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Cost and Profit Efficiency of Ethiopian Insurance Industry and its Determinants: Application of Stochastic Frontier Analysis

By

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Declaration

I hereby declare that this thesis titled **"Cost and Profit Efficiency of Ethiopian Insurance Industry and its Determinants: Application of Stochastic Frontier Analysis"** has been carried out by me under the guidance and supervision of my Advisor Dr. Yitbarek Takele. The thesis is original and has not been submitted for the award of any degree or diploma to any university or institution.

Researcher's Name Signature Date

Eyob Nigussie G/Mariem

Certification

This is to certify that Eyob Nigussie G/Mariem has carried out this research work on the topic **"Cost and Profit Efficiency of Ethiopian Insurance Industry and its Determinants: Application of Stochastic Frontier Analysis."** Under my supervision this research is his original work and has not been presented for a degree in any university, and all sources of materials used for the study have been duly acknowledged. Thus, it is sufficient for submission for the partial fulfillment of the requirements for the award of Executive Master of Business Administration.

Advisor: Yitbarek Takele (PhD)
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Abstract

This paper analysed the cost and profit efficiency of Ethiopian insurance industry over the period of 2011-2020.Two stage procedure was employed. The first method involves the estimation of profit and cost efficiency using the Stochastic Frontier Approach. In the next stage, the Tobit regression model was employed to investigate factors that determining difference in the efficiency of Ethiopian insurance industry. To obtain information relevant to the study, secondary data from the financial statement of insurance companies were used. In the study, all operational insurance companies in Ethiopia were taken as study population and purposive sampling method was used to select sample from the population. Accordingly, one state owned insurance company and 12 private owned insurance companies were incorporated in the study.

Results of the Stochastic Frontier Approach indicated that the average level of cost and profit efficiency of insurance companies under the study period was 0.78 and 0.77 respectively, suggesting that there is a room that Ethiopian insurance industry, on average, could reduce their actual cost by 22% and increase their actual profit by 23% with the existing available resource during the sample period. The findings also indicate that both cost and profit efficiency tend to increase with annual average growth rate of 1.6% and 2.5% respectively over the study period. Besides, the study revealed that state owned insurance company was more cost and profit efficient than private insurance companies on average by 8 % and 16% respectively in the study period.

In the second stage , Tobit regression analysis indicated that gross written premium , investment income, price of labour, size of insurance , number of branch have positive and statistically significant relationship with both cost and profit efficiency of Ethiopian insurance industry. Moreover, age of insurance has a positive relationship with both cost and profit efficiency, however, the result is not statistically significant with cost efficiency. On the other hand, leverage ratio has a negative relationship with cost and profit efficiency but the result is not statistically significant with cost efficiency.

Keywords: Ethiopia, Cost Efficiency, Profit efficiency, Insurance Industry, Stochastic Frontier Approach, Tobit Regression Model

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List of Abbreviations

AE: Allocative efficiency

AfCFTA : African Continental Free Trade Area

DEA: Data Envelope Analysis DEA

EE: Economic efficiency

EIC: Ethiopia Insurance Corporation

MLE: Maximum Likelihood Estimate

NBE; National Bank of Ethiopia

SCF: Stochastic Frontier Approach

TE : Technical efficiency

UNIC: United Insurance Insurance Company

CHAPTER ONE: INTRODUCTION

This chapter presents the background of the study, problem statement, research questions, objectives the study, research hypothesis, significance of the study, scope of the study, limitation of the study and organization of the thesis.

1.1.Background of the Study

Insurance is the backbone of a country's risk management system and it is considered as an imperative for economic growth and development (Ward and Zurbruegg, 2000; Kugler and Ofoghi, 2005; Haiss and Sumegi, 2007). It provides unique financial services that range from the underwriting of risks inherent in economic entities and the mobilization of large amount of funds through premiums for long-term investments. The risk absorption role of insurance promotes financial stability in the financial markets and provides a sense of peace to economic entities (Mwangi, 2015).

Moreover, insurance is a necessary precondition for many economic activities that would not or could not take place otherwise. Without the guarantee of insurance, most businesses could not operate as they do today and even unsustainable since risky business may not have the capacity to retain all kinds of risks in this ever changing and uncertain global economy (Ahmed , Zulfqar and Ishfaq , 2010 ; Weisbart, 2018).

Therefore , it is necessary and helpful to investigate the healthy status and performance of the insurance sector so as to assure its contribution for the overall economy. In line with this, an increasing number of studies are using efficiency as the performance indicator index (Eling and Luhnen ,2008 ; Cummins and Weiss ,2011.Contemporary researches used frontier models to analyse the efficiency of insurance industry that measures firm performance relative to ‘‘best practice’’ frontiers (Cummins and Weiss, 2011).

There are two scientific frontier approaches that are used to analyse efficiency of insurance industry which are Stochastic Frontier Approach (SCF) and Data Envelope Analysis (DEA). Moreover, there are two major type of efficiency in evaluating insurance performance, which are

cost and profit efficiency which corresponds with the two important economic objectives of cost minimization and profit maximization respectively (Cummins, Tennyson and Weiss, 1999). This study also aims to measure the cost and profit efficiency of Ethiopian insurance industry using frontier model.

Besides the above mentioned facts, there are also reasons that trigger to study the efficiency of Ethiopian insurance industry. The Ethiopian government has taken the first step towards liberalizing the finance sector by granting a license to start business operations for a foreign-owned company in the financial sector (Wilson, 2019). The government has also ratified the African Continental Free Trade Area (AfCFTA) (African Union, 2019) and has resumed the WTO accession negotiations (World Trade Organization, 2020). Both of these initiatives push for the liberalization of the financial sector in general and insurance industry in particular (Meseret, 2019). Therefore, to survive and competent with the coming foreign insurance company , Ethiopian insurance industry has to identify and fill its efficiency gap .

Furthermore, strong and competitive insurance industry is considered as an imperative for economic development of the country (University of Oslo, 2014).In this regard, the Ethiopian Insurance industry is characterized by unhealthy stiff competition and pricing policy, limited product range, using out-dated premium setting method, lack of risk assessment methodology and not use of advanced technology (Antenhe,2017; Fikeru,2018).Therefore, to improve the competitiveness of the insurance industry , it is necessary to identify the efficiency gap and strengthen the efficiency level accordingly.

In the context of the above discussion, the purpose of this study is to assess the cost and profit efficiency of Ethiopian insurance industry using frontier model. To the best of the researcher's knowledge , this study is the first time Ethiopian insurance industry has been analysed in terms of both cost and profit efficiency .

1.1.1. History of Insurance in Ethiopia

The history of Ethiopian insurance industry dates back 1920's and it doesn't have a long history of development despite the country's long history of civilization (Hailu, 2007). Historically, the first insurance business was transacted in Ethiopia by the Bank of Abyssinia which began operation in 1905 during the reign of Minilik II that served as an agent to a foreign company. Since then the insurance industry has undergone immense regulatory reforms and changes (Anteneh, 2017).

Following the liberation of the country from the Italian occupation in 1941, during the Emperor Hailessalssie's regime, there were different private owned insurance companies. After the fall of the Emperor, in 1974, thirteen privately owned insurance companies were nationalized under the socialist regime of Ethiopia by proclamation No. 261 / 1975 and merged them into a single unit called Ethiopian Insurance Corporation (Ashagrie and Gizachew ,2018)

In the years following nationalization, Ethiopian Insurance Corporation became the sole operator. After the change in the political environment in 1991, the proclamation for the licensing and supervision of insurance business heralded the beginning of a new era. Immediately after the enactment of the proclamation in the 1994, private insurance companies began to increase (Anteneh, 2017 and Hailu, 2007) and Awash insurance company was established in 1994. Africa insurance company also comes to the scene, on December 1994, as a share company (National Bank of Ethiopia, 2021)

As of December, 2020 there are 17 insurance companies operate in Ethiopia (National bank of Ethiopia 2020).

1.2.Statement of the Problem

There has been considerable research in area of efficiency and it is one of the most empirically investigated topic around the world (Berger & Mester,1997;Cummins & Zi,1998;Chen, 2014; Cummins & Weiss ,2011;Eling & Luhnen,2010; Fenn, Vencappa, Diacon, Klumpes &O'Brien,2008; Gustavo& Sonia, 2017; Jarraya & Bouri, 2012;Mutasem ,2019).This is mainly due to an efficient insurance industry has significant importance not only for the business success of the industry itself but also for the stability of the financial sector (Arfaz and Mohammed ,2020).

Besides the above-mentioned rationale, the insurance industry has its own distinct features that make it unique from other businesses due to its contribution to the development of the country's economy as it provides sense of security; a means of sharing risk; a tool to manage risks efficiently; facilitating trade and investment. Due to this distinctiveness, it is a risky business whose failure may result in systematic risk and failure of the whole economy and hence efficiency analysis of insurance industry is essential and becomes inevitable (Yared and Bogale, 2020).

While there has been a rapidly growing literature that deal with the efficiency of insurance industry in developed countries , few studies were studied in African countries (Joseph, Frank, Lordina and Richard ,2010; Kabalan ,2007; Mwangi, 2015; Barros and Wanke,2016; Martin and Michael,2019).To the best of the researcher knowledge, there is a few research related directly to the efficiency of Ethiopian insurance industry (Ashgrie and Gizachew,2018; Mulugeta, 2012).

Not only were the previous studies few in number in Ethiopia but they also had a limitation in terms of scope and methodological perspective. From scope perspective , the previous studies focused on cost and technical efficiency of the insurance industry and none of them focused to measure the profit efficiency of the industry. However, analysing profit efficiency constitutes a more important source of information for management than the partial analysis of the cost efficiency. This is because, a firm that is successful in minimizing cost may be less successful in maximizing revenue. Hence, the objective of maximizing profit does not only

require that goods and services to be produced at the minimum cost (Cummins, Tennyson and Weiss, 1999; Joaquin, Jose, Francisco, and Javier, 1999).

Second ,as to the methodology employed, all the previous studies employed the non-parametric approach of Data Envelopment Analysis (DEA) techniques which has its own methodological weakness as it assumed that any deviation from the best practice frontier is entirely due to inefficiency without considering the exogenous factors that are beyond the control of the management(Jarraya and Bouri,2012).

Unlike the DEA approach , this study used the parametric approach of Stochastic Frontier Analysis (SCF) which allows to decompose the whole deviation from the best practice frontier in to inefficiency and "noise"(stochastic shock) (Kumbaker and Lovell, 2000).This methodological difference of the two approaches make the DEA technique generally to give lower efficiency score but greater dispersed estimates as compared to the SCF approach(Carlos ,Nazare,&Maria,2003).

Therefore , the main objective of this research is to fill these empirical gaps by analysing both cost and profit efficiency of Ethiopian insurance industry using SCF approach and identifying determinants that affect the efficiency of insurance companies.

Other additional factors add to the motivation for this research, beyond the empirical gap are. First, the Ethiopian insurance industry is not yet matured and characterized by unhealthy stiff competition. Identifying efficiency gap is thus a major issue to improve the competitiveness of the industry. Second, it is necessary to build competent domestic insurance companies to cope up with the trade competition challenges of huge foreign insurance companies during Ethiopia's liberalization of the insurance sector. Hence, efficiency of the insurance industry is essential and needs to be paid more attention. Third, it enables to identify determinants that affect the efficiency level of Ethiopian insurance industry. Finally, it enables for early detection of problematic insurance company and takes prompt early corrective action.

1.3.Objective of the Study

1.3.1. General Objective

The general objective of the study is to measure and analyse the cost and profit efficiency of Ethiopian Insurance Industry

1.3.2. Specific Objectives

To meet the general objective, the study focuses on the following specific objectives:

- To compute the cost and profit efficiency score of Insurance Companies operating in Ethiopia
- To compare the cost and profit efficiency level of private and state owned Insurance Companies
- To identify determinants of cost and profit efficiency of Ethiopian insurance companies.

1.4.Hypothesis

In line with the objectives of the study, the following hypotheses have been framed.

- **Hypothesis 1:**Cost efficiency is less than profit efficiency in Ethiopian Insurance industry
- **Hypothesis 2:**Ethiopian Private insurance companies are more efficient than state owned insurance company in terms of cost and Profit
- **Hypothesis 3:**Company size and number of branch have a positive and significant relationship with cost and profit efficiencies
- **Hypothesis 4:** Premium growth , leverage and age of insurance have a negative and significant relationship with cost and profit efficiency

1.5.Scope of the Study

The study was tried to measure the efficiency performance of insurance companies in Ethiopia over a recent 10 years (2011-2020).This is because it is appropriated to use at least 10 years

data in order to analyse the change of efficiency over time and factors explaining differences in efficiency across companies (Ashagre and Gizachew,2018; Cummins and Weiss ,2011; Christian, Martin, Jan,2015; Carlos, Nazare and Maria,2003).Moreover, in Ethiopia there was a political and economic growth instability over the past 10 years which alter the insurance industry behaviour in a significant manner and it is reflected in efficiency performance. Accordingly, those insurance companies that have not been stayed in the business since 2011 was not incorporated in the study such as Berhan Insurance, Lucy Insurance S.C, Tsehay Insurance, Zemen Insurance (See Annex 1).

1.6. Significance of the Study

The findings of this study have an importance from operational and academic point of view. From the operational point of view, the study enables top management of insurance companies to know their insurance company efficiency level and to take measure accordingly. Equally, the study also aware the regulator body of financial sector, National Bank of Ethiopia, to identify those insurance companies that need intervention and corrective measures.

Institutions and/or individuals who are interested to know the efficiency of insurance companies in Ethiopia can use the document as a reference. Besides, it is a useful reference for researchers and other personnel interested in this topic, and serves as a base for any further studies to be conducted in this area of study.

1.7. Organization of the Study

The study is organized as follows: chapter one presents statement of the problem, objectives, hypothesis, scope, significance of the study. Chapter two provides a literature review that covers the main theories and empirical studies concerning efficiency of insurance. Chapter three discusses the methodology and presents the way how to measure cost and profit efficiency of Ethiopian Insurance Companies and the determinant that explains the difference in efficiency level among insurance companies. Chapter four reports the empirical results and provides the analysis of the findings. The final chapter five presents the conclusion and recommendations.

CHAPTER 2: LITERATURE REVIEW

This chapter presents the theoretical and empirical literature review.

2.1. Theoretical Literature

2.1.1. Efficiency Concept

Koopmans (1951) and Debreu (1951) are the pioneers of efficiency concept. Koopmans is the first who proposes a measure of efficiency concept and Debreu the first who empirically evaluates efficiency. The concept of efficiency is broad but it is the ability of doing without waste, unnecessary expense, time and effort. It is also a comparision between the actual with optimal values. The optimal defined by frontier or best practice. The comparision can take the form of the ratio of observed to maximum potential output obtainable from thegiven input, or the ratio of minimum potential to observed input required toproduce the given output, or some combination of the two. In these two comparisions the optimum is defined interms of production possibilities.In management , efficiency is defined as the study of optimized use of internal factors of the firm (Nadar, Mayssa, Israa and Reda,2018)

It is also possible to define the efficiency in terms of behavioural goal of the production unit. In this event efficiency is economic and is measured by comparing observed and optimum cost and profit, or whatever the production unit is assumed to peruse, subject to the appropriate constraints on quantities and prices (Lovell, 1993).

2.1.2. Type of Efficiency

Efficiency can be defined by its type like technical, allocative , economic , cost ,revenue ,profit and etc. In this regard, Farell (1957) is the first who shows the efficiency of a firm consisting of two components: technical and allocative efficiency.

Technical Efficiency

Technical efficiency means the ability of an organization or decision-making unit to obtain the maximum amount of output using the available inputs or it is the maximum reduction of inputs to produce the same output as before (Jaloudi, 2019).

Allocative efficiency

It reflects the ability of a firm to use the inputs in optimal proportions, given their respective prices and the production technology. Price information is necessary for the discussion of allocative efficiency (Tamiru, 2002). Referring to Cummins and Xie (2008), this efficiency concept allows finding either the optimal combination of inputs that minimizes cost, either the optimal combination of outputs that maximizes revenue.

EconomicEfficiency

Economicefficiency is defined as the product of technical and allocative efficiency. A firm both technicallyand allocatively efficient is said to be an economically efficient firm (Farell,1957).

Cost and Profit Efficiency

It is also possible to define efficiency in terms of behavioural goals, where efficiency is economic and measured by comparing observed and optimal costs and profits subject to the appropriate constraint on quantities and price, leading to cost and profit efficiencies respectively and these two types of efficiency are measured on two different behavioural assumption: cost minimization and profit maximization (Tamiru, 2002). Both technical and allocative efficiency is possibly involved in cost or profit efficiency (Coelli, 1996).

Cost Efficiency

It is defined as the ratio of the total cost to be incurred if the firm is operate at the most optimal point (i.e. the ideal cost of production) to the actual cost of the firm . It is derived from a cost

function in which the cost depends on the price of input and the quantity of output. A firm is considered as efficient in terms of cost if it achieves the lowest production cost in a sample characterized by the same exogenous variables (input prices, variable output quantities and fixed net puts)(Berger and Mester,1997).

Several research works investigate cost efficiency in insurance industry such as: Fecher et al. (1991), Gardner and Grace (1993), Berger et al. (1997), Cummins (1999), Berger et al. (2000), Cummins and Nini (2002), Greene and Segal (2004), Choi and Weiss (2005), Hao and Chou (2005), Cummins et al. (2006), Hao (2007), Choi and Weiss (2008) and Fenn et al. (2008).

Profit Efficiency

It defined as the ratio of actual profit to the predicted maximum profit, which could be earned if a firm is as efficient as the best practice firm. It is also the ability to achieve maximum profit given an amount of inputs and outputs and level of their prices. Profit efficiency is a broader concept than cost efficiency since it takes into account the effects of the choice of vector of production on both costs and revenues (Berger and Mester, 1997).

Type of Profit efficiency

There are two main approaches to study profit efficiency: Standard Profit Efficiency and Alternative Profit efficiency

Standard Profit Efficiency

Standard profit efficiency measures the firm's capacity to achieve the maximum profit given particular levels of inputs prices, outputs prices, fixed net-puts quantities and environmental variables. It assumes the existence of perfect competition in both input and output factors, and thus firms are price-takers, i.e., no market power of output prices. Contrary to cost function, the standard profit function is maximize profit by varying the quantity of input as well as the output quantity (Jarraya et.al, 2012)

Alternative Profit efficiency

Unlike standard profit efficiency, alternative profit efficiency maximizes profit by varying the price of output and quantity of input while quantity of output and price of input are given. It also assumes that the existence of imperfect competition or firms have market power in setting output prices. Hence, alternative profit efficiency function is based on the same dependent variable as the standard profit function and the same exogenous variables of the cost function. Several research works investigate profit efficiency in insurance industry such as: Berger et al. (1997), Berger et al. (2000), Ward (2002), Klumpes (2004).

2.1.3. Efficiency Measurement Concept

Efficiency measurement concept was first introduced by Farell in1957.According to Farell, the concept of efficiency measurement has two concepts which are technical efficiency and the allocative efficiency. To illustrate Farell's idea of efficiency measurement, Coelli et.al. (1998) developed two efficiency measurement models: Input-Oriented Efficiency Measures and Output-Oriented Efficiency Measures model.

Input-Oriented Efficiency Measures

This measure addresses the question of by how much can input quantities be proportionally reduced without changing the output quantities produced. For clear clarification of this concept , assuming a given firm is using two inputs X_1 and X_2 to produce a single output Y at point P (see figure 2.1).$UU^{/}$ shows an isoquant the possible combination of inputs the firm can produce the same output .Hence,any firm which produces on this isoquant is said to be a technically efficient . From the figure, the firm is efficient at point Q but the firm is operating at point P. Hence, additional input are used to produce the same level of output and the firm doesn't use input efficiently.

The technical efficiency (TE) of a firm is the ratio of the distance from point Q to the origin over the distance of the point from origin i.e. TE=OQ/OP. The distance QP is the technical inefficiency of a firm in which the firm can reduce QP amount of input without reduction of output.

While AA′ is the isocost in which all the possible combination of input that cost the same amount to firm . It shows the input price ratio. Hence, the allocative efficiency (AE) of the firm is AE=OR/OQ

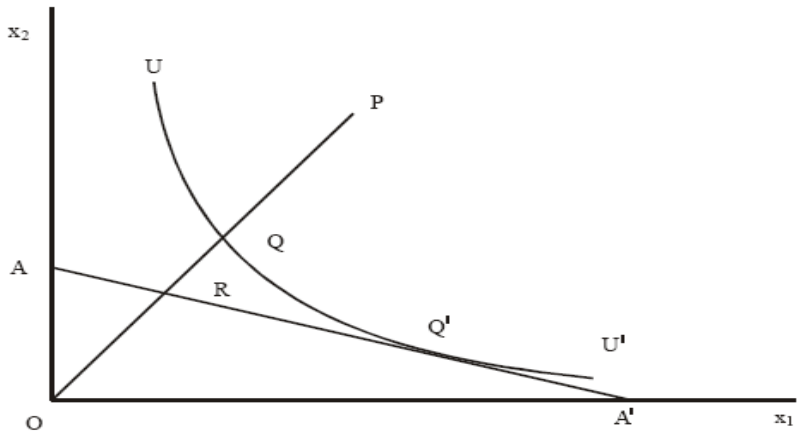
At point Q/ a farm is both technically and allocatively efficient.

The overall efficiency of economic efficiency(EE) is defined as the product of technical(TE) and allocativeefficiency(AE).

EE = OQ/OP X OR/OQ

EE = OR/OP

Figure 2.1: Input-Oriented Measures for Technical, Allocative and Economic Efficiency



Source: Coelli, *et al.* (1998)

Output-Oriented Efficiency Measures

This measure addresses by how much output quantities can be proportionally expanded without altering the input quantities used. As shown in figure 2.2 below, let assume that a firm producing two outputs (y1 and y2) with one input (x1).

$DD^{|}$ in the figure is a production possibilitycurve showing different combinations of two outputs (y1 and y2) produced using a given level of input (x1). Any firm that is producing on this curve is said to be a technical efficient firm.

Let assume that a firm produce at A and hence the firm is technically inefficiency because it produce below the production possibility curve. The technical efficiency (TE) of a firm is defined by the ratio of thedistance of the point A to the origin over the distance from the point B to the origin i.e. TE = OA/OB

The distance AB represents the level of technical inefficiency. It is the amount by which outputs could be increased without requiring extra inputs.If we have price information we can calculate allocative efficiency. In order to estimate the allocative efficiency (AE), iso revenue curve ($RR^{/}$) is drawn tangent to the production possibility curveat B′. The line OB meets it at point C.Hence, the allocative efficiency of the firm that produce at point A is the ratio of the distance of point B to the origin over the distance of point C to the origin *i.e.* AE=OB/OC

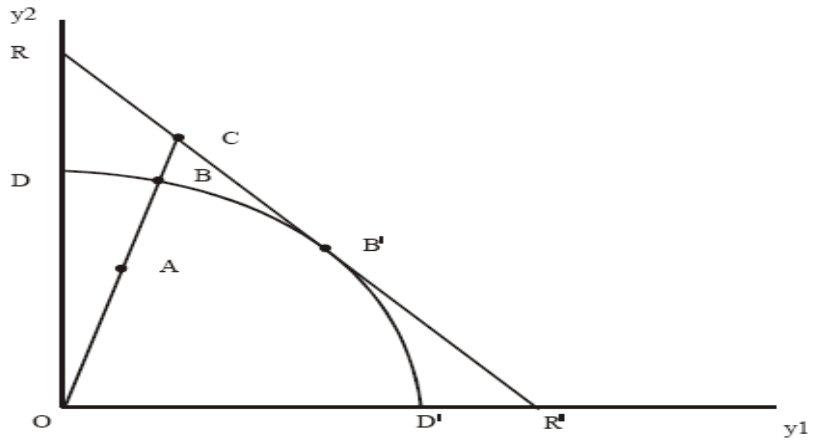
The economic or overall efficiency of the observed firm is defined as:

EE= OA/OB X OB/OC

EE = OA/OC

This has revenue increasing interpretion, while in the input-orientated case ithas cost reducing concept.

Figure 2.2: Output-Oriented Measures for Technical, Allocative and Economic Efficiency



Source: Coelli, *et al.* (1998)

2.1.4. Efficiency Measurement Approach or Technique

A number of different measurement technique have been used in measuring efficiency of a firm or insurance such as accounting based ratios, linear regression , parametric and non-parametric approach. However, in the literature dealing with the efficiency study, the two major technique used in measuring efficiency from frontier point of view are parametric and non-parametric approach.

2.1.4.1. Accounting Based Ratios

Accounting ratios are a crude measure used by financial analysts to measure efficiency and performance of insurance. These are simple ratios like operating ratio, operating income ratio, operating equity ratio and which are calculated based on the financial statement of the insurance company. These ratios are popular for analysing the efficiency of insurance industry because they are simple to construct and easy to use .However, measuring insurance efficiency by this method inappropriate unless all insurance company are nearly identical in terms of product mix, size, market condition and other factors that affect the insurance company expense. Moreover, insurance company efficiency is a complex phenomenon for which simple analysis can yield misleading conclusions. Therefore, to overcome such limitation, many studies use other alternative insurance company efficiency measurement (Kabalan, 2007).

2.1.4.2. Simple Regression Analysis

It applies Ordinary Least Squares (OLS) for estimating efficiency. The OLS regression model cans be written as follows (Haunter and Peiris, 2005):

$$\mathbf{Y_i = f(X_i, \beta) + V_i}$$

Where ,Y_i is denotes the actual output level ,X_i is a vector of inputs, β is a vector of parameters to be estimated and V_i is the random error factor (exogenous factor) that are not under the control of the firm or management .The main advantage of OLS is that it is computationally easy and

straightforward. It can easily estimate the institutional and environmental factors that influence firms' efficiency. The main drawback is , it only considers the error term as measure of exogenous factor, however, the error could be due to other endogenous factors (inefficiency) which are under the control of the management .As a result, the estimate of the coefficient could be biased and inconsistent .The other limitation is that regression analysis does not calculate frontier that is similar to the original function. It calculated a fitted average function that provides no direct information on inefficiency in the sample (Kabalan, 2007).

2.1.4.3. Parametric and Non Parametric Approach

Frontier efficiency methodologies measure the performance of a company relative to a "best practice" frontier, which (in the case of single input/output) is determined by the most efficient companies in the industry (Luhnen,2019).In this regard, there are two principal approaches to frontier efficiency measurement: Parametric or econometric approach and Non Parametric or mathematical programming approach. These methods all involve determining an efficient frontier in achieving either the observed minimum cost or observed maximum profit (or revenue)(Wang,2019).Moreover, both approach assumes that the production function or the best practice frontier of the fully efficient decision unit is known (Carlos, Nazare and Maria,2003)

Parametric Frontier Approach-SFA

The parametric or econometric approaches specify a production, cost, revenue, or profit function with a specific shape and make assumptions about the distributions of the inefficiency and error terms. The most widely parametric approach used is SFA as introduced by Aigner *et.al.* (1977). SFA is usually applied in two steps: In the first step, a production, cost, revenue, or profit function is estimated, determining the efficient frontier. In the second step, for individual firms, deviations from the efficient frontier due to inefficiency and a random error are calculated (Cummins and Weiss, 2000). To illustrate SFA formally, we use a translog cost or profit function that has been widely used in literature and shown to approximate the form of the real underlying cost or profit function fairly well.

Aigner *et.al.* (1977) proposed the estimation of a stochastic frontier production (SFA), where exogenous factor or noise is accounted in the error term. Accordingly, the error term composed of two parts i.e., exogenous factor (the noise term) and endogenous factor (inefficiency factor).They specified the function as follows:

$$\mathbf{Y_i = f(X_i, \beta) + U_i + V_i}$$

Where ,Yi is denotes the actual output level ,Xi is a vector of inputs, β is a vector of parameters to be estimated ,Ui is the endogenous factor (inefficiency factor) and Vi the exogenous factor .

The first component represents the inefficiency term and it is assumed to be half normally distributed. The second component is the error term that follows a symmetric distribution (also called standard normal distribution). This method ensures that efficiency term is non-negative. Several studies apply this approach in the insurance industry: Cummins and Weiss (1993), Yuengert (1993), Toivanen (1997), Berger et al. (2000), Chaffai and Ouertani (2002), Ward (2002), and Ennsfellner et al. (2004).

Non Parametric Approach-DEA

Compared with the econometric approaches, the mathematical programming approaches put significantly less structure on the specification of the efficient frontier and do not decompose the inefficiency and error terms. The most widespread mathematical programming approach is data envelopment analysis (DEA) introduced by Charnes etal(1978), which uses linear programming to measure the relationship of produced goods and services (outputs) to assigned resources (inputs). DEA determines the efficiency score as an optimization result.

By using DEA, one limitation is the estimated result can only account for technical efficiency because this technique does not consider price vectors; another potential limitation is that the result is also sensitive to some constraints (Canton *et al.*, 2005).

According to Charnes, Cooper and Rhodes (198) specify thenon-parametricfunction asfollowsconsidered the estimation of non-parametric frontier production ininput/output space. They specified the function as follows:

Yi = f(Xi, β) +Ui

Where ,Yi is denotes the actual output level ,Xi is a vector of inputs, β is a vector of parameters to be estimated and Ui is the endogenous factor (inefficiency factor) that are under the control of the firm or management .One of the criticisms of this approach is that no account is taken exogenous factor or other noise that are out of the control of the management that can change the shape of the estimated frontier, since all observed deviations from the estimated frontier are assumed to be the result of endogenous factor (inefficiency).

In general, DEA does not specify the explicit specification of the form of the underlying production relationship, and thereby omits any possibility of random fluctuation in efficiency. In contrast, SFA attributes at least part of the deviation from the best-practice frontier to inefficiency and assumes a distribution of inefficiency effect by specifying a particular form of production, cost or profit function. In addition, SFA has arguable superiority in estimating economic efficiency over DEA, largely because the latter typically ignores price information, even where available (Berger and Mester, 1997).Then, SFA is applied in this study, and the non-parametric approach would not be explained any further.

2.2. Empirical Literature

This section reviews and discusses some of the related empirical literature on insurance efficiency. Over the years, models of insurance efficiency have evolved along the two distinct frontier estimation techniques of SFA and DEA models which have received substantial application in the insurance efficiency literature. However, this paper focuses on literatures that are mainly used SCF technique since the study used this model for analysis purpose. Early models of the insurance efficiency literature were mainly for developed countries; particularly the United States and Europe while there have been limited number of studies undertaken in developing countries and countries in transition. However, this study tried to review insurance efficiency of both developed and developing country.

Jarraya and Bouri (2014) examines the profit efficiency of in a sample of 9 countries of the European Union for the period 2002-2008 which are Germany, United kingdom ,Belgium, Spain, France ,Netherland ,Italy , Sweden using a SCF approach. For measuring of profit efficiency the study used the following input variables which were price of operating expenses; price of equity capital and reserves; price of financial debt capital; while the output variable were incurred claims plus additions to reserves and total investment .It was found out that the average profit efficiency of all countries of the European insurance company was 54.05%. Among such countries, the highest profit efficiency score is that of French with an average inefficiency of 29.70% followed by Denmark and Belgium with an average of profit inefficiency scores about 37.19% and 37.55% respectively. However, the most inefficient in the profit issue are that of Spain, Italy and Germany with an average of profit inefficiency scores about 54.47%, 59.18% and 62.97%, respectively. While trying to search the sources of this profit inefficiency it was found that European insurance companies sustain additional charges in their operating expenses. So, they have to minimize their expenditures to reach the optimal level of operating expenses. In addition, our results show that there is an under-investment and they have to enhance both equity and debt capitals.

Wang (2019) estimated the cost and profit efficiency of UK insurance market's performance during 1996-2017 using the SFA approach. The study specified two outputs: net claim paid and total investment while three inputs were used labour, business, financial capital, and technical provision. The result of the study revealed, that insurers have opportunities to improve their performance – approximately 40% for cost efficiency and 70% for profit efficiency. Nonetheless, the findings also indicate that both cost and profit efficiencies tend to remain within a relatively stable range over the study period (i.e., no significant improvements in both cost and profit performance from the past 20 years). Besides, evidence shows that the UK insurers may tend to put more efforts on cost management since the insurers' cost efficiency is higher than their profit efficiency.

Luhnen (2009) examines the determinant of efficiency in German insurance companies from the year 1995-2006.One major contribution of this paper is the analysis of six efficiency determinants. Accordingly, it was found out that there is a positive relationship between size and efficiency, that is large insurers are more efficient than medium-sized and small insurers.

Furthermore, the analysis of different distribution systems shows that exclusive agent insurers are more efficient than independent agent insurers, which is in line with results for other markets such as the United Kingdom and the United States. With regard to the relationship between ownership and efficiency, mutual are more efficient than stocks. Considering the impact of different degrees of specialisation on efficiency, there is evidence in support of the strategic focus hypothesis: specialised insurers are more cost efficient than those who spread their business across several lines. With regard to the effect of leverage on efficiency, there is a positive relationship. We find a negative relationship between premium growth and efficiency: strongly growing insurers are less efficient, which may be attributed to a lack in underwriting discipline in favor of growth aspirations.

Another notable focus of research on insurance efficiency has been that received from the South American country. In analysing the insurance efficiency of Argentinean Insurance Company Ferro and Leo´n (2017), used SCF approach to analyse the technical efficiency of the insurance companies from the year 2009-2014. In the study, technical and financial loss (total losses) used as an output variables while three input variables were taken which are labour, commission to broker and financial capital. The finding of the study was the average technical efficiency of the insurance market obtained from the selected model yielded a value of 42 per cent. More than 70 per cent of the firms in the sample obtained between 20 per cent and 60 percent efficiency levels. Moreover, the sector's performance did not reveal significant changes that would show efficiency evolution over time.

Jaloudi (2019) also examined the efficiency performance of Jordan Insurance companies using panel data for 22 insurance companies operating inside Jordan over the period 2000–2016.The study found that there is a slight development of technical efficiency for the Jordanian insurance companies during the study period. In addition, there is a substantial efficiency difference among insurance companies each year, and there is a variation at the level of efficiency for each company in each year. The results also showed that owners' equities are among the most important internal determinants of companies' efficiency, and there is a significant correlation between type, size and return on assets of the insurer and its efficiency.

Abudulai et al . (2010) evaluate the relative efficiency performance of Ghanaian general insurance companies from the year 2002 to 2007. They used Debt capital, Equity capital and Management expenses as inputs that are used by insurers to produce premium, claims and investment income. They tested hypotheses relating to the roles played by dimension and market share in the efficiency of the Ghanaian general insurance companies. It was observed that Ghanaian general insurers with higher dimension and market shares tend to have higher efficiencies; implying that general insurers could increase their efficiencies by trying to increase among other things their dimension and market shares.

Gustavo and Sonia (2017) examined the efficiency of Argentina's Non-Life Insurance Market using Stochastic Frontier Analysis .The study use labour , Commissions to brokers , financial capital as an input while total losses as an output. The finding of the study revealed that the average technical efficiency of the non-life insurance market obtained from the selected model yielded a value of 42 per cent. More than 70 per cent of the firms in the sample obtained between 20 per cent and 60 per cent efficiency levels. Moreover, the results of the study highlight two policy points: efficiency improvements are possible by increasing the output with the same existing inputs or decreasing the inputs but maintaining current output levels. One way for inducing the former is to decrease the heavy taxes on policies (to induce an increase of insurance demand, which permits apportioning more appropriately the inputs in use).

As to the researcher knowledge, studies on both cost and profit efficiency of Ethiopian insurance companies are not done so far .However; there are two studies that focus on cost and technical efficiency of Ethiopian insurance companies using DEA approach.

Accordingly , Ashagrie and Gizachew (2018), estimated Ethiopian insurance company technical efficiency using DEA between the year 2006 to 2015 . The study use total expenditures and total assetsas an input and while profit after tax and total Premiums was the output of the study. The study found that Ethiopian insurance corporation was efficient and was best peer in maximizing net profit and gross premium. Nyala insurance company took the second position in terms of efficiency and it was second most efficient and best peer insurance company in the

country. Nile insurance company was the least efficient company even though it was efficient in 2006 & 2007. United insurance company was third best peer company in maximizing its profit and premium. The remaining insurance companies (National, Global,Nib and Awash)were not consistent in terms of their efficiency to maximize their profit in particular they failed to be efficient in recent years.The study was also used Tobit regression Model to identify the efficiency determinants . Accordingly, The result shows that size (negatively), number of branches(positively) and age (positively) o were significantly affecting efficiency score of insurance company w but leverage value was not significantly affecting efficiency score.

Mulugeta (2012) examined the technical efficiency of Ethiopian insurance companies using DEA input oriented approach in the period 2006-2010. The study was used a given set of outputs (such as premiums and investment income) via the use of inputs such as administrative and general expenses and financial capital.The finding of the study reavealed that the technical efficiency of Ethiopian insurance companies during the study period was 86.7%.

2.3.Determinants of Efficiency

In the following it has been tried to summarize the determinant of cost and profit efficiency of insurance companies based on the empirical evidences, and finally formulate the direction of the hypothesis for this paper as per Ethiopian insurance industry context.

Company Size

Many frontier efficiency studies in insurance have found a positive relationship between size and efficiency, which can be explained by large insurers' significant scale advantages with regard to the production technology .Scale advantages result from average per unit output cost reductions when the volume of output increases. The most frequently discussed source of scale economies is the spreading of a firm's fixed production costs, such as computer systems and financial capital, over a larger volume of output. Similarly, scale economies may arise from the learning effects gained by managers operating at larger scale. In addition, in the insurance sector it is usually assumed that a larger scale of operation reduces income volatility, since the pooling of risks works better the larger the risk pool (Cummins and Zi (1998); Cummins and Rubio-Misas (2006); Luhnen (2009).

Though many studies find results in line with the theoretical predictions of a positive relationship be-tween size and efficiency ,there are studies argue that the very largest firms suffer from diseconomies of scale (e.g., due to complexity) so that they are not as efficient as middle-sized insurers (Fenn et al., 2008). Diacon et al. (2002) find, however, that large and small insurers are more (technically) efficient than middle-sized insurers, indicating a u-shape of efficiency values. While Yuengert (1993) concludes that size and efficiency are statistically unrelated. For life and non-life insurance there is concave relations between size and cost/profit efficiency (curvilinear and inverted u-shape).

According to Jaloudi (2019), large insurers expected to benefit from economies of scale and scope in the form of lower per unit cost of production derived from the large scale of production. In other hands, the inability of the larger firm to monitor and control activities of large-scale operation results in diseconomies of scale, a negative relationship. Size of the insurer is measured by natural logarithm of company assets. Large insurer seems to have improved flexibility to arrange the best combination of inputs and outputs and benefits from the economies of scale.

Following the theoretic line of economic scale reasoning and the most widespread empirical findings , it is hypothesized that company size and efficiency has a positive relationship.

Leverage

As per the study conducted Cummins and Nini (2002), Luhnen (2009) and Eliang and Luhnen (2010) the relationship between leverage (proxied by the ratio of Debt to total assets) and efficiency was negative, that is higher leverage means higher degrees of inefficiency, but only up to a certain, debt to assets ratio (above-median leverage). The argument could be made that when the company has more debt than equity , it negatively affect the company ability to manage unexpected losses and long run sustainability. It may also lead the company to be at risk of bankruptcy if they are unable to make payment on their debts (Renbao Chen and Kie Ann Wong (2004) , Hifza Malik (2011).

However, as per the study conducted by Ashagre and Gizachew (2018) on efficiency of Ethiopian insurance industry, it was found out that leverage (defined as the ratio of debt to total asset) has no any significant relationship with the efficiency of Ethiopian insurance industry.

Hence, based on the economic rationale and in line with this first empirical evidence, it is hypothesized that there will be a negative relationship between leverage and efficiency in Ethiopian insurance industry.

Premium Growth

It was found out that there is a negative relationship between premium growth and efficiency: strongly growing insurers are less efficient, which may be attributed to a lack in underwriting discipline in favour of growth aspirations but it attract bad risks, which turn out to be costly. Moreover, short-term increase of premium volume might often be outweighed by heavy investments in creating that growth (e.g. costly marketing campaigns, which increase operating expenses) (Luhnen, 2009) .

According to Epermanis and Harrington (2006), though there are many factors outside of management control have been identified as significant drivers of premium volume like changes in regulation, general economic conditions, and market competition , financial strength ratings and reputation, are more influenced by management's strategic decisions. Growth in premiums might also be driven by higher operating expenses resulting from marketing efforts. In addition, if insurers massively increase premium volume, proper underwriting may well be abandoned in the process, leading to increased exposure to adverse selection. Underwriting discipline thus might affect efficiency which indicates a negative impact of premium growth on efficiency.

Based on the economic rationale and in line with this empirical evidence, it is hypothesized that there is a negative relationship between premium growth and efficiency in Ethiopian insurance industry.

Company Age

Company age is the time span between the founding year and the study period .There are two opposing arguments regarding the impact of age on efficiency. On the one hand, the long-term persistence of a firm in a given market might indicate its ability to successfully adapt its technology to changing market conditions, thus suggesting above-average efficiency and productivity. Firms with a long history are also likely to be more well-known and to enjoy a good reputation. On the other hand, relatively new firms might be more innovative in the use of state-of-the-art production technology, signifying competitive and efficiency advantages for "young" firms (Biener and Eliang, 2012).

Both Hussels and Ward (2007) for the German and U.K. life insurance find that older insurance firms are less efficient than younger ones. This indicate that the innovation argument outweigh the reputation argument about the relationship between efficiency and age in German and UK insurance company .

Accordingly, it is hypothesized that the innovation argument seems to outweigh the adaption ability and reputation argument in Ethiopian insurance industry and it is also expecting that there is a negative relationship between company age and efficiency in Ethiopian insurance industry .

Number of Branch

There are different findings, regarding the relationship between efficiency and branch expansion of insurance companies. According to the study conducted by Hrechaniuk, Lutz and Talavera(2007) , number of branches found to be positively related with cost and profit efficiency of insurance companies .This finding related with as insurance companies number of branch is increased ,it create its own difference in operating cost which emanating from possible scale effect and hence when the number of branch increases, the unit cost per branch is decreased (economic scale argument) which in turn increase the cost and profit efficiency of the insurance company .

A study conducted by Ashagre and Gizachew(2018), they used number of branch as one of the determinate factor for efficiency of Ethiopian insurance industry .The finding of the study also indicated that there is appositive and significant relationship between efficiency and number of branch .As the study also indicated that as insurance company branch increases by one unit , the efficiency score of the insurance company increases approximately by 0.01 keeping the effect of other companies constant.

On the other hand, a study conducted by Micheal (2009) revealed that branch expansion has a negative impact on both cost and profit efficiency , which is exacerbated by increased cost of the branches compared to the revenue obtained from that specific branch. Moreover, the study conducted in Portugal on the effect of branch expansion on cost and profit efficiency of insurance companies , it was identified the following results .First, focusing on the local activities without expanding branch network is associated with improved cost efficiency. Also, expanding branch network in certain level exhibit higher cost efficiency, whereas excessive branch expansion causes lower cost efficiency. Next, in contrast to the results for cost efficiency, focusing on the local activities exhibit lower profit efficiency. However, excessive branch expansion also relates to lower profit efficiency (Barros, Barroso and Borges,2005).

Hence, considering the economic scale argument and the empirical findings, it is hypothesized that branch expansion has a positive relations ship with cost and profit efficiency of Ethiopian insurance industry.

Ownership

Three are two conflicting views on the impact of ownership (state or private) on efficiency of insurance companies. One view argue that state owned insurance companies are more cost and profit efficient than private insurance companies. This is because state owned insurance companies have got special favour an advantage from the government which enhance their efficiency without competing their equivalent private insurance companies. Moreover, the government has also a positive impact on firms efficiency by sending a positive signals to markets , by being effectively involved in monitoring the management and by subsidizing the firms during trouble time (Brockett etal,1998).

On the other hand , the other view emphasizes that private insurance companies are more cost and profit efficient than state owned insurance companies . This is because state owned insurance company managers experience less intense performance pressures than their private peers. Consequently, this creates a problem of moral hazard on the part of state owned managers since there is often no fear of job losses or erosion of managerial reputation arising from poor performance. This reduces the level of vigilance on efficiency performance by encouraging unproductive activities which undermine cost rationalisation. Moreover, Jeng and Lai (2005) also found out that there is bureaucracy and clumsy formal organizational forms in state owned insurance company which make managers are not react quickly to changing market conditions. Therefore, this situation leads to the government owned insurance companies not to be efficient in both cost and profit.

According to Greene and Segal (2004) ,under private ownership system, in which individuals or organizations are assigned the rights, owner of the resource will invest the resource with objective of neoclassical profit maximization. So the private property right system promotes resource usage and exchange until the resource achieves its optimal value. Therefore, the private property right system along with individual profit maximization concept in a competitive market, promotes efficient allocation of resources in the economy. While in state ownership system, the state decides to invest in state-owned resources. The efficiency results will not be the same as in private property right system. In private property right system, individual or organizational wealth maximization is followed, while in state property right system, wealth maximization of whole society is followed. This outcome would require that state's decision making process should reflect and incorporate interests of all members of the society. Since the state does not follow profit maximization principle for the society, economic efficiency in the state ownership system will be far less than private property right system .In state property right system, mostly political objectives are pursued rather than profit maximization of whole society (Erhemjamts and Leverty,2010).

CHAPTER THREE: RESEARCH METHODS

The purpose of this chapter is to present the data types, source of data, study population, sampling method, method of data analysis, descriptions of variables and specification of model.

3.1. Data types and Source of Data

Secondary data was used required to meet the objectives of the study. To measure the efficiency and identify factor that determine of efficiency difference among insurance companies , Panel data (pooled time serious and cross-section data) from year 2011to 2020 was used.

The main source of data was the annual audited financial statement of each insurance companies, reports and bulletins of National Bank of Ethiopia .It was also collected from different related journals, magazines and paper written by individual as well as companies related to the topics. The required data was collected from the sources by approaching the concerned officials mainly from National Bank of Ethiopia and from each respective individual insurance company.

3.2. Study population and sampling method

3.2.1. Study population

All operational insurance companies in Ethiopia were taken as the study population. Currently there are 18 operational insurance companies in Ethiopia and out of which 17 of them are private owned insurance companies and only one insurance company is state owned insurance company .

3.2.2. Sampling Method

The target population would be all insurance companies that are operational in the country. Currently, in Ethiopia, there is one state-owned insurance company and 17 private insurance companies that are operating throughout the country. From the target population, sample was selected based on purposive sampling method which is a non- probability sampling procedure

that ensures certain characteristics of population sample could represent the exact extent that the researcher desires.

In order to analyse the efficiency and factors explaining differences in efficiency across companies, it is appropriated to use at least 10 years data about the industry (Ashagre and Gizachew,2018; Cummins and Weiss ,2011; Christian, Martin, Jan,2015; Carlos,Nazare and Maria,2003).

In view of these facts, the sample was considering those insurance companies that are operating in the past 10 consecutive year's i.e. from the year 2011 to 2020.Accordingly, one government owned insurance company (Ethiopian Insurance Corporation) and 12 private insurance companies (Awash Insurance Company S.C, Africa Insurance Company S.C, National Insurance Company of Ethiopia S.C (NICE)., Nyala Insurance Company S.C, Nile Insurance Company S.C, The United Insurance S.C, Global Insurance Company S.C., NIB Insurance Company, Lion Insurance Company S.C, Ethio-Life and General Insurance S.C., Oromia Insurance Company S.C.) , Abay Insurance S.C with a total of 13 insurance companies was included in the sample.

3.3. Method of Data Analysis

The study used both descriptive and econometrics model to analyse the data. Percentage, mean and standard deviation will be used for descriptive analysis. While to measure the efficiency performance of insurance companies and to identify factor that determine efficiency level of such companies , econometric model like Stochastic frontier model(SFA) and Tobit model was used respectively . These models are briefly discussed below.

3.3.1. Specification of Stochastic Frontier Analysis Model

Stochastic frontier analysis (SFA) refers to a body of statistical analysis techniques used to estimate production, cost, profit functions in economics, while explicitly accounting for the existence of firm inefficiency. In this regard , two types of efficiency was analysed – cost and profit efficiency which correspond to the two important economic objectives: respectively, the minimization of costs and the maximization of profits, and are based on the comparison of

observed values (of costs and profits) with the optima, determined by the respective frontier(Maudos and Pastor, 1996)

3.3.1.1. Specification of Cost Efficiency Function

Cost efficiency is defined as the quotient between the minimum cost at which it is possible to obtain a given vector of output as determined by the frontier (*C**) and the cost actually incurred (*C*). Thus, a cost efficiency value of *CE=C*/C* implies that it would be possible to produce the same vector of production with a saving in costs of (1-*CE*)·100 per cent**(Maudos and Pastor, 1996)**.Cost Efficiency ranges over the (0,1] interval, and equals one for the best-practice insurance in the sample (**Joaquin etal,1999)**.Moreover, cost efficiency gives a measure of how close a firm's (insurance's) cost is to the cost of a best-practice firm (Insurance) producing the same output bundle under the same conditions (Berger and Mester, 1997)

According to Aigner *et. al.* (1977) who is the founder of SFA, Battese and Coelli (1995) and different literatures (see, e.g., Choi and Weiss, 2005; Cummins and Weiss, 2000; Cummins and Zi, 1998; Rai, 1996), the cost of a firm or an insurance depend on the output vector (Y), the price of inputs (W), the level of inefficiency (U) and a set of random factors (V) which incorporate the effect of errors in the measurement of variables or uncontrollable factor (Joaquin etal, 1999).

C=f(Y,W,U,V) or (Equation 1)

$$C_{it}=f(Y_{it},W_{it})+\varepsilon_{it} \text{ , where } \varepsilon_{itit=} U_{it+}V_{it}$$

Where C_{it} is the total cost insurance i incur at time t; f(Y_{it} ,W_{it}) is a functional form ; Yit is the output of insurance i at time t; Wit is the price of input of insurance i at time t and $\varepsilon$is the error term .

The cost function of the insurance can be also written in logarithm form as follows:

$\mathbf{lnC_{it} = f(Y_{it},W_{it})+ln\ U_{it}+lnV_{it}}$ **(Equation 2)**

The error term in cost function is decomposed in to two components i.e. the sum of the random error and inefficiency term since inefficiency factor increase the level of the cost of the insurance company.

$\boldsymbol{\varepsilon_{it=}\ U_{it\ +}\ V_{it}}$**(Equation 3)**

Where V_{it} represent random error factor (exogenous factor) which has an impact on the cost of the insurance production. It represents a temporary rise or fall in the insurance's costs due to the random factor that may stem from a data / measurement error, or unexpected / uncontrollable factors such as weather, labor strikes, war, etc., that are not under the influence of the management. In using SFA, the random error (V_{it}) is assumed to be two sided ,normally distributed with zero mean and variance of σ^2_V i.e., V_{it}~ $N(0, \sigma^2_v)$.

While U_{it} represents inefficiency factor (endogenous factor) pertaining to insurance i. It measure the difference between the cost or the profit of the best practice firm and another firm . This difference is due to inefficiency. In using SFA also ,the inefficiency factor (U_{it}) is assumed to be one sided , half normally distributed with U_{it} mean and variance of σ^2_{Ui} i.e.,U_i~ $N(U_{it}, \sigma^2_u)$.The underlying reason half normal distribution assumption is that inefficiencies cannot be negative and hence the inefficiency factor usually assumed to be one sided positively distributed. The term U_{it} also denotes a rise in the cost of insuranceproduction due to the inefficiency factor that may result from the mistakes of the management, such as non-optimal employment of the quantity or mix of inputs given their prices.

On the other hand , cost efficiency function can be also defined as the ratio of the minimum costs (C^{min}) incurred by an efficient insurance company to produce the output vector and the costs actually incurred by the i^{th} insurance company (Wang,2019):

$$CE_i = \frac{C_{min}}{C} = \frac{\exp[f(w_i,y_i)]+V_i]}{\exp[f(w_i,y_i)+ V_i+U_i]} = \frac{1}{\exp(U_i)} \quad \textbf{(Equation 4)}$$

Accordingly, cost efficiency ranges over (0, 1] and equals one for a best-practice insurance within the observed data (Jaloudi, 2019). For example, an insurance with cost efficiency of 0.70 is 70% efficient or equivalently 30 % of its cost are wasted relative to the best practice insurance producing the same output and facing the same conditions. That means a cost of 1 birr to produce a unit of output that can be produced by 0.70 cent by efficient insurances.

In the stochastic frontier analysis, the two functional forms usually used to estimate efficiency are the Cobb-Douglas and the translog form.In this paper, the translog form is used to estimate cost and profit efficiency scores of the insurance companies. This functional form is chosen because of its flexibility while the Cobb-Douglas imposes restrictions on returns to scale and hence it is not a flexible functional form(Coelli et al., 2005).

Accordingly, the full form of translog cost function is expressed as follows:

$$\ln TC_{it} = \alpha_0 + \sum_{i=1}^{3} \alpha_i \ln W_{it} + \sum_{k=1}^{2} \beta_k \ln Y_{kt} + \frac{1}{2}\sum_{i=1}^{3}\sum_{j=1}^{3} \alpha_{ij} \ln[W_{it}W_{jt}] + \frac{1}{2}\sum_{k=1}^{2}\sum_{m=1}^{2} \beta_{km} \ln[Y_{kt}Y_{mt}] + \sum_{i=1}^{3}\sum_{k=1}^{2} \gamma_{ik} \ln W_{it} \ln Y_{kt} + V_{it} + U_{it}$$ **(Equation 5)**

This form can be rewrite in the following way :

$$\ln TC_{it} = \alpha + \alpha_1 \ln W_1 + \alpha_2 \ln W_2 + \alpha_3 \ln W_3 + \beta_1 \ln Y_1 + \beta_2 \ln Y_2 + \alpha_{11}\frac{1}{2}[\ln W1]^2 + \alpha_{12}\ln W_1W_2 + \alpha_{13}\ln W_1W_3 + \alpha_{22}\frac{1}{2}[\ln W_2]^2 + \alpha_{23}\ln W_2W_3 + \alpha_{33}\frac{1}{2}[W_3]^2 + \beta_{11}\frac{1}{2}[\ln Y_1]^2 + \beta_{12}\ln Y_1Y_2 + \beta_{22}\frac{1}{2}[\ln Y_2]^2 + \gamma_{11}\ln W_1Y_1 + \gamma_{12}\ln W_1Y_2 + \gamma_{21}\ln W_2Y_1 + \gamma_{22}\ln W_2Y_2 + \gamma_{31}\ln W_3Y_1 + \gamma_{32}W_3Y_2 + U_{it} + V_{it}$$

(**Equation 6)**

Where ,TC is defined as the total cost of the insurance ; Wis the of price of input ;Yis the output; Vit is the random error term ; Uit is the inefficient term and β ,α ,γ are coefficients of the parameter .

Duality require a number of restrictions to be imposed a prior in order to estimate the cost and profit functions. Following Coelli (1996),the required symmetry and linear homogeneity in input

price is insured by imposing the following parameter restrictions. First, the Trans log cost and profit function must be linearly homogeneous (homogeneous degree one) in input prices.

For this purpose, homogeneity degree one in input price is imposed by normalizing the dependent cost and profit function (equation 5 and Equation 15) and input prices by one of the input prices. In accordance with this assumption the cost (TC), profit (Π), price of labour (W1) and price of financial capital (W2) are normalized by price of Business Service and Material(W3).

Therefore, in accordance with the above restrictions, the normalized trans log cost function is specified as follows:

$$\ln\left[\frac{TC}{W_3}\right] = \alpha_o + \sum_{i=1}^{2}\alpha_i \ln\left[\frac{W_i}{W_3}\right] + \sum_{i=1}^{3}\beta_k \ln Y_k + \frac{1}{2}\sum_{i=1}^{2}\sum_{j=1}^{2}\alpha_{ij}\ln\left[\frac{W_i}{W_3}\right]\ln\left[\frac{W_j}{W_3}\right] +$$

$$\frac{1}{2}\sum_{k=1}^{2}\sum_{m=1}^{2}\beta_{km}\ln Y_k \ln Y_m + \sum_{i=1}^{2}\sum_{k=1}^{2}\gamma_{ik}\ln\left[\frac{W_i}{W_3}\right]\ln Y_k + v_i + u_i$$

(Equation 8)

3.3.1.2. Specification of Profit Efficiency Function

Profit efficiency is a broader concept than cost efficiency since it takes into account the costs and revenue variable thus it gives offering complementary information that is useful for the analysis of the efficiency of insurance company (**Maudos and Pastor ,1996)**

Two profit functions can be distinguished, depending on whether or not there is market power: the standard profit function and the alternative profit function. The standard profit function assumes that markets for outputs and inputs are perfectly competitive. Given the input and output price (W) and (P), the insurance maximizes profits by adjusting the amounts of inputs and outputs. Thus, the profit function can be expressed as:

$$\Pi = f(W, P, V, U)$$

$$\Pi_{it} = f(W_{it}, P_{it}) + \varepsilon_{it} \quad \text{, where} \quad \varepsilon_{it} = V_{it} - U_{it} \qquad \textbf{(Equation 9)}$$

Where, Π_{it} is the total profit of insurance i generate at time t; f(W_{it} ,P_{it}) is a functional form ; W_{it} is the price of input of insurance i at time t; P_{it} is the price of output of insurance i at time t and ε is the error term .

In logarithmic terms:

$\ln(\Pi+\theta) = f(W, P)+\ln V - \ln U$ **(Equation 10**)

Where θ is a constant added to the profits of each firm in order to attain positive values, thus able to take logarithms. Standard profit efficiency can be also defined as the ratio between the actual profit of an insurance and the maximum level that could be achieved by the most efficient insurance and can be written as**(**Joaquin,etal,1999):

$$SPE_i = \frac{\Pi}{\Pi max} = \frac{\exp[f(W_i,P_i)]+V_i- U\ i]}{\exp[f(W_i,P_i)+ V_i]} = \exp(-Ui) \quad \textbf{(Equation 11)}$$

Similar to cost efficiency, standdared profit efficiency ranges over (0, 1] equals one for the best-practice firm that maximizesprofits (Maudos and Pastor ,1996;Jaloudi, 2019).

The exogenous nature of prices in the above concept of profit efficiency assumes the existence of no market power on the insurances' side. If, instead of taking prices as given, it has been assumed the possibility of imperfect competition, it would take as given the output vector, and not that of prices. In this way we define the alternative profit efficiency where insurance take as given the quantity of output (Y) and the price of inputs (W) and maximise profits by adjusting the price of the output (P) and the quantity of inputs **(Joaquin,etal,1999).**Accordingly, the alternative profit function is :

$\Pi = f(Y, W, V, U)$

$\Pi_{it} = f(Y_{it}, W_{it}) + \varepsilon_{it}$, where $\varepsilon_{it} = V_{it} - U_{it}$ **(Equation 12**)

This expression is equivalent to that of the cost function and only cost is substituted by profit as the dependent variable. Alternative profit efficiency (APEi) can be also defined as the ratio of actual profit to maximum profit and can be written as follows (Jaloudi,2019).

$$APE_i = \frac{\Pi}{\Pi max} = \frac{\exp[f(W_i,Y_i)]+V_i- U\ i]}{\exp[f(W_i,Y_i)+ V_i]} = \exp(-Ui) \quad \textbf{(Equation 13)}$$

Similar to cost efficiency, alternative profit efficiency ranges over (0, 1] and it equals one for the best-practice firm that maximises profits(Maudos and Pastor ,1996;Jaloudi, 2019).For example, an insurance with profit efficiency of 0.70 would suggests that the insurance company can earn 30% more profit than what it is making now if it were operating on efficient frontier or relative to the best practice insurance company producing the same output and facing the same conditions. It also means that an insurance company has profit that is 30 % below the maximum profit defined by the frontier. That means the insurance company is earning a profit of 0.70 cent by producing a unit of output while the efficient insurance company can earn 1 birr by producing the same output and facing the same conditions.

However, as indicated by Berger and Mester (1997), alternative efficiency is a closer representation of reality whenever the assumption of perfect competition in the setting of prices is questionable, when there are differences in output quality among individuals of the sample, or when there are problems of information for the calculations of output prices(Maudos and Pastor ,1996).Therefore, this study use alternative profit efficiency function considering the reality in Ethiopia. Accordingly, the alternative profit function or profit function of the insurance company can be written in logarithm form as follows:

$$\ln (\Pi_{it} + \Theta) = \ln f(Y_{it}, W_{it}) + \varepsilon_{it} \quad \textbf{(Equation 14)}$$

Where Θ is a constant added to profit of each insurance company which equals the lowest profit obtained in the sample plus one, to avoid having negative profit for any insurance company observation so that we may take logarithms of all profit function variables: ln f(Yit

,Wit) is the logarithmic functional form ;Y is the vector of output ;W is vector of price of input and ε is the error term . However, the error term in profit function is defined as Vit- Uit since the inefficiency factor (Uit) reduces levels of the profit of the insurance company but the distribution assumptions of Vit and Uit are specified similarly to the expression in cost function .

The functional form restrictions impose in cost function are on the same way applied for profit function. Accordingly, the full form of translog profit function is expressed as follows:

$$\ln(\pi_{it} + \theta) = \alpha_0 + \sum_{i=1}^{3} \alpha_i \ln W_{it} + \sum_{k=1}^{2} \beta_k \ln Y_{kt} + \frac{1}{2}\sum_{i=1}^{3}\sum_{j=1}^{3} \alpha_{ij} \ln[W_{it} W_{jt}] +$$

$$\frac{1}{2}\sum_{k=1}^{2}\sum_{m=1}^{2} \beta_{km} \ln[Y_{kt} Y_{mt}] + \sum_{i=1}^{3}\sum_{k=1}^{2} \gamma_{ik} \ln W_{it} \ln Y_{kt} + V_{it} - U_{it}$$ **(Equation 15)**

By considering the restrictions that are stated in cost function, the normalized trans log profit function are specified as follows:

$$\ln\left[\frac{\Pi_{it}+\theta}{W_3}\right] = \alpha_o + \sum_{i=1}^{2} \alpha_i \ln\left[\frac{W_i}{W_3}\right] + \sum_{i=1}^{3} \beta_k \ln Y_k + \frac{1}{2}\sum_{i=1}^{2}\sum_{j=1}^{2} \alpha_{ij} \ln\left[\frac{W_i}{W_3}\right] \ln\left[\frac{W_j}{W_3}\right] +$$

$$\frac{1}{2}\sum_{k=1}^{2}\sum_{m=1}^{2} \beta_{km} \ln Y_k \ln Y_m + \sum_{i=1}^{2}\sum_{k=1}^{2} \gamma_{ik} \ln\left[\frac{W_i}{W_3}\right] \ln Y_k + v_i - u_i$$

(Equation 16)

The above stated models of normalized translog cost function (Equation 8) and alternative profit frontier functions (Equation 16) are estimated by using maximum likelihood estimation technique with the help of Frontier 4.1c which was developed by Coelli (1996).

3.3.2. Specification of Censored Tobit Model

Once the cost and profit efficiency of insurance company are evaluated using SFA analysis , it is necessary to identify the determinates that appear to affect the efficiency of the insurance companies using censored Tobit Regression Model .

The censored Tobit regression model has strength of estimating equations whose dependent variable values are restricted within some range.Therefore , since the measure of efficiency scores take value between 0 and 1 (i.e.$0 \leq e \leq 1$)**,** where e the magnitude of the efficiency measures , it is appropriate to use Censored Tobit Model in this study(Christian and Martin, 2015).

Following the empirical finding of different studies regarding determinats of the efficiency score of insurance companies(Ashagrie and Gizachew,2018;Jaloudi,2019 ;Luhnen,2009, Christian etal,2015) , it has been tried to identify the independent variables that affect the efficiency score of Ethiopian insurance industry, namely: Size of insurance company or Economic of scale (SIZ) ,Leverage (LVG) , Age (AG), Premium growth (PMG), Organizational form or Ownership (OWN) and Number of Branch (NBR).

Accordingly , the dependent variables of the profit efficiency and cost efficiency scores obtained from SFA analysis are regressed on independent variables .More specifically, the Tobit regression model defined by:

$$E_{jt} = \beta_0 + \beta 1\ SIZ_{jt} + \beta_2 LVG_{jt} + \beta_3 AG_{jt} + \beta_4 PMG_{jt} + \beta_5 OWN_{jt} + \beta_6 NBR_{jt} + \varepsilon_{it}$$ **(Equation 17)**

Where,

E_{jt} is the cost efficiency or profit efficiency of the jth Insurance in period t obtained from stochastic frontier models;
SIZ is natural logarithm of total asset of Insurance j in period t;
LVG is the ratio of total debt over Asset of Insurance j in period t;
AG is measured by date of establishment of Insurance j in period t;
PMG is measured by the Gross premium

OWN is the organizational form of Insurance j in period t. It is dummy (0=Private, 1=Public)
NBR is the number of branch of Insurance j in period t;

3.3.3. Descriptions of Variables

The definition of inputs, outputs and their corresponding prices has a key role in efficiency investigations. A poor definition of these variables can lead to non-significant or erroneous results. This problem is more serious in the service sector especially in the insurance industry, where some quantities are intangible, implicit or not available. So, several works researches try to find the most suitable definitions of inputs, outputs and their prices(Jarraya etal, 2012).

In this study, two types efficiencies, cost and profit efficiency, is estimated. First, the insurer's operating expenses that associated with both underwriting and administrative costs is used to determined total cost. While total profit is the simple operating profit, profit before tax of a given insurance company (Berger et al., 2000; Kasman and Turgutlu, 2011). Hence, both the total cost and profit before tax is considered as the independent variable of the equation. Then , in order to estimate the efficiency scores, it is necessary to identify and define the insurance output , input and price of input which is called dependent variable of the equation

3.3.3.1. Specification of Input and Input Price

3.3.3.1.1. Input specification

There is a well-known agreement in most previous research work regarding the input definition. Accordingly, there are three main insurance inputs: labor, business service and materials, and capital (Cummins et al, 1999; Cummins and Weiss, 2000)

The insurance industry is a labor-intensive industry because the product is an intangible commodity and it needed a lot of salesmen and office staffs to run the business so it is one of the key input (Cummins et al., 2010).The category of business service and materials includes

items like travel, communications, and advertising and others (Cummins etal 1999; Cummins and Weiss, 2000).In empirical evidences, several studies use the operating expenses as an input that represents business services and materials (Diacon et al.2002; Fenn et al. 2008; Eling and Luhnen ,2010)

Regarding to Capital, it has two main categories of capital can be distinguished: physical and equity capital (Cummins etal, 1999; Cummins and Weiss, 2000).Here, equity capital is termed as financial capital. Since the risk pooling/bearing and the financial intermediation are two main functions of insurers, financial capital can be regarded as the main input used to provide these services (Diboky and Ubl, 2007; Jeng etal, 2007; Klumpes, 2007; Erhemjamts and Leverty, 2010)

Many research works consider the equity capital as an imperative input (Cummins and Weiss (2000), Eling and Luhnen (2009). This input has a role to ensure claims payment and regulatory requirement when losses exceed expectation and hence equity capital is considered as an input. Equity capital includes any balance sheet item in relation with shareholders' capital or reserves.

The physical capital is a fixed asset used as an input but it is considered under the input of business service and materials (Elign and Luhnen 2010; Cummins and Weiss, 2000).
Therefore, for the selection of inputs in this study, it has been followed the recent literature on efficiency. Accordingly, labor, businesses service and material, financial capital (Equity Capital) considered as inputs following Berger et al (1997) and Cummins & Rubio-Misas , 2006. Table 3.1 explains all input, input prices and output variables which have been used in the analysis of this paper.

3.3.3.1.2. Input's Prices Specification

When researchers use cost function or profit function to investigate efficiency using SCF, they must necessarily specify the price of each input. Hence, this study has computed the price of the labor by dividing the total labor cost to total number of permanent employees. The price of business services and material is computed by dividing the operating expense to total assets.

(Afza and Asghar, 2010). While the price of financial capital is proxied as the ratio of the ordinary profits to the sum of equity capital and total reserve (Jeng and Lai, 2005)

3.3.3.1.3. Output Specification

In existing studies of insurance companies' efficiency, there are three principal approaches to define outputs: the intermediation approach, the user cost method and the value added approach.

- **The intermediation approach***:* the insurance company is considered as a financial intermediary and hence it borrows funds from policyholders transforming them to assets, essentially by paying out claims, investing in capital market. But insurance companies offer other services in addition to financial intermediation. Ignoring these other functions allocated to the insurance company leads to erroneous results in efficiency studies (Brocket et al.1998).
- **The user cost method***:* This approach aims to classify financial product as an input or output basing on its net contribution to the firm's revenues (Hancock, 1985). Hence, if an asset's return (or a liability's cost) exceed (is less than) its cost opportunity then the product is considered as an output, else it is considered as an input. At the theoretical level, this approach is the most ideal, but at a practical level, it is almost impossible to find the necessary data.
- **The value added approach:** this is the most used approach for studying insurance companies' efficiency. The value-added approach or production approach counts outputs as important if they contribute a significant added value based on operating cost allocations (Berger et al., 2000). According to this approach, the insurance company is assumed to provide three main services, which need to be proxy by appropriate variables: (1) risk pooling and risk bearing; (2) financial services relating to insured losses and (3) intermediation (Luhnen, 2009).

Therefore , considering the value added approach , different studies adopts premiums or gross premium as output variable because it represents the risk pooling and risk bearing function of insurance companies. Houston and Simon (1970) argued that premiums paid should be used as a proxy for output which is analogous to measuring output as total sales. Moreover, Cummins and

Weiss(2000) use Premium for the proxy of the two service i.e. risk pooling and risk bearing and financial service relating to insured losses.

As a financial intermediary, insurance firms invest their funds which they receive from policyholders. Researchers have used investment income as a financial variable to represent the intermediary function of the insurers. Different studies has considered the investment incomes as a second output variable with the fact that a significant portion of net profit is generated from investment revenues (Worthington and Hurley, 2002) .Hence, The output variable used as a proxy for the intermediation function is total investment Income. Investment Income is the total amount of generated income from all the investment activities for the year (Luhnen, 2009).

Therefore, considering different literature, this study consider premium as one of the insurance company output variable, because premium insurance is the main revenue to the insurance company (Cummins et al., 2010). According to Hwang and Kao (2006), investment revenue is the second source revenue on the insurance company. Therefore, this study also chooses the investment revenue for the second output variable of insurance company.

Table 3.1: Input and output variables

Symbol	Variable	Measure
C	Total Cost	The sum of total expenses
II	Total Profit	Profit Before tax
Y1	Premium	Gross Premium
Y2	Investment Income	Total amount of generated income from all the investment activities
X1	Labor	Salaries, wages & other benefits
X2	Financial Capital	Equity Capital
X3	Business Service and Material	All operating expenses excluding labor cost &depreciation
W1	Price of Labor	Salaries, wages & other benefits / Total Employees
W2	Price of Financial Capital	Profits / sum of equity capital and total reserve
W3	Price of Business Service &Material	Operating expenses/ Total Assets

CHAPTER FOUR: RESULTS AND DISCUSSION

In this section, the results of the study are presented and discussed, afterwards the research hypothesis are adequately addressed.

4.1 Maximum Likelihood Result of Cost and Profit Efficiency Model

This study aims to examine the cost and profit efficiency performance of Ethiopian insurance industry over the period of 2011 to 2020 using Stochastic Frontier Analysis (SFA) model which is estimated using Frontier (4.1C). Accordingly, the table 4.1 below presents the Maximum Likelihood Estimate (MLE) for the parameters of trans log cost and profit function and related statistically test result obtained from the Stochastic Frontier Analysis (SFA).

One of the reason that make to use SFA model is the assumption of there is inefficiency (U_i) in Ethiopian insurance industry otherwise using the traditional average response function model(OLS) which assumes no inefficiency in the model is more appropriate. Hence, in order to test the presence of cost and profit inefficiency in Ethiopia insurance industry, Likelihood Ratio Test (LR test) shall be carried out. Accordingly , the result obtained from the MLE indicates that the value of LR test is 41.57 and 139.66 for cost and profit efficiency model respectively which is greater than the critical chi-square value of 27.688 at 13 degree of freedom and 1% significance level(given by Kodd and Palm,1996). Therefore, this result suggests that there is a cost and profit inefficiency effect inEthiopian insurance industry. The presence of such inefficiency in the model also indicates that SCF model is more appropriate representation than using the standard OLS model in analysing the cost and profit efficiency of Ethiopian insurance industry.

The gamma value **(γ)** at the MLE of stochastic frontier of cost and profit function model is 0.71 and 0.69 which is statistically significant at 1% level and implies that about 71% of variation in the cost of insurances companies and 69 % variation in the profit of insurance companies is due to the difference inefficiency effect while the rest 29 % and 31 % variation in cost and profit respectively emanate from random shock or noise.

The estimated sigma square (δ^2) for cost and profit efficiency function is 0.05 and 0.004 respectively and significant at 1% level which indicates highly significant of cost and profit efficiency parameters estimates(Goodness of test).

Table 4.1: Maximum likelihood estimation of cost and profit function

Betas	Variable name	Cost Efficiency		Profit Efficiency	
		Coefficient	t-ratio	Coefficient	t-ratio
β_0	Constant	-16.65	-15.93*	-17.16	-6.41*
β_1	ln(Q1)	0.30	1.69***	2.13	4.10*
β_2	ln(Q2)	4.47	4.48*	1.28	1.64***
β_3	ln(w1)	2.74	12.01*	2.95	7.72*
β_4	ln(w2)	0.42	0.4	-1.57	-0.42
β_5	0.5*lnQ1*lnQ1	0.35	2.43*	-0.06	-1.35
β_6	0.5*lnQ2*lnQ2	0.18	1.33	0.058	1.90***
β_7	lnQ1*lnQ2	-0.19	-1.49	-0.06	-1.01
β_8	0.5*lnW1*lnW1	-0.19	-7.2*	-0.22	-7.4*
β_9	0.5*lnW2*lnW2	0.005	0.068	-0.038	-1.81***
β_{10}	lnW1*lnW2	-0.011	-0.14	0.11	4.36*
β_{11}	lnQ1*lnW1	-0.017	-0.14	-0.16	-5.35*
β_{12}	lnQ2*lnW1	-0.26	-3.69*	-0.077	-1.33
β_{13}	lnQ1*lnW1	-0.08	-0.85	0.11	5.26*
β_{14}	lnQ2*lnW2	0.113	0.89	0.019	0.52
Sigma Squared ($\delta^{2)}$		0.052	6.21*	0.0041	4.57*
Gamma(γ)		0.711	7.00*	0.69	11.68*
LR test			41.57*		139.66*

***, **, *** represent that the estimates are significant at 1%, 5% and 10% respectively

Q1=Gross Premium, Q2=Investment Income, W1=Price of Labour, W2= Price of financial Capital

Furthermore, the trans-log cost and profit frontier models are estimated considering variables of outputs, input prices and their mixed products and the square of the inputs and outputs with a total of 14 variables as indicated in the table 4.1 above. Accordingly, the results of the maximum likelihood estimation of such variables are presented in Table 4.1 above for both cost and profit models.

The output variable , gross written premium and investment income is found positive and statistically significant for both cost and profit efficiency model. On the other hand, the input variable , price of labour , is significant and positive for both cost and profit efficiency at 1 % level with the coefficient value of 2.74 and 2.95 respectively. This means that an increase 1 % in price of labour, it could increase the cost efficiency by 2.7% and profit efficiency by 2.95 %. Price of financial capital is found insignificant for both cost and profit efficiency model while is also found positive for cost efficiency and negative for profit efficiency. While the result of the square of output and input price variable and mixed products are clearly depicts in the table 4.1 above.

4.2 Cost and Profit Efficiency of Ethiopian Insurance Industry

The average cost and profit efficiency score of Ethiopia insurance companies on the study period (2011-2020) are illustrated in table 4.2 below. Accordingly, the average cost and profit efficiency of the Ethiopian insurance industry over the study period are 0.78 and 0.77 respectively, suggesting that there is a room that Ethiopian insurance industry, on average, could reduce their actual cost by 22% and increase their actual profit by 23% using their existing available resources or without the need to use additional resources. On the other hand, incurring of 22 % additional cost and loss of 23 % profit came from due to inefficiency reason in the Ethiopian insurance industry.

In economic terms, these result also indicates how insurance companies are operating either above or below the cost and profit efficiency frontier .Accordingly, it indicated that a typical insurance company on average produce its products at a cost approximately 22% greater than the cost required by the best performing insurance company while a typical insurance company on average generate a profit approximately 23% less than the profit obtained by the

best performing insurance company with the same environment and condition. Therefore, the Ethiopian insurance industry has a potential of reducing cost inefficiency by approximately 22% and increase the profit by 23% as far as they are using their existing resource effectively .

Table 4.2: Efficiency Score of Ethiopian Insurance Industry

Year	Cost Efficiency	Profit Efficiency
2011	0.72	0.68
2012	0.74	0.70
2013	0.75	0.73
2014	0.76	0.75
2015	0.78	0.77
2016	0.79	0.79
2017	0.80	0.81
2018	0.81	0.82
2019	0.82	0.84
2020	0.83	0.85
Average	**0.78**	**0.77**
Standard Deviation	0.036	0.058

Source: Cost and Profit efficiency score using SFA

As shown in the table 4.2 above also, the average cost efficiency of Insurance industry is almost equal with the profit efficiency which contradict the **hypothesis 1** which stated that Ethiopian Insurance industry are more profit efficient than cost efficiency . Such result also indicates that there is a need of to give equal efforts for the improvement of both cost and profit of Ethiopian insurance industry .

Regarding to the growth trend of cost and profit efficiency of Ethiopian insurance industry during the study period (2011-2020), it shows that there is a sustained upward growth trend in both cost and profit efficiency with annual average growth rate of 1.6% and 2.5% respectively. Specifically , the cost efficiency was increased from 72% in the year 2011 to 83% in 2020 while on the same token the profit efficiency increase from 68% to 85 % in the indicated year . Conversely, it means that there is a reduction in inefficiency (both profit and cost) over the sample period.

The increment in both cost and profit efficiency coincides with significant positive growth of the country in general and improvement of insurances industries management practice in particular. The trend result also provides useful information to the policy maker regarding the Ethiopian insurance industry gradually contributed positive impacts to the financial sector and economy of the country.

4.3 Cost and Profit Efficiency of Each Insurance Companies

4.3.1 Cost Efficiency of Each Insurance Companies

The result of cost efficiency score using SCF approach of each Ethiopia insurance companies during the year 2011-2020 are presented in table 4.3 below. According to the result, Awash Insurance company is the most cost efficient insurance company with an average cost efficiency of 92 % in the study period.

NIB insurance company is the second cost efficient insurance company with annual average cost efficiency score of 88% as depicted in the table 4.3 below. Next to Awash and NIB insurance company , the most cost efficient insurance company is Nile insurance with annual average cost efficiency score of 84% followed by Oromya (84%), EIC(83%), UNIC(78%), Abay(77%), Africa(76%), Nylala (75%), Nice(75%) and Lion(71%).

On the other hand , Ethio life and Global Insurance companies are the least performing Insurance with average cost efficiency score of 64% for both insurance during the study period (see table 4.3 below). These result shows that both companies had a capacity of reducing their cost on average by36% without employing any additional resources.

Table 4.3: Cost Efficiency of Insurance Companies over time

Year	EIC	Awash	Global	Nile	Nice	Africa	Nib	Nyala	Ethio-Life	UNIC	Oromia	Abay	Lion
2011	0.79	0.90	0.54	0.81	0.69	0.71	0.86	0.69	0.54	0.72	0.80	0.71	0.64
2012	0.80	0.91	0.57	0.82	0.70	0.72	0.86	0.70	0.57	0.74	0.81	0.72	0.66
2013	0.81	0.91	0.59	0.83	0.72	0.73	0.87	0.72	0.59	0.75	0.82	0.74	0.67
2014	0.82	0.92	0.61	0.83	0.73	0.75	0.88	0.73	0.61	0.76	0.83	0.74	0.69
2015	0.83	0.92	0.63	0.84	0.75	0.76	0.88	0.75	0.63	0.77	0.84	0.78	0.71
2016	0.84	0.92	0.65	0.85	0.76	0.77	0.89	0.76	0.65	0.78	0.84	0.78	0.72
2017	0.84	0.93	0.67	0.86	0.77	0.78	0.89	0.77	0.67	0.80	0.85	0.79	0.73
2018	0.85	0.93	0.69	0.86	0.78	0.79	0.90	0.78	0.69	0.81	0.86	0.81	0.75
2019	0.86	0.93	0.70	0.87	0.79	0.80	0.90	0.79	0.70	0.81	0.87	0.81	0.76
2020	0.87	0.94	0.72	0.88	0.80	0.81	0.91	0.80	0.72	0.82	0.87	0.83	0.77
Average	**0.83**	**0.92**	**0.64**	**0.84**	**0.75**	**0.76**	**0.88**	**0.75**	**0.64**	**0.78**	**0.84**	**0.77**	**0.71**

Source: Cost efficiency score using SFA

It is also found out that even though there is cost inefficiency in all insurance companies during the study period as shown in the table 4.3 above, the cost efficiency all these insurance companies have increased significantly since 2011 which suggests that the management practices of all insurance companies are improved from year to year.

4.3.2. Profit Efficiency of Each Insurance Companies

The result of profit efficiency score of each insurance company during the year 2011-2020 is presented in table 4.4 below. The result show that EIC is the most profit efficient insurance company among others insurance company with an average profit efficiency score of 88%. The profit efficiency score of the company increase from 82 % in the year 2011 to 92 % in the year 2020.Though the insurance company is the most profit efficient insurance company, there is also a room the company to increase its profit on average by 12% by strengthen the existed status without employing any other additional resources.

Table 4.4: Profit Efficiency of Insurance Companies over time

Year	EIC	Awash	Global	Nile	Nice	Africa	Nib	Nyala	Ethio-Life	UNIC	Oromia	Abay	Lion
2011	0.82	0.75	0.60	0.73	0.61	0.68	0.76	0.75	0.56	0.70	0.62	0.64	0.56
2012	0.84	0.77	0.63	0.75	0.64	0.70	0.78	0.77	0.59	0.72	0.64	0.65	0.59
2013	0.85	0.79	0.66	0.77	0.67	0.73	0.80	0.79	0.62	0.75	0.67	0.70	0.62
2014	0.86	0.81	0.69	0.79	0.70	0.75	0.82	0.81	0.65	0.77	0.70	0.70	0.65
2015	0.88	0.82	0.71	0.81	0.72	0.77	0.83	0.82	0.68	0.79	0.72	0.71	0.68
2016	0.89	0.84	0.74	0.83	0.74	0.79	0.85	0.84	0.70	0.81	0.75	0.74	0.71
2017	0.90	0.85	0.76	0.84	0.77	0.81	0.86	0.85	0.73	0.82	0.77	0.80	0.73
2018	0.91	0.87	0.78	0.86	0.79	0.82	0.87	0.87	0.75	0.84	0.79	0.80	0.75
2019	0.92	0.88	0.80	0.87	0.80	0.84	0.89	0.88	0.77	0.85	0.80	0.81	0.77
2020	0.92	0.89	0.82	0.88	0.82	0.85	0.90	0.89	0.79	0.87	0.82	0.81	0.79
Average	**0.88**	**0.83**	**0.72**	**0.81**	**0.73**	**0.77**	**0.84**	**0.83**	**0.68**	**0.79**	**0.73**	**0.74**	**0.69**

Source: Profit efficiency score using SFA

Next to EIC, the most profit efficient insurance company are Nib, Awash, Nyala, Nile and UNIC with respective average profit efficiency score of 0.84, 0.83, 0.83, 0.81 and 0.79 and there efficiency level is slightly above the average profit efficiency score of all insurance companies. Africa, Abay , Oromya ,Nice, Global and Lion also with average profit efficiency score of 0.77,0.74, 0.73,0.73,0.72 and 0.69 respectively have done slightly below the average profit efficiency of all Insurance companies from the sample taken. On the other hand, Ethio life insurance Company with average profit efficiency of 0.68 is the most inefficient insurance company in Ethiopia from the sample taken. Put differently, the level of profit inefficiency of the company is around 32%. This means that the company lost 32% of its potential profit, which could have been generated using the existed resources. In other words, the company has a capacity to increase its profit by 32% without employing additional resources.

4.4.Efficiency Comparison of State Owned & Private Insurance Companies

It is tried to study whether insurance company ownership is related to their efficiency in Ethiopia. Accordingly, as shown in the table below state owned insurance company (EIC) has an average cost and profit efficiency of 83% and 88% respectively is greater than the average cost and profit efficiency of private insurance companies which is 77% and 76% respectively. Therefore, state owned insurance company is more cost and profit efficient on average by 8 % and 16% respectively than Private insurance companies (see table 4.5 below).

Table 4.5: Efficiency score Comparison

Year	Cost Efficiency		Profit Efficiency	
	State-owned Insurance Company	Private Insurance Companies	State-owned Insurance Company	Private Insurance Companies
2011	0.79	0.72	0.82	0.66
2012	0.80	0.73	0.84	0.69
2013	0.81	0.75	0.85	0.71
2014	0.82	0.76	0.86	0.74
2015	0.83	0.77	0.88	0.76
2016	0.84	0.78	0.89	0.78
2017	0.84	0.79	0.90	0.80
2018	0.85	0.80	0.91	0.81
2019	0.86	0.81	0.92	0.83
2020	0.87	0.82	0.92	0.84
Average	**0.83**	**0.77**	**0.88**	**0.76**

Source: Cost and profit efficiency score using SFA

To test whether the mean cost and profit efficiency difference of private and state owned insurance company are statistically significant, the study employs equality of mean test (t- test). Accordingly , the test of equality of mean of cost efficiency of private and state owned insurance company yields a t-statistic of 4.1954, with probability value of 0.0005, while the test for equality of mean of profit efficiency of private and state owned insurance companies yields a t-statistic of 5.1066, with probability value of 0.0001 (see Annex 2).Therefore, the probability value for both profit and cost efficiency are smaller than 5%,suggesting that the difference in the mean cost and profit efficiencies between private and state owned insurance companies is

statistically significant, and state owned insurance is more cost and profit efficient than private insurance companies which different from our **hypothesis 2.**

This unexpected result is driven by the fact that state owned insurance specifically Ethiopia Insurance Corporation (EIC) exist in the market for long period of time which enables to has ample experience and qualified staff in the industry. In addition, it has great public images which creates trust worthiness and give reputational advantage. Furthermore, it also enables the company to receive customer loyalty, which contributes to have broader and extensive customer base. Moreover, the state owned insurance company (EIC) has a strong financial base and a reliable reinsurance arrangement with internationally renowned reinsurers which make the company cope with any claims. Furthermore ,due to the fact that the company has an affiliation with the government , the Ethiopian large public company and big government project are working with EIC only which make EIC become more advantageous and beneficiary in terms of growth premium and investment income with low effort and less costly. Hence, absence of such level playing field for all insurance companies contribute for efficiency difference between state owned and private insurance companies (Taye , 2019; and Tesfa ,2016)

On the other hand most private insurance companies took price cutting (price war or cut throat) strategy to attract more customer which is unethical method of competition and such mal practice negatively affect the efficiency of such insurance companies (Fikeru,2018; Asrate and Tesfahun,2016).Therefore , given all the indicated strength , state owned insurance (EIC) has become more cost and profit efficient than private insurance companies in the country.

4.5.Determinants of Cost and Profit Efficiency

The cost and profit efficiency score of insurance companies in Ethiopia is influenced by a set of characteristics of the insurance companies. The efficiency score from SFA model is used as a dependent variable and regressed against its determinants by using a censored Tobit model which is presented in the table 4.6 below. The findings are intended mainly to indicate where insurance companies might look for clues toward increasing their efficiency.

Size

The explanatory variable of insurance size which is represented by the log of total asset bears a positive and statistically significant impact on cost and profit efficiency at 5 % and 1 % significance level respectively. This positive result appears to support the economic scale argument in which large insurer have significant scale advantage in the form of lower per unit cost of production derived from large scale operation. In this regard ,the most frequently discussed source of scale economies is the spreading of a firm's fixed production costs, over a larger volume of output and lower administrative cost per output . Similarly, scale economies may arise from the learning effects gained by managers operating at larger scale. Moreover, large insurer seems to have improved flexibility to arrange the best combination of inputs and outputs and benefits from the economies of scale. This finding supports Diacon et al.(2002),Barros et al. (2005) and Yao et al. (2007).

On the other hand, this finding also indicates that it is much harder for smaller companies to write insurance premiums than for bigger ones since smaller company cannot secure their clients in the cases of aggregate uncertainty or big catastrophe event (Asrat and Tesfahun ,2016).

Furthermore, large insurance companies normally have greater capacity for dealing with adverse market fluctuations than small insurance companies have and have more economies of scale in terms of the unit cost, which is the most significant production factor for delivering insurance services and a better expenses management. The finding of this study is congruent with, Chen (2014) ,Asrat and Tesfahun (2016).

Generally, the result of this study is consistent with the hypothesis of the study and the result obtained by Cummins and Zi (1998); Luhnen (2009); Eling and Luhnen (2010b) ,Rai (1996) ; Eling and Luhnen, 2010b) Christian etal (2015);Abate Gashaw (2012).

Number of Branch

Consistent with the expectation , number of branch has positive and statistically significant relationship with both cost and profit efficiency at 1% significance level which suggest that insurance companies with more branches are more profit and cost efficient than those with

lower number of branches. This is due to the fact that when the number of branch increase, the unit cost per branch is decreased (economic of scale argument) which in turn increase the cost efficiency of the insurance company . Moreover, as the number of branches increase, the amount of gross premium collected by such branches will increase which in turn increase the profit efficiency of the insurance company .The finding of this study also consistent with the result obtained by Ashagrie and Gizachew ,2018.

Age of Insurance

Age of the insurances companies which is measured by date of establishment of the insurance bears a positive impact on both cost and profit efficiency which is not in line with the hypothesis. However, the result is not statistically significant in the case of cost efficiency while it is statistically significant at 1 % level in the case of profit efficiency.

The unexpected sign indicates that in Ethiopia relatively older insurance company are more experienced, have enjoyed the benefits of learning, are not prone to the liabilities of newness, and can therefore enjoy superior performance. Older firms may also benefit from reputation effects, which allow them to earn a higher margin on sales.

Furthermore, the long-term persistence of a firm in a given market might indicate its ability to successfully adapt the changing market conditions, which in turn make the insurance company to be efficient in both cost and profit. This finding is consistent with the result of studies Christian etal (2015); Ashagrie and Gizachew (2018); Hussels and Ward (2007) and Biener and Eling (2011).

Leverage

The explanatory variables leverage is measured by the ratio of total debt to asset. This ratio shows the degree to which a business is utilizing borrowed money. It reflects insurance companies' ability to manage their economic exposure to unexpected losses. The Tobit regression result of the study show there is a negative relationship between leverage ratio of insurance companies with their cost and profit efficiency. However, the result is not statistically significant in the case of cost efficiency while it is statistically significant at 1 %

significance level in the case of profit efficiency. The sign of the variable is also consistent with what is anticipated in the hypothesis.

The finding of the study indicates that as the amount of debt used to finance the company asset increase, the company will have more debt than equity which make the company to be more leveraged beyond the optimum level. And hence, this situation negatively affect the company ability to manage unexpected losses and long run sustainability. It may also lead the company to be at risk of bankruptcy if they are unable to make payment on their debts. The finding of the study consistent with Renbao Chen and Kie Ann Wong (2004 , Hifza Malik (2011), Abate Gashaw (2012).

Premium growth

As a further consistency and robustness cheek , it is employed a Tobit regression to analyse the impact of premium growth on efficiency of Ethiopian insurance industry . Accordingly, premium growth has appositive and significant relationship for both cost and profit efficiency at 1 and 5 % significance level respectively which is not in line with the hypothesis of the study . This finding suggest that those insurance companies underwrite more premium over the years have been chance of being efficient for the reason that the main source of profit for insurance companies in Ethiopia is gross premium. This result also lends support to the finding of Christian etal (2015), Hrechaniuk et al. (2007), Agiobenebo and Ezirim (2002), Asrat and Tesfahun (2016).

Ownership

As a further robustness check of the unexpected result of ownership effect on cost and profit efficiency Ethiopian insurance industry, Tobit regression model is also carried out. Accordingly, it is also found that ownership type has a statistically significant impact on cost and profit efficiency of Ethiopian insurance industry at 1% significance level. Furthermore, it is found that government owned insurance company (EIC) is more efficient in terms of cost and profit than private insurance companies which are in contrary with the hypothesis.

This finding is also contradict with the study result Rebao and Ann(2004) who found that state owned insurance company are less efficient than private insurance companies because state owned insurance company managers experience less intense performance pressures than their private peers. Consequently, this creates a problem of moral hazard on the part of state owned managers since there is often no fear of job losses or erosion of managerial reputation arising from poor performance. This reduces the level of vigilance on efficiency performance by encouraging unproductive activities which undermine cost rationalisation. Moreover, Jeng and Lai (2005) also found out that there is bureaucracy and clumsy formal organizational forms in state owned insurance company which make managers are not react quickly to changing market conditions. Therefore, this situation leads to the state owned insurance companies not to be efficient in both cost and profit.

Table 4.6: Determinants of Cost and Profit Efficiency

Variables	**Cost Efficiency**		**Profit Efficiency**	
	Coefficient	**t-ratio**	**Coefficient**	**t-ratio**
Constant	-0.1769388	-1.01	-0.6218621	-7.25
Gross Premium	0.0445012	2.93*	0.015904	2.15**
Number of Branch	0.639598	4.16*	0.026521	3.53*
Ownership	0.1086017	4.11*	0.0928289	7.19*
Age	0.0001644	0.17	0.0021692	4.66*
Size	0.0207906	2.01**	0.0579777	11.49*
Leverage	-0.0227991	-0.35	-0.1228612	-3.84*

Notes: *1% significance level; ** 5% significance level; ***10% significance level

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1.Conclusion

This paper attempts to analyze the cost and profit efficiencies of Ethiopian insurance industry using SCF approach and panel data from the year 2011 to 2020.It also analyzes factors driving efficiency difference among insurance companies using Tobit regression model . Besides, the study also compares the efficiency performance of state owned and private insurance companies during the study period. Accordingly, the findings of the study are as follows:

- The average cost and profit efficiency of Ethiopian Insurance Industry under the study period was 0.78 and 0.77 respectively, suggesting that there was a room that Ethiopian Insurance Industry, on average , can reduce their actual cost by 22% and increase their actual profit by 23% without the need to use additional resources. It mean also that incurring of 22 % additional cost and loss of 23 % profit came from due to inefficiency reason in the Ethiopian insurance industry. Such inefficiency is came from either using inputs incorrectly, or these inputs cannot achieve the required level of output
- The average cost and profit efficiency of Ethiopian Insurance Industry is almost equal which needs the mamagement of insurance companies to exert equal efforts in both profit maximization and cost minimization.
- The growth trend of cost and profit efficiency of Ethiopian insurance industry during the study period indicates that there is a sustained upward growth trend in both cost and profit efficiency with annual average growth rate of 1.6% and 2.5% respectively. In addition, there is also an efficiency improvement of each insurance company in each year during the study period.
- From methodological perspective, the result obtained from the Maximum Likelihood Estimate (MLE) indicates that there is a cost and profit inefficiency in Ethiopian insurance industry. The presence of such inefficiency in the model indicates that SCF model is more appropriate representation than using the standard OLS model in analysing the cost and profit efficiency of Ethiopian insurance industry.
- State owend insurance company (EIC) is more cost and profit effeciant than private insurance companies .

- Awash insurance company is the most cost efficient insurance company followed by NIB, Nile, Oromya , EIC, UNIC, Abay , Africa, Nylala , Nice , and Lion. On the other hand, Ethiolife and Global insurance companies are the least cost efficient insurance company under the study period.
- EIC is the most profit efficient insurance company followed by Nib , Awash , Nyala , Nile , UNIC , Africa, Abay , Oromya , Nile, Global and Lion .On the other hand , Ethio life insurance company is the most inefficient insurance company in Ethiopia from the sample taken .
- Gross written premium , investment income, price of labour, size of insurance , number of branch have positive and statistically significant relationship with both cost and profit efficiency of Ethiopian insurance industry. On the other hand, Age of insurance and leverage ratio has a positive and significant relationship with profit efficiency.

5.2. Recommendation

On the basis of the findings of the result, the following recommendations are forwarded.

- The result of the analysis indicated that Ethiopian insurance industry is inefficient which indicates that the industry has an opportunity to improve its efficiency without the need of additional resources .Thus, management of insurance companies should take corrective measure by identifying the problems.
- The finding of the study showed that the average cost and profit inefficiency of Ethiopian insurance industry is somehow the same. Hence, the insurance industry management should give equal emphasis for the improvement of both cost and profit efficiency simultaneously.
- Though efficiency improvements are possible either by increasing the output with the same existing inputs or decreasing the inputs but maintaining current output levels, the first alternative shall be recommended from Ethiopian context than the second one. This is because reducing inputs (labour, financial capital and physical capital) is difficult since some of the inputs have a fixed input nature like physical capital while the other input is not possible to reduce from legal perspective like labour.

- It was found out that the size of insurance companies has a positive and significant relationship with on cost and profit efficiency which indicates that large insurance company are more efficient than small insurance company .Hence ,insurance companies shall enhance their size(asset) through different mechanism like acquiring of fixed asset especially buildings, selling of additional share for fixed asset purchase , reinvesting shareholders dividends for acquiring of fixed asset .
- Since branch expansion has appositive and significant relationship with cost and profit efficiency , the management of insurance companies should expand their number of branches as strategy of their business through conducting a feasibility study on the viability of opening a new branch on specific area. Moreover, it is recommended to open a new branch where there is underserved potential customers, low competition and easily accessible for customers.
- The positive and statistical significant relationship between gross premium and efficiency of Ethiopian insurance companies implies that the management of insurance companies shall give a strong emphasis for the growth of premium which may be through aggressive marketing campaigns and developing need based and strategic new insurance products rather than focusing the homogeneous traditional insurance product.
- The finding of the study indicated that there is a negative and significant relationship between leverage and profit efficiency of insurance companies .It is implied that insurance companies should give an emphasis for internally generated funds and equity capital than debt capital as the source of financing
- Insurance companies mobilize significant financial resources predominantly in the form of premiums on insurance policies and significant portion of these financial resources is usually invested by insurance companies in income earning assets in order to maximize profits. In this regard , this study revealed that investment income has a positive and statistical significant relationship with cost and profit efficiency which indicates that insurance companies shall actively participate on viable investment activities that enable to enhance their investment income . However, most insurance companies in Ethiopian is currently invest on time deposit of banks which brings relatively low return as compared other investment alternatives like investing on real state and company shares . Hence, it is recommended insurance companies to diversify their investment type

that bring relatively high returns as per the NBE directive of licensing and supervision of insurance business investment of insurance funds (Directive No. SIB/25/2004)

- The positive and statistically significant relationship of price of labour and efficiency of insurance company suggest that insurance companies shall improve their price of labour (salary and benefits) that make them competitive in the industry.
- The regulatory body, National Bank of Ethiopia, should design appropriate policy to improve the efficiency of insurance industry and take corrective action on less efficient insurance companies.
- There are a number of important issues left for future research. In particular, efficiency determinants should be analysed in more detail. In this regard, the study sought to investigate the determinant of cost and profit efficiency of Ethiopian insurance industry using firm specific variable only. Thus, further research shall be conducted considering the macroeconomic variables that can affect the efficiency of Ethiopian insurance industry. Furthermore, the discussion on efficiency comparison of state owned and private owned insurance companies should be deepened and analysed in more detail, for example , through conducting rigorous study on the reasons why the efficiency difference happen due to ownership difference .

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Annex

Annex 1: Year of Establishment

Insurance company	Year of Establishment
Ethiopian Insurance Corporation	1975
Awash Insurance Company S.C	1/10/1994
Africa Insurance Company S.C	1/12/1994
National Insurance Company of Ethiopia S.C.	3/9/1994
Nyala Insurance Company S.C	6/1/1995
Nile Insurance Company S.C	11/4/1995
The United Insurance S.C	1/4/1997
Global Insurance Company S.C.	11/1/1997
NIB Insurance Company	1/5/2002
Lion Insurance Company S.C	1/7/2007
Ethio-Life and General Insurance S.C.	3/10/2008
Oromia Insurance Company S.C.	6/1/2009
Abay Insurance Company	6/7/2010
Berhan Insurance S.C.	4/5/2011
Lucy Insurance S.C.	1/10/2012
Tsehay Insurance S.C.	8/3/2012
Bunna Insurance S.C.	1/5/2013
Zemen Insurance S.C	2020

Annex 2: Test of equality of mean

Cost Efficiency

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
state	10	.8304941	.0079491	.0251374	.8125119	.8484763
private	10	.7736483	.0109728	.0346989	.7488262	.7984704
combined	20	.8020712	.0092737	.0414731	.7826612	.8214812
diff		.0568457	.0135495		.0283792	.0853123

diff = mean(state) - mean(private) t = 4.1954
Ho: diff = 0 degrees of freedom = 18

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9997 Pr(|T| > |t|) = 0.0005 Pr(T > t) = 0.0003

Profit Efficiency

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
state	10	.8780882	.0108862	.034425	.8534621	.9027144
privte	10	.7647614	.0193388	.0611547	.721014	.8085088
combined	20	.8214248	.0169006	.0755818	.7860514	.8567982
diff		.1133269	.0221923		.0667026	.1599511

diff = mean(state) - mean(privte) t = 5.1066
Ho: diff = 0 degrees of freedom = 18

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0001 Pr(T > t) = 0.0000