standard classification of non-life insurers using their size (IRA, 2009). For the purposes of this study, non-life insurers are categorized into three groups using total paid up capital. The study used the 2009 total paid up capital since it is compliant with the new reforms that require non-life insurers to raise their paid up capital. The highest total paid up capital in the sector in real terms is Kshs. 365,800,000 the lowest is Kshs. 59,000,000. Due to this range, firms with real capital less than Kshs. 161,000,000 are considered small those with real capital between Kshs. 161,000,000 and Kshs 264,000,000 are considered medium sized. Lastly, those with real capital exceeding Kshs 264,000,000 are considered large. The study assumes that non-life insurers in the same group are homogenous in nature and portray the similar characteristics. The classification yielded 5 large, 16 medium and 11 small non-life insurers. Figure 4.2 shows the distribution of TFP change indices for these categories.

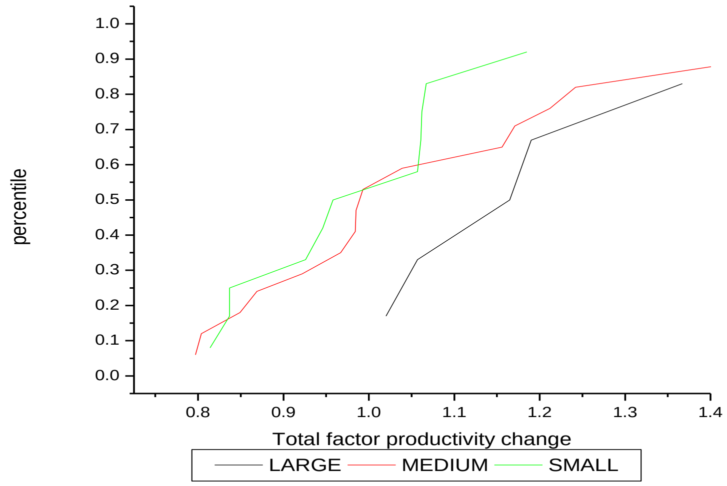

Figure 4.2: KS-test comparison percentile plot for TFP change indices for large, medium and small non-life insurers.
Source: Own calculations

Figure 4.2 shows that there is systematic difference between the distributions for the large non-life insurers and small & medium, since the distribution curve for large non-life insurers does not cross or overlap the distributions curves for medium and small non-life insurers. The figure further shows that the TFP change indices for large non-life insurers dominate those of small and medium insurers at all points. This means that the TFP change indices for large non-life insurers at all points are larger compared to those of medium and small non-life insurers. More over, figure 4.2 shows that the distribution curves for medium and small non-life insurers cross at various points implying that there is no systematic difference between the distributions for the small and medium non-life insurers.

4.4 Sources of TFP change

The second objective of the study was to establish the sources of TFP changes. TFP changes were decomposed into two main sources, technological change and efficiency change. Since, the study assumed a variable returns to scale technology the efficiency change component was decomposed into pure efficiency change and scale efficiency change. This section examines the TFP changes and seeks to identify whether the changes were sourced from efficiency changes or technical changes. Table 4.6 shows the sources of TFP change for non-life insurers for the period 2005 to 2009.

Table 4.6: Sources of TFP change for non-life insurers for the period 2005 to 2009

Period	Efficiency change	Technological change	Pure efficiency change	Scale efficiency change	Total factor productivity change
2005-2006	0.892	1.162	0.911	0.979	1.037
2006-2007	1.015	0.918	1.016	0.999	0.931
2007-2008	1.025	1.014	1.025	1.000	1.040
2008-2009	0.778	1.424	0.848	0.917	1.107
MEAN	0.922	1.114	0.947	0.973	1.027

Source: Own calculation

Table 4.6 shows that there was an overall deterioration in efficiency for non- life insurers for the period 2005 to 2009 of 7.8 percent. However, there was an overall improvement in technology of 11.4 percent during the same period. The improvements in technology are contrary to IRA position that non-life insurers are not innovative. Therefore, the 2.7 percent improvement in TFP for the entire period could be attributed to improvement in technology. Infact, deterioration efficiency only eroded the technological gains.

The 11.4 percent improvement in technology implies that non-life insurers required less input to produce the same level of output in 2005. These results are contrary to Muli (2010) whose study showed that the life insurance sector in Kenya experienced 7.4 percent deterioration in technology over the same period and Cummins *et al* (1996) whose study found out that the Italian insurance industry experienced a 3.4 percent decline in technology for the period 1985 to 1993. Efficiency is made up of two components pure efficiency change and scale efficiency change. The decomposition of efficiency change into the two components reveals that the 7.8 percent decline was occasioned by 2.7 percent decline in scale efficiency and 5.3 percent decline in pure efficiency.

The decline in scale efficiency shows that non-life insurers have abandoned some products. This evidenced by data from IRA which shows that investment channels such as investing in local government securities, debentures and preference shares are no longer popular among most non-life insurers. Therefore, to improve efficiency non-life insurers need to improve scale efficiency by ensuring product survival or substituting declining products with better ones. The decline in pure efficiency shows that resources invested by non-life insurers are under utilized. To improve pure efficiency non-life insurers need to improve their managerial skills and achieve a better balance between inputs and outputs

Figure 4.3 shows Kolmogorov-Smirnov test comparison percentile plot for technological change indices while figure 4.4 shows Kolmogorov-Smirnov test comparison percentile plot for efficiency change indices.

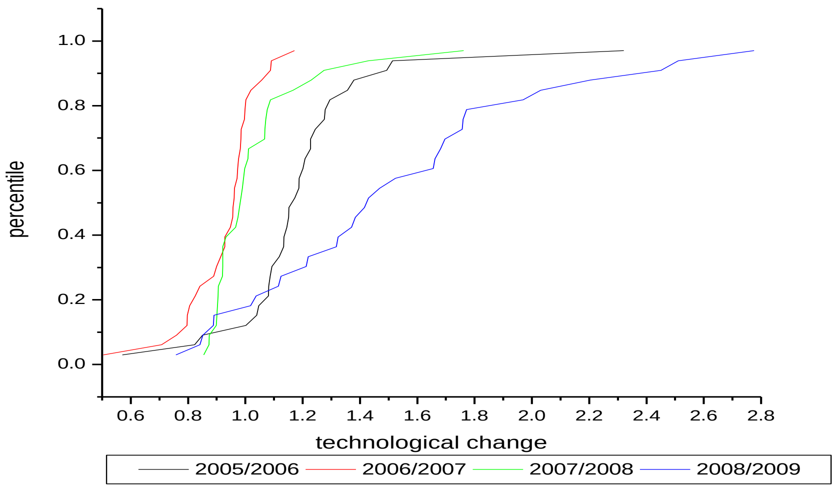

Figure 4.3: KS-test comparison percentile plot for technological change indices
Source: own calculation

Figure 4.3 shows that the distribution curves cross at the lower end only except those for period 2006-2007 and 2007-2008 that cross and overlap at the middle. This means that there is no systematic difference in the technological change indices for periods 2006-2007 and 2007-2008. More over, the figure shows that the technological change indices for the period 2006-2007 were dominated by technological change indices in the rest of the periods. This means that the technological change indices for 2006-2007 were lesser to all the other technological change indices during the study period at almost all points. In addition, the distribution curve for the period 2008-2009 dominates the other periods. This means that technological change indices for period 2008-2009 are greater than those of the rest of the periods at almost every point.

A test for the similarity of the distribution of technological change indices between the periods was conducted using the non-parametric K-S test (see table 4.7).

Table 4.7: KS-test for similarity of distribution of technological change indices

PERIOD	2005-2006	2006-2007	2007-2008
2005-2006			
2006-2007	0.000		
2007-2008	0.000	0.270	
2008-2009	0.001	0.000	0.000
PROBABILITY VALUES REPORTED			

Source: own calculations

The results revealed that there was difference between the distributions for any other two periods under consideration at 1% level of significance except for the periods 2006-2007 and 2007-2008.

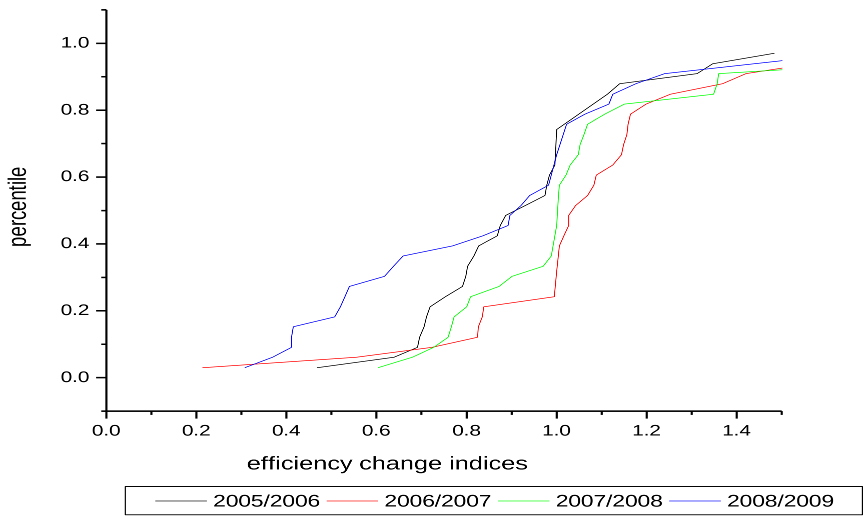

Figure 4.4: KS-test comparison percentile plot for efficiency change indices

Source: own calculation

Figure 4.4 shows that the distribution curves cross and overlap at the lower end, middle and the upper end. This means that there in no systematic difference between the efficiency change indices between the periods. These results are contrary to those found for the distribution of technological change. This was confirmed by the non-parametric K-S test which showed that the distribution was not significantly different at any level of significance (see table 4.8)

Table 4.8: KS-test for similarity of distribution of efficiency change indices

PERIOD	2005-2006	2006-2007	2007-2008
2005-2006			
2006-2007	0.102		
2007-2008	0.388	0.428	
2008-2009	0.189	0.322	0.246
PROBABILITY VALUES REPORTED			

Source: Own calculation

The analysis on the sources of TFP change can further be extended according to the size. Table 4.9 shows the sources of TFP change for each category.

Table 4.9: Sources of TFP change by firm size

Size	**Efficiency change**	**Technological change**	**Pure efficiency change**	**Scale efficiency change**	**Total factor productivity change**
Large	1.000	1.153	1.015	0.985	1.153
Medium	0.930	1.122	0.934	0.996	1.043
Small	0.983	0.988	0.993	0.989	0.971

Source: own calculation

Table 4.8 shows that changes in TFP for the large non-life insurers were exclusively sourced from changes in technology. The 15.3 percent improvement in technology contributed wholly to the 15.3 improvement in TFP for large firms since their efficiency change experienced stagnation during the period. To experience gains in TFP large firms need acquire skills commensurate to work with the improved technology. The table further shows that the growth in TFP for medium sized firms can almost be exclusively attributed to the 12.2 percent improvement in technology. This implies that medium sized firms need to invest in skills commensurate to work with the improved technology. The deterioration in TFP for the small firms can be attributed to a decline in both efficiency and technology. Therefore, small non-life insurers need to invest in both new technology and skills in order to improve their TFP.

CHAPTER 5

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Summary

This study estimated the performance of non-life insurance sector in terms of TFP change and its sources. The study used an output orientation to estimate Malmquist TFP change indices using non-parametric DEA. To obtain the sources of TFP change the Malmquist productivity change indices were decomposed into technological and efficiency change. In addition, efficiency change was decomposed into pure efficiency change and scale efficiency change.

The results revealed that, there was 2.7 percent progress in TFP for the sector. The progress in TFP was sourced from innovations. Further analysis of the TFP changes revealed that there was no systematic difference in the distribution of TFP change indices between the various periods. Categorization of the firms into large, medium and small non-life insurers and consequent plotting of their TFP change indices distribution curves revealed that the TFP change indices for large firms were larger than those of small and medium firms. The categorization further reveals that the progress in TFP for the large and medium non-life insurers was sourced from innovations, whereas the decline in TFP for small non-life insurers was a result of decline in both innovations and efficiency.

The decomposition of efficiency change into scale efficiency change and pure efficiency change revealed that the 7.8 percent decline in efficiency for the entire sector was occasioned by 2.7 percent decline in scale efficiency and 5.3 percent decline in pure efficiency

5.2 Conclusion

The study concludes that during the study period non-life insurance sector experienced growth in total factor productivity. More over, the study concludes that politics adversely influence the investment behaviour of non-life insurers. In addition, the categorisation of firms into small, medium and large firms revealed that large non-life insurers are better in terms of TFP change.

The study further reveals that the growth in TFP can be exclusively attributed to technological progress contrary to insurance regulatory authority's view that non-life insurers are bedevilled by lack of innovation. From the categorization of firms into large medium and small insurers, the study concludes that all the categories have problems with efficiency. The efficiency of large non-life insurers stagnated whereas that of medium and small insurers declined eroding the gains made in technology.

Finally, from the decomposition of efficiency into scale and pure efficiency change, the study concludes that the decline in efficiency for the entire sector can be attributed to deterioration in scale and pure efficiency change.

5.3 Policy implications

In the light of the study findings, the following recommendations are made:

First, for the non-life insurers to continue improving their TFP they need to sustain the high innovations and improve efficiency. To improve efficiency non-life insurers need to improve their level of resource utilization (pure efficiency) and improve on product survival (scale efficiency).

Secondly, large non-life insurers are better than small and medium non-life insurers in terms of TFP change. Therefore, IRA should continue with the efforts to consolidate the non-life insurance sector. Importantly, the study findings can be used to inform consolidation efforts.

Finally, since politics adversely influence the investment behaviour of non-life insurers the government should ensure a peaceful political climate to stimulate investments by non-life insurers.

5.4 Areas for further research

The areas for further research include extending the current to estimate efficiency of non-life insurance sector and its determinants. To study the robustness of the study findings the study proposes the use of parametric methods to estimate total factor productivity change for non-life insurers. Productivity studies do not focus on changes in total factor productivity and technical efficiency only. Therefore, the study proposes estimation of other forms of efficiency such as cost efficiency and profit efficiency for non-life insurers.

REFERENCES

Anderson, A.K., (2004). Deregulation, Disintermediation, and Agency Costs of Debt: Evidence from Japan, *Journal of Financial Economics,* **51(2),** 309–339.

Association of Kenya Insurers (2009). *Insurance Industry Annual Report* Nairobi, Association of Kenya insurance.

Association of Kenya Insurers (2004). *Insurance Industry Annual Report* Nairobi, Association of Kenya insurance.

Avkiran , J., (1999). 'The Evidence on Efficiency Gains: The Role of Mergers and the Benefits to the Public', Journal of Banking & Finance, **23(7),** 991-1013.

Barbara, C and Claudia, G (2002). An analysis of the relevance of OBS items in explaining productivity change in European banking, *Journal of Productivity Analysis*, **8,** 170-190.

Barros, C .P, Barrosso, N and Borges, M. R (2005). Evaluating the Efficiency and Productivity of Insurance Companies with a Malmquist Index: A Case Study for Portugal *the Geneva papers*, **30,** 244-267.

Bernstein, J. I., (1998). Total Factor Productivity Growth in the Canadian Life Insurance Industry: 1979-1989*, Canadian journal of economics*, **32(2),** 500-517.

Chames, A., W.W. Cooper and E. Rhodes (1978), "Measuring the Efficiency of Decision Making Units", European Journal of Operational Research**, 2,** 429-444.

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

Cummins, J.D., Tennyson, S., and Weiss, M. A., (1999). Consolidation and Efficiency in the U.S Life Insurance Industry, Journal *of Banking & Finance* **(23),** 325-357.

Cummins, J. D., and Zi, H., (1996). Measuring Cost Efficiency in the U.S Life Insurance Industry: Econometric and Mathematical Programming Approaches, working *paper series* **97(03)**

Cummins, J. D., Turchelti, G. and Weiss, M. A., (1996). Productivity and Technical Efficiency in the Italian Insurance Industry, *Wharton working paper series* **96(10)**

Diewert, W. E., (1982). Fisher Ideal Output, Input and Productivity Indexes Revisited, *Journal of Productivity Analysis,* **3,** 211-248.

Doherty, N. A., (1981). The Measurement of Output and Economies of Scale in

Property Liability Insurance, *Journal of Risk and Insurance,* **48,** 391-402.

Fare, R., S. Grosskopf and J. Logan (1983), "The Relative Efficiency of Illinois Electric Utilities", Resources and Energy, **5**, 349-367.

Gachanja, P. M (2008). Total Factor Productivity Change In The Kenyan Manufacturing Sector: A Malmquist index analysis. Unpublished PhD thesis.

Greene, W. H. and Segal, D., (2004). Profitability and Efficiency in the U.S Life Insurance Industry , *journal of productivity and analysis,* **21,** 229-247.

Haiss, I. J. And Sumegi N. H (2006) The Relationship of Insurance and Economic Growth .A Theoretical and Empirical Analysis, *journal of growth* **17**, 45-60

Insurance Regulatory Authority (2007). *Report of the Insurance Regulatory Authority for the Year Ended 31st December, 2007,* Nairobi, Insurance Regulatory Authority.

Insurance Regulatory Authority (2009). *Report of the Insurance Regulatory Authority for the Year Ended 31st December, 2009,* Nairobi, Insurance Regulatory Authority.

Insurance Regulatory Authority (2009). *Insurance Regulatory Authority strategic Plan 2008-2012,* Nairobi, Insurance Regulatory Authority.

International Association of Insurance Supervisors (IAIS) (2002). *Principles on the supervision of insurance activities.* October, 2002.

Kamau, W. A (2010). Efficiency in the Banking sector: An empirical investigation of commercial banks in Kenya. Unpublished PhD Thesis

Mutua, C. (2008). Micro Insurance in Eastern Africa Nairobi Swedish Cooperative Centre and Vi Agroforetry

Muli, A. (2010). Efficiency of the life insurance sector in Kenya, unpublished YP 2010/2011

Price water house coopers Kenya limited (2011) *On Financial Services 2011 Risk Survey* Nairobi

Raab, R. And Litchy, R. W (2002). 'Identifying Sub Areas that Comprise a Greater Metropolitan Area: the criterion of county relative efficiency' *journal of regional science* **42(3)** 579- 594.

Rand, G. K., (2004). Diagnosis and improvement of service quality in the insurance industries of Greece and Kenya, *Lancaster University working paper series,* **2004(046).**

Republic of Kenya, (1978). *Kenya Gazette*, Nairobi: Government Printer

Republic of Kenya, (2007). *The Kenya Vision 2030*, Nairobi: Government printer

Swiss Re, (2008). *World Insurance Report,* Zurich: Switzerland

Wachtel, I. P (2001) The Effect of Banking and Insurance on The Growth of Capital and Output *working paper* **2(1),** 156-196

Weber, W. L., (2001). Efficiency and Productivity Change of Non-Life Insurance Companies in Japan, *Pacific Economic Review* **6(1),** 129–146.

Yuengert, A.M., (1993). The Measurement of Efficiency in Life Insurance: Estimates of A Mixed Normal Gamma Error Model, *journal of banking and Finance* **17,** 483-496.

Zhang, Y., and R. Bartels (1998), "The Effect of Sample Size on the Mean Efficiency in DEA: With an Application to Electricity Distribution in Australia, Sweden and New Zealand", *Journal of Productivity Analysis***, 9,** 187-204.

APPENDICES

APPENDIX I: GDP DEFLATORS

Table A1: GDP deflators

year	2005	2006	2007	2008	2009
deflator	120	130	137	156	170
2001=100					

Source: Central Bank of Kenya

APPENDIX II: DATA USED IN ESTIMATING TFP CHANGE

TABLE A2: DATA USED IN ESTIMATING TFP CHANGE

COMPANY	YEAR	CLAIMS INCURRED (q1)	TOTAL INVESTMENT (q2)	TOTAL PAID UP CAPITAL (x1)	COMMISSIONS EXPENSE (x3)	ADMINISTATIVE EXPENSE (x2)
AIG/ CHARTIS****	2005	218786	608769	83302	66902	231058
AMACO	2005	36947	42263	133280	14522	72146
APA INSURANCE	2005	750104	1477372	124950	142231	193232
BLUESHIELD	2005	547414	4459104	83300	145204	434131
BRITISH AMERICAN	2005	57173	189450	83300	43101	65119
CANNON	2005	66037	421229	83300	17079	59410
CFC LIFE	2005	154068	192853	83300	59522	58904
CONCORD	2005	226793	176794	83300	62502	123247
COOPERATIVE	2005	254152	214560	101106	88106	137822
CORPORATE	2005	79399	159421	117120	14120	61670
FIDELITY SHIELD	2005	225781	289651	84133	53703	109993
FIRST ASSURANCE	2005	197256	453637	120785	77940	91353
GATEWAY	2005	140864	337847	107510	20058	109297
GEMINIA	2005	140170	216009	141610	41730	67508
GENERAL ACCIDENT	2005	156711	817601	166600	35279	79970
HERITAGE ALL	2005	330413	1198100	374850	142713	200355
ICEA	2005	321081	505622	208250	121157	147907
INTRA AFRICA	2005	165222	244536	83300	21330	83251
JUBILEE	2005	722019	1417664	308210	127890	225364
KENINDIA	2005	967741	957524	258478	338176	326971
KENYA ORIENT	2005	53531	46562	99960	11232	33482
KENYA ALLIANCE	2005	144566	1307041	83300	46810	101381
LION OF KENYA	2005	387539	1621424	166600	124597	117057
MADISON	2005	350793	198461	83300	57808	147921
MERCANTILE	2005	41245	209486	124950	26738	65218
OCCIDENTAL	2005	173797	113349	87465	25654	96270
PHOENIX	2005	92507	685018	124950	36086	90230
REAL	2005	191095	97309	83300	68462	108237
TAUSI	2005	223029	169852	87465	85926	75780
THE MONARCH	2005	23126	10532	83383	6235	36259
TRIDENT	2005	148969	190164	83300	25661	42475
UAP PROVINCIAL	2005	449414	2094285	166600	171098	232592
AIG/	2006	277129	540919	123202	206621	245614

CHARTIS****						
AMACO	2006	62964	38249	123200	22030	95962
APA INSURANCE	2006	761071	2082523	192500	174218	224489
BLUESHIELD	2006	614640	519842	154000	92771	433210
BRITISH AMERICAN	2006	74399	137001	77000	54474	62195
CANNON	2006	98971	448577	77000	26918	66844
CFC LIFE	2006	418125	384936	77000	70251	72820
CONCORD	2006	209252	169597	92400	50467	107460
COOPERATIVE	2006	375715	346140	99077	88592	192038
CORPORATE	2006	87166	168326	77000	19092	71803
FIDELITY SHIELD	2006	231520	295638	85547	60327	111475
FIRST ASSURANCE	2006	223236	484779	110110	85803	94603
GATEWAY	2006	127853	358841	115500	17239	111334
GEMINIA	2006	134567	207975	142450	38843	66645
GENERAL ACCIDENT	2006	265566	722991	154000	37621	16987
HERITAGE ALL	2006	326671	1209180	346500	132432	252780
ICEA	2006	346122	605586	192500	131128	138118
INTRA AFRICA	2006	148407	267351	77000	16627	73365
JUBILEE	2006	903403	1783276	284900	134682	256331
KENINDIA	2006	1110490	865594	200429	324209	321544
KENYA ORIENT	2006	69614	58039	92400	17589	43872
KENYA ALLIANCE	2006	195135	1251021	77000	39141	76992
LION OF KENYA	2006	411524	1723149	154000	124962	113877
MADISON	2006	202300	396384	77000	53436	163660
MERCANTILE	2006	53492	192480	115500	20385	64960
OCCIDENTAL	2006	181823	136562	80850	38872	84025
PHOENIX	2006	77450	899329	115500	36760	98122
REAL	2006	216167	129176	100100	80238	92079
TAUSI	2006	240100	282119	96211	82171	79459
THE MONARCH	2006	12117	76867	166667	10785	39017
TRIDENT	2006	165072	255517	77000	30907	40426
UAP PROVINCIAL	2006	407211	3088913	385000	129485	284437
AIG/ CHARTIS****	2007	233085	735905	181770	208629	233707
AMACO	2007	124915	67894	116800	35350	145761
APA INSURANCE	2007	980268	2045181	292000	186347	265453
BLUESHIELD	2007	68064	496004	146000	168508	542510
BRITISH AMERICAN	2007	123299	550446	146000	75529	70672
CANNON	2007	129510	566259	73000	53295	84652
CFC LIFE	2007	259368	291876	73000	56425	104974
CONCORD	2007	175456	197914	87600	54354	101475
COOPERATIVE	2007	447686	551514	188958	79462	184418

CORPORATE	2007	102357	142363	73000	23993	74660
FIDELITY SHIELD	2007	212426	462109	136253	63642	107079
FIRST ASSURANCE	2007	317540	607533	109500	103218	108146
GATEWAY	2007	145328	356226	111949	16445	127262
GEMINIA	2007	145458	221410	109500	45979	71990
GENERAL ACCIDENT	2007	157873	749000	146000	46370	115694
HERITAGE ALL	2007	425473	766293	328500	145323	289954
ICEA	2007	339592	718977	182500	122677	203004
INTRA AFRICA	2007	142257	300362	73000	16219	91624
JUBILEE	2007	990744	1811946	270100	154884	260509
KENINDIA	2007	1462525	997562	226518	329069	431555
KENYA ORIENT	2007	93121	134934	144540	21156	58916
KENYA ALLIANCE	2007	151731	1188869	73000	31761	82318
LION OF KENYA	2007	458866	342139	146000	111180	102442
MADISON	2007	239802	219488	73000	43839	100738
MERCANTILE	2007	39016	186572	109500	13487	67564
OCCIDENTAL	2007	207119	201254	114975	33633	103853
PHOENIX	2007	110776	921425	109500	39024	123899
REAL	2007	208770	125623	94900	76373	121804
TAUSI	2007	188412	385096	91213	59222	83862
THE MONARCH	2007	27539	8526	158009	12071	59242
TRIDENT	2007	170141	465304	73000	22977	44259
UAP PROVINCIAL	2007	569625	3360807	365000	201020	323481
AIG/ CHARTIS****	2008	397940	131678	192000	210402	204026
AMACO	2008	218470	168938	136320	639647	176596
APA INSURANCE	2008	982061	1766916	256000	226014	280911
BLUESHIELD	2008	718582	304412	128000	160589	581134
BRITISH AMERICAN	2008	202978	494945	192000	82815	84532
CANNON	2008	161375	595265	192000	48921	79176
CFC LIFE	2008	257566	250698	153600	53254	86540
CONCORD	2008	170374	198608	76800	50931	100855
COOPERATIVE	2008	363736	568837	173731	63077	183296
CORPORATE	2008	105759	179238	64000	20163	66422
FIDELITY SHIELD	2008	192348	248030	131400	61250	98586
FIRST ASSURANCE	2008	333534	757707	153600	113949	108982
GATEWAY	2008	105547	401557	107388	23208	196503
GEMINIA	2008	133891	233564	96000	45118	65370
GENERAL ACCIDENT	2008	205155	632442	128000	62899	176348
HERITAGE ALL	2008	514348	756950	288000	140431	283673
ICEA	2008	427172	407995	160000	79738	188772

INTRA AFRICA	2008	145715	263087	128000	16685	111209
JUBILEE	2008	1067992	1544704	236800	177703	280788
KENINDIA	2008	839686	978614	231688	269147	289953
KENYA ORIENT	2008	117421	170828	147200	27468	97689
KENYA ALLIANCE	2008	60179	983878	64000	14452	103487
LION OF KENYA	2008	451297	1981324	128000	108327	108621
MADISON	2008	180378	201227	64000	44414	82749
MERCANTILE	2008	37402	176647	96000	12924	61608
OCCIDENTAL	2008	215077	218348	134400	34872	100806
PHOENIX	2008	119563	215930	192000	48374	125392
REAL	2008	203153	100632	83200	82550	132389
TAUSI	2008	128213	333055	79967	53053	73700
THE MONARCH	2008	23564	55140	85152	10583	51939
TRIDENT	2008	136616	319844	64000	26376	8682
UAP PROVINCIAL	2008	580181	2976691	288000	217354	428531
AIG/ CHARTIS****	2009	326725	158942	177000	200373	257157
AMACO	2009	324248	327515	250750	189245	205106
APA INSURANCE	2009	1122360	1906280	295000	78170	355784
BLUESHIELD	2009	688030	219401	159890	245914	764700
BRITISH AMERICAN	2009	364928	694329	177000	114433	102010
CANNON	2009	200094	707221	177000	108633	91377
CFC LIFE	2009	302766	200663	271400	56162	124289
CONCORD	2009	246273	213601	70800	62930	100086
COOPERATIVE	2009	468554	574578	168522	49335	223146
CORPORATE	2009	108301	161337	59000	84846	64874
FIDELITY SHIELD	2009	228633	482756	157475	13558	98660
FIRST ASSURANCE	2009	420389	803742	177000	59186	132418
GATEWAY	2009	150652	437979	177000	118638	125795
GEMINIA	2009	130451	277129	88500	27446	68918
GENERAL ACCIDENT	2009	257753	860075	177000	49183	127644
HERITAGE ALL	2009	522027	1328385	265500	76375	275145
ICEA	2009	484452	825734	177000	150469	5879
INTRA AFRICA	2009	123579	233526	118000	130091	97746
JUBILEE	2009	1199996	1982957	365800	19203	284995
KENINDIA	2009	651014	782634	213587	214979	269269
KENYA ORIENT	2009	136882	117532	160480	257100	122567
KENYA ALLIANCE	2009	31550	1030691	177000	26023	105385
LION OF KENYA	2009	450198	1943350	177000	18686	78212
MADISON	2009	184730	101082	177000	105207	62213
MERCANTILE	2009	32106	184030	88500	42698	63295

OCCIDENTAL	2009	234540	238825	185850	13372	97638
PHOENIX	2009	125643	680630	177000	30862	107113
REAL	2009	247301	226701	177000	29276	160654
TAUSI	2009	72541	397484	129778	89934	55987
THE MONARCH	2009	23324	35418	113900	51733	11165
TRIDENT	2009	149539	731632	147500	6592	37884
UAP PROVINCIAL	2009	876151	2301151	354000	29555	440204

**** AIG K changed name to CHARTIS.

Source: Several IRA annual reports.

APPENDIX III: CLASSIFICATION OF FIRMS BY SIZE

Table A3: Classification of firms by size

LARGE FIRMS	MEDIUM FIRMS	SMALL FIRMS
APA INSURANCE	AIG/ CHARTIS****	BLUESHIELD
CFC LIFE	AMACO	CONCORD
HERITAGE ALL	BRITISH AMERICAN	CORPORATE
JUBILEE	CANNON	FIDELITY SHIELD
UAP PROVINCIAL	COOPERATIVE	GEMINIA
	FIRST ASSURANCE	INTRA AFRICA
	GATEWAY	KENYA ORIENT
	GENERAL ACCIDENT	MERCANTILE
	ICEA	TAUSI
	KENINDIA	THE MONARCH
	KENYA ALLIANCE	TRIDENT
	LION OF KENYA	
	MADISON	
	OCCIDENTAL	
	PHOENIX	
	REAL	

Source: Author