UNIVERSITY OF GHANA

DETERMINANTS OF EFFICIENCY IN THE INSURANCE INDUSTRY OF GHANA

BY

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THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MPHIL ECONOMICS DEGREE

DEPARTMENT OF ECONOMICS
SCHOOL OF SOCIAL STUDIES

JULY, 2016
DECLARATION

I, David Mensah Otoo, the author of this thesis titled “DETERMINANTS OF EFFICIENCY IN THE INSURANCE INDUSTRY OF GHANA”, hereby declare that, this work was done entirely by me under supervision at the Department of Economics, University of Ghana, Legon from August 2014 to July 2016.

This work has never been presented either in whole or in part for any other degree at this University or elsewhere, except for past and present literature, which have been duly cited.

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ABSTRACT

Ghanaians do not ordinarily purchase insurance due to their perception of low performance of the insurance companies in Ghana. An attempt to revert this mindset by insurers has resulted into an intense competition, price cutting, high management expenses, and duplication of functions among others. This make insurers face regular complaints of repudiation of claims, delay in settlement of claims, dispute over quantum, and delay in payment of settled claims. Thus, these interventions rather have been aggravating the perception of Ghanaians, deepening the problem year after year in the industry. This study therefore analyses the overall (cost) efficiencies, and their determinants in the insurance industry of Ghana using an unbalanced panel data on thirty (30) insurers from 2005 to 2014 with both DEA and SFA methodologies. It was observed that insurers operating in the industry operated with 81.2% average cost inefficiencies under the DEA model while the SFA model which separates random errors from inefficiencies reported 53.8% cost inefficiencies. Thus confirming the perception of Ghanaians on the performance of companies in the insurance industry. Life insurers were observed to be more cost efficient than non-life insurers but several parametric and non-parametric tests attributed this observation to their operation in different environments with different technologies. From the results, there exist differences in the choice of methodologies in efficiency analysis. But these observed differences were in terms of relationship of determinants and not in terms of determinants since both methods identified reinsurance, business type, capitalization, firm size, market share and regulation as the determinants of cost efficiency in the Ghanaian insurance industry. Based on the finding, the study recommended among other things that, NIC should endeavor to make the industry less stringent by eliminating all bureaucracies and huge financial demands on reinsurance and cultural based policies like agricultural insurance and micro insurance, to increase cost efficiency in the insurance industry.
DEDICATION

This thesis is dedicated to my mother, Mrs. Georgina Acquah for the extraordinary love and care she has shown me throughout the study.
ACKNOWLEDGEMENT

Words cannot explain my appreciation of the grace and mercies of the Lord God towards me throughout this study. He endowed me with the required knowledge and understanding, miraculously provided financial support and placed a seal of favor upon me so as to receive every needed support from people I came into contact with. Elohim, you are indeed the only true God who deserve praise and worship forever and forever.

I greatly appreciate the tireless effort of Prof. A. Baah-Nuakoh and Dr. Michael Danquah whose constructive criticisms and detailed supervision invaluably enriched this study. I am very grateful to Prof. Arne Henningsen who made very critical and insightful comments and shared some useful materials with me on the R statistical software package discussion platform. I cannot overlook the assistance of Mrs. Esther Armah and Mr. Cosmos Amankwah Owusu who helped me obtain the necessary data for the study from National Insurance Commission (NIC).

I am highly indebted to Covenant Family; especially Mr. Emmanuel Acquah, Mrs. Georgina Acquah and Mrs. Esther Obenewaa Omari for their spiritual and financial support which has seen me through this study. They were actually my backbone considering their provision of fees, feeding, printing and transportation cost during the period. I also thank Lawyer Francis Sosu for his purposeful advice and financial support which has really impacted my life and this study. Finally, God bless everyone whose name could not be mentioned here due to lack of space; especially members of my family; my father, Mr. John Oscar Otoo whose wings I have dwelled on in every stage of my life, my sisters; Mrs. Beatrice Owusu-Omari and Mrs. Gifty Asare for their encouragement, financial support and exceptional demonstration of love to me.
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<table>
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<tr>
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<tbody>
<tr>
<td>BC95</td>
<td>Battese and Coelli (1995)</td>
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<td>BOG</td>
<td>Bank of Ghana</td>
</tr>
<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
</tr>
<tr>
<td>COLS</td>
<td>Corrected Ordinary Least Squares</td>
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<td>CPI</td>
<td>Consumer Price Index</td>
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<tr>
<td>CR</td>
<td>Concentration Ratios</td>
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<tr>
<td>CRS</td>
<td>Constant Returns to Scale</td>
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<td>DEA</td>
<td>Data Envelopment Analysis</td>
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<td>DFA</td>
<td>Distribution Free Analysis</td>
</tr>
<tr>
<td>DMU</td>
<td>Decision Making Unit</td>
</tr>
<tr>
<td>FDH</td>
<td>Free Disposable Hull</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>HHI</td>
<td>Herfindahl Hirschman Index</td>
</tr>
<tr>
<td>IAIS</td>
<td>International Association of Insurance Supervisors</td>
</tr>
<tr>
<td>MOLS</td>
<td>Modified Ordinary Least Squares</td>
</tr>
<tr>
<td>NIC</td>
<td>National Insurance Commission</td>
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<tr>
<td>NRCD95</td>
<td>Insurance Amendment Decree of 1972</td>
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<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
</tr>
<tr>
<td>OLS</td>
<td>Ordinary Least Squares</td>
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<tr>
<td>SFA</td>
<td>Stochastic Frontier Analysis</td>
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<td>SIC</td>
<td>State Insurance Corporation</td>
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UN  United Nations

VIF  Variable Instrumental Factor

VRS  Variable Returns to Scale

WHO  World Health Organization

WTO  World Trade Organization
CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The paradigm of agriculture led economic growth in the world’s economies has seen a change in the past few decades, as the service sector rises to dominance over all the other sectors, especially considering it’s 60% contribution of the world’s gross domestic product in 1989 (Outreville, 1990). This trend has attracted a lot of attention from both policy makers and researchers on the service sector through restructuring, regulations, rigorous research and several other innovations. Despite the general rise in the service sector, financial and insurance activities (financial industry) has become the main driver of growth in the sector among the economies in the world. Levine (1997) for instance, argues that the prediction of future rates of economic growth, capital accumulation and technological change depends on the development of the financial industry. These importance of the industry has become irresistible since transactional and informational cost which are the main reasons for its existence would always continue to create the need to mobilize savings, allocate resources, exert corporate controls, facilitate risks management and ease trading of goods and services, which serve as the functions of the industry in every economy.

Several economists and researchers such as Levine, 1997; Beck et al. (2000); Skipper, 2002; and Berger and Humphrey (1997) among others have uniquely expressed the value of the financial industry through their volumes of research on the industry. In the past few decades the trend of studies on the industry have shifted to efficiency analysis since the impact of an efficient industry is more desirable to the economy than just any ordinary industry. Unfortunately, this increase in research is skewed towards banks despite the classification by Beck et al. (2000) of the financial
industry as a composition of central banks, deposit money banks and other financial institutions such as the insurance companies. This trend in the economic literature had veiled the economic significance of insurance expressed by Boonyasai et al. (2002) as promoting financial stability, mobilizing savings, facilitating trade and commerce, enabling risk to be managed more efficiently, encouraging loss mitigation, fostering efficient capital allocation and also serving as a substitute for and complement to government security programs.

Currently, following the various risks related to environmental and globalization challenges in the world as well as the growing awareness of insurance in most economies, economists have intensified their studies on the insurance industry especially studies on efficiency and its determinants. Several other innovations had also stirred up the rise in insurance efficiency studies, notable is the regulation by the European Union to unify all European insurance industries as a single insurance market by 1994 (Kasman and Turgutlu, 2009).

A review of 74 studies on insurance efficiency by Cummins and Weiss (2013) showed a domination of the literature by Europe and United States with scanty studies on Africa. This observation shows a strong neglect of the insurance efficiency literature on developing countries despite the argument of Han et al. (2010) that both life and non-life insurance play a relatively more important economic function in developing countries than they do in more developed parts of the world. Few studies discovered on Africa were limited to South Africa, Kenya, Ghana, Nigeria and Tunisia. The likely reasons for this trend is as a result of the low patronage or performance of insurance in Africa (KPMG Africa, 2014), the unavailability of insurance data for research and the unfavorable religious beliefs especially among the Islamic countries.
Apart from the developed economy bias in the literature, there exist incongruous arguments on factors explaining efficiencies since the knowledge of such factors are essential for improving the results of firms (Lovell, 1993). For instance, while Rai, 1996; Kasman and Turgutlu, 2009; and Bikker et al. (2008) confirmed that small firms were more cost efficient than larger firms, Caves, 1992; and Ansah-Adu et al. (2012) confirmed larger firms to be more cost efficient. Berger et al. (2000) and Cummins et al. (2010) studied the US insurance market but identified different observations on scope economies. The former confirmed composite firms as more cost efficient while the latter confirmed specialized firms as more cost efficient. Again, while Barros et al. (2010) identified small firms to be more efficient than large firms in Greece, Yao et al. (2007) confirmed large firms to be more efficient than small firms in China. According to Ansah-Adu et al. (2012) these differences in the literature are as a result of a myriad of factors among which are, measurement methodologies, definition of input and output prices, sample sizes, nature of insurance companies used and operating environments or markets. Cummins and Weiss (2013) explain that, the solution to these challenges lie in the addition of new information through empirical studies.

The trend of growth and innovations in the Ghanaian insurance industry presents an ideal environment to study efficiency from the perspective of developing economies in order to add new information to the incongruous factors of efficiency determinants in the insurance literature. The industry started as an appendage of the United Kingdom market but through several regulations now exist as a solid industry with numerous domestic and foreign insurers. Thus, making the industry very cosmopolitan in the past few years. Baah-Nuakoh (2003) using data on the manufacturing industry argues that imperfect competition is the necessary condition for the existence of much of X-inefficiency in the Ghanaian economy as competition eliminate high cost
producers and make management discipline to oversee the effective utilization of inputs by employees. By this argument, it is therefore important to fill the gap in the developing economy insurance efficiency literature as well as the need to explore several likely factors that influence efficiency using the Ghanaian insurance industry.

1.2 Problem Statement

The economic significance of insurance companies have been proven by several economists as providing long term funds for physical and social infrastructure in every economy (Kugler and Ofoghi, 2005; Vadlamannati, 2008). Han et al. (2010) examined the relation between insurance development and national economic growth, and concluded that both life and non-life insurance play a relatively more important economic function in developing countries than they do in more developed parts of the world. The understanding of this assertion should have changed the attitude and perception of insurance operation in developing economies. This is because, emerging and developing economies are usually characterized by huge infrastructure gap which can be solved through long term investment easily obtained from insurance operation. World Bank and other multilateral institutions in 2009 reported that an amount of US$ 93 billion per year is required for curbing the infrastructural gap in Sub-Sahara Africa. Considering this huge investment requirement, pursuing Africa’s economic development without building an efficient insurance industry may simply be a mirage.

According to Vadlamannati (2008) a well-developed insurance sector is necessary for the economic development of an emerging economy like India, as it provides long-term funds for physical and social infrastructure, while simultaneously strengthening risk-taking abilities. But evidences from global statistics on insurance suggest that whilst insurance penetration of the World
is 6.6% and that of the advanced economies is 8.6%, emerging economies is 2.8% (Swiss Re, 2012). This observation shows that insurance operation which should have been high, is very low in most developing countries. Meaning that the unique role of the insurance industry is not felt in almost all the emerging economies especially Ghana where despite the prospects in the industry there are still certain challenges which prevent the efficiency of the industry.

Insurance penetration which measures the ratio of gross premiums to GDP has been around 1% in Ghana compared to South Africa – 14.8%, Namibia – 7.3%, Kenya – 2.8%, Nigeria – 0.5% and Malaysia – 4.8% (Swiss Re, 2010 Sigma report). This indicates that the role of insurance operation in the economy is relatively low. The finscope survey commissioned by the Government of Ghana on the financial sector explains that excluding national health insurance holders, only 5% of the population have an insurance product (NIC report, 2011), that is, more than 23 million Ghanaians (out of a total population of 25.9 million) are living without any form of insurance. According to a research report on the insurance industry of Ghana by Baah-Nuakoh et al. (2001), despite the factors such as income, size of family, age, occupation, educational background, cultural factors and social security schemes which determine the patronage of insurance in Ghana, people do not ordinarily purchase insurance due to the low performance of the insurance companies in Ghana. Thus the inefficiency of insurance companies who form the embodiment of insurance could be the reason for low insurance operation in Ghana. This assertion which has become a canker in the minds of Ghanaians for several years demands to be investigated thoroughly to ascertain the true state of the insurance industry in Ghana.

The insurance industry in Ghana yearly face complaints of repudiation of claims by insurers, delay in settlement of claims, dispute over quantum and delay in payment of settled claims which are usually the signs of inefficiency. Instead of long term investments which can resolve the
infrastructure problem in the country, the industry has consistently seen increased short term investment (which is in the form of treasury bill, fixed deposit, call account, unit trust and bonds) over long term investment (NIC report, 2011). There are several risks that could be insured but currently the industry is concentrated on only motor, fire, accident, marine and life/health insurance due to fear of underwriting large risk. Reconciling the above characteristics of the insurance industry in Ghana with their yearly growth in assets and premiums clearly suggest that the effective combination of the industry’s resources is questionable.

The challenges of the industry which indicate a lot of untapped potentials have attracted many firms and institutions into the industry. Currently, the unrestricted entry of new foreign and local firms as well as bank and telecommunication insurance operation in Ghana has caused an unhealthy rivalry in the industry. This competitive pressure has forced many insurance companies to change corporate strategies in order to reduce operating costs while maintaining or improving the quality of their services. Thus, considering the perception cancer, the low patronage challenge and the immense competition, it is imperative to undertake a study to help managers and stakeholders identify the companies that are best positioned to respond to and thrive in the changing environment in terms of cost. Reconciling the current challenges in the insurance industry to the argument of Leibenstein (1966), that, the amount to be gained by a firm or an industry by increasing allocative efficiency is trivial compared to the amount gained by increasing X-efficiency, this study examines cost efficiency and its determinants in the insurance industry of Ghana.

Ansah-Adu et al. (2012) analyzed the cost efficiency of 30 insurance companies comprising of both life and non-life insurers in Ghana using data envelopment analysis (DEA) from the period
They argued that market share and firm size are positively related to efficiency while the ratio of equity to total invested asset is negatively related to efficiency. Their study revealed that the insurance industry is filled with a lot of inefficient firms since an average of four firms out of the 30 firms analyzed obtained average cost efficiency score of more than 0.5 (50%) yearly. But their study examined only three consecutive years with a constant returns to scale data envelopment analysis. Considering the argument of Cummins and Zi (1998) that choice of methodology influences the results of efficiency analysis it is obvious that the short time period used in their study, the choice of methodology which assumes every deviation as inefficiency and the constant technology assumption imposed by the study can hinder the actual problem in the industry hence this study analyses cost efficiency with several methodologies over a longer time period to ascertain the true nature of cost efficiencies in the insurance industry.

1.3 Objectives of the Study

The general objective of the study is to examine the determinants of cost efficiency of the insurance industry in Ghana for the period 2005 to 2014. This objective can be achieved through the following specific objectives:

1. Measuring the level of cost efficiency for insurance companies in Ghana using both data envelopment analysis (DEA) and stochastic frontier analysis (SFA).

2. Analyzing the determinants of cost efficiency by using the efficiency scores as the dependent variable and firm size, business type, market share, capitalization, ownership type, regulation and reinsurance as the independent variable.

3. Examine the influence of choice of methodology on factors explaining firm inefficiencies.
1.4 Research Questions

- What is the level of cost efficiency in the insurance industry of Ghana?
- Which factors determine cost efficiency among the insurance companies in Ghana?
- Does choice of methodology influence factors determining efficiency?

1.5 Significance of the Study

The study of Ansah-Adu et al. (2012) serves as the only cost efficiency study in Ghana as well as Sub-Saharan Africa. They used DEA technique to estimate cost efficiency for only three years but considering the limitations of DEA there is the need to supplement their study with a different estimation technique in order to actually depict the true nature of cost efficiency in the Ghanaian insurance industry. This study provides the additional information which helps to fill the gap in the insurance efficiency literature in Ghana.

Again, the study would become the first to analyze the cost efficiency of both life and non-life companies in Ghana using the SFA methodology. A major challenge of the DEA approach is its inability to distinguish random errors from inefficiencies since it attributes every deviation from the efficiency frontier to inefficiencies. This challenge is easily solved by the SFA methodology hence the need to study the cost efficiency of the industry with the SFA approach.

The 2006 insurance act 724 which regulates the insurance industry in Ghana prohibits the National Insurance Commission from issuing composite insurance license to firms. This study also makes a thorough investigation of the regulation to determine whether it has impacted negatively or positively on the efficiency of the insurance industry.
Observations from this study would enhance research and knowledge of the insurance industry players. Estimating efficiency scores of insurers, providing rankings of these firms as well as explaining the reasons for their inefficiencies would be beneficial to National Insurance Commission, insurance companies, insurance policy holders, students and government officials among others.

Finally, insurance efficiency studies are skewed toward developed economies like United States and Europe, which makes knowledge of insurance efficiency in the literature limited hence this study would add up to the growing economic literature on the relationship of efficiency determinants which has become incongruous and provide additional information on insurance efficiency from the perspective of a developing country.

1.6 Organization of the Study

The thesis is organized as follows: Section 2 discusses the overview of the insurance industry of Ghana. Section 3 presents the literature review of insurance efficiency. Section 4 discusses methodology and data of the study. Section 5 discusses the empirical result while section 6 presents the conclusion and policy recommendation of the study.
CHAPTER TWO

OVERVIEW OF THE INSURANCE INDUSTRY IN GHANA

2.1 History of the Insurance Industry in Ghana

The idea of pooling resources against losses (insurance) has been a cultural practice especially pertaining to funerals among almost every tribe in Ghana. Members make a pool through periodic contributions to help finance the burial cost in case of death in the family. This contribution is usually referred as “eeto” among Akans. Despite the existence of the mindset, it never transformed into an industry until the early part of the 20th century when the British merchants started trading on the shores of the Gold Coast. The insurance industry has undergone several stages since its inception. From a noble existence as an appendage of the British insurance market, the industry has now grown through several regulations to become one of the emerging markets on the African continent upholding international insurance practices.

2.1.1 The Appendage Period

The inception of insurance operation in Ghana can be traced far back to the wave of globalization in the early 20th century which brought numerous British merchants to trade in the then Gold coast. As they basically imported and exported cash crops, minerals, textiles and machinery in the Gold Coast, the traders initiated their insurance practices which sought to protect them from all associated risk of the trading activities. This beginning of the industry caused it to exist as an appendage of the British insurance market since the practice of insurance was controlled and regulated mostly by UK companies through their agents in the country without any local presence.
During this period, the British insurance market was regulated under the Assurance Companies Act 1909 by the British Board of Trade which operated on the principle of freedom with publicity (Daykin and Cresswell (2001)). According to Booth (2007), the phrase `freedom with publicity' implies an environment where insurance companies can operate with complete business freedom as long as they publish their financial positions in such a way that it can be verified by independent actuaries and other interested parties. The unrestricted business environment introduced in the Gold coast saw marine (cargo) insurance as the first insurance policy in Ghana (then Gold Coast). Other insurance policies from various insurance companies in Europe and Asia were later introduced but covered only the foreign nationals.

Insurance business outperformed commercial banking during this period and caused the establishment of insurance companies in the Gold coast. Royal Exchange Assurance Company established the premier insurance agency branch in 1924 known as Royal Guardian Enterprise which now operates under the name Enterprise Insurance Company (EIC) Limited. Insurance operation in the Gold coast was skewed towards the European nationals with no or less attention on local citizens. This operational gap created in the insurance sector led to the formation of the first Ghanaian insurance company (Gold Coast insurance company) in 1955 to transact only life businesses for local folks. Several other companies such as General Insurance Company and Cooperative Insurance Society were established in 1957 and 1958 respectively to compete in the developing insurance market in Ghana.

Despite the establishment of local companies, the little knowledge, experience, involvement, lack of local regulations and the absence of statistics in Ghana deepened the dominancy of the foreign control in the industry until the setting up of the State Insurance Company (SIC) in 1962 which was given the monopoly over all state owned organizations and state businesses. According to
Alhassan et al. (2015) the first national insurance company, SIC, came to existence through a merger of Gold Coast Insurance Company and Cooperative Insurance Society. This period of appendage existed until 1963 when the industry began its own regulation.

2.1.2 The Regulatory Period

After several years of depending on other regulations in the insurance industry in Ghana, the industry began to depend on its own regulation with the promulgation of the Workmen’s compensation Act of 1963 (Act 174), the Insurance Law of 1965 (Acts 288), the insurance regulations of 1966 (LI 497) and the Insurance amendment decree of 1972 (NRCD 95). These laws provided the path for undertaking insurance business in Ghana by requiring every insurer operating in Ghana to be incorporated locally with at least 40 percent of the proprietary interests owned by Ghanaians while twenty percent of local non-life businesses and five percent of international non-life treaties were to be ceded to the Ghana reinsurance company (a new company instituted by NRCD 95 in 1972 to undertake reinsurance businesses). These regulations resulted in reducing the eleven (11) insurance companies as at the end of 1971 to seven (7) insurance companies, one (1) Reinsurance Company and two (2) brokerage firms as at the end of 1976. It also increased the number of locally owned insurance companies from one (1) in 1971 to twelve out of the eighteen insurance companies registered in 1989.

The Baah-Nuakoh et al. (2001) research report argued that, the year 1972 is the real turning point in the history of the Ghanaian insurance industry since NRCD 95 gave the control of the industry to Ghanaians. This change of control plagued the industry into unprofessional practices and a lot of divisive tendencies especially due to the low knowledge of insurance operation among the local folks. A report of the Gepi-Attee committee in 1983 confirmed a sharp increase in the level of
malpractices, insolvency, and failure to pay claims as well as general insurance fraud among others in the industry during the early part of 1980s. The malpractices during this period created a negative impression of the industry in the minds of most Ghanaians. These phenomena were mostly attributed to the absence of a developed supervisory body to oversee the activities of the companies in the industry.

In 1989, the National Insurance Commission (NIC) was instituted as the supervisory body of the industry by the enactment of The Insurance Law 1989 (PNDCL 227). This new body was charged with the responsibilities of ensuring effective administration, supervision, regulation and control of the business of insurance in Ghana. The industry through innovations from NIC began to boost the confidence of most insured as the commission became a third party between the insurers and the insured. Later legislations such as the insurance amendment law 1991 (law 260), the financial institution (non-banking) law 1992 and the insurance amendment law 1993 (law 316) helped NIC to create the enabling environment for insurance operation. This increased the number of insurance entities from sixteen insurance companies, one state-owned reinsurance company, ten (10) brokers and adjusters as at the end of 1991 to twenty insurance companies, two state-owned reinsurance company and eighteen (18) brokers as at the end of 1996.

2.1.3 The Efficiency Regulatory Period

This period marks the restructuring of the regulation of the industry to suit the standard regulation of international insurance bodies. The institution of the 2006 Insurance Act (Act 724) marked the beginning of the efficiency regulatory period in the industry. This law was in accordance with the core principles of the International Association of Insurance Supervisors (IAIS) hence upgraded
the insurance practices in Ghana to match the standard of all IAIS members. The minimum capital requirement of insurance companies changed to the cedi equivalent of US$1 million, the monopoly enjoyed by SIC and Ghana Reinsurance Company was repealed and as well the non-issuance of composite license were the major conditions under the Act 724.

As compared to the previous acts and regulations which discouraged foreign participation, the 2006 Insurance Act opened the industry for foreign competition to increase the efficiency of the industry. Currently, considering the oil discovery in Ghana as well as the need of efficiency among the insurance companies in order to underwrite huge risk such as oil and gas risks, NIC has reviewed the minimum start-up capital of US$1 million to GHC5 million (NIC, 2010) in 2011 and again to GHC 15 million in 2015 (NIC, 2014).

According to Ansah-Adu et al. (2012), as at July 2009, the insurance industry was made up of 21 non-life companies, 18 life companies, two reinsurance companies, 38 brokerage companies, one reinsurance broking company and one loss adjusting company. Out of which about 12 of life and non-life companies doing business in the country have some form of foreign participation. This suggests that there are several untapped opportunities in the industry which needs to be explored and utilized. The expansion of insurance operation from the initial marine insurance to more specialized areas such as micro insurance and agriculture insurance has seen a continuous growth in the revenue mobilization as well as the number of firms in the industry.

2.2 Structure of the Insurance Industry

The insurance industry has undergone several regulatory changes resulting in its rapid growth since the 1920s. From an initial foreign dominated industry made up of 4 chief agents, the insurance
industry now comprise of 49 insurance companies, 3 reinsurance companies, 69 brokers, 1 reinsurance broker, 1 loss adjustor, 1 oil and gas company and 6000 agents (www.nicgh.org). The growth in the industry from the 1920s to the 1990s can mainly be attributed to the various regulations passed in the industry. The period experienced several fluctuations in terms of number of registered insurers, ownership and type of insurance companies. Before 1957, there existed 33 companies made up of one local and 32 foreign insurers in the industry but as at the end of 1971 only 15 companies were operating in the industry. The number further decreased to 7 companies comprising of 2 composite, 4 non-life and 1 life companies at the end of 1976.

According to the Baah-Nuakoh et al., (2001) research report, the initial decreased was possibly due to the provision in the 1965 Act which made it compulsory to invest all life funds in the country while the latter reduction can be attributed to the NRC72 regulation. The 20 companies operating in the industry as at 1989 suggest that the immediate response to the NRC72 regulation by the firms were mostly to ceased operation for some time after which they started operations again. These firms continued operation in the industry until NIC’s stringent measures further eliminated 3 incompetent firms from the industry as at 1999. These fluctuation observed in the industry was not only limited to insurance companies but brokers as well. Only two reinsurance companies existed at the end of 1999, Ghana Reinsurance Company established in 1972 and Mainstream Reinsurance Company, a private company established in 1995.

The insurance act of 2006 Act 724 which is the current legislation under which the insurance industry operate restrict the issuance of composite license hence dividing the industry into two main sectors that is life and non-life sectors. According to Alhassan et al. (2015), up until the passage of Act 724, there was no clear distinction between life and non-life insurance businesses
as some companies were known to use premiums from life to support non-life operations. Thus the actual birth of the life sector became clearer after the promulgation of the Act 724.

Table 1: Structure of the Ghanaian Insurance Industry

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of Industry Premium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 10m</td>
<td>39%</td>
<td>30%</td>
<td>41%</td>
<td>66%</td>
<td>64%</td>
<td>88%</td>
<td>89%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5 - 10m</td>
<td>0%</td>
<td>22%</td>
<td>25%</td>
<td>25%</td>
<td>12%</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>3 - 4.99m</td>
<td>12%</td>
<td>15%</td>
<td>14%</td>
<td>5%</td>
<td>6%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>1 - 2.99 m</td>
<td>27%</td>
<td>21%</td>
<td>18%</td>
<td>3%</td>
<td>3%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>below 1m</td>
<td>22%</td>
<td>11%</td>
<td>2%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>29</td>
</tr>
</tbody>
</table>

Source: Author’s computation from NIC reports

A glance at table 1 shows that, out of the 29 insurers in the industry 28 had gross premiums below GHC5 million in 2000 by contributing 61% of the industry gross premium. Only one firm (SIC insurance) obtained premium above GHC10 million as it contributed 39% of the industry’s premium. A similar trend was observed in 2003 as 31 firms out of the 32 firms operated below GHC10 million with 70% contribution of the industry’s premium whereas the 30% was obtained by one firm. This can be explained by the increase in the number of life insurers from 14 to 17 which increased the industry premium. 3 and 6 firms operated above GHC5 million in 2005 and 2006 with industry premium contribution of 52% and 65% respectively. In 2008 when the
minimum capital requirement was raised to US$ 1 million (equivalent to GHC 3 million) 18 firms obtained premiums above GHC 5 million representing 91% of the industry premium. This trend continued until 2013 when 35 out of the 42 firms operated above GHC 5 million which accounted for 99% of the industry’s premium.

From table 1, it is clear that non-life insurers dominated the industry from 2000 to 2005 but the latter growth in the life sector made 9 out of the 17 firms to operate above GHC 10 million compared to 13 out of 25 firms in the non-life sector. It is obvious that the industry experienced growth in large firms during the period.

Figure 1: 2-Firm Concentration Ratio

A critical look at the structure of the industry in terms of concentration ratio also revealed that there has been a decline in the predominance of the two largest firms. From Figure 1, it is observed that the 2 firm concentration ratio for the industry decreased from 43.5% in 2001 to 38.36% in 2004 then rise to 41.1% in 2005 after which it declined through to 2011. The same trend was recorded in the 4 firm concentration ratios which was 63.6% in 2001 but reduced to 40.29% in
2014. This means there has been a tradeoff of some market power from the 2 and 4 largest firms in the industry to smaller firms. The reason behind this trend is the decrease in the concentration ratios for the non-life firms compared to the rise in the life firm. The poor initial growth in the life sector caused the non-life to dominate the industry until 2008 when the life actually started its influence in the industry.

Figure 2: 4-Firm concentration ratio

As at 2013, the 2 largest firms in the industry were life firms (that is, SIC life and Enterprise Life) clearly showing the outstanding performance of the sector. Life firms are more concentrated than the non-life firms in the industry, as the 2 and 4 largest firms control 54.24% and 76.28% of sector premiums compared to the 28.17% and 48.23% recorded in the non-life sector respectively.
It can be observed that the level of competition among the non-life companies is keener than the life companies. This observation is as a result of the infant nature of the life sector which is characterized by several new and young companies in the industry. Again, the control of market share in the insurance industry is in the hands of small large firms which suggest that the insurance market in Ghana exhibits the qualities of an oligopolistic market structure.

2.3 Conduct of Insurance Companies in Ghana

The conduct of insurance businesses in Ghana can be seen in two main markets, that is, life and non-life markets as provided in the Act 724. These markets differ in traded products but not in operations. Both life and non-life firms seek approval from NIC on new products before trading them on their respective markets. Four main channels of distribution of insurance products co-exist in both markets in the industry namely, direct sales, agent sales, brokerage sales and banc assurance. Direct, agent and brokerage sales are usually referred as the traditional distributional channels since they have been the ideal channels of distribution since the inception of the industry.

Banc assurance can be traced to 2007 when Enterprise life signed an agreement with Standard chartered bank to market their products through their outlet. This practice ever since 2007 has been a common practice among both life and non-life insurers in the industry.

There is currently no legislation in the industry which enforces fixed rates of premiums for the various classes of business in the insurance industry. A study by Price Waterhouse (1993) revealed that despite the non-existence of fixed agreed and enforceable rates of premiums in the industry, there is a similar trend in premium rate, as most firms adopt the trade practices of State insurance company which happens to be the former home of all senior management staff members in the industry.
industry. Recently, firms like Enterprise Insurance Company (EIC), Star Assurance and Metropolitan Insurance together with SIC who control greater share of the non-life sector have become dominant firms which the young and smaller firms emulate their trade practices, customs, usages and premium rates. A replica of these practices can be seen in the life sector as SIC life, Enterprise Life, Glico life and Starlife exist as pace setters in the life industry. According to the Baah-Nuakoh research report there is a clear resemblance of a mixed price leadership-collusive arrangement in the insurance industry.

A current phenomenon in the insurance industry is the increasing cost in advertising. The industry existed with little attention on adverts but the 2006 Act 724 which led to an increase in insurance companies due to the separation between life and non-life businesses as well as the increase in foreign participation has plague the industry with an unhealthy competition leading to high marketing expenditures. Other firms have adopted underpricing strategies which in returns hindering the productivity and efficiency in the industry.

2.4 Performance of Insurance Companies in Ghana

Statistics on insurance operations in the world describes Africa as the continent with the least developed insurance sector as it only generate about 1.6% premium revenues (that is US$71.9 billion) out of the world’s total insurance premium of US$4612.5 billion recorded in 2012 (KPMG Africa, 2014). This state of insurance operation in Africa excludes South Africa which through a developed financial sector contributed not less than 76% of the total insurance premium revenue in Africa in 2012 (KPMG Africa, 2014).
Several other countries aside South Africa such as Kenya, Namibia, Mauritius, Botswana and Morocco have intensified their insurance operations through various innovations and legislation which have yielded a lot of results in their individual insurance industries. The general acceptance and adoption of the core principles of IAIS in the continent has also caused most countries like Ghana to also build the necessary environment which is fueling the development and growth of insurance in those countries.

Table 2: Breakdown of Insurance Premiums, Assets and Investments

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Asset (GH¢ m)</th>
<th>Total Investment (GH¢ m)</th>
<th>Total Gross Premium (GH¢ m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Life %</td>
<td>Non-life %</td>
<td>Life %</td>
</tr>
<tr>
<td>2007</td>
<td>421.2</td>
<td>32.0%</td>
<td>68.0%</td>
</tr>
<tr>
<td>2008</td>
<td>599.10</td>
<td>32.3%</td>
<td>67.7%</td>
</tr>
<tr>
<td>2009</td>
<td>723</td>
<td>34.9%</td>
<td>65.1%</td>
</tr>
<tr>
<td>2010</td>
<td>948.8</td>
<td>38.7%</td>
<td>61.3%</td>
</tr>
<tr>
<td>2011</td>
<td>1142.6</td>
<td>43.1%</td>
<td>56.9%</td>
</tr>
<tr>
<td>2012</td>
<td>1456.8</td>
<td>46.0%</td>
<td>54.0%</td>
</tr>
</tbody>
</table>

SOURCE: Compiled by Author from NIC reports

The Ghanaian insurance market was ranked 10th among African countries in insurance premium volume behind Tunisia as it contributed US$719.0 million which represented 1.1% of the total premium volume on the continent in 2012 (Swiss Re, 2012). This position is due to a prolonged average growth of about 28.57%, 28.4% and 34.23% in total gross premiums, total asset and total investment respectively since 2008 (NIC, 2012). Total gross premium of GHC 278 million in 2008 grew to GHC 851 million in 2012 whilst total asset that was GHC 599.1 million in 2008 grew to GHC 1456.8 million in 2012. This trend is also seen in total investment as it grew from GHC302.4 million in 2008 to GHC 922.7 million in 2012.

The dominancy of the non-life sector in terms of control of gross premium, total asset and investment can be seen from Table 2. The non-life sector controls an average of 62.3%, 62.2% and 50.6% of total industry premium, asset and investment respectively. With an initial control of 68%
of total asset in 2007 and a continuous decline to 54% in 2012 clearly shows an improvement in the life sector suggesting a convergence of the two sectors in some few years. The strong performance of the life sector can be seen as it overtook the non-life sector in total investment with only 18 firms compared to the 24 non-life firms in the year 2011.

There has been continuous increase in the market share of life premiums while that of the non-life indicate a decrease from 2007 to 2012. The traditional operation of insurance which concentrated on only the formal sector is gradually being eroded in the country as innovative products such as agricultural insurance and micro-insurance which targets the low income earners are currently gaining recognition and attention in the industry. Thus the industry is now matching the trend of growth on the continent as it expands its scope of operation to cover both the formal and informal sector of the economy.

2.4.1 Classes of Insurance Business in Ghana

The Ghanaian insurance industry has grown from the initial over concentration on motor insurance to incorporate a wide class of businesses comprising of fire insurance, motor insurance, accident insurance (which includes personal accident, workmen compensation, general accident and engineering), marine (that is marine cargo and marine hull/aviation) insurance, life/health insurance and other forms of insurance such as travel and bonds investment insurance. These conventional insurance policies have been the focus of the industry until recently when certain vigorous innovative index insurance policies in the form of micro-insurance, agricultural insurance and oil and gas insurance among others were introduced on the insurance market.
Perception of insurance in Ghana has since the 1950s been narrowed to motor insurance especially due to the compulsory and mandatory motor insurance policy requirement for all vehicles in Ghana coupled with the inadequate education of the public on the alternative available insurance policies. This challenge made motor insurance dominate the insurance market till 2009 when life/health insurance overtook it as the major contributor to gross premiums.

Table 3: Distribution of industry premiums by class of business

<table>
<thead>
<tr>
<th>Year</th>
<th>Motor</th>
<th>Accident</th>
<th>Marine</th>
<th>Fire</th>
<th>Others</th>
<th>Life/Health</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>40</td>
<td>19.9</td>
<td>9.01</td>
<td>14.9</td>
<td>16.2</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>38.3</td>
<td>14.9</td>
<td>10.3</td>
<td>17.4</td>
<td>19.1</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>40.2</td>
<td>16.9</td>
<td>7.7</td>
<td>15.3</td>
<td>19.9</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>38.3</td>
<td>16.1</td>
<td>7.9</td>
<td>13.6</td>
<td>24.1</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>39.8</td>
<td>14.6</td>
<td>7.6</td>
<td>12.5</td>
<td>25.6</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>35.9</td>
<td>13.5</td>
<td>6</td>
<td>14.3</td>
<td>30.2</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>32.9</td>
<td>18.1</td>
<td>4.9</td>
<td>11.7</td>
<td>0.2</td>
<td>32.2</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>32.8</td>
<td>17.7</td>
<td>4.8</td>
<td>11.2</td>
<td>0.8</td>
<td>32.7</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>30.9</td>
<td>14.2</td>
<td>2.9</td>
<td>14.6</td>
<td>1.7</td>
<td>35.7</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>27</td>
<td>15.7</td>
<td>3</td>
<td>12.3</td>
<td>1.3</td>
<td>40.7</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>25.8</td>
<td>12.6</td>
<td>4.6</td>
<td>12.4</td>
<td>1.6</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>25.4</td>
<td>12.5</td>
<td>4.9</td>
<td>11.8</td>
<td>3.6</td>
<td>41.8</td>
<td></td>
</tr>
</tbody>
</table>

SOURCE: Compiled by Author from NIC reports

Table 3 gives the breakdown of insurance premiums according to the various classes of business in the industry. It can be observed that the market share of motor insurance fluctuated within 2001 and 2005 then declined from 2006 through 2012. This observation does not suggest a reduction in the patronage of motor insurance but rather an improvement in other businesses such as the life/health business which experienced a continuous increase in market share throughout the period.

According to the 2005 NIC report, the steady growth in the life/health sector of the industry is as a result of its vigorous education on insurance as well as the insurance companies’ innovation of
introducing new universal life products which provided a hedge against inflation. These innovations have made savings through insurance product more profitable relative to other savings avenues.

From 9.01% of market share in 2001 to 4.9% in 2012, marine insurance has been the least contributor of premiums in the Ghanaian insurance industry despite being the first policy introduced in the country. Its poor performance can be attributed to the inability of NIC to fully implement section (63) of the insurance law 1989 which requires all imports into the country to be insured. The numerous challenges facing the Ghana port and harbor industry could also account for the poor performance of the marine sector.

Fire and accident insurance fluctuated throughout the entire period especially due to their seasonal nature. Considering the motives for purchasing insurance, most Ghanaians undertake fire and accident policies based on speculative motives hence causing fluctuations in that sectors of the industry. The current compulsory fire insurance for all commercial and uncompleted buildings under the 2006 insurance act 724 can increase the contribution of fire insurance when fully implemented.

Product innovations in the industry led to the introduction of products that covered micro-insurance, agricultural insurance and financial assets such as bonds and securities in 2007. These new products recorded increase growth from 2007 - 2009 and 2011-2012 but declined in 2010. The decline period coincide with the discovery and production of oil and gas in commercial quantities which led the non-life insurance companies in the country to formation a consortium in order to underwrite the oil and gas business that has emerged in the economy. The recent
innovations and growth have expanded the insurance business to cover both the formal and informal sector of the economy.

2.4.2 Ghanaian Economy and Insurance Growth

The economy of Ghana experienced several erratic growth until the implementation of the economic reforms in the mid-1980s. These reforms caused a strong economic growth rate since 1984 due to its ability to shift the management of the economy from the control of the state to a more liberalized one (Alagidede et al., 2013). Agriculture and infrastructure such as roads, schools and hospitals were the main source of investments under the reform hence causing the agricultural sector to be the major contributor of growth since the 1980s till early part of 2000 when the service sector with the support of liberalization dominated the growth of the economy of Ghana.

According to Alagidede et al. (2013), the structural transformation of the Ghanaian economy from agricultural dominancy to services in terms of growth can be attributed largely to the performance of trade, hospitality, telecommunication and financial subsector which saw increased private sector participation due to liberalization in the economy. Out of the above subsectors, Enu et al. (2015) argued that the financial subsector is the main driver of the service sector in Ghana especially considering their contribution to the economy’s GDP and labor force. This assertion implicitly and explicitly reveals the importance of the insurance industry to the Ghanaian economy. Considering the insurance industry as part of the financial sector and the support it provides to trade, hospitality and telecommunication industries it is worth accepting the arguments of Ward and Zurbruegg, 2000; Webb et al., 2002; Liedtke, 2007; and Arena, 2008 that insurance promotes economic growth in Ghana.
Table 4: Insurance Contribution and Economic Growth

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross Industry GDP</th>
<th>Premium GH₵ growth</th>
<th>Life % Growth</th>
<th>Non-life % Growth</th>
<th>GDP Growth</th>
<th>Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>32251600.2</td>
<td>16.16%</td>
<td>83.84%</td>
<td></td>
<td>4.20%</td>
<td>1.26%</td>
</tr>
<tr>
<td>2002</td>
<td>47205989.86</td>
<td>46.4%</td>
<td>72.43%</td>
<td>80.96%</td>
<td>41.34%</td>
<td>4.50%</td>
</tr>
<tr>
<td>2003</td>
<td>71283978.5</td>
<td>51.0%</td>
<td>57.68%</td>
<td>80.12%</td>
<td>49.44%</td>
<td>5.20%</td>
</tr>
<tr>
<td>2004</td>
<td>92524218</td>
<td>29.8%</td>
<td>57.38%</td>
<td>75.96%</td>
<td>23.06%</td>
<td>5.80%</td>
</tr>
<tr>
<td>2005</td>
<td>122233596</td>
<td>32.1%</td>
<td>40.11%</td>
<td>74.43%</td>
<td>29.46%</td>
<td>5.80%</td>
</tr>
<tr>
<td>2006</td>
<td>164207266</td>
<td>34.3%</td>
<td>58.74%</td>
<td>69.79%</td>
<td>25.96%</td>
<td>6.20%</td>
</tr>
<tr>
<td>2007</td>
<td>209554718</td>
<td>27.6%</td>
<td>36.13%</td>
<td>67.77%</td>
<td>23.93%</td>
<td>5.70%</td>
</tr>
<tr>
<td>2008</td>
<td>278255336</td>
<td>32.8%</td>
<td>35.11%</td>
<td>67.21%</td>
<td>31.68%</td>
<td>7.30%</td>
</tr>
<tr>
<td>2009</td>
<td>342973719</td>
<td>23.3%</td>
<td>35.65%</td>
<td>64.35%</td>
<td>18.02%</td>
<td>4.00%</td>
</tr>
<tr>
<td>2010</td>
<td>458694746</td>
<td>33.7%</td>
<td>40.84%</td>
<td>53.22%</td>
<td>22.69%</td>
<td>8.00%</td>
</tr>
<tr>
<td>2011</td>
<td>628528775</td>
<td>37.0%</td>
<td>44.21%</td>
<td>57.01%</td>
<td>32.34%</td>
<td>15.00%</td>
</tr>
<tr>
<td>2012</td>
<td>850657054</td>
<td>35.3%</td>
<td>41.82%</td>
<td>31.68%</td>
<td>58.18%</td>
<td>38.10%</td>
</tr>
</tbody>
</table>

SOURCE: Compiled by Author from NIC reports

From table 4, there exist a similar trend of growth of the insurance industry and the economy of Ghana since 2005. Insurance growth increased from 32.1% to 34.3% in 2006, declined to 27.6% in 2007 then increased to 32.8% in 2008 while growth in the economy increased from 5.8% to 6.2% in 2006, declined to 5.7% in 2007 then rise to 7.3%. The major contributor of insurance growth is the life subsector which contributed higher yearly growth than the non-life subsector during the period under study. This trend is largely attributed to the introduction of funeral policies in the life insurance sector which has received a lot of recognition in the country due to the cultural values placed on funerals. According to the CEO of enterprise life, when the burden to finance funerals became so high that people began taking out bank loans, they saw there was space for insurance. He confirmed that funeral policy now accounts for over 65% of its revenue (KPMG Africa, 2014).

Again, the 34.9% annual average insurance growth contributed to a persistent increase in the market share of insurance in the economy (that is, insurance penetration) during the period unless the decline encountered in 2006 and 2011 which is largely attributed to the rebasing of the national
account exercise done in 2006 and the production of oil and gas in commercial quantities which increased the size of the economy without a proportional increase in oil and gas insurance in 2011. These observations show that there is a direct relationship between insurance growth and economic growth in Ghana but the relationship runs from insurance to economic growth especially considering the amount of growth traded off for economic growth from insurance.

The causality between insurance and economic growth has received a lot of attention in the economic literature leaving three main school of thoughts in the literature. The first school of thought argues that achieving economic growth results in the demand of financial services like insurance (demand-following hypothesis), the second also argues that insurance growth brings about economic growth (supply-leading hypothesis) whilst the third school of thought posits for both directions (feedback hypothesis). Alhassan and Fiador (2014) examined the causality between insurance penetration and economic growth in Ghana from 1990 to 2010 using ARDL bounds approach to co-integration by Pesaran et al. (1996; 2001). They identified a uni-directional causality running from aggregate insurance penetration, life and non-life insurance penetration to economic growth in Ghana which is supported by the estimates in table 4.
CHAPTER THREE
LITERATURE REVIEW

3.1 Meaning of Efficiency

The general consensus about efficiency in the economic literature is the ability of a decision making unit (DMU) to successfully produce as large as possible an output from a given set of inputs (Farrell, 1957). From the Paretian philosophy, efficiency is seen as the level of operation where no further reallocation of resources of a firm would permit more of one good to be produced without necessarily reducing the output of some other good. In other words, efficiency is the maximum attainable output from an appropriate combination of inputs at a given level of technology. This concept is a theoretical ideal of the full exploitation of the resources of an economic agent usually expressed in the form of a utility function for consumers and cost, production, revenue or profit function for producers. This indicates that, individuals or firms who are able to operate on these utility, cost, production or profit functions or frontiers are classified as fully satisfied or efficient while those below the frontiers are assumed to be less satisfied or inefficient. Thus, the state of efficiency or inefficiency of a firm is determined by comparing a firm’s performance to these frontier functions.

The concept of efficiency signifies the institution of benchmarks in a firm or an industry but not a representation of a particular absolute level of operation of a firm. Assuming ten firms exist in an industry, it is obvious to observe that despite the use of similar inputs and the production of homogenous products some firms may produce at a lower cost, a higher quality or a high quantity (best practice) relative to their competitors in the industry. Instituting marks in such an industry either using the best practice firms or a statistical function to distinction between best and worst firms in the industry refers to the concept of efficiency.
According to Diacon et al. (2002) efficiency is a relative concept, meaning that, it is not possible to define some "ideal" level of efficiency; instead, companies have to be compared with those that currently constitute best practice in the market given the current state of production technology in the industry. The underlining idea of the establishment or identification of these best practices in the industry is to serve as benchmarks which can help identify a firm as efficient or inefficient. Alhassan and Biekpe (2015) argue that the objective of efficiency analysis is the identification of best performing decision making units (DMUs) to serve as a role model for the inefficient ones. The best practice or frontiers are basically represented by production or cost frontiers which indicates the minimum inputs required to produce a given level of output of a firm (usually represented by dominant firms in the industry) operating at 100% efficiency (Cummins and Weiss, 2013).

According to Yao et al. (2007), the word ‘efficiency’ can be termed in different ways, such as Pareto efficiency, technical efficiency, allocative efficiency, exchange efficiency, X-efficiency and market efficiency among others which may have different meanings, but the essence is the same: how inputs can be used most effectively to produce outputs.

Farrell (1957) decomposed the productive, cost or economic efficiency of a firm into two main components, that is, technical efficiency and price or allocative efficiency. Technical efficiency is the ratio of actual output to the maximum output attainable with given amounts of inputs, thus, the deviation of a firm’s output or performance from the output or performance of the best practice firm’s output or performance. In other words, technical efficiency is the distance from a firm’s output to the output of the efficient frontier or best practice firm. Allocative or price efficiency on the other hand reflects to the ability of a firm to combine the inputs and output in optimal proportions, given their respective prices. Firms have cost and production constraints which
prevent them from producing at every level on their efficient frontier just as consumers are also constrained by limited resources in their satisfaction of needs. The ability of firms to choose maximum outputs on their efficient frontiers permitted by their cost or production constraints is known as allocative efficiency.

According to Forsund et al. (1980), technical and allocative efficiencies are necessary conditions for a firm to be efficient but not a sufficient condition. They argued that a firm is fully efficient when it attains technical, allocative and scale efficiency thus making scale efficiency the sufficient condition for the efficiency of a firm. This concept of frontier functions currently used to indicate efficiency of firms or industries has a strong presence in the economic literature especially due to its widely acceptance and usage in all branches in economics and beyond. The studies below provide the theoretical underpinning and the empirical literature of the efficiency concept.

3.2 Measurement of Efficiency

The concept of efficiency had existed in the economic literature for several centuries in the form of efficient utilization of resources, efficient distribution of resources and efficient level of satisfaction among others. According to Greene (2008) measurement of efficiency is the provision of an empirical estimation of the theoretical idea of full resource exploitation. But the unavailability of an ideal empirical estimation technique caused the domination of measures such as average productivity of labor or capital, cost of production comparison and several efficiency indices in the economic literature. Koopman (1951) directed the focus of efficiency measurement by arguing that a firm is technically efficient if only it operates on a constructed efficiency frontier
with zero input and output slacks. This understanding of efficiency measurement made the concept of production, revenue or cost functions as the basic foundation for efficiency measurement.

Debreu (1951) utilized Koopman’s concept of efficiency to provide a theoretical estimation of efficiency. According to Debreu (1951), the distance between optimality and non-optimality of resource utilization is the dead loss which represents the monetary value of physical resource thrown away without preventing the achievement of the prescribed level of satisfaction. He referred to this value as the inefficiency of the economy and attributed it to either underemployment of physical resources, technical inefficiency of production units (which is usually the concern of the economist) or inefficiency of economic organization. Irrespective of the contributions of Debreu’s study, it escaped the basic question of how the efficient production possibilities or functions which forms the bases for studying the efficiency concept were estimated. This shortcoming lingered in the literature until Farrell (1957) proposed a solution for the gap between theory and empirical estimation of efficiency.

Farrell (1957) argues that the productive or economic efficiency of a firm which is obtained from their efficient production functions can be decomposed into technical efficiency (minimum input usage) and price or allocative efficiency (optimal combination of inputs). He identified two possible ways of estimating the efficient production functions of an economic agent. That is, either by theoretical functions usually specified by professional (engineers) or empirical functions specified through practical observations. But considering the challenges associated with the theoretical functions such as difficulty in specification and specification errors among others, Farrell resorted to only the use of the empirical efficient production functions of a firm given its inputs and outputs. According to Farrell (1957), given a simple case of a firm with one input and one output the efficient function can be estimated in two steps. First, by drawing the scatter plot
of the input and output combinations and secondly drawing an isoquant of the plot based on the
convexity and non-positive slope assumptions of a curve. Upon this simple case, he provided a
generalized form of the efficient production function comprising of several inputs and output of a
firm or industry by the help of matrix estimations based on the assumption of constant returns to
scale as firms produce and use homogeneous inputs and outputs.

Farrell’s efficient production function appeared in the form of an envelope isoquant for both the
firm and the industry. Firms on the envelope isoquant are identified as technically efficient firms
as the isoquant represented the minimum input combinations while the optimal combination of
inputs obtained given the firm’s budget line represent their price efficiency. Farrell used his study
to bridge the gap between economic theory and empirical studies but limited this good contribution
to only constant returns to scale production processes hence still giving room for further
contributions.

As a way of understanding the existence and why most firms operate below Farrell’s frontier
concept, Leibenstein (1966) provided evidences of allocative inefficiencies and X-inefficiencies
(cost inefficiencies) which indicated that the magnitude of X-inefficiencies on a firm or industry
is greater than allocative inefficiencies. Leibenstein (1975) used the presence of incomplete job
contracts, the understanding of direction and controls as well as effort entropies to prove that
consumers, producers and firms would not operate at a minimum cost. He established that given
the right allocation of resources there would be a difference between maximal effectiveness of
utilization and actual utilization which can be attributed to X-inefficiency of the firm. This work
of Leibenstein provided a theoretical justification of the measurement of efficiency of every firm
since the assumption of minimum cost in economic theory which imputes efficiency on firms is
practically questionable.
The contribution of the above theoretical studies cannot be underestimated in the economic literature. Apart from establishing the existence of inefficiencies in the transformation of resources into outputs by firms it also provided the roadmap for estimating efficiency empirically through efficient frontier functions. Farrell’s observation of theoretical and practical means of constructing the efficient frontier led to the evolution of two main methodologies to efficiency measurement, that is, parametric (theoretical observation) and nonparametric (practical observation) approaches which have been developed to be stochastic frontier analysis (SFA) and data envelopment analysis (DEA) respectively. The studies below provide the theoretical understanding and justification of the DEA and the SFA techniques.

3.2.1 Parametric or SFA Approach

The use of parametric techniques in estimating efficient frontier functions can be traced to Aigner and Chu (1968) despite the long existence of parametric frontier functions. Aigner and Chu (1968), identified two major observations of the frontier functions in the economic literature. First, the difficulty of most economists in estimating and explaining empirically the parametric frontier functions hence resulting to the widely acceptance of average frontier production functions as the efficient frontier functions for individual firms in an industry. Secondly, the generalization problem of Farrell’s model due to its inability to be used to estimate production functions of productions which conform to the law of variable proportions. In responses to these challenges, Aigner and Chu estimate the industry production frontier function from a homogeneous Cobb-Douglas production function in the form;

$$Y_i = f (X_i, \beta)$$  \hspace{1cm} (1)
Where

\[ Y_i = \text{the maximum attainable output by the } i\text{th firm} \]

\[ X_i = \text{vector of the non-stochastic inputs used by the } i\text{th firm} \]

\[ \beta = \text{unknown parameter to be estimated} \]

Aigner and Chu (1966) used mathematical programming techniques to estimate \( \beta \) as they undertook a minimization of

\[
\sum_{i=1}^{N} |Y_i - f(X_i, \beta)| \text{ subject to } Y_i \leq f(X_i, \beta)
\]  

(2)

According to Forsund et al. (1980), the mathematical programming makes no assumptions about the regressors or the disturbance hence produce estimates which have no statistical properties. By this weakness no inferential results can be obtained from mathematical programming estimates.

Afriat (1972) explicitly assumed a disturbance which follows beta distribution to improve the specification in (1). That is,

\[ Y_i = f(X_i, \beta) + \varepsilon_i, \]  

(3)

\[ \varepsilon_i \leq 0, \text{ where } \varepsilon_i \text{ are the disturbance term.} \]

He proposed that the disturbance term can be estimated with the maximum likelihood technique.

Schmidt (1976) argues that if the inefficient term is assumed to be exponential then the result of Aigner and Chu’s linear mathematical programming procedure is maximum likelihood while that of the quadratic mathematical programming procedure is maximum likelihood if the inefficient term is half normal. Despite the innovations made to (1) its deterministic nature raised a lot of criticisms. Deterministic frontiers assume common technology and as well attribute every
deviation from the frontier to inefficiencies, meaning that the total production (cost) is not affected by random and exogenous events which are not associated with inefficiency.

The production (or cost) function above satisfy all the assumptions of the classical regression model except the zero conditional mean assumption hence estimating with the OLS estimator provides an unbiased and consistent estimates of the slope of the frontiers but an inconsistent and uncertain efficiency of the intercept term. According to Greene (1980), if the error term involves more than one parameter it may be possible to estimate all the parameters of the model using additional moments of the OLS residuals, thus, adjusting (either by correcting or modifying) the OLS residuals can help estimate the function above. This implies that techniques such as corrected OLS (COLS) and modified OLS (MOLS) can be used in estimating the cost function.

In the case of the COLS, the intercept parameter is shifted down with the lowest negative residuals to give the equation of the frontier (that is, $\alpha_0^* = \alpha_0 - \text{Min} (U_i)$). This makes the frontier function lie below all the observations exception the lowest negative residuals which becomes the efficient observation based on which comparisons are made. Greene (1980) explains that irrespective of the correction of the intercept some of the residuals will still have theoretically wrong sign which may impede the computation of the efficiency estimates which rely on sign conformity. According to Evans et al. (2001), the major disadvantages of the COLS estimator is that it restricts the frontier to be a parallel shift of the OLS function that penalizes the efficiency estimates of firms with low OLS residuals and are mostly problematic when there is heteroscedasticity in the sample. They further argued that the COLS is inherently deterministic approach, meaning that inefficiency cannot be disentangled from random errors.
The MOLS terminology which is attributed to Lovell (1993) on the other hand, adjust the intercept by subtracting the mean of the OLS residuals (that is, \( \alpha_0^* = \alpha_0 - E(U_i) \)). According to Greene (2008), the MOLS is a bit less orthodox than the COLS since it is unlikely to result in a full set of positive residuals, implying that cost efficiency could be greater than one. But Richmond (1970) argues that the COLS and the MOLS are basically the same. The suitability of COLS and MOLS is questionable especially considering their deterministic nature and their two stage approach to efficiency measurement. These weaknesses of the two techniques have become the main reasons for adopting the stochastic frontier which overcomes all such limitations.

Aigner et al. (1977) and Meeusen and van den Broeck (1977) jointly proposed the stochastic frontier model by arguing that a production process is subjected to two economically distinguishable random disturbances with different characteristics.

That is;

\[
Y_i = f(X_i, \beta) + V_i - U_i
\]  

Where \( V_i \geq 0 \) and \( U_i \leq 0 \)

\( V_i \) = the symmetric term assumed to be independent and identically distributed as \( N(0, \sigma_v^2) \)

\( U_i \) = the inefficiency term assumed to be independent of \( V_i \) with a half normal distribution in one case and exponential distribution in another case.

They assumed a Cobb-Douglas production as they estimated (4) with maximum likelihood technique. The main contribution of their study to the economic literature is the separation of the individual error terms which was not considered in (1). According to Aigner et al. (1977), the stochastic frontier collapses to the deterministic frontier (Aigner and Chu, 1966) and the Zellner
et al. (1966) stochastic frontier when $\sigma_v^2 = 0$ and $\sigma_u^2 = 0$ respectively. In specifying the stochastic cost frontier function, the composed error ($\epsilon_i = v_i - u_i$) of the production frontier is converted into $\epsilon_i = v_i + u_i$, in order to transform the production frontier into cost frontier (Coelli (1996)). This is because, inefficient firms or observations are below the production frontier (−$u_i$) but above the cost frontier (+$u_i$), since the production function specifies the maximum output level and the cost function specifies the minimum cost level required to make a firm efficient.

From the above specifications, Coelli (1996) defines the Debreu – Farrell input orientation cost efficiency as the ratio of frontier cost ($C^*$) to observed cost ($C$) which is represented by $\exp(u_i)$

that is, $\frac{c(y,p)e^v u^e}{c(y,p)e^v} = \frac{C^*}{C} = e^u = \exp(u)$

By this definition a firm is fully cost efficient when (5) = 1 and inefficient when (5) < 1. Instead of using the variance parameter of the noise term ($\sigma_v^2$) and the scale parameter of the inefficiency term ($\sigma_u^2$), Battese and Corra (1977) provided a new parameterization approach for obtaining the efficiency term, $\exp(u_i)$, by arguing that

$\sigma = \sigma_u^2 + \sigma_v^2$ and $\gamma = \frac{\sigma_u^2}{\sigma_v^2}$ are computational preferable to the $\lambda = \frac{\sigma_u^2}{\sigma_v^2}$ used by Aigner et al., 1977. The parameter $\gamma$ lies between zero and one and indicates the importance of the inefficiency term. If $\gamma = 0$, the inefficiency term is irrelevant to the cost frontier and the result of the frontier equals that of the OLS estimation. However, if $\gamma = 1$ the random error term is irrelevant implying that the cost frontier is only explained by the cost inefficiency term. A cost (production) function is stochastic only when the residual term is right (left) skewed implying that $0 < \gamma < 1$. Henningsen
(2013) explains that endogeneity, measurement error, omission of relevant explanatory variable, inappropriate functional form and imprecise parameter estimates of the OLS regression causes a deviation of the right (left) skewedness of the cost (production) function. This argument suggests that a correctly specified stochastic frontier overcomes endogeneity, multicollinearity and other challenges of the OLS estimation.

Jondrow et al. (1982) proposed a different approach of separating the random error term from the inefficiency term. They explained that the conditional probability distribution of $U_i$ given $\epsilon_i$ provides an estimate of the ratio of frontier costs to actual costs for each firm in the sample. They defined the mean inefficiency mathematically as;

$$E(u_i/\epsilon_i) = \left[ \frac{\sigma \lambda}{1 + \lambda^2} \right] \left[ \frac{\phi(\frac{\epsilon_i \lambda}{\sigma})}{\psi(\frac{\epsilon_i \lambda}{\sigma})} + \frac{\epsilon_i \lambda}{\sigma} \right],$$

Where $\sigma = (\sigma_u^2 + \sigma_v^2)^{1/2}$ is the standard deviation and $\phi(\frac{\epsilon_i \lambda}{\sigma})$ and $\psi(\frac{\epsilon_i \lambda}{\sigma})$ are the density and CDF of the standard normal distribution respectively for the half normal distributed inefficiency term.

Since the introduction of the SFA models several innovations have been introduced to correct the several challenges of the technique. Pitt and Lee (1981) identified the cross-sectional limitation of the models and extended the technique to cover panel data observations by defining the composed error term as;

$$\epsilon_{it} = v_{it} - u_{it}$$

But their model restricted the inefficiency term to be time invariant (that is, $u_{it} = u_i$).
As a justification of the use of panel data Schmidt and Sickles (1984) argue that increase in observations increases the consistency of the inefficiency estimates hence using panel data does not require the strong distributional assumptions observed in the earlier models. Schmidt and Sickles (1984) observed that when the inefficiency term is time invariant (that is, presence of firm effect but no time effect) the stochastic frontier fits exactly the framework in the panel data literature therefore introduced fixed and random effect SFA models.

Cornwell et al. (1990) and Battese and Coelli (1992) released the time invariant assumption in the literature by assuming time varying models where there are both firm effect and time effect.

Battese and Coelli (1995) criticized the earlier models as they adopted two stage approaches in determining factors that influences the inefficiency term. They argued that the independent and identically distributed assumption made in the first stage is being contradicted if a second stage is implemented to find drivers of efficiency. Hence modeled the inefficiency term to incorporate both environmental influences and a random term such as:

$$ u_{it} = z_{it} \delta + W_{it} $$

(8)

Where \( z_{it} \) are the explanatory variables that influence inefficiencies; \( \delta \) is an unknown parameter to be estimated while \( W_{it} \) are random variables assumed to be normally distributed.

Greene (2005) utilized the one stage concept to provide solution to two major issues in the literature. He introduced the true random and true fixed effect models which solved the time invariant assumption in the Schmidt and Sickles (1984) models and also accounted for unobserved heterogeneity among firms which may be in the form of firm characteristics not measured in the model. He specified the true random and true fixed model for cost functions as;
\[ Y_{it} = \alpha + \beta'X_{it} + w_i + V_{it} + U_{it} \]  \hspace{1cm} (9)

\[ Y_{it} = \alpha_i + \beta'X_{it} + V_{it} + U_{it} \]  \hspace{1cm} (10)

\[ w_i \sim (N(0, \sigma^2_w), V_{it} \sim (N(0, \sigma^2_v)) \text{ and } U_{it} \sim (N(0, \sigma^2_u)) \]

Where \( w_i, V_{it} \) and \( U_{it} \) are assumed to be uncorrelated of each other.

Greene (2005) estimated the above models by the Maximum Stimulated likelihood (MSL)

### 3.2.2 Non-parametric or DEA Approach

Unlike parametric approach, the non-parametric approach do not assume specific functional forms of the relationship between inputs and outputs or specify distributional assumptions of the inefficiency terms. The study of Farrell (1957) serves as the foundation of this approach in the economic literature. Farrell (1957) constructed the efficiency frontier using best observed input and output combinations of firms in the industry. By this approach the efficiency frontier envelopes the input and output combinations of all firms in the industry.

Charnes et al. (1978) explored the concept of Farrell using mathematical programming techniques to propose the Data Envelopment Analysis. They modelled efficiency as the maximum ratio of weighted output to weighted inputs subject to the condition that similar ratios for every decision making unit (DMU) be less or equal to one. This definition brought to bear the relative concept of the term efficiency as every DMU’s efficiency is rated relative to other DMUs using similar input and output combinations in a collection they referred as program. By this approach DEA is seen as a managerial tool for analyzing efficiency. According to Charnes et al. (1978) efficiency is not
a solely scalar measure hence a DMU attains efficiency only when its optimal value obtained from the linear mathematical programming optimization absorbs every slack input or output variables (that is all slack variables must be equal to zero).

One of the major contributions of this model is its ability to allow for multiple outputs and inputs in the study of efficiency since modern firms hardly produce one output. This pioneering study of Charnes et al. (1977) (CCR model) limited its scope to the constant returns to scale assumption of Farrell hence resulting in a lot of questions about DMUs experiencing increasing and decreasing returns to scale in their production process.

Banker et al. (1984) contributed to the DEA literature by proposing a variable returns to scale DEA which extended the model of Charnes et al. (1978) to incorporate production processes with varying size and technology. By this intervention DEA has become a common technique for estimating scale efficiencies which were not accounted for in the CCR model. That is, they decomposed technical efficiency into pure technical efficiency and scale efficiency.

The CCR and BCC models of DEA efficiency measure have become the traditional models based on which several economists have developed new ideas and innovations. According to Ray (2004), as at 1992 472 studies were observed to have used the DEA methodology but 3183 studies from 2152 Authors were observed in 2002. This trend in the literature clearly shows the acceptance of the DEA methodology as a managerial tool for analyzing efficiency.

3.3 Determinants of Efficiency

A review of the economic literature reveals that the number of procedure or processes undertaken to unravel the drivers of efficiency determines the approaches to efficiency determinants. The approaches to determinants of efficiency are adumbrated below.
3.3.1 Two-stage Approach

The two-stage approach to determinants of efficiency can be seen to be the most common approach in the DEA literature. Just as the name suggests, this approach undertakes two major processes to discover the determinants of efficiency. It estimates the efficiency score of the decision making units then uses this value as a dependent variable on possible independent exogenous variables in a regression model to discover the possible drivers of efficiency of the DMU. Researches such as Kalirajan (1981) and Pit and Lee (1981) among others utilized this approach in the SFA literature while Yanga and Pollitt (2007), Yao et al. (2007), Owusu-Ansah et al. (2010) and many more made use of the approach in the DEA literature.

The domination of this approach in the DEA literature is due to the mathematical programming technique in their models. This technique does not have any statistical properties which makes it possible for other exogenous factors to influence the error term but this is not the case in the SFA technique. The SFA literature heavily criticizes the two-stage approach of contradiction. The first step assumes an independent and identically distributed relationship existing between the inefficiency terms while the second step tries to find factors that have some relationship with the inefficiency term. Thus making the second step a contradiction of the first step (Danquah and Ouattara, 2015). This contradiction identified in the SFA literature forced economists to innovate the one-stage which overcomes the challenges of the two-stage approach.

3.3.2 One-stage Approach

Under this approach, the two processes in the two-stage approach are consolidated into one single process. That is, firm characteristics and other factors that explain the deviation of a firm from their frontier are included in the estimation technique at the first step thus eliminating the contradictory second step process in the case of SFA. Kumbhakar et al (1991), Reifschneider and

The use of a one-stage approach in DEA is a current phenomenon since such procedure had not been developed in the literature until recently when Johnson and Kuosmanen (2011) proposed such approach which they referred to as stochastic semi non-parametric envelopment of z variable data.

### 3.4 Efficiency Measurement Orientations

Microeconomic theory of the firm assumes profit maximization as the basic objective of a firm achievable either through cost minimization or revenue maximization. This cost or revenue constraint to profit maximization provides two broad approaches to the measure of efficiency, that is, the input orientation or output orientation approaches. Whilst the input orientation undertakes optimization by minimizing inputs conditional on output, the output orientation achieves optimization by maximizing output conditional on input usage.

The input approach considers output as an exogenous variable which can be achieved by varying factors of production (inputs). It is predominantly used under the competitive market structures (that is, perfect competitive, monopolistic and oligopolistic markets). Profitability under these markets are pegged at marginal cost equals marginal revenue thus marginal cost reduction is the desired objective for firms to be able to dominant the markets. This indicates that the competitive environment directly or indirectly make these firms adhere to varying their inputs to achieve output hence representing the input orientation approach to efficiency.
Under the output approach to efficiency measurement, firms vary outputs as they consider inputs to be fixed or exogenous. The objective of using this approach to measure efficiency is to maximise output. The ability of a monopolist to vary its outputs makes this approach popular in the monopoly market structure. A diagrammatical explanation of the two approaches can be seen in figure 3 below. Figure 3 exhibits the case of firms using one input (X) to produce one output (Y). From the diagram, a firm is efficient only when its production or cost frontier lies on the efficient frontier of CRS or VRS. Considering the input orientation of efficiency where inputs are varied to obtain an exogenous output, firm B producing 5 units of Y can be efficient by reducing input X from 5 (B) to 2 (B1) or 3 (B2) to achieve efficiency under the CRS or VRS model respectively. Thus firm B knowing its inability to alter output due to its exogenous nature or the competitive environment of the firm varies its input to realize efficiency. Firm B under the output orientation approach to efficiency operates on a fixed input (X) of 5 but increases output (Y) from 5 to 10 to obtain efficiency at C which is an efficient point under both CRS and VRS models of efficiency. It is
clear that irrespective of the choice of the two approaches the firm is able to operate on the efficiency frontier.

Considering the unhealthy competitive pressure in the Ghanaian insurance industry the study follows Eling and Luhnen (2010) to adopt an input orientation approach in estimating the efficiency of firms in the industry.

### 3.5 Empirical Review of the Use of the Frontier Techniques

The use of the frontier technique is not limited to a particular field of study but rather has a strong presence in literature on almost every sector. From an initial application to the Agricultural sector by Farrell (1957) the techniques have extended to almost every department, firm, industry and countries among others. This can be observed in the studies below.

Danquah and Ouattara (2015) examined the determinants of national efficiency among 18 Sub-Saharan African countries from 1970 to 2010 with the SFA technique. Using physical capital stock, labor force and human capital as inputs and real GDP as output their study revealed that trade openness, machinery import, stock of research and development, landlockness and the quality of institutions determines the national efficiency of SSA countries.

Danquah et al. (2013) investigated the differences (similarities) in inefficiency estimates in stochastic frontier models that control for unobserved heterogeneity in inefficiency (proposed by Greene, 2004; 2005) and production or technology frontier. They estimated pure technical efficiency of a panel of 133 Ghanaian rural community banks from 2006 to 2011 as they considered the conventional stochastic frontier estimates as the base line for the comparison. It was observed that the pooled model obtained larger estimates for their parameters relative to the true fixed and
random parameter frontier estimates indicating that the unaccounted unobserved heterogeneities in the pooled model inflate their estimates. Danquah et al. (2013) confirmed a correlation of 99.9% in the controlled unobserved heterogeneity models and as well proved with the help of the kernel density estimator a lower mean distribution in the controlled models relative to the pooled model.

According to Baah-Nuakoh (2003), imperfect competition is a necessary condition for the existence of much of X-inefficiency since competition eliminate high cost producers and make management discipline to oversee the effective utilization of inputs by employees. In an attempt to empirically prove this assertion he used data on 356 Ghanaian manufacturing firms made up of 16 subsectors in 1974 using Farrell’s (1957) technical inefficiency estimates as one measure of efficiency and the ratio of actual capital over labor (K/L) in an establishment over K/L of the most efficient labor intensive establishment in the industry as another measure of efficiency. These estimates confirmed the existence of large inefficient establishments among the manufacturing industry in Ghana due to the imperfect nature of the market. Baah-Nuakoh (2003) confirmed that firm size, control of raw materials, capital requirement and specialization are the determinants of X-inefficiencies in the manufacturing industry.

Fukuyama (1997) investigated the productive efficiency of stocks and mutual companies of the Japanese Life insurance industry amiss the several economic conditions using non-parametric technique of a panel data from 1988 to 1993. He observed that the primary source of inefficiencies is pure technical efficiency for mutuals and scale efficiency for stocks as overall technical efficiency increases throughout the period for mutuals but declines from 1988 to 1990 then increases from 1990 to 1993 for stocks. According to Fukuyama (1997), stock firms were quicker to adopt innovations in the boom period than mutual firms.
3.6 Empirical Review of Insurance Efficiency

The insurance industry in the past few decades have witnessed an increase in the application of the efficiency frontier techniques. This trend can be attributed to the insurance market unification agenda of the European Union in 1994. By this regulation, there exist a huge skewness of the insurance efficiency literature on Europe and US with less attention on developing countries in Africa. Since most studies focused on the preparedness of the individual member states as well as the corresponding consequence on the efficiency of firms in the industry.

The study divides the academic literature into two kinds as it examined the determinants of efficiency. First, considering the impact of imprecision in measurement of outputs, inputs and input prices on the frontier methodologies, the study analyses the functions of insurance to know the ideal measurement of insurance input and output variables in efficiency studies. The second part discusses the empirical studies on efficiency and its determinants.

3.6.1 Empirical Literature on Output and Inputs

Measurement of outputs may be very easy in production industries like manufacturing and agriculture especially due to the tangibility of their outputs. But this is not the case in the service industry where outputs are intangible which make output measurement a very difficult task in such industry. Three approaches have been discovered in the definition of outputs in the financial industry; asset or intermediation approach, user cost approach and value-added approach. This section discusses the three approaches to output measurement in the insurance industry to obtain the outputs, inputs and input prices for the study.
According to Sealey and Lindley (1977), the appropriate concept of output of a financial institution is the services it provides to its debtors which can be expressed as the various types of earning assets of the firm. This means that, firms receives deposits from their debtors or policyholders (in the case of insurance) as an input and transforms these funds with an interest in a period of time for these debtors as an output. Under this approach, borrowed funds becomes inputs while assets become outputs. Cummins and Weiss (2013) argue that the use of this approach is inappropriate for property liability insurers since they provide numerous services apart from intermediation. But they explained that as intermediation is the main function of life insurers the approach is true to some extent in the life insurance industry.

The user cost approach on the other hand determines an output or input depending on the net contribution of the variable in question to the revenue of a firm. Hancock et al. (1985) explained that when the return on an asset exceeds the opportunity cost of funds or when the cost of liability is less than the opportunity cost then the variable in question is defined as an output, otherwise it is an input. Despite the suitability of this approach, the demand of opportunity cost and information which are usually not available in the public makes the usage of the approach limited in the insurance literature.

The third approach which is mostly regarded as an appropriate measure of outputs in the insurance efficiency literature is the valued added approach. This approach differs from the two approaches above as it considers every category of liability and asset to have some characteristics of output rather than distinguishing inputs from outputs in a mutually exclusive way (Berger and Humphrey (1992)). Under this approach, categories or activities are considered as outputs when they have significant valued added which can be judged using operating cost allocations. Therefore a thorough examination of the activities or functions of the insurance industry can help discover the
outputs of the industry. Insurance companies have three main functions, which are, risk-pooling or risk bearing, intermediation and real financial services relating to insured loses.

Under the risk-pooling function, insurers provide the opportunity of reducing insurable risk of an insured through pooling. The insurer collects premiums and redistribute the funds to policyholders who would suffer lose under the insurance contract. According to Cummins et al. (1999), the actuarial, underwriting and related expenses incurred as a result of operating the risk pool is an important value added in the industry. Again, the economic security granted policyholder against loses and investment shocks creates value added to insurers. Claims and additions to reserves are mostly used as proxies under this function of insurance which is measured as the amount of claims less reinsurance claims. According to Fenn et al. (2008), the random fluctuations encountered in claims cause it to deviate from expect future value which stands as a good proxy of output but its consistency with principle continues to make it a relevant measure in insurance literature.

Insurers offer several services to policy holders apart from the risk pooling function. Such services include counseling, personal financial planning, pension and benefit administration, risk prevention services and risk survey among others. These services are known as the real financial services relating to loses of the insurance industry. The suitability of this function in efficiency studies was questioned by Berger et al. (1997) as they argued that these proxies ignores the output qualities of loss control and risk management of insurers. And again, does not capture any systemic difference between direct insurers and independent agency insurers.

Under the intermediation function, insurers act as investors for policyholder as they invest funds from insurance contracts into securities and assets which are usually not available to other investors. These funds are then withdrawn during maturity or termination of policy by
policyholders (life policies) or are needed for claims settlement. The net interest margin between the return on the investment assets and the rate credited to the policyholder is the value-added of the intermediation function. Premium income and investments income are mostly used to represent this function of insurance in the literature. The use of premiums has heavily been criticized in the insurance literature since it is a product of price and output but not only output. Yuengert (1993) also argues that systematic differences in price across large and small firms may lead to misleading inferences about average costs if premiums are used as an output proxy.

There is a wide conformity in the literature concerning the choice of inputs usage in efficiency studies in insurance. According to Cummins et al. (1999), inputs can be divided into 4 groups, that is, home office labor, agent labor, materials (including physical capital) and financial capital. But financial capital mainly comprise of debt and equity. For simplicity and reduction of parameters, several economists have combined labor and materials to obtain operating expenses (Ennsfellner et al., 2004) making inputs represented by operating expenses, debt and equity capital (Eling and Luhnen, 2009).

Equity capital is a very important input variable as it indicates an insurer’s ability to pay claims even when it exceeds expectation as well as help insurers meet regulatory requirements. This indicates that the higher the equity, the higher the confidence of policyholders in the insurer. Debt capital on the other hand makes funds available for investment into assets hence the higher the debt capital the higher the available funds for investment. For conformity with literature the study adopted the input definition of Eling and Luhnen (2009) to define inputs as Operating expenses, debt capital and equity capital for estimating efficiency. Equity capital among insurers in Ghana is made up of stated capital, capital surplus, retained earnings, contingency reserves, income surplus, available to sale reserves and regulatory and statutory reserves. The major factors among
these variables are stated capital and retained earning which makes equity more connected with the activities of shareholder in the industry. Debt capital also comprise of financial liabilities, bank overdrafts, loans, bonds, unearned premiums, outstanding claims, deferred levies and taxes and customers deposits. Operating expenses is basically made up of commissions, salaries, printing, transportation and other operating cost.

3.6.2 Empirical Literature on Insurance Efficiency Determinants

The insurance literature on efficiency determinants have incongruous results usually attributed to methodology, economic issues analyzed, sample size and different economies among others.

Eling and Luhnen (2009) investigated the economic issue of different methodologies, organizational form, countries, company size and line of business to provide a new empirical evidence on the efficient frontier measurement for the international insurance industry using data on 6462 insurers from 36 countries for the period 2002 to 2006. They observed an average technical efficiency of 50% and 71%, cost efficiency of 38% and 59% for non-life and life firms respectively under VRS DEA and a corresponding technical efficiency of 81% and 84%, cost efficiency of 74% and 59% for non-life and life firms using BC95 SFA. They recorded a steady growth of efficiency in the international insurance market during the period which was characterized by higher efficiency values of developed economies and lower values for emerging countries.

Small and medium firms exhibited increasing returns to scale whereas large firms exhibited decreasing returns to scale confirming that smaller firms were more efficient than larger ones. The expense preference hypothesis was not confirmed since mutuals were found to be efficient relative
to stock and also diversification in different line of business is not always better than strategic focus on one line. There was a negative relationship between capitalization and efficiency (technical and cost) for non-life firms as well as technical efficiency for life firms but cost efficiency for life firms recorded a positive relationship. Despite the similarity in trend relationship between DEA and SFA, they used the standard conditional mean approach to determine the differences between them to conclude that capitalization (solvency), company size and organization form are the main drivers of efficiency in the international insurance industry.

Considering the 1994 deregulation of the insurance market of the European Union, Fenn et al. (2008) analyzed the influence of firm size and market structure on cost efficiency for 14 European countries from 1995 to 2001 using the one stage SFA suggested by Kumbhakar and Lovell (2000). Instead of the constant variance assumption the study modeled variance to comprise of systematic influences as well as one and two tail heteroscedasticity coefficient variables. The study revealed an average increase in X-inefficiency over the period with a strong evidence of X-inefficiency of specialist insurers, large firm sizes and domestic market share compared to the low X-inefficiency of composite insurers varying with small firm size. Increasing returns to scale was experienced for majority of European insurance companies throughout the period across every line of business which then explains the reason for the increasing firm size and market share through mergers and acquisition during the period. According to Fenn et al. (2008) the existence of scale efficiency in the insurance industry is the main source of efficiency gains over the period.

Diacon et al. (2002) examined the value-base efficiency of the insurance industries in 15 European countries by the input-oriented BCC-DEA technique during the period 1996 to 1999. They analyzed the significant variations in the cross country efficiency score using a two stage regression model which confirmed a U shape between technical efficiency and firm size, an
inverted U shape between scale efficiency and firm size and a positive linear relationship between mix (allocative) efficiency and firm size. Mutual insurers and stock insurers with higher solvency ratio turns to have higher technical efficiency while profitability is positively related with scale efficiency and negative related with mix efficiency just as higher reinsurance has a negative relationship with mix efficiency. According to Diacon et al. (2002) after controlling for size, mutuality, solvency and country specific effects reveals that specialized firms are more efficient than composite firms.

Rai (1996) examined the cost efficiency of 106 insurance firms across 11 different countries over a period of five years from 1988 to 1992 within Europe, Japan and US using a half normal translog cost stochastic frontier and distributional-free models of efficiency estimation. There was an average cost inefficiency of 27.3% observed among the firms. Rai (1996) classified his 415 observations according to size (that is, large and small firms), specialization (that is, composite and specialize firms) and countries as they estimate cost efficiency. This segregation confirmed that efficiency varies by country, firm size and specialization that is, small firms were more cost efficient than large firms; specialized firms were more cost efficient than composite firms while firms in countries like Finland Denmark were more cost efficient than UK firms. To establish his observation he undertook a second stage regression together with the estimation of economies of scale and cost complementarity which all confirmed his claims above. The Distribution free (DFA) model provided estimates which were very inconsistent with the stochastic model but Rai explained that the short sample period could not allow the inefficiency error term to cancel out hence he chose the stochastic frontier estimates over the DFA model. Despite the tremendous contribution of Rai’s paper it assumed a constant technology among all the 11 countries in the sample hence the likely probability of biasing the results of his estimates.
From the above international studies, factors such as firm size, capitalization, organizational form, market share, business type and country of operation determined cost efficiency in the insurance literature. Among these factors there exist a consistent negative relationship between firm size and cost efficiencies under the SFA methodology indicating that small firms are relatively cost efficient compared to large firms. The other factors had varying relationships depending on the individual studies but these can be verified depending on the individual country studies below.

Pottier (2011) analyzed the impact of regulation on cost, profit and revenue efficiency by using a cross-sectional data on 277 United States life firms in 2005 with a VRS DEA model. The observed average efficiencies recorded were 66.2%, 43.2% and 64.9% for cost, revenue and profit efficiency respectively. These averages which are higher compared with most DEA results from other studies were also consistent with conventional performance measures such as cost to benefit, revenue to benefit and return on assets ratios. The two stage multivariate ordinary least square regression reported a positive relationship between firm size and all the three frontiers and a negative relationship of the three efficiencies with entities (number of insurers affiliated to a group) and capitalization (premiums/capital). State licensed (regulatory compliance cost) had a significant and negative relationship with cost efficiency but not significant with revenue and profit efficiency. Pottier (2011) argues that the positive revenue to benefit ratio observed with state licensed offset the cost associated with the cost inefficiencies hence no effect on profit efficiency. From the study, firm size, capitalization, entities and states licensed are the determinants of cost efficiency among US life insurers.

The short time period examined in most insurance efficiency analysis makes them rely on the time invariant assumption despite the theoretical development in the stochastic panel frontier models with temporal variation in efficiency. This observation motivated Shi and Zhang (2011) to analyze
the suitability of the time invariant and time varying assumptions of the translog cost stochastic panel frontier models using a panel data on 801 US property causality insurers from 2001 to 2006. The generalized $R^2$ were 98% and 99% with accompanying average cost efficiency scores of 0.185 and 0.838 for the time invariant and time varying assumptions respectively, indicating that the time varying estimates are consistent with literature. They argued that the non-adherence of the time invariant model to changes in best practice firms over the period account for the observed biasness. As a robustness test, they breakdown the sample into two groups that is stock and mutual insurers and examined their correlation coefficients. The consistency between the correlations of the time varying estimates with their corresponding two groups clearly confirmed the suitability of the time varying assumption over the time invariant assumption.

Hao and Chou (2005) analyzed the influence of market share, optimal scale and product diversification strategies on cost efficiency in the Republic of China using an unbalance panel on 26 insurers during the period 1977-1999 with both DFA and BC92 models. Results from the DFA model reported an average cost inefficiency of 33.98% while that of BC92 report 81%. According to Hao and Chou (2005) the high inefficiency recorded in the BC92 indicated wrong distributional assumption which does not fit their data hence they chose the DFA over the BC92. Their results showed that market share and firm size had a positive relationship with cost efficiency.

The contradiction in the literature regarding deregulation and consolidation on efficiency in the European insurance market after the implementation of the third insurance directives in 1994 led Barros et al. (2010) to provide additional evidence on the relationships using DEA technique with data from 1994 to 2003. They obtained 12% average technical inefficiency gap over the period with only 15 (representing 7 life and 8 non-life) out of the 71 firms obtaining average efficiencies above 90%. They used the two stage approach by Coelli et al. (1998) to investigate the
determinants of efficiency which revealed that there exist a negative relationship between firm size and technical efficiency, a positive relationship between market share and efficiency and a negative relationship between equity/invested asset and efficiency. According to Barros et al. (2010) the competition of market share is the main driver of technical efficiency in the Greek insurance industry.

The preparedness of China in opening up its insurance market by 2006 after joining the World Trade organization (WTO) in 2001 propelled Yao et al. (2007) to examine the level of technical efficiency and its determinants in the insurance industry of China. They utilized a panel of 22 companies (12 non-life and 10 life) from 1999 to 2004 on the input-oriented CCR-DEA and the Malmquist index techniques. Non-life firms obtained an average technical efficiency of 77% compared to the 70% efficiency in the life sector. Only four firms maintained their position as best practice firms over the period. These estimates were further explained by the Malmquist indexes of the firms to examine the role of technical change and frontier shift in determining their productivity change. A two stage approach revealed that firm size, direct sales, human capital and ownership structure determines the level of efficiency in the insurance industry of China. According to Yao et al. (2007), firm size, human capital and direct sales have a positive relationship with technical efficiency but state-owned firms were more efficient than non-state firms.

The several liberalization paradigms after the post-1980 period in the Turkish economy in the form of deregulation of the financial industry as well as the legal adjustments that required insurance companies to specialize in either life or non-life branches before 1994. This motivated Kasman and Turgutlu (2009) to analyses the cost efficiency and the scale economies of 85 Turkish insurance firms over the period 1990 to 2004 using the stochastic frontier analysis technique. From
a minimum cost inefficiency of 18.3% and a maximum of 36.9%, the Turkish insurance industry experienced an average of 30.6% cost inefficiency.

According to Kasman and Turgutlu (2009), the highest inefficiency level was recorded after the specialization regulatory act in 1994 with an average of 35.9% inefficiency indicating that the regulation worsened the cost inefficiencies of the firms in the industry. It was also observed that all firms in the industry operated under increasing returns to scale indicating that economies of scale existed at every level of production in the industry. A second stage regression model confirmed that the drivers of efficiency in the Turkish insurance industry were capitalization, market structure and ownership type. That is, during the period the excess of equity capital over total asset as well as the high concentration of the insurance market led to lower efficiencies while the firms owned by foreigners in the market were more efficient than the domestic firms.

Cummins and Zi (1998) studied the choice of methodology in efficiency analysis using data on 445 US life insurance firms for the period 1988 to 1992 as they examined the cost efficiency of US life insurance industry. They reported 7 SFA models with different distributional assumptions and 2 DEA models. Average cost efficiencies varied among the models as free disposal hull (FDH) obtained the highest average efficiency of 91% and the distributional free method recorded the lowest score of 44%. The econometric model had an average rank correlation of 96% while that of the programming model had 67% indicating a strong preservation of ranks in the econometric models. In identifying best and least firms, they estimated a pairwise agreement statistics which confirmed econometric models as reasonable in identifying firms with an average of 85% to 90% accuracy. They confirmed a positive relationship between firm size and cost efficiency and a higher cost efficiency in mutual relative to stock insurers in all the models. But a control of firm size proved equal efficiencies of both mutual and stock firms.
Their data showed robustness of the econometric models towards distributional assumptions whilst both techniques had a high correlation with the conventional performance models. They also observed the existence of economies of scale in firms with small size as well as the appropriateness of the monotonicity assumption as it had the same trend with the cost inefficiencies in the data. Cummins and Zi (1998) argue that despite the robustness of their data towards choice of estimation methodology, it is appropriate to use more than one methodology in analyzing efficiency.

The operation of Australian general insurers at cost above international best practices and the increased competition due to the deregulation and relaxation of bank and insurance regulations motivated Worthington and Hurley to examine the cost efficiency among the Australian general insurers. They used the VRS DEA methodology on a cross-section of 46 insurers in 1998. From a second stage Tobit regression, Worthington and Hurley (2002) argued that the major determinant of cost efficiency in the Australian general insurers is firm size as both small and large firms recorded a positive relationship with cost efficiency.

It is clear from the above studies that there is no harmony in the relationship between efficiency and the various determinants observed in the literature. The same factors continuous to determine efficiency but attains different relationships depending on the type of efficiency study and the methodology involved. The issue of whether these trends are globe observations may depend on the insurance efficiency studies on Africa below.

Alhassan and Biekpe (2015) undertook a comprehensive analysis of efficiency, productivity and returns to scale economies on the South African non-life insurance industry using the Simar and Wilson (2007) bootstrap DEA technique with 418 firm-year observational data from 2007 to 2012. The controversy on premiums as an output variable in the economic literature caused them to
undertake two separate models where model 1 uses net premiums earned and investment income as output variables and model 2 uses incurred losses and investment income as output variable whereas management expense, total equity and total liabilities remains the inputs variable for the two models. The observed technical, pure technical and scale efficiency for model 1 were 52.15%, 59.25 and 87.80% while that of model 2 were 57.25%, 67.19% and 87.34% respectively implying that pure technical efficiency is the major source of technical inefficiencies in the industry hence efficiency can be improved by adopting technology-enhancing systems for premium pricing and claims management especially as majority of the firms in the industry operate under decreasing and increasing returns to scale.

An inverted U relationship existed between size and scale whereas a U relationship is observed between pure technical efficiency and size from both models since small, medium and big insurers operated under increasing returns and large insurers operated under increasing returns to scale. The Malmquist productivity index showed that improvement in productivity over the period is attributed to a frontier shift due the ability of insurers to adopt best technologies through innovations. According to Alhassan and Biekpe, reinsurance, leverage and age of insurers have negative relationship with efficiency whilst product line diversification has a positive relationship with efficiency but size and efficiency exhibited a U relationship. Insurers who operate at constant returns to scale had low leverage, low reinsurance, high diversification of service line and non-linear size relationship. They also observed that inefficient insurers catch up efficient insurers at a slower rate.

Wasseja and Mwenda (2015) studied the technical efficiency of 20 life insurance companies in Kenya from the period 2004 to 2009 using a bootstrap data envelopment analysis (DEA) proposed by Simar and Wilson (1998) and the multi-stage DEA approach used by Coelli et al. (1996). They
obtained an average industry technical efficiency of 52.9% with about 47.1% of the firms operating below 50% efficiency score. The decomposition of technical efficiency into pure technical and scale efficiency revealed that life insurers experienced deteriorated managerial skills indicating no investment in organizational factors associated with insurance management as well as no innovative improvement in the period under study. From a two stage regression model, Wasseja and Mwenda (2015) confirmed that firm size and listed stock exchange firms were positively related to efficiency whereas specialized firms were less efficient compared to composite firms.

Barros and Obijiaku (2007) studied the efficiency of the insurance industry in Nigeria with four well-known DEA techniques using a panel data on 10 insurance companies (representing about 40% of the insurance market) from 2001 to 2005. They observed that most of the firms in the sample were pure technically efficient which indicates managerial efficiency but their distinction is dependent on scale efficiency. A comparison of the rankings of the four techniques by Mann-Whitney U test proved the superiority of super-efficient DEA over cross-efficient DEA, CCR-DEA and BCC-DEA techniques especially since 8 out of the 10 firms were on the efficiency frontier. They carry out a second stage panel analysis which confirmed the hypotheses that large firms were more efficient than small firms, bank network-managed insurance firms were more efficient than non-bank network-managed firms, higher market share firms turns to have higher efficiency than low market share firms. Hence, firm size, market share and insurance connection with bank networks determine efficiency in the Nigerian insurance industry.

Alhassan et al. (2015) analyzed the effect of market structure and efficiency on profitability in the Ghanaian life and non-life insurance industries using panel data of 18 life and 22 non-life insurers from 2007 to 2011. Herfindahl Hirschman index (HHI) and concentrated ratio (CR4) were proxies for market structure, DEA estimate of technical and pure technical efficiency were efficiency -
estimates. Ratio of profit after tax over total assets were profitability together with both firm specific and macroeconomic determinants of insurer profitability and efficiency to test the efficient structure hypothesis and structure conduct performance hypothesis. They observed life insurers to be more efficient in resource utilization than non-life insurers in Ghana. Their regression results rejected the SCP hypothesis and failed to reject the ES hypothesis for both life and non-life insurers. According to Alhassan et al. (2015), underwriting risk, leverage and inflation determines the profitability of non-life insurers whereas size, underwriting risk, leverage and inflation determines profitability in life insurers in Ghana.

Ansah-Adu et al. (2012) examined the cost efficiency of 14 life and 16 non-life (accounting for about 90% of premium market share) of insurance companies in Ghana using an output orientation approach of CCR-DEA from the period 2006 to 2008. Profit or loss, net premiums and investment income represented outputs, total operating expenses, total capital and total investment were inputs whereas total operating expenses/total assets, total capital/total assets and total investment/total assets represented input prices. It was observed that average efficiency score for the three consecutive years were 31%, 23% and 43% respectively with only one firm obtaining 70% average efficiency score over the period. Life insurers obtained higher average efficiency values (31%) than non-life insurers (28%) in Ghana. Their two-stage regression model confirmed that market share and firm size are positively related to efficiency while the ratio of equity to total invested asset is negatively related to cost efficiency in the Ghanaian insurance industry.

Owusu-Ansah et al. (2010) investigated the efficiency of general insurers in Ghana using a panel data of 10 insurance companies (representing 90% of general insurance market share) from 2002-2007 with a input oriented DEA approach used by Yanga and Pollitt (2007). They estimated pure technical, scale and technical efficiencies of the insurers by assuming a variable returns to scale.
They observed that the minimum and average technical, pure technical, and scale efficiencies in the industry were 18.4% and 68%, 41% and 87% and 34% and 78% respectively. This indicated that the average insurer in the Ghanaian industry is managed with higher managerial skills. From a Mann-Whitney U test, they confirmed that large firms (based on equity capital) and large market share holders (based on premiums) turns to be more efficient in the Ghanaian general insurance industry. Thus, firm size and market share are determinants of efficiency among general insurers in Ghana. The huge efficiency scores observed in their study, depicts the small sample size challenges of the DEA methodology.

Critical observation of the literature above revealed that, studies on Europe and US showed a balanced utilization of both SFA and DEA on the various forms of efficiencies such as cost, profit, revenue, technical, allocative, scale and scope efficiency. But these trends deviate from that of Africa where studies are predominately DEA with more focus on technical efficiency relative to cost efficiency. Having the study of Ansah-Adu et al. (2012) serving as the only cost efficiency study apart from the inclusion of South Africa in an international study by Eling and Luhnen (2009) indicates a gap of SFA utilization and cost efficiency studies in the insurance literature on Africa. One major contribution of this study is therefore the use of SFA in analyzing the determinants of cost efficiency from an African country perspective.
CHAPTER FOUR
METHODOLOGY AND DATA

4.1 Conceptual Framework

The conceptual framework of this study embodies the microeconomic theory of the firm and the Debreu – Farrell’s explanation of cost (overall) efficiency. Microeconomic theory of the firm assumes that firms whose basic task is to transform inputs into outputs produces maximum outputs at minimum cost. By this assumption every firm is assumed to operate at minimum cost (theoretically minimum cost) but this level of operation is usually not observed among firms.

According to Leibenstein (1975), firms do not operate at the cost minimizing output levels due to the presence of X-inefficiencies (cost inefficiencies) which are defined as the difference between the optimal (ideal cost) and the observed cost of production. That is, firms are cost inefficient when their cost of production lies above the theoretical required minimum cost of production. Firms become efficient only when they operate on the efficient cost frontier.

Using the Debreu - Farrell measure of efficiency, the study defines cost efficiency as the product of technical efficiency and allocative efficiency. Technical efficiency is the firm’s ability to minimize input usage conditional on output whereas allocative efficiency is the optimal combination of inputs conditional on outputs.

Considering a firm utilizing two inputs in producing one output, figure 4 illustrate the measurement of input orientation cost efficiency. From the diagram, the isoquant QQ’ represents the various combinations of the two inputs required to produce the fixed output given the best technology available. Firms operating on the isoquant are considered technically efficient as they minimize their input usage by the help of the best technology available.
Despite the input and output choices available on the isoquant, the optimal operating point is at D where the isocost WW’ is tangential to the isoquant QQ’. Firms operating at this point are considered to be fully cost efficient. Firm A lies above QQ’ hence exhibits both technical and allocative inefficiency.

**4.2 Empirical Models**

In examining cost efficiency of insurers the study adopted peculiar models for estimations in both DEA and SFA. These models vividly explains the procedures for generating the cost efficiencies and as also provides solid justifications for each step.

**4.2.1 DEA Cost Efficiencies**

A cost function can be defined as the minimum cost (C) of producing an output vector (y) with given input prices (w) using a particular technology (t).
Thus, 

\[ C = C(y, w, t) \]  \hspace{1cm} (11) 

According to Caves et al. (1971), the satisfaction of certain regularity conditions makes a cost function a dual of a production function. Thus, a cost function must be continuous, twice differentiable, symmetric as well as linear homogeneous of degree one in prices. The confirmed duality between cost and production ease the output measurement challenge in insurance as supply equation estimations can be done using cost by assuming an objective function of cost minimization. Making additional assumption of exogenous outputs the study follow Cummins and Weiss (2013) by specifying an input-oriented DEA cost frontier as

\[ C(y, w) = \min_{x_s} (w_s^T x_s : x_s \in V(y_s)) \]  \hspace{1cm} (12) 

where \( C(y, w) \) is the cost frontier for firm \( s \) with output-input vector \( (y_s, x_s) \) and \( W_i = (W_{1i}, W_{2i}, \ldots, W_{si})^T \) denote input price vector corresponding to input vector \( X_i = (X_{1i}, X_{2i}, \ldots, X_{si})^T \). \( T \) represent the vector transpose and \( s = 1, 2, \ldots, S \) represent the number of firms. The cost efficiency can simply be estimated in two procedures.

The first step is to solve the linear mathematical programming problem below for each firm.

\[ \min_{x_s} w_s^T x_s \]

Subject to

\[ Y\lambda_s \geq y_s \]
\[ X\lambda_s \leq x_s \]
\[ \lambda_s \geq 0 \]

Where \( Y \) is a \( N \times S \) output matrix and \( X \) a \( M \times S \) input matrix for all firms in the sample, \( y_s \) is a \( N \times 1 \) output vector, \( x_s \) a \( M \times 1 \) input vector for firm \( s \), and \( \lambda_s \) is a \( S \times 1 \) intensity vector for firm \( s \) (the inequalities apply to each row of the relevant matrix). \( w_s \) is the input prices of the various.
inputs. The optimization solution $X_s^*$ obtained from the above estimations become the cost minimizing input assuming CRS. According to Ansah-Adu et al. (2012), the simplicity in computation and interpretation as well as the satisfaction of assumptions such as homogeneity, (weak) monotonicity, commensurability and various forms of continuity among others by the CRS assumption makes it a preferred choice over the other technological assumptions. But considering the heterogeneity observed in table 5 and the ten year period under review, it is unlikely for firms in the industry to maintain a constant technology hence the study assumes a variable returns to scale. By this assumption the study recognizes that firms may not be operating at their optimal scale of operation therefore inefficient firms are only compared to others that may be more or less the same size.

For variable return to scale, a new constraint $\sum_{i=1}^{s} \lambda_{si} = 1$ is also imposed on the cost function to obtain the solution $X_s^*$ which is the cost minimizing input vector for the input price vector $w_s$ and the output price vector $y_s$. 

The second step is to calculate cost efficiency for firm $s$ as the ratio of frontier cost to actual cost.

$$\eta_s = \frac{w_s^T x_s^*}{w_s^T x_s}$$

(13)

Cost efficiency is between 0 and 1 where 1 represents full efficiency while any deviation from 1 may indicate some level of cost inefficiency. It is important to note that cost efficiency is the product of technical efficiency and allocative efficiency, therefore firms with higher cost relative to the frontier may not be using the most efficient technology (technical inefficiency) and/or because they are not using the cost-minimizing input mix (allocative inefficiency).
4.2.2 SFA Cost Efficiencies

The cost minimization objective of a firm can be represented with a particular cost technology which transforms (11) into a unique function in the form;

\[ C_{it} = f(y_{it}, p_{it}) + \varepsilon_{it} \quad (14) \]

Where \( \varepsilon_{it} = u_{it} + v_{it} \).

The cost function of insurance is unknown but there is a wide utilization of the translog cost function over Cobb-Douglas and other functional forms in the insurance literature. Since it is able to make inefficiency an additive term (Henningsen, 2011) and does not put prior restrictions on the functional form (Shi and Zhang, 2011). For consistency with literature the study assumes a translog cost function with a non-neutral technology. Therefore, (14) becomes

\[
\ln\left(\frac{C_{it}}{P_{kit}}\right) = \delta_0 + \sum_{m=1}^{M} \delta_m \ln(y_{mit}) + 0.5 \sum_{m=1}^{M} \sum_{n=1}^{N} \delta_{mn} \ln(y_{mit}) \ln(y_{nit}) + \sum_{k=1}^{K} \delta_k \ln(P_{kit}^*) + 0.5 \sum_{k=1}^{K-1} \sum_{l=1}^{K-l} \delta_{kl} \ln(P_{kit}^*) \ln(P_{lit}^*) + \sum_{k=1}^{K-1} \sum_{m=1}^{M} \delta_{km} \ln(P_{kit}^*) \ln(y_{mit}^*) + \delta_1 t + 0.5 \delta_{11} t^2 + \sum_{m=1}^{M} \delta_{1m} t \ln(y_{mit}) + \sum_{m=1}^{M} \delta_{1k} t \ln(P_{kit}^*) + U_{it} + V_{it} \quad (15)
\]

Where \( C_{it}, P_{kit} \) and \( y_{mit} \) represent the total cost (obtained by multiplying the inputs by their prices) of the ith firm at t year, the kth input price of the ith firm at t year and the mth outputs of ith firm at time t respectively. One input price (such as \( P_{kit} \) in the case above) is used to divide the dependent variable \( (C_{it}) \) and all other input prices to ensure linear homogeneity of degree 1 in input prices, (thus \( P_{kit}^* = \frac{P_{kit}}{P_{kit}} \)). Operating expenses is used for the linear homogeneity assumption in this study.
The time factor $t$ included as a regressor in the model account for the technological assumption whilst $\delta$ are coefficients to be estimated in the model.

Several techniques exist to estimate (15) but considering the general objective of examining the determinants of cost efficiency in the Ghanaian insurance industry, the study adopts the one-stage or condition mean approach proposed by Battese and Coelli (1995). Under this approach the cost inefficiency term which was assumed to be monotonic decaying becomes:

$$u_{it} = \eta_{it} u_i = \{\exp[-\eta(t - T)]\} u_i$$

and is transformed into

$$u_{it} = z_{it} \delta + W_{it}$$

where, $u_{it}$ are the non-negative variables associated with cost inefficiencies assumed to be independently distributed such that it is obtained by truncation (at zero) of the normal distribution with mean, $z_{it} \delta$ and variance $\sigma^2_u$ where $z_{it}$ is a (1 X m) vector of explanatory variables associated with cost inefficiency while $\delta$ is a (m X 1) vector of unknown coefficients. $W_{it}$ are the random variables defined by the truncation of normal distribution with mean zero and a constant variance, $\sigma^2$, such that the point of truncation is $-z_{it}\delta$ (that is, $W_{it} \geq z_{it}\delta$). $V_{it}$ are the statistical noise assumed to be identically and independently distributed $\text{N}(0, \sigma^2_v)$ and is independent of $u_{it}$.

According to Cummins and Zi (1998), efficiency estimation is robust to the distributional assumptions of the error terms in SFA, thus efficiency scores are usually not affected by distributional assumptions.
Inefficiencies are modelled as dependent on large firms (large), small firms (small), capitalization (CAP), market share (MT), business type (BT), ownership type (OT), regulation (REG), reinsurance (REI). The model for the inefficiency is defined as:

\[ u_{it} = \delta_0 + \delta_1 large + \delta_2 small + \delta_3 (CAP)_{it} + \delta_4 BT + \delta_5 OT + \delta_6 (MS)_{it} + \delta_7 (REI)_{it} + \delta_8 (REG)_{it} + W_{it} \] (16)

The study adopts the re-parameterization approach of Battese and Corra (1977) to obtain the Debreu – Farrell cost efficiency estimates of the individual observations.

### 4.3 Second Stage DEA Regression

The DEA two-stage approach adopted in this study requires undertaking a regression to obtain factors that influence efficiency in the insurance industry. OLS and Tobit regression had mostly been the preferred choice of the DEA second stage. But considering the challenges explained by Simar and Wilson (2007) about the serial correlation which bias the efficiency scores and the unattainable assumptions found in Tobit and OLS respectively, the study adopts the truncated bootstrapping regression proposed by Simar and Wilson (2007).

DEA is a non-parametric approach which do not have statistical properties hence Simar and Wilson (2007) adopts maximum likelihood method in estimating the two stage regression. This approach proves superior to other panel regressions like fixed and random effect in the DEA literature. This is due to its ability to control for time effect and as well regenerate efficiency scores which has statistical properties. Under this approach, the cost efficiency estimates are regress on explanatory variables in a model such as:
\[ \hat{Y}_i = Z_i \delta + \varepsilon_i \geq 1 \]

(17)

Where \( \varepsilon_i \) are the random errors \( N(0, \sigma^2_{\varepsilon}) \) truncated at \( (1- Z_i \delta) \), \( Z_i \) are the explanatory variables which influence cost efficiency, \( \hat{Y}_i \) are the Shephard’s distance approach efficiency scores obtained by reciprocating the Farrell oriented DEA cost efficiency scores obtained in this study and \( \delta \) are unknown parameters to be estimated.

The following steps embodies the technique:

First, bootstrap for each insurer \( i=1,\ldots, n \) and draw from the distribution \( N(0, \sigma^2_{\varepsilon}) \) \( \varepsilon^*_i \) with left truncation at \( (1- Z_i \delta) \) and compute \( \hat{Y}^*_i = Z_i \delta' + \varepsilon^*_i \).

Secondly, construct a pseudo sample \( (X_i) \) by setting \( X_i^* = X_i \hat{Y}_i / \hat{Y}^*_i \) for all firms and keep output measure unchanged, \( \hat{Y}_i = \hat{Y}^*_i \).

Re-estimate DEA cost efficiency \( \hat{Y}^*_i \) by replacing \( (X_i, \hat{Y}_i) \) by \( (X_i^*, \hat{Y}^*_i) \).

Loop over this procedure 100 times \( (L_1=100) \), take the mean \( (\bar{Y}) \) of the 100 \( \hat{Y}^*_i \) estimates then compute the bias-corrected estimates \( \check{Y}_i = 2 \bar{Y}_i - \check{Y}_i \). The reciprocal of \( \check{Y}_i \) gives the Farrell bias-corrected cost efficiency estimates.

Re-estimate the marginal effect of the explanatory variables \( Z_i \) using the bias-corrected efficiency to obtain the coefficient estimates \( \delta' \) by left-truncation with \( L_2=1000 \) bootstrap replications. Once the set of \( L_2 \) bootstrap parameter estimates for the coefficients and error random are obtained the percentile bootstrap confidence interval are then constructed.

This procedure of Simar and Wilson (2007) currently dominant the DEA literature due to its superiority over OLS and Tobit regression techniques.

We control for time effect hence the model to be estimated becomes;
\[ CE_{it} = \delta_0 + \delta_1 \text{large} + \delta_2 \text{small} + \delta_3 (CAP)_{it} + \delta_4 BT + \delta_5 OT + \delta_6 (MS)_{it} + \delta_7 (REI)_{it} + \delta_8 (REG)_{it} + \delta_t T + \varepsilon_{it} \]  

(18)

Where the additional term \( \delta_t T \), is the time effect variable with \( T \) as year (time) variable and \( \delta_t \) as unknown parameters to be estimated.

4.4 Data

The data used in this study are drawn from the regulatory annual statements filed by insurance companies with the National Insurance Commission (NIC). Firms were included in the study based on their registration under the 2006 Insurance Act 724 by NIC in 2007. Out of the 34 registered firms 30 were used in the study due to the liquidation of 2 firms and data challenges on the 2 other firms over the period. Observations were eliminated when firms recorded large missing, negative or zero values in any of the input and output variables. The final data used in estimating the efficiency of the firms were an unbalanced panel of 280 observations comprising of 30 firms observed from 2005 to 2014. All the monetary variables were deflated with the Consumer Price Index (CPI) using 2005 as the base year.

The study adopted the added valued approach to define outputs as net incurred benefits (life), net claims incurred (non-life) and investment income (both life and non-life) to represent risk bearing and intermediation functions of insurance respectively as used by Alhassan and Biekpe (2015). Life firms pay surrender values, withdrawals and claims while non-life firms pay claims to their policyholders hence subtracting reinsurance claims from these expenditures represent net incurred benefits (life) and net claims (non-life).

For consistency with literature the study follow Eling and Luhnen (2009) and Ansah-Adu et al. (2012) to define inputs and input prices respectively. Hence inputs are defined as; equity capital,
debt capital and operating expenses while input prices are defined as; equity capital/total asset, debt capital/total asset and operating expenses/total asset. There exist several proxies of input prices but the study’s choice is due to data availability.

Table 5 provides a description of the variables obtained from the pooled sample used in this study. From the table, the large values of standard deviations over the mean for all the input and output variables indicate the heterogeneity in the insurance industry. Suggesting that firms in the industry vary from each other by all variable used in the study.

Table 5: Description of sampled variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean (GHC)</th>
<th>Standard Deviation (GHC)</th>
<th>Minimum (GHC)</th>
<th>Maximum (GHC)</th>
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<tr>
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<td></td>
<td></td>
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<td>116000000</td>
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<tr>
<td><strong>Outputs</strong></td>
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<td></td>
<td></td>
</tr>
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<td>Net claims incurred/benefit(Y1)</td>
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<td>13600000</td>
<td>1952.701</td>
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<td>Investment income(Y2)</td>
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<tr>
<td><strong>Input prices</strong></td>
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<td></td>
</tr>
<tr>
<td>Price of operating expenses(W1)</td>
<td>0.282592</td>
<td>0.141687</td>
<td>0.010886</td>
<td>0.962063</td>
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<tr>
<td>Price of equity capital(W2)</td>
<td>0.36465</td>
<td>0.178885</td>
<td>0.006472</td>
<td>0.962063</td>
</tr>
<tr>
<td>Price of debt capital(W3)</td>
<td>0.628875</td>
<td>0.206645</td>
<td>0.00998</td>
<td>1.39987</td>
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<tr>
<td><strong>Other covariates</strong></td>
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<td></td>
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<tr>
<td>Reinsurance</td>
<td>3710239</td>
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<td>0.178885</td>
<td>0.006472</td>
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</tr>
<tr>
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<td>0.03336</td>
<td>0.040888</td>
<td>0.000139</td>
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<tr>
<td>Asset</td>
<td>28600000</td>
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<td>436000000</td>
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<tr>
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<td>259.3761</td>
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<td>116.6</td>
<td>404</td>
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</tbody>
</table>

Note: The above monetary variables are deflated by the CPI using 2005 as base year

Source: Author’s computation using STATA 13
4.4.1 Description of Explanatory Variables

Firm size is a very important variable in the insurance industry as it has a lot of connotation with economies of scale and scope which can lead to reduction in cost of production. It is measured as the log of total asset of firms but for clarity of the effects on cost efficiency the study divides it into small, medium and large. Following the classification by Rai (1996), small represented firms with size below the second quartile, medium represented firms with size below the third quartile and large represented firms with size above the third quartile in the sample. The firm size of an insurer sometimes serves as security for policyholders which attract several new businesses for an insurer but the ability of the insurer to manage the increase in businesses as well as other growth challenges determines whether their cost can increase or decrease. This challenge is why Fama and Jensen (1983) argue that business complexity can make monitoring managerial behavior more difficult and less effective in large entities than in smaller companies. Insurance literature on size firm reveals a negative relationship with cost efficiency in cross-country studies (Eling and Luhnen, 2010; Fenn et al., 2008; and Rai, 1996) but a positive relationship in individual country studies (Pottier, 2011; Worthington and Hurley, 2002; Ansah-Adu et al., 2012; Cummins and Weiss, 1998).

Capitalization is measured as the ratio of equity capital to total asset in the financial literature. Stated capital and retained earnings are the main components of equity capital of insurers in Ghana hence capitalization represent the portion of the asset owned to shareholders. An increase in capitalization may indicate increase cost of production which has a negative effect on cost efficiency. This relationship has been confirmed in the insurance literature (Kasman and Turgutlu, 2009; Ansah-Adu et al., 2012; Pottier, 2011).
The portion of industry premiums controlled by a firm represents market share in the insurance literature. This variable serves as an indicator of the structure of the firm usually expressed in concentration ratios, Herfindahl Hirschman Index or Lerner Index. According to Baah-Nuakoh (2003) there exist a negative relationship between market structure and cost efficiency, that is when markets become concentrated (high concentration ratio or high market share) cost efficiency decreases because the absence of competition bleeds a lot of cost inefficiencies. This observation which has a strong presence in economic theory was confirmed differently in the insurance literature as Weiss and Chou (2008) argued that despite the possibility of insurers in competitive and non-stringently regulated markets benefiting from market power and charging higher prices they are on average more cost efficient and charge lower prices. Hence high market share in such markets can have a positive or a negative relationship with cost efficiency. This can be observed as Fenn et al. (2008) reported a negative and Barros et al. (2010) reported a positive relationship between market share and efficiency among countries in the European Union who are in the same market.

The concept of risk diversification is practiced in insurance through reinsurance as firms share their uncertain risks with other insurers or reinsurers by ceding part of received premiums to these partners. These practices allow an insurer to benefit from large numbers as the burden of carrying all the risk of those policies are lifted by the reinsurance partner. Contrary to the benefits it can also reduce the available funds for investments as well as become a cost burden on the insurer hence the relationship of the reinsurance and efficiency depends on the benefits and cost attached to the activity.
The study used a dummy of 1 to represent domestic insurers and 0 for foreign to control for ownership type in the insurance of Ghana. The international experience of foreign firms have been observed to make them more efficient relative to domestic firms (Kasman and Turgutlu, 2009) but the long absence of foreign domination in the Ghanaian insurance industry makes this relationship unpredictable.

Several insurance regulations have been introduced in Ghana with different agenda. Regulations on the Ghanaian insurance market have pursued several goals in the form of derailing foreigners from the industry, correcting malpractices in the industry, boosting confidence of citizen as well as increasing efficiency of the firms in the industry. Out of these several agenda, the 2006 Insurance Act 724 had the objective of ensuring efficiency of insurers in the industry hence this study examines the influence of the Act on the cost efficiency of the firms by using a dummy of 1 to represent periods of the Act in the study and 0 otherwise. Regulation marks the environment in which insurance businesses are undertaken which may have different forms of restrictions. But considering the various possible kinds of restrictions Weiss and Chou (2008) identified cost efficiency in a non-stringently regulated industries. Pottier (2011) also identified an inverse relationship between cost efficiency and state licensed (regulatory requirements).

Business type is usually analyzed between composites and specialized in order to confirm the conglomerate and strategic focus hypothesis in the insurance literature. But considering the non-issuance of composite license in Ghana since 2007 and the data availability challenges made this trend of analysis difficult therefore we considered the efficiency between life and non-life insurers
in Ghana using a dummy of 1 for non-life and 0 for life insurers. Previous study on Ghana found life insurers to be more cost efficient relative to non-life insurers.

4.4.2 Source of Data

The 2006 insurance act 724 which currently regulate insurance in Ghana requires every insurance firm to submit quarterly and annually financial report to National Insurance Commission (NIC). These reports contain the book value of financial activities of all registered insurance companies in Ghana reported according to the principles of accounting. This study uses the input and output data from NIC as well as publications from insurance companies, Banks of Ghana and Ghana Statistical Service on the insurance industry to analysis the determinants of efficiency in the insurance industry of Ghana.
CHAPTER FIVE
EMPIRICAL RESULTS AND DISCUSSION

5.1 Cost Efficiency Estimates

The first objective of the study requires the estimation of cost efficiency of insurance firms in the sample using both DEA and SFA methodologies. This section reports the cost efficiency scores generated using the R Statistical Software for insurers and reveal the trends and observations in these estimates.

5.1.1 Data Envelopment Analysis

Table 6: DEA Cost Efficiency Scores

<table>
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<tr>
<th>DMU</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<th>2013</th>
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<tr>
<td>1</td>
<td>0.318</td>
<td>0.357</td>
<td>0.164</td>
<td>0.274</td>
<td>0.130</td>
<td>0.109</td>
<td>0.118</td>
<td>0.122</td>
<td>0.120</td>
<td>0.190</td>
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<tr>
<td>2</td>
<td>0.065</td>
<td>0.078</td>
<td>0.045</td>
<td>0.041</td>
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<td>0.098</td>
<td>0.083</td>
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</tr>
<tr>
<td>3</td>
<td>0.081</td>
<td>0.156</td>
<td>0.123</td>
<td>0.150</td>
<td>0.192</td>
<td>0.146</td>
<td>0.096</td>
<td>0.177</td>
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<td>0.209</td>
<td>0.156</td>
<td>0.166</td>
<td>0.144</td>
<td>0.144</td>
<td>0.369</td>
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<td>29</td>
<td>0.186</td>
<td>0.125</td>
<td>0.130</td>
<td>0.143</td>
<td>0.161</td>
<td>0.131</td>
<td>0.133</td>
<td>0.087</td>
<td>0.153</td>
<td>0.139</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.130</td>
<td>0.103</td>
<td>0.206</td>
<td>0.145</td>
<td>0.148</td>
<td>0.156</td>
<td>0.154</td>
<td>0.111</td>
<td>0.130</td>
<td>0.168</td>
<td>0.145</td>
<td></td>
</tr>
</tbody>
</table>

Average: 0.201 0.160 0.129 0.137 0.177 0.163 0.189 0.171 0.250 0.301 0.188

Observations from average scores

<table>
<thead>
<tr>
<th>Firm size</th>
<th>Ownership</th>
<th>Business type</th>
<th>Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>small</td>
<td>domestic</td>
<td>life</td>
<td>1989 1.062</td>
</tr>
<tr>
<td>medium</td>
<td>foreign</td>
<td>non-life</td>
<td>2006 0.198</td>
</tr>
<tr>
<td>large</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

77
Table 6 reports the input oriented DEA variable return to scale cost efficiency scores for the sampled insurers. By assuming variable returns to scale, the study acknowledges the heterogeneity of the insurance industry which results in different levels of operation as well as the possibility of cost efficiency under each scale of operation.

From table 6, GUA life (DMU 5) was the insurer with the lowest cost efficiency scores as it recorded 2.5% cost efficiency whereas EIC (DMU 17), ELAC (DMU 3), SIC life (DMU 11), Vanguard Life (DMU 14) and Regency Alliance (DMU 26) recorded 100% cost efficiencies respectively. Considering the literature, DEA identifies the firms which incurred minimum cost in producing their outputs and use their cost prudence as a measuring rod in the industry. Therefore, EIC (DMU 17), ELAC (DMU 3), SIC life, Vanguard Life (DMU 14) and Regency Alliance (DMU 26) obtaining 100% cost efficiency scores became the dominant firms which other firms were compared to during the period under review. These firms comprise of three life (ELAC, SIC life and Vanguard life) and two non-life firms (EIC and Regency Alliance) but the life firms were relatively larger compared to the non-life firms in terms of premium revenue.

SIC life is currently the largest insurer in Ghana in terms of premium revenue since 2013 and controls an average of 27.9% of life businesses over the period under study. Becoming the best cost efficient insurer indicates their ability to control and monitor their managerial behavior which Fama and Jensen (1983) observed to be the cause of cost inefficiencies in large firms. Regency Alliance is relatively low compared to the other four dominant insurers in terms of market share as it controls only 0.85% industry gross premium but the prudent utilization of inputs in 2005
caused it to be part of the best practice insurers with an average efficiency of 28.5%. This indicates that, cost efficiency dominancy is not a phenomenon for only large firms but also smaller firms. Donewell life became the least efficient insurer in the sample with an average efficiency of 6.7%. This observation can be attributed to the huge deficits reported in their income accounts resulting in negative total equity capitals observed over the period especially from 2010 to 2012.

The life insurers (DMU 1-14) outperformed the non-life insurers (DMU 15-30) by obtaining an average cost efficiency of 22.4% compared to the 15.7% recorded by the non-life insurers over the period. This observation had the same trend reported in Ansah-Adu et al. (2012) but differs in terms of values. Since they obtained average cost efficiency of 28% for non-life and 31% for life insurers. We attribute this observed difference in average efficiency to the input and output variable choices and technology assumptions between the two studies as the average efficiency of the period 2006-2008 was 16.4% in this study but 30% in their study. The life and non-life cost efficiency values in this study are relatively low compared to other studies like Eling and Luhnen (2009) who reported average cost efficiencies of 38% and 59% for non-life and life firms respectively in a cross-country study.

Dividing the efficiency scores according to firm sizes in table 6 reveals that small insurers had an average of 17.7% which is less than the 23.3% but more than the 16.3% obtained by large insurers and medium respectively. This indicates that large insurers were more cost efficient than the smaller insurers over the period. Foreign firms slightly dominated the industry over the Domestic firms by obtaining an average efficiency of 20.1% higher than the 18.1% average observed among
the domestic insurers. There was also an average increase in cost efficiency for insurers during the 2006 regulatory periods than the period under the 1989 regulation.

Figure 5: Trends in Yearly Average Cost Efficiencies

It is also observed that the overall average cost efficiency recorded was 18.8% due to the growth rate of 49.52% experienced over the period. From Figure 5, cost efficiencies increased in the periods 2007 – 2009 and 2012 - 2014 after the prolonged decrease from 2005 to 2007. The period 2009 to 2012 marked a period of fluctuations in the industry. There was yearly change in the direction of cost efficiencies but this period coincided with the discovery and production of oil in commercial quantities in the country. It led to the formation of a consortium by the non-life firms to be able to underwrite the new oil and gas risk introduced. Comparing the overall cost efficiency of 18.8% to the 53.4% and 69.9% reported by Worthington and Hurley (2002) on Australia and Kasman and Turgutlu (2009) on Turkish insurance industry respectively suggest lags in the Ghanaian industry.
5.1.2 Stochastic Frontier Analysis

Table 7: SFA Cost Efficiency Scores

From table 7 above, the average SFA cost efficiency was 46.2% which is higher than the 18.8% DEA average. This is due to the separation of random error from inefficiencies undertaken in the SFA. Average growth rate in cost efficiency was -21.41% over the period suggesting a deteriorating performance in the industry. Figure 5 reveals that, the negative growth is due to the steep decrease recorded in the periods 2005 – 2007, 2009 - 2010 and 2012 – 2013 against the gradual rise in 2008 – 2009 and 2011 – 2012. The DEA and SFA estimates had the same trend

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from 2005 to 2012 except 2012-2013 where SFA reported a decline while DEA observed an increase.

The ten best insurers were all life insurers having Quality Life as the leader with an average efficiency of 78.7%. Quality Life controls an average of 0.7% insurance premiums in Ghana but its performance in 2005, 2006, 2010 and 2011 as the best cost efficient insurer actually accounted for their domination in the industry. Quality life has proved its reliance on best cost practices in undertaking their life businesses in Ghana. This is so because, apart from its position observed in this study, the study of Ansah-Adu et al. (2012) ranked it as the best cost efficient insurer. GUA life on the other hand who controls only 0.3% of insurance businesses is the third best practice insurer in the sample with an average efficiency of 74.2%. In the DEA results above, GUA life recorded the lowest efficiency score in 2007 but managed to overturn this poor performance to attain the 6th position in table 6. This clearly shows their efficient combination of inputs and outputs over the period.

The least efficient insurer was SIC (DMU 27) who is the only public or state owned non-life insurer and also the largest non-life insurer in terms of premium revenue and assets. This indicates that the difficulty associated with monitoring managerial behavior when firm size increases converted the economies of scale and scope supposed to have been enjoyed by SIC into cost inefficiencies (Fama and Jensen, 1983).

The average cost efficiency of foreign firms observed was 46.4%, which is higher than the 46.1% recorded by the domestic firms. This indicates that the existence of subsidiaries and branches of
foreign firms on several continents make them acquire numerous technologies for undertaking their activities in the industry. Hence making them more cost efficient under a non-constant technology assumption. The increased minimum capital requirements characterizing the 2006 regulatory period made firms to operate with several new technologies due to the expansion in their capital reserves hence making them more cost efficient in the period. Life firms continued to outperform non-life firms over the period with an average cost efficiency of 57.8% compared to the 36.3% observed in the non-life. The trend of firm size and cost efficiency deviated from the observation in the DEA considering the 57.4%, 41.8% and 28.9% efficiencies recorded by small, medium and large firms respectively.

There existed consistency in the relationship between cost efficiency and business type, regulation and ownership type for all the two models but this trend changes with firm size. The DEA models confirmed large firms to be more cost efficient while the SFA confirmed smaller firms to be more cost efficient. The likely reason can be attributed to methodological choice but for explicit confirmation the study undertook one way analysis of variation test (see appendix C) as well as Kruskall-Wallis test (see appendix A) to check whether the different firm sizes operated with the same level of technology. The two tests rejected the hypothesis that the firm size operated in the same population or technology at 5% significance level or better. Indicating that the various firm sizes operated on different frontiers in the industry.

As a way of further analysis, the study examined the suitable of business type in the pooled model using both parametric and non-parametric test. Results from the one way ANOVA, the Kruskall-Wallis test and the Wilcoxon rank-sum test (see appendix) rejected the hypothesis that life and non-life firms operated in the same population or use the same technology under all the models.
Therefore comparing the two business types in a pooled model can be misleading as firm operated on different technology and skills in the industry. This may account for the higher efficiencies recorded by the life firms against the non-life firms recorded in the estimates.

5.2 Determinants of Cost Efficiencies

The second objective of the study is to determine the factors that influence cost efficiencies in the insurance industry. In order to achieve this objective we adopted the BC95 and the Simar and Wilson (2007) models for SFA and DEA approaches using R Software and STATA 13 respectively. The results of these estimations are reported and discussed below.

5.2.1 Data Envelopment Analysis

Table 8: Correlation Matrix of Independent Variables

<table>
<thead>
<tr>
<th>Correlation of Independent Variables</th>
<th>small</th>
<th>large</th>
<th>MT</th>
<th>CAP</th>
<th>REG</th>
<th>OT</th>
<th>BT</th>
<th>REI</th>
</tr>
</thead>
<tbody>
<tr>
<td>small</td>
<td>1</td>
<td>-0.5651</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>large</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MT</td>
<td>-0.4604</td>
<td>0.4783</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAP</td>
<td>-0.056</td>
<td>0.0672</td>
<td>0.0831</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REG</td>
<td>-0.348</td>
<td>0.2484</td>
<td>-0.0448</td>
<td>-0.0357</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OT</td>
<td>0.038</td>
<td>0.0744</td>
<td>0.0226</td>
<td>-0.0628</td>
<td>-0.0323</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BT</td>
<td>-0.07</td>
<td>-0.0621</td>
<td>0.1376</td>
<td>0.2817</td>
<td>0.001</td>
<td>-0.0889</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>REI</td>
<td>-0.2135</td>
<td>0.1912</td>
<td>0.1475</td>
<td>0.1106</td>
<td>0.2104</td>
<td>-0.2433</td>
<td>0.5659</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 8 presents the correlation matrix of the independent variables small, large, market share (MT), capitalization (CAP), regulation (REG), ownership type (OT), business type (BT) and
reinsurance (REI). According to Alhassan and Biekpe (2014), a correlation coefficient above 0.7 indicates the presence of multicollinearity.

From table 8, the highest correlation recorded was 0.5659 between reinsurance and business type which clearly falls below 0.7 hence no multicollinearity exist in our model. Again, the mean variance inflation factor (VIF) estimated for the model was 1.53 which is less than the 10 mean required for multicollinearity by Kader et al., 2010. Therefore, the two approaches confirm the absence of multi-collinearity in equation (18).

Table 9: Simar and Wilson DEA Second Stage Regression Result

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard error</th>
<th>z value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.0465415</td>
<td>0.0387438</td>
<td>1.2</td>
</tr>
<tr>
<td>large</td>
<td>-0.0270008</td>
<td>0.0236635</td>
<td>-1.14</td>
</tr>
<tr>
<td>small</td>
<td>0.0526559</td>
<td>0.0179046</td>
<td>2.94***</td>
</tr>
<tr>
<td>capitalization</td>
<td>0.1299875</td>
<td>0.0341623</td>
<td>3.8***</td>
</tr>
<tr>
<td>marketshare</td>
<td>0.5907842</td>
<td>0.2243044</td>
<td>2.63**</td>
</tr>
<tr>
<td>business type</td>
<td>-0.10169</td>
<td>0.0153764</td>
<td>-6.61***</td>
</tr>
<tr>
<td>ownership type</td>
<td>0.001696</td>
<td>0.013929</td>
<td>0.12</td>
</tr>
<tr>
<td>regulation</td>
<td>0.1125655</td>
<td>0.0377722</td>
<td>2.98***</td>
</tr>
<tr>
<td>reinsurance</td>
<td>0.0062185</td>
<td>0.0025016</td>
<td>2.49**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>efficient firms</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>observation</td>
<td>280</td>
</tr>
<tr>
<td>Fstatistic</td>
<td>64.655</td>
</tr>
<tr>
<td>Pvalue</td>
<td>0</td>
</tr>
<tr>
<td>Variance</td>
<td>0.1026675</td>
</tr>
</tbody>
</table>

NOTE: Significance at: *10%, **5% and ***1% after controlling for time effect

Source: Author's Computation from STATA 13

Table 9 in accordance to our second objective reports the determinants of cost efficiency in the Ghanaian insurance industry following the methodology proposed by Simar and Wilson (2007). The Wald $\chi^2$ (Prob> $\chi^2$ less than 0.05) shows the fitness of the model estimated. In the regression
the dependent variable is the cost efficiency scores obtained from the DEA estimations regressed on the independent variables in equation (18).

From the table, large firms had a negative but insignificant relationship with cost efficiency. Small firms on the other hand recorded a significant positive relationship with cost efficiency at 1% significance level. This means that small firms increased their cost efficiency by 0.0527 more than larger firms during the period under study. Implying a negative relationship between firm size and cost efficiency. This observation serves as a contradiction of the findings of Ansah-Adu et al. (2012) who observed a positive relationship in the Ghanaian insurance industry. The reason behind this contradiction is the uncontrolled time effect in the study of Ansah-Adu et al. (2012) since similar observation was recorded in this study when time effect was eliminated (see appendix D).

Capitalization is the ratio of equity capital to total assets of insurers in the insurance industry. There was an observed positive relationship between efficiency and capitalization. By this results, firms in the sample who manage to increase the portion of their shareholder’s contribution to their total assets were more cost efficient. From the table, when capitalization increases by 10%, cost efficiency increases by 12.4% at 1% significance level. Capitalization increases through two main channels in this study, that is, increasing equity capital or decreasing total asset, but the latter is not likely to occur hence if an increase in equity capital increases cost efficiency then it means that equity capital which is a security for insurance clients attracted more clients for the firms to enjoy the benefits of large numbers during the period.

Business type was the major determinant of cost efficiency in this study, as it recorded the highest t statistic. It had a negative relationship with cost efficiency. This means that non-life insurers who served as reference point in this study decreased their cost efficiency compared to that of the life insurers over the period under study. By this observation non-life insurers decreased their cost
efficiencies by 0.1007 compared to life firms at 1% significant levels. Thus, life firms were more cost efficient than non-life firms over the period.

Insurers undertake reinsurance to diversify their risks in order to underwrite more insurance businesses. This study identifies a positive relationship between diversifying risks (reinsurance) and cost efficiencies, that is, firms who undertook reinsurance benefited by reducing their cost inefficiencies over the period at 1% significance levels. The security attained by insurers help them exercise good cost management practices that reduces their cost inefficiencies. This means that when an insurer increases its reinsurance contracts by 100%, cost efficiency increases by 0.2%. Alhassan and Biekpe (2015) recorded this same observation, as they discussed technical efficiency and reinsurance.

Table 9 reports a positive and significant relationship between market share and cost efficiency, suggesting that firms benefited from controlling higher portions of the premiums in the industry. As a result, an increase in firms’ market share by 100% increased cost efficiency by 59.1% at 1% significance level during the period. This finding confirms the study of Ansah-Adu et al. (2012), Fenn et al. (2008) and Kasman and Turgutlu (2009) but contradicts the argument of Baah-Nuakoh (2003) who supports a negative relationship between market share and cost efficiency.

There existed a negative relationship between regulation and cost efficiency during the period under review. The 2006 insurance act 724 which was the reference regulation increased the cost efficiency of insurers more than the 1989 regulation. By this observation, insurers who operated under the Act 724 obtained 0.1126 cost efficiency more than those who operated under the 1989 Act. Free entry was one of the major innovations of the Act 724 contrary to the foreign firm restrictions observed under the 1989 regulation. This policy made the insurance industry very
competitive hence eliminating much cost inefficiencies in the industry. The study of Weiss and Chou (2008) confirmed this relationship as they observed cost efficiency among non-stringently regulated industries.

From the above observations it is clear that firm size, capitalization, business type, market share, regulation and reinsurance are the factors that determine cost efficiency in the insurance industry of Ghana. Ownership type had a positive but statistically insignificant relationship with cost efficiency thus making it a non-determinant of cost efficiency during the period under review.

5.2.2 Stochastic Frontier Analysis

The estimates in section 5.1.2 reveal trends in the SFA cost efficiency scores but as a confirmation of the actual influences of these variables table 9 below provides the results of the determinants of cost efficiency following the conditional mean approached proposed Battese and Coelli (1995). This methodology which overcomes the contradictions in the two stage approach has become an ideal method for assessing firm characteristics which influence cost inefficiencies. Adopting this methodology helps to achieve objective three of the study.

The likelihood-ratio test rejects at 1% significance level the hypothesis that the inefficient term is not different from zero in the model indicating the presence of inefficiencies among firms in the sample. This observation confirms the used of stochastic frontier in analyzing the firms in the model.
Table 10: Maximum likelihood estimates for parameters of the translog stochastic frontier Cost with inefficient component

<table>
<thead>
<tr>
<th>Cost function</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>z value</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>8.824804</td>
<td>1.1650365</td>
<td>7.5747***</td>
</tr>
<tr>
<td>log(w2/w1)</td>
<td>0.1120727</td>
<td>0.2518545</td>
<td>0.445</td>
</tr>
<tr>
<td>log(w3/w1)</td>
<td>1.1342318</td>
<td>0.2452556</td>
<td>4.6247***</td>
</tr>
<tr>
<td>log(y1)</td>
<td>0.1944823</td>
<td>0.2161669</td>
<td>0.8997</td>
</tr>
<tr>
<td>log(y2)</td>
<td>0.0838507</td>
<td>0.1673061</td>
<td>0.5012</td>
</tr>
<tr>
<td>(0.5*log(w2/w1)^2)</td>
<td>0.1054228</td>
<td>0.0424593</td>
<td>2.4829**</td>
</tr>
<tr>
<td>(0.5*log(w3/w1)^2)</td>
<td>0.4782632</td>
<td>0.0494791</td>
<td>9.666***</td>
</tr>
<tr>
<td>log(w3/w1)*log(w3/w1)</td>
<td>-0.2249724</td>
<td>0.0401429</td>
<td>-5.6043***</td>
</tr>
<tr>
<td>0.5*log(y1)^2</td>
<td>0.0578163</td>
<td>0.0349689</td>
<td>1.6534*</td>
</tr>
<tr>
<td>0.5*log(y2)^2</td>
<td>0.0521109</td>
<td>0.0195322</td>
<td>2.668***</td>
</tr>
<tr>
<td>log(y1)*log(y2)</td>
<td>-0.0426314</td>
<td>0.0263444</td>
<td>-1.6182</td>
</tr>
<tr>
<td>log(w2/w1)*log(y1)</td>
<td>-0.027698</td>
<td>0.0329734</td>
<td>-0.84</td>
</tr>
<tr>
<td>log(w2/w1)*log(y2)</td>
<td>0.0279664</td>
<td>0.0344334</td>
<td>0.8131</td>
</tr>
<tr>
<td>log(w3/w1)*log(y1)</td>
<td>-0.0367426</td>
<td>0.0346116</td>
<td>-1.0616</td>
</tr>
<tr>
<td>log(w3/w1)*log(y2)</td>
<td>0.0021837</td>
<td>0.0384113</td>
<td>0.0569</td>
</tr>
<tr>
<td>year</td>
<td>0.137967</td>
<td>0.1107766</td>
<td>1.2455</td>
</tr>
<tr>
<td>year*log(w2/w1)</td>
<td>0.0310972</td>
<td>0.0110487</td>
<td>2.8146***</td>
</tr>
<tr>
<td>year*log(w3/w1)</td>
<td>0.0133699</td>
<td>0.0158822</td>
<td>0.8418</td>
</tr>
<tr>
<td>year*log(y1)</td>
<td>-0.0121709</td>
<td>0.0126527</td>
<td>-0.9619</td>
</tr>
<tr>
<td>year*log(y2)</td>
<td>0.0053372</td>
<td>0.0107671</td>
<td>0.4957</td>
</tr>
<tr>
<td>0.5*year^2</td>
<td>0.0026832</td>
<td>0.010404</td>
<td>0.2579</td>
</tr>
</tbody>
</table>

Inefficiency effects

| constant                      | 0.5274604   | 0.2029093      | 2.5995***|
| large                         | 0.4019997   | 0.0917191      | 4.3829***|
| small                         | -0.2910508  | 0.0792881      | -3.6708***|
| capitalization                | 1.1070089   | 0.29464        | 3.7572***|
| marketshare                   | 3.1630009   | 1.0413387      | 3.0374***|
| businessstype                 | 0.4600707   | 0.081036       | 5.6774***|
| ownershiptype                 | 0.0295187   | 0.0584654      | 0.5049  |
| regulation                    | -0.1868504  | 0.1029539      | -1.8149*|
| reinsurance                   | -0.0205854  | 0.0112102      | -1.8363*|

Variance parameters

| σ²                            | 0.1102061   | 0.0122624      | 8.9873***|
| γ                             | 0.7546793   | 0.1574503      | 4.7931***|
| log-likelihood                | -73.06444   |               |         |

Observation: 280

Source: Author’s computation using R Software

NOTE: Significance at: *10%, **5% and ***1%
From table 9 below, the 0.7546 gamma ($\gamma$) revealed that the model comprise of both inefficiency and random error but cost inefficiency serves to be major contributor of errors in the insurance industry. The time variable (year) used to test technological change revealed a positive but insignificant relationship with the cost frontier, implying that changes in cost techniques were not observed over the period under review. Input and output elasticities were observed to be monotonic non-decreasing revealing that the continuous increase in inputs and outputs increases cost without decreasing. The input variables debt capital ($w_3$) and operating expenses ($w_1$) are the actual inputs that had significant impact on cost during the period since their elasticity recorded a significant relationship.

From the table, the cost inefficiencies increased proportionately with large firm size and inversely with small firm size over the period at 1% significance level. That is, large firms in the sample were not able to monitor their managerial behavior compared to smaller firms hence increased their cost inefficiencies in returns. This observation contradicts the findings of Kasman and Turgutlu (2009) and Ansah-Adu et al. (2012) that cost efficiency increases with firm size but supports Fenn et al. (2008) who observed large firms with high inefficiencies in 14 European countries. In support of Rai (2006), this study observed smaller firms to be more cost efficient over the period under review. By this observation, the SFA models find firm size to have a negative relationship with cost efficiency over the period indicating that smaller firms were more cost efficient compare to large firms.

Capitalization was positively related with cost inefficiency at 1% significance level, that is, if capitalization increases by 10%, cost inefficiencies increases by 11.07%. This indicates that firms that increased the portion of their assets owned by shareholders increased their cost inefficiencies
through the dividends and other agency problems they encountered. Kasman and Turgutlu recorded the same observation in the Turkish insurance industry.

Ansah-Adu et al. (2012) identified a positive relationship between market share and cost efficiency but this study contradicts that observation as market share rather increases with cost inefficiencies during the period under review. In the Ghanaian insurance industry large firms control the market in terms of premium revenue hence if large firms were cost inefficient then it is obvious that market share would follow that same direction. This means that the freeway attached to market power trapped firms during the period to be cost inefficient. During the period, an increase in market share by 10% increases cost inefficiencies by 30.16%. Fenn et al. (2008) report a similar trend in their study.

Amidst the several regulations in Ghana, the 2006 Insurance Act 2006 was intended to increase the efficiency of insurers in Ghana. This study observes that periods covering the implementation of the Act made insurers reduce cost inefficiencies by 0.187 more than period covering the 1989 insurance Act at 10% significance level. Having non-life firms as reference point the study confirmed positive relationship between business type and cost inefficiencies at 1% significance level. This indicates that non-life firms increases their cost inefficiencies by 0.416 more than the life firms over the period under review. That is, life insurers were more cost efficient than non-life firms in the sample data.

Insurers undertake reinsurance to diversify their risks in order to underwrite more insurance businesses. This study identifies an inverse relationship between diversifying risks (reinsurance) and cost inefficiencies, that is, firms who undertake reinsurance benefit by reducing their cost inefficiencies over the period at 10% significance levels. The security attained by insurers help
them exercise good cost management practices that reduces their cost inefficiencies. Meaning that, when an insurer increases its reinsurance contracts by 100% cost inefficiencies decreases by 2%. Ownership type had a positive relationship with cost inefficiencies, thus, domestic firms’ cost inefficiencies increased by 0.03 more than foreign firms over the period. But this observation was not statistically significant in this study.

The results of the DEA and SFA models reported above reveals several similarities and differences which makes the study confirm the argument of Cummins and Zi (1998) that the choice of methodology affects the results of an efficiency analysis. From the study, the two methodologies together confirmed six factors and rejected one factor as determinants of cost efficiency in the insurance industry of Ghana. Out of the six factors, four recorded same relationship irrespective of methodology. A positive and significant relationship existed between cost efficiency and reinsurance during the period. Suggesting that, firms gain from diversifying risk in the insurance industry during the period. Again, life insurers were more cost efficient than non-life insurers during the period. Small firm size and regulation also had positive and significant relationship with cost efficiency during the period.

Aside these similarities, the two methodologies observed different observations regarding the relationship between cost efficiency and the other efficiency determinants, which were capitalization and market share. As DEA identifies a positive relationship, the SFA identifies a negative relationship. This same trend was also observed between market share and cost efficiency. SFA identified a negative relationship and the DEA identified a positive relationship. These differences observed which is attributed to the estimation procedures does not make one approach superior to the other but depending on the objective of a study one approach can be chosen over the other (Cummins and Weiss (2013).
CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion
The primary objective of the study is to examine the determinants of efficiency in the insurance industry of Ghana for the period 2005 to 2014. Achieving such an objective required an initial task of measuring the level of efficiency among insurers in the industry. By reviewing previous studies on the industry as well as financial statements of insurers together with NIC, revealed cost as the type of efficiency that demand immediate examination especially considering the intense competition, price cutting, duplication of functions and high management expenditures which keep evolving in the industry. Therefore, using an unbalanced panel data on 30 insurers comprising of both life and non-life insurers, the study estimated the cost efficiencies of the insurers with both SFA and DEA by assuming a variable returns to scale in the DEA model and a non-constant technology on the SFA model.

Adopting the conditional mean approach of Battese and Coelli (1995) and the Simar and Wilson (2007) bootstrapping regression approach for SFA and DEA respectively, the study examined the determinants of cost efficiency in the insurance industry in Ghana.

From the results, the average cost inefficiency for the period were 81.2% and 53.8% for the DEA and the SFA models respectively. These average cost inefficiencies reported by the two methodologies suggested a problem of cost inefficiency in the insurance industry during the period. This stands to confirm the long existed perception of Ghanaians on the poor performance of the industry. Most of the firms were utilizing more inputs than required as well as misallocating their inputs for operating their insurance business.
Using Kruskall-Wallis test, Wilcoxon rank-sun test and one way ANOVA, the study rejected the hypothesis that life and non-life average cost efficiencies as well as average cost efficiencies of the various firm sizes came from the same population. Thus, the two business types and the three firm sizes operated in different environment hence must be analyzed separately.

From the results, the two methodologies were robust in identifying cost efficiency determinants but the relationship of these determinant factors deferred between the two methodologies. Both methodologies confirmed reinsurance, business type, capitalization, firm size, market share and regulation as the determinants and ownership type as a non-determinant of cost efficiency over the period. Out of the variables determined to influence cost efficiencies, the two methods showed consistent relationship for four factors and inconsistent relationship for two factors. This implies that there exist differences in the choice of methodologies on efficiency analysis which proves the third objective of this study. It is important to note that these observed differences are in terms of relationship but not in terms of determinants of cost efficiency.

It was observed that regulation and reinsurance had a positive relationship with cost efficiency while business type and firm size had a negative relationship with cost efficiency under the two methodologies. Comparing the 1989 regulation with the 2006 regulation, the positive relationship of regulation means that firms became more efficient during the 2006 regulatory period than they were under the 1989 period. The good practices upheld by NIC during this period must be pursued to increase the cost efficiency of firms in the industry. Information asymmetry makes insurance companies lose several investable funds in their operations hence the need to hedge themselves against such occurrences. Reinsurance which is a means of diversifying risks makes insurers immune to the effect of huge loses therefore increasing their cost efficiencies. Hence the positive relationship recorded between reinsurance and cost efficiency.
Business complexity made monitoring managerial behavior very difficult among large insurers, thus resulting in a negative relationship between firm size and cost efficiency during the period. The negative relationship recorded by business types with cost efficiency means that non-life had their cost efficiency decreased relative to life firms over the period. By this observation, comparing life and non-life firms on the same level of operation, life firms turn to have comparative advantage of being cost efficient than non-life firms in the insurance industry of Ghana.

The study finds life and non-life firms to be different and operating with different technology and skills hence life firms being more cost efficient implies the implementation of unique activities in their industry. Ansah-Adu el al. (2012) and NIC report (2010) reveal that life firms have innovated cultural valued products which are appreciated and cherished by Ghanaians hence disabusing the negative perception and concept about insurance and attracting more clients. Ghanaians understand their culture and traditions, designing a product in line with these values has caused several citizens to understand what insurance is about therefore causing life insurers to enjoy large numbers which increases their cost efficiencies. C. C. Bruce, CEO of ELAC (the second largest insurer in Ghana since 2013) confirmed this observation as he explained that 65% of his company’s revenue comes from funeral policies (Africa, 2014). The understanding from these observations is that for cost efficiency to increase, non-life firms must emulate life firms by conceptualizing insurance policies to suit the economy of Ghana.

This study observed that during the period 2005 to 2014, firm size, market share, capitalization, reinsurance, regulation and business type were the determinants of cost efficiency in the insurance industry of Ghana but the choice of methodology strongly influences the relationship of these factors.
6.2 Recommendations

The study discovered several observations which makes it significant to all players in the insurance industry especially NIC and insurance companies.

One major finding of this study, is the confirmation of the low performance perception of Ghanaians about the insurance industry. This perception was as a result of the bureaucracies during claims payments and the unclear processes in the industry. Overcoming such challenges lies in product innovations. The nature of some insurance products reduces the number of processes required before claims payments. For instance, the Kenyan insurance industry with the help of weather service stations and telecommunication companies innovated weather index insurance products which made claim payments via mobile phones without any written documentation (KPMG Africa, 2014). By this innovation, premium mobilization by the Kenyan insurance industry increased therefore making it one of the dominant markets in Africa. An introduction of such insurance products on the Ghanaian insurance market would help overcome the negative perception challenge that has befallen the industry. And this in effect would also go a long way to increase the efficiency of insurers in the insurance.

From the study, regulation was positively related to cost efficiency which suggest that the environment of insurance in the period covering the 2006 Act 724 was relatively better than the 1989 regulatory period. Apart from the increased minimum start-up capital, the Act 724 repealed the 40 percent proprietary interests required to be owned by a Ghanaian before becoming an insurer in Ghana and the monopoly enjoyed by SIC and GRC. This less stringent measures in the Act 724 reduced the bureaucracy and the huge financial requirements to create the enabling environment for both domestic and foreign firms to operate freely. Therefore, the more NIC tries to make the insurance less stringent the more cost efficiency may increase.
The study identified the uniqueness of the two business types in the industry, therefore regulatory requirements of NIC that treats life and non-life insurers on equal grounds especially in terms of cost must be amended. This policy recommendation serves as the economic justification of the new solvency framework for both life and non-life insurers introduced by NIC in 2015. The framework separated life from non-life insurers and gave unique definition of the two business types. An extension of such innovations in all aspects of insurance operation in the industry especially in areas like statutory cost and product approval or innovation cost among others would cause cost efficiencies to increase, which may lead to higher industrial growth.

Again, elimination of all bureaucracies and financial demands for implementing the recent cultural based policies such as agricultural insurance and micro insurance can greatly cause increased cost efficiency in the industry. Life firms’ dominance is observed to be dependent on these cultural based products hence reduction or elimination of financial restrictions on such products would lead to increase innovation of such products in the industry. Furthermore, NIC should endeavor to use efficiency frontier approaches in their evaluation of firms in the industry. The adoption of these efficiency frontier approaches in assessing insurers can reveal the true state of firms and as well help distinguish between efficient and inefficient firms which may give early signals of liquidation. The history of liquidation usually comes as a surprise to various players in the industry due to the unclear nature of insurers’ financial standings. This can be easily curbed by the use of the efficiency frontier methodologies.

This study reports factors that are under the control of insurers which has the potential of deepening or lessening the perception of poor performance of Ghanaians on the industry. Hence the era of
targeting other mediums or activities to increase cost efficiencies must be relegated as the study identifies firm size, capitalization, reinsurance, business type, market share and regulation as the determinants of cost efficiencies in the Ghanaian insurance industry. Insurance companies in Ghana enjoy the benefits of large numbers through risk diversification. Hence, streamlining reinsurance policies by both NIC and insurers to attractive more reinsurance contracts can increase cost efficiency among insurers in Ghana.

The knowledge on efficiency analysis from developing countries had been very limited in the insurance literature, this study therefore provides additional information on cost efficiency from the perceptive of a developing economy. It also provides a roadmap which researchers can replicate on technical, allocative, profit, revenue, scale and scope efficiencies on different countries and industries. Future studies on the Ghanaian insurance industry can also undertake separate analyses for life and non-life insurers. Since such knowledge will help identify the actual cost efficiency of the individual business types.

This study reveals the existence of several models and methodologies on the estimation of efficiency but it is important to note that the choice of methodology influences efficiency analysis hence it may be appropriate to undertake efficiency studies with more than one methodology.
APPENDIX

APPENDIX A: Kruskal-Wallis Equality of Population Rank Test

DEA Cost efficiencies and firm size

<table>
<thead>
<tr>
<th>Firm Size</th>
<th>Observation</th>
<th>Rank Sum</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>137</td>
<td>20081</td>
<td>Chi-squared = 7.838 with 2 d.f.</td>
</tr>
<tr>
<td>Medium</td>
<td>73</td>
<td>8614</td>
<td>Probability = 0.0199</td>
</tr>
<tr>
<td>Large</td>
<td>70</td>
<td>10645</td>
<td>Reject equality</td>
</tr>
</tbody>
</table>

SFA Cost efficiencies and firm size

<table>
<thead>
<tr>
<th>Firm Size</th>
<th>Observation</th>
<th>Rank Sum</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>137</td>
<td>25359</td>
<td>Chi-squared = 99.605 with 2 d.f.</td>
</tr>
<tr>
<td>Medium</td>
<td>73</td>
<td>9203</td>
<td>Probability = 0.0001</td>
</tr>
<tr>
<td>Large</td>
<td>70</td>
<td>4778</td>
<td>Reject equality</td>
</tr>
</tbody>
</table>

DEA Cost efficiencies and Business Type

<table>
<thead>
<tr>
<th>Business Type</th>
<th>Observation</th>
<th>Rank Sum</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life</td>
<td>129</td>
<td>20273</td>
<td>Chi-squared = 10.12 with 1 d.f.</td>
</tr>
<tr>
<td>Non-life</td>
<td>151</td>
<td>19067</td>
<td>Probability = 0.0015</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reject equality</td>
</tr>
</tbody>
</table>

SFA Cost efficiencies and Business Type

<table>
<thead>
<tr>
<th>Business Type</th>
<th>Observation</th>
<th>Rank Sum</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life</td>
<td>129</td>
<td>23532</td>
<td>Chi-squared = 64.106 with 1 d.f.</td>
</tr>
<tr>
<td>Non-life</td>
<td>151</td>
<td>15808</td>
<td>Probability = 0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reject equality</td>
</tr>
</tbody>
</table>

APPENDIX B: Two-sample Wilcoxon Rank-Sum (Mann-Whitney) Test

DEA Cost efficiencies and Business Type

<table>
<thead>
<tr>
<th>Business Type</th>
<th>Observation</th>
<th>Rank Sum</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life</td>
<td>129</td>
<td>20273</td>
<td>18124.5</td>
</tr>
<tr>
<td>Non-life</td>
<td>151</td>
<td>19067</td>
<td>21215.5</td>
</tr>
<tr>
<td>Combined</td>
<td>280</td>
<td>39340</td>
<td>39340</td>
</tr>
</tbody>
</table>

Decision

H0: cost efficiency (life) = cost efficiency (non-life)
z = 3.181
Prob > |z| = 0.0015
Reject Ho

SFA Cost efficiencies and Business Type

<table>
<thead>
<tr>
<th>Business Type</th>
<th>Observation</th>
<th>Rank Sum</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life</td>
<td>129</td>
<td>23532</td>
<td>18124.5</td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
<td>-------</td>
<td>---------</td>
</tr>
<tr>
<td>Non-life</td>
<td>151</td>
<td>15808</td>
<td>21215.5</td>
</tr>
<tr>
<td>Combined</td>
<td>280</td>
<td>39340</td>
<td>39340</td>
</tr>
</tbody>
</table>

**Decision**

H0: cost efficiency (life) = cost efficiency (non-life)

\[ z = 8.007 \]

Prob > |z| = 0.0000

Reject H0

---

**APPENDIX C: Analysis of Variance**

### SFA Cost efficiencies and Firm Type Size

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Prob &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>3.9457</td>
<td>2</td>
<td>1.9729</td>
<td>65.57</td>
<td>0</td>
</tr>
<tr>
<td>Within groups</td>
<td>8.3346</td>
<td>277</td>
<td>0.0301</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>12.2803</td>
<td>279</td>
<td>0.044</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bartlett's test for equal variance: chi2(2) = 8.0875  Prob>chi2 = 0.018

Decision: Reject equality

### DEA Cost efficiencies and Firm Type Size

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Prob &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>0.3329</td>
<td>2</td>
<td>0.1664</td>
<td>7.01</td>
<td>0.0011</td>
</tr>
<tr>
<td>Within groups</td>
<td>6.5724</td>
<td>277</td>
<td>0.0238</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6.9053</td>
<td>279</td>
<td>0.0248</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bartlett's test for equal variance: chi2(2) = 57.0232  Prob>chi2 = 0.000

Decision: Reject equality

### DEA Cost efficiencies and Firm Business Type

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Prob &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>0.3093</td>
<td>1</td>
<td>0.3093</td>
<td>13.04</td>
<td>0.0004</td>
</tr>
<tr>
<td>Within groups</td>
<td>6.596</td>
<td>278</td>
<td>0.0237</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6.9053</td>
<td>279</td>
<td>0.0248</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bartlett's test for equal variance: chi2(2) = 26.9886  Prob>chi2 = 0.000

Decision: Reject equality

### SFA Cost efficiencies and Firm Business Type

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Prob &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>3.2337</td>
<td>1</td>
<td>3.2337</td>
<td>99.37</td>
<td>0</td>
</tr>
<tr>
<td>Within groups</td>
<td>9.0466</td>
<td>278</td>
<td>0.0325</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>12.2803</td>
<td>279</td>
<td>0.044</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bartlett's test for equal variance: chi2(2) = 23.6220  Prob>chi2 = 0.000

Decision: Reject equality

---

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## APPENDIX D

Simar and Wilson DEA Second Stage Regression Result without Controlling for Time Effects

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard error</th>
<th>z value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.0330693</td>
<td>0.0371599</td>
<td>0.89</td>
</tr>
<tr>
<td>large</td>
<td>0.0406416</td>
<td>0.0197024</td>
<td>2.06**</td>
</tr>
<tr>
<td>small</td>
<td>0.0305375</td>
<td>0.0166394</td>
<td>1.84*</td>
</tr>
<tr>
<td>capitalization</td>
<td>0.1241099</td>
<td>0.0359515</td>
<td>3.45***</td>
</tr>
<tr>
<td>marketshare</td>
<td>0.0555762</td>
<td>0.1937585</td>
<td>0.29</td>
</tr>
<tr>
<td>businessype</td>
<td>-0.1007137</td>
<td>0.0159404</td>
<td>-6.32***</td>
</tr>
<tr>
<td>ownershiptype</td>
<td>0.0026466</td>
<td>0.014383</td>
<td>0.18</td>
</tr>
<tr>
<td>regulation</td>
<td>0.023452</td>
<td>0.015771</td>
<td>1.49</td>
</tr>
<tr>
<td>reinsurance</td>
<td>0.0082863</td>
<td>0.0024487</td>
<td>3.38***</td>
</tr>
</tbody>
</table>

**efficient firms** 5

**observation** 280

**Wald \( \chi^2 \)** 64.655

**Prob > \( \chi^2 \)** 0.000

**Variance** 0.1026675

NOTE: Significance at: *10%, **5% and ***1%

Source: Author's Computation from STATA 13
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