
# Applicability of Business Failure Prediction Models to the Insurance Sector of Ethiopia

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# Declaration

I, the undersigned, declare that this Thesis, submitted by me for the M.A. degree in Master of Business Administration in Finance at the Addis Ababa University, is my original work and it has not been presented to this or to other universities, colleges or institutes for a degree or other purposes, and that all sources of the materials used therein have been duly acknowledged.

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**Addis Ababa University**

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**Master of Business Administration**

This is to certify that the thesis prepared by *Tibebu Girma*, entitled: *Applicability of Business Failure Prediction Models for Insurance Companies of Ethiopia*, and submitted in partial fulfillment of the requirements for the degree of Master of Arts in Business Administration complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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## Abstract

*The bankruptcy of insurance companies recorded in different parts of the world sends messages to interested stakeholders of insurance companies operating in Ethiopia to utilize the existing verified models or to develop new models of business failure prediction so as to identify and manage potential business failure risk in the insurance sector. Two global and two local accounting-based statistical models developed with MDA (Multiple Discriminant Analysis) are examined in this study to determine their applicability to the insurance sector of Ethiopia. The selected models are: Altman's Z''-score model developed in USA, Springate's model developed in Canada, Wondim's Model developed in Ethiopia on Public Enterprises, and Fufa's Model developed in Ethiopia on Private Enterprises. Fourteen out of 16 insurance companies operating in Ethiopia for the recent five years of 2012 to 2016 are sampled for the study. The prediction accuracy in correctly identifying non-bankrupt insurance companies of the country for year 2017 is calculated for each of the four models. The research found out that, from the four models studied, only the adjusted Altman's Z''-score model has satisfactorily predicted non-bankrupt insurance companies of the country, with accuracy rates of* 85.71% *for prediction made two-years prior to the year prediction is made for (2017). The applicability of the remaining three models to the Ethiopian insurance sector is not supported by the study as the maximum prediction accuracy achieved by the models is 28.57%. It is suggested that Altman's Z'' score model be considered as an instrument in prediction of business failure risks in the Ethiopian insurance sector, and recommendations are provided on further studies that need to be made to identify bankruptcy prediction models specifically appropriate to the insurance sector of the Ethiopia.*



Keywords: Insurance, Multivariate Discriminant Analysis; Bankruptcy Prediction Models; Altman's Z''-Score Model; Springate's Model

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## List of Acronyms and Abbreviations

Abbay: Abbay Insurance Company

ACCA: Association of Certified Chartered Accountants

Africa: Africa Insurance Company

Awash: Awash Insurance Company

BE/TL: Book Value of Equity/Book Value of Total Liabilities

Birhan: Birhan Insurance Company

EBT/CL: Earnings before Tax / Current Liabilities

EBIT/TA: Earnings before Interest and Taxes to Total Assets

EIC: Ethiopian Insurance Company

GAAP: Generally Accepted Accounting Principles

Global: Global Insurance Company

IFRS: International Financial Reporting Standards

IMF: International Monetary Fund

Lion: Lion Insurance Company

MDA: Multiple Discriminant Analysis

Nib: Nib Insurance Company

NICE: National Insurance Company of Ethiopia

Nile: Nile Insurance Company

Nyala: Nyala Insurance Company

Oromia: Oromia Insurance Company

RE/TA: Retained Earnings / Total Assets

S/TA: Sales/Total Assets

Tsehay: Tsehay Insurance SC

United: The United Insurance Company

WC/TA: Working Capital / Total Assets

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the Study

### 1.1.1 Definition

Bankruptcy in French or Latin is formed of two words "*bancus*", meaning table and "*ruptus", meaning* "broken". Hence, bankruptcy literally means "broken table".

Dictionary definition of bankruptcy or business failure is the Legal procedure for liquidating a business which cannot fully pay its debts out of its current assets. Bankruptcy is called voluntary when the insolvent company itself claims bankruptcy, while involuntary bankruptcy occurs when, based on creditors' petition, bankruptcy is issued by court orders (Business Dictionary.com)

Bankruptcy has been explained differently in the reviewed empirical literatures. For example, Fufa (2011) constructed that business failure occurs when the firm is unable to pay debts at due dates, while Kirui (2012) described it as a situation where the totals liabilities of a company exceed the fair value of its assets.

Definition of Bankruptcy in Ethiopian law is provided by the Commercial Code of Ethiopia, Book V, Article 969 and 970, which requires two conditions for a trader to be considered bankrupt. The first condition refers to the fact that the trader has suspended payments and has been declared bankrupt. The second condition requires that a sentence is passed by a competent criminal court in respect of bankruptcy or any offence connected with bankruptcy. The second condition is related to the Penal Code of Ethiopia of 1957, which explains those offences associated with bankruptcy in Book VI, Title II, Chapter II with the title " Offences Relating to Proceedings of Debt, Execution and Bankruptcy" (Mada & Tilahun, 2009).

In this study, Business Failure and Bankruptcy are considered to have the same meaning, and it is defined as a situation where the average return on investment is significantly and continually lower than the firm's minimum cost of capital, measured by the minimum interest rate paid on bank accounts, as defined by Wondim (2003).

### 1.1.2 Importance of the study

Identifying corporate failures and finding the appropriate early warning model for business failures is expected to contribute for the best interest of the various stakeholders of the concerned companies. Stakeholders of the insurance sector include the regulatory body, the management, the employees and the insured, and the impact of un-managed business failures is discussed below.

Accurate business prediction methods that signal financially impaired insurers in sufficient time would support the regulatory body in taking appropriate action that prevents insolvency or minimize the occurrence and severity of bankruptcy, while governments could design relevant policies and programs that stimulate the sustainability of insurance companies in a country. Early warning methods provide insight to the management of insurance companies to introduce timely and appropriate risk mitigating strategies on bankruptcy; Insurance policy-holders would be enabled to closely follow up the financial situations of their insurers so as to reduce the risk of unpaid outstanding claims. Similarly, insurance companies themselves can be prevented from financial loss related to other insurance companies that have re-insurance arrangements. Business failure of individual insurance companies affects the whole insurance industry of a country as business failure of an insurer could create lack of trust in the insurance sector and a more strict government regulations and financial levies could be introduced upon the insurance companies.

In addition to loss of financial remunerations, future livelihood of employees of bankrupt insurers is also affected, particularly if the industry attaches any stigma on employees that have worked for a failed insurance company. Creditors could lose money owed from the bankrupt insurers, while shareholders could lose on future dividends and their invested

capital. Auditors can use prediction models to assess risk and going-concern issues of their clients.

When appropriate business failure prediction models are not used in the insurance sector of a country, failure of insurance companies comes as a surprise, creating unemployment and additional cost to an economy. When large insurance companies fail, many firms will be left without insurance cover, negatively affecting future operations, creating additional cost to a nation's economy. Higher taxes could be levied on the society to cover the additional unemployment benefits and other social costs. Due to the reduced level of competition of successful insurance companies in the marketplace, the general public could also be charged with higher insurance premium.

Bankruptcy of a fully operational insurance company is not yet recorded in Ethiopia; though an insurance company (i.e., Universal Insurance) which had been licensed to operate in Ethiopia, was subsequently shut down in 1997 before it starts operation, and consequently it returned borrowed fund of establishment to the lenders (IMF, 2003). However, a large number of corporate failures have occurred in the insurance business in various countries of the world. In the USA, for example, 640 companies have failed in the 30 years period of 1969 to 1998 (Bhattacharya, et al., 2003). The major causes of failure in insurance companies, in descending order of importance, are: insufficient reserves, rapid growth, underpricing, alleged fraud, overstated assets, catastrophic losses, significant changes in business, impaired affiliate, and failures of reinsurance companies. According to IMF (2003), business failure of life insurance companies was caused by financial deregulation, economic expansion and large price fluctuations.

In general, studies on identifying appropriate business failure prediction models are crucial in detecting potential financial problems at the earliest possible time and in supporting the decision making of various stakeholders of insurance companies. This would facilitate the survival of economically efficient companies by reallocating available resources, and contribute to the stability of the economic and social environment of the country.

The study would also add to the existing literature by identifying and testing bankruptcy prediction models developed in different economies to the insurance business of developing countries such as Ethiopia.

## 1.2 Statement of the Problem

The insurance sector in Ethiopia plays important role in the country by encouraging investment through appropriate management of insurable risks, by providing consultation services on loss minimization and control activities, by facilitating credit transactions of banks by providing covers for collateral pledges.

Nevertheless, the insurance sector has faced a number of challenges that need to be properly managed. The Ethiopian insurance business is a young, underdeveloped sector as it contributes less than 1% of the GDP of the country, which is lower than the contribution of the insurance sector in other African countries. Furthermore, suffering from lack of qualified and experienced professionals, inefficiency of the sector in providing insurance services is cited by Azize (2015).

IMF (2003) identified that the likelihood of insurance failure will be higher when there is close relationship between banks and insurance companies. When the insurance companies are closely related to the banking sector, a minimal amount of insurance companies' returns are reinvested, which limits the capacity to develop existing infrastructure, to launch innovative products, and to develop new market opportunities. In Ethiopia, most insurance companies have sister banks and generate business by using the banks as a distribution channel.

The number of insurance companies operating in Ethiopia has reached 17 in the seven year period of 2007 to 2014. Though new insurance companies have not joined the insurance sector for the recent three years of 2014 to 2016, total profit of the sector has fallen by14% during the period, according to the database of NBE. More specifically, the number of insurance companies that reported net loss in their two recent financial statements has increased: compared to net profit of the previous year, 24% of the insurance companies

earned lower profit in year 2015, while their number increased to 57% in year 2016. In the financial statements of each of the recent five years period of 2012 to 2016, a minimum of one and a maximum of three insurance companies have reported a net loss. For instance, in year 2013, three companies reported annual net loss which totals 15 million Birr, which amounts 2.5% of insurance sector's total profit of the year.

Berhane (2017) highlighted a number of factors that caused the fall in profit of the insurance sector. For instance, the stiff competition among insurers has dramatically reduced the insurance premiums that made it three times lower than neighboring countries such as Kenya. The extraordinarily high amount of claims paid for policyholders, particularly in the motor insurance claims, has eroded the profit of insurers. Poor marketing strategies of most insurance companies have prevented introduction of new insurance products, which has made competition to be made by cutting prices to the level that has endangered profitability of the insurers. This has resulted in disproportional dependency on general insurance business, resulting in only 3% life insurance services to be provided by the sector, while global benchmarks show that life insurance services cover 50% of total insurance premium of an economy.

The declining profit observed in the sector, and in individual insurance companies, requires a closer analysis of the insurance business so as to contribute in improving the performance of the insurance companies and in stabilizing the economy, at large. To prevent business failure and to take appropriate strategic and corrective action on potential bankruptcies, an early warning system and relevant prediction model of bankruptcy (or non-bankruptcy) should be put in place for Ethiopian insurance sector.

Some researches were made aimed at identifying relevant bankruptcy prediction model to the context of Ethiopia. However, despite the key role that the insurance businesses play in the socio-economic environment of the country, none of the studies has focused on identifying the appropriate model of bankruptcy for the insurance sector of the country. Absence of empirical researches aimed at identifying appropriate early warning models on the financial status of Ethiopian insurance companies has initiated this study.

## 1.3 Objective of the Study

Strategic management and good governance requires effective risk management, and the risk of bankruptcy in businesses, such as the insurance industry, is the main risk that needs to be managed not only by internal managers, but also by the various stakeholders of insurance companies.

Several studies have been undertaken internationally in predicting corporate failure so that the concerned stakeholders could take appropriate preventive or corrective actions. Empirical researchers and practitioners frequently use bankruptcy prediction models that are developed for manufacturing companies of the developed countries, such as Altman's Z score model. Nevertheless, the suitability of international models to a particular environment need to be assessed, as corporate failure models derived in a specific environment may not be effectively applicable in another country or industry (Odipo & Sitati , 2008).

The general objective of the study is to assess the capability of the four bankruptcy prediction models (Z score models of Altman, Springate, Wondim and Fufa) in predicting non-failed status of Ethiopian insurance companies in 2017.

Based on the general objective, the specific objectives explicated include:

i. To calculate the Z-score of each of the four models of sampled insurance companies for year 2017, using financial data of the recent five fiscal years.
ii. To determine the prediction accuracy of the four models in correctly predicting non-failed insurance companies of the country, using the predetermined cut-off points of each model.
iii. To identify the most appropriate model(s) by comparing the strength of the locally developed prediction models with the global models in predicting corporate business status of the insurance companies.
iv. To build on the existing knowledge on bankruptcy prediction models researched in the Ethiopia.

## 1.4 Research Hypotheses

Based on the findings of domestic and international literatures, the following hypotheses are developed to achieve the study objectives.

Hypothesis 1: The prediction models of Altman, Springate, Wondim and Fufa will predict non-bankruptcy of insurance companies in Ethiopia for the year 2017, with a minimum of 80% accuracy, for prediction made one year prior to the year prediction is made for.

Hypothesis 2: Being developed based on data of Ethiopian companies, domestically developed bankruptcy prediction models of Wondim and Fufa will achieve higher prediction accuracy than the accuracy of the global models of Altman and Springate, in predicting non-bankrupt Ethiopian insurance companies for year 2017.

Hypothesis 3: The accuracy of prediction models would be higher when more recent years' financial data is used for the prediction.

## 1.5 Scope of the Study

The insurance sector in Ethiopia comprises a number of operators, including Insurance Companies, Brokers, Loss Assessors, Surveyors, and Sales Agents (NBE, 2012). The study is confined to determining the applicability of four business failure prediction models to Ethiopian insurance companies. While 17 insurance companies have been in operation in year 2016, the study is made on 14 sampled Ethiopian Insurance companies that have been in operation for a minimum of the recent five consecutive years of 2012 to 2016. The study focused on two global and two locally developed Z-score bankruptcy prediction models; namely, models of Altman (1993), Springate (1978), Wondim (2003) and Fufa (2010). Only Accounting based models are selected as the models are commonly used by practitioners and researchers, and as audited financial data of the insurance companies are publicly available. Market-based prediction models are not included due to lack of company-level information of the insurance companies for market variables of the models.

## 1.6 Limitation of the Study

As the sampled accounting-based prediction models are based entirely on quantitative and company-specific historical information, macroeconomic, market-based and qualitative factors that may affect the survival of businesses are not taken into account in predicting the healthiness of the insurance companies studied.

Although audited financial statements are used for the study, the sampled insurance companies did not prepare financial statements with a uniform financial reporting system: some of the insurance companies use GAAP, while others use IFRS. Hence, differences in recognition, measurement, presentation and disclosure of financial information of the various reporting systems could affect the Z scores calculated for the sampled insurance companies. This limitation is expected to be circumvented after year 2019, as the country has adopted IFRS and uniform reporting system will be a legal requirement, according to Proclamation No. 847/2014, "Financial Reporting Proclamation".

## 1.7 Organization of the Study

The study is organized in five chapters. The first chapter introduces the research highlighting the importance of predicting bankruptcy, the research hypotheses, the scope of study, and the motive for focusing on the insurance business. The second chapter deals with review of literature and summarizes alternative global and local bankruptcy prediction models. Empirical studies made on corporate failure prediction models for the general businesses, for specific industries, and specifically for the insurance business are also discussed. The chapter also defines the variables and conceptual framework of the models tested. The research design and reasons for selection of sampled prediction models are presented in chapter three. The fourth chapter explains the findings of statistical analyses made on each of the four models studied, examines the hypotheses and presents additional findings obtained in the study. The last chapter concludes on the results obtained in the study and provides relevant recommendations.

# CHAPTER TWO

# LITERATURE REVIEW

From the various literatures reviewed, this chapter presents selected theoretical and empirical researches relevant to objectives of the study. The first section highlights the different quantitative and qualitative global bankruptcy prediction models available, and identifies the two local models developed for Ethiopian enterprises that are customized from Altman's Z' Score model. Global empirical studies that compared two or more prediction models are explored in the second section, and local researches made on business failure prediction on data of Ethiopian companies is also discussed.

## 2.1 Theoretical Literature Review on Business Failure Prediction Models

### 2.1.1 Global Models of Bankruptcy Prediction

Corporate failure prediction models can be divided into two categories: quantitative models and the qualitative models (ACCA, 2008). The following sections discuss the two broad groups of models.

**QUANTITATIVE MODELS**

Quantitative models are mostly based on published financial statements to identify the coefficients and type of financial ratios that differentiate between surviving and failing companies, based on which prediction of business failures can be made. Based on the number of variables included in the models, Quantitative models can be further subdivided into Univariate models and Multivariate models.

**Univariate Models**

Univariate models are quantitative approaches of predicting financial situation of companies using a single financial ratio that is selected to best explain the status of the companies.

Patrick (1932) is considered to be the author who used ratio analysis to predict corporate failure, which was then followed by studies of Beaver (1966 ) that pioneered the use of Univariate model for corporate failure prediction. With a sample of 79 failed firms and 79 non-failing firms, Beaver (1966 ) investigated the predictive power of 30 financial ratios, of which he found out that the ratio of Cash Flow to Total Debt is the main factor to predict business failure having 78% success rate for five years before bankruptcy.

Univariate approach is favored for its simplicity. However, as a company's financial situation can be too complex to be identified by a single ratio, and as inconsistent results may appear with different ratios, more powerful methods of business failure prediction were sought for, which created multivariate approaches.

**Multivariate Models**

Multivariate approach uses a combination of two or more financial ratios in predicting bankruptcy. Multiple Discriminant Analysis (MDA) is a typical type of multivariate approach, which is defined as a statistical technique used to classify an observation into one of several *a priori* groups dependent upon the observation's individual characteristics; and it attempts to derive a linear (or quadratic) combination of these characteristics which best discriminates between the groups.

Many researches made on business failure prediction have developed linear combination of ratios that best distinguished groups of failing companies from non-failing companies. Where two groups are identified and the dependent variable can only take two values, MDA technique is an appropriate technique for classification. MDA is favored as it incorporates multiple financial ratios that cover the characteristics common to specific companies, provides appropriate coefficients for each independent variable. MDA relieves classification problems by simultaneously analyzing the entire variable profile of an object, instead of sequentially examining individual characteristics of the object. MDA is also easy to apply once the model is developed.

In comparing the two groups of quantitative models, Altman and Hotchkiss (2006) indicated that a multivariate model can provide improved results than any Univariate (single-variable) type models.

Of the Multivariate models, the most common and widely researched bankruptcy models are the Altman's and Springate's Z-Score models, details of which are provided in the following sections.

## A. Altman's Business Failure Prediction Model

The initial Altman's Z score model was developed in 1968 for manufacturing companies. Subsequently, the model was mainly revised twice: the first revision (Revised Z' Score model) was made to suit the model for companies whose stocks are not publicly traded, and the second revision (Adjusted Z'' Score model) was made to customize the model for non-manufacturing companies, such as financial institutions.

### *i. Altman's Z score*

A single discriminant score (called Z score) combines the selected financial ratios of the MDA model, and a score above the Z score indicates that the company is a non-bankrupt, while prospective bankrupt companies are identified by scores below the Z score. Altman's Z score model was developed in 1968 on 66 manufacturing that are divided into equal number of bankrupt and successful companies.

The study has chosen five ratios, from a total of 22 financial ratios, as major factors of predicting business situation. Liquidity, profitability, leverage, solvency, and activity financial ratios are represented in the MDA model. The original Z score equation of Altman has the form:

$$\mathbf{Z=0.012X_1+0.014X_2+0.33X_3+0.006X_4+0.999X_5}$$

where,

$X_1$= Working capital/Total Assets

$X_2$= Retained Earnings/ Total Assets

$X_3$= profit before interest and tax/ Total Assets

$X_4$= market value of Equity/book value of Total Liabilities

$X_5$= Sales/ Total Assets

The model discriminates non-bankrupt companies if the Z score is above 2.67, while companies with a score below 1.88 are considered as potential failures. If the Z score is in the range of 1.88 to 2.67, called Zone of Ignorance (or Gray Area), the business situation of the company could not be definitely predicted as failure or non-failure.

The predictive accuracy of the original model of Altman (1968) for bankrupt companies is 93.9% one year prior to bankruptcy,71.9 % two years prior to bankruptcy, 48.3 % three years prior to bankruptcy, 28.6 % four years prior to bankruptcy, and 36 % five years prior to bankruptcy. On the other hand, the predictive accuracy of the model for successful companies is 97 % and 93.9 % for one and two years prior to non-bankruptcy, respectively.

### *ii. Revised Altman's Z' score*

Altman has revised the business prediction models a few times. The original Z score was modified by Altman in 1983 to suit non-stock companies that could not use the original model, as the $X_4$ variable (Market value of Owner's Equity) could not be objectively obtained for such companies. Accordingly, the revised model (Z' score model) has changed the market value of variable $X_4$ (Owner's Equity) with its book value, and identified new coefficients of the five variables with the following form:

$$\mathbf{Z' = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_4 + 0.998X_5}$$

where,

$X_1$= Working capital/Total Assets

$X_2$= Retained Earnings/ Total Assets

$X_3$= profit before interest and tax/ Total Assets

$X_4$= Book Value of Equity/book value of Total Liabilities

$X_5$= Sales/ Total Assets

The interpretation of the model is also modified: firms with Z' score above 2.9 are considered to be healthy, while those whose score is below 1.23 are expected to go bankrupt. Scores that lie in the range of 1.23 to 2.9 represent the Gray Area, where no strong prediction is given on their success or failure.

### *iii. Adjusted Altman's Z'' score*

The earlier two versions of Altman's Z score models were developed to predict the likelihood of bankruptcy for manufacturing firms. To apply the prediction model to non-manufacturing business companies, another modification of the model was made, where one of the variables, $X_5$ (Sales/ Total Assets), was excluded from the model, so that the effect of industry sensitive variable of Asset Turnover can be minimized (Altman,1993).

The new model has different coefficients for the remaining four variables, with the form:

$$\mathbf{Z'' = 6.56\ X_1 + 3.26\ X_2 + 6.72\ X_3 + 1.05\ X_4}$$

where:

Z'' = Overall Index

X1= (Current Assets – Current Liabilities) / Total Assets

X2= Retained Earnings / Total Assets

X3= Earnings before Interest and Taxes / Total Assets

X4= book value of equity / total liabilities

The cutoff point is also amended for the new model, where companies with Z'' scores of 2.6 and greater are considered to be safe, while companies with scores below 1.1 are predicted to be bankrupt; and scores ranging from 1.1 to 2.6 represent the Gray Area, where no clear prediction can be made on financial situation of the firm.

This particular model is also useful within an industry where firms have different types of financing of assets and where no major accounting adjustments, such as lease capitalization, are necessary.

### *B. Springate's Business Prediction Model*

With insights from Altman's MDA model developed in the USA, Gordon Springate developed a new accounting-based business failure prediction model that is based on financial data of companies operating in Canada.

Springate developed the model using a sample of manufacturing sector that comprised 20 failed companies matched with 20 non-failed companies, and using step wise multiple discriminate analysis, Springate selected four out of 19 common financial ratios (Springate, 1978). The four financial ratios are: Working Capital scaled by Total Assets, Earnings before Interest and Taxes scaled by Total Assets, Sales scaled by Total Assets, and Net Profit before Taxes scaled by Current Liabilities. Springate's model has the following form:

**Z=1.03A+3.07B+0.66C+0.4D**

where:

Z= Overall Index

A= Working capital / Total Assets

B=Profit before Interest and Tax / Total Assets

C=Profit before taxes / Current Liabilities

D=Sales / Total Assets

The cutoff point for Springate's model is 0.862, where companies of Z score of less than 0.862 are classified as "failed", and companies whose score is below the cutoff point are classified "non-failed". Prediction accuracy of the model is 92.5%, for prediction made one year before the year of bankruptcy.

## QUALITATIVE MODELS

As financial measures may not solely explain performances of companies, Quantitative models are exposed to limitations in totally predicting business failures. Hence, qualitative models that use non-accounting or qualitative variables are also used in prediction of bankruptcy.

Of the Qualitative models, Argenti's "A score" model is the most commonly used model of business failure prediction developed by Argenti in 1976. The model indicates that business failure process follows predictable sequence that starts with Defects, followed by Mistakes Made and finally reaching at Symptoms of Failure (Argenti, 1976).

"Defects" are described by the model with two elements: Weaknesses of Management and Deficiencies in Accounting. Weaknesses of management of a company includes, in descending order of their importance, poor response to change, autocratic chief executive, failure to separate role of chairman and chief executive, lack of balanced skills in management team, passive board of directors, and weak finance director. Deficiencies in Accounting are explained by inadequacy in cash flow plans, budgetary control, and costing system. Each weakness/deficiency is given a mark, or given zero if the problem is not present in the company. The total mark for "Defects" is 45, and Argenti considers that a company with a mark of 10 or less is considered to be in satisfactory status.

The suggested pass mark for "Mistakes" is 15, from a total mark of 45 that is equally distributed to the three elements of "Mistakes"; namely, High Gearing, Overtrading and Entering into Unmanageable Big Projects.

The final stage of the model is reached when "Symptoms" of failure become visible. The symptoms are classified into four categories with total of 12 marks, which are, in their descending order of importance: Financial Signs, Creative Accounting, Non-financial Signs, and Terminal Signs.

The "Argent's A" model has overall pass mark of 25; where companies with overall score well above 25 (often 35–70) are usually classified as risky, while companies not at risk have fairly low scores (commonly between 0–18). The predictive accuracy of the model has not been adequately tested, though a 5 % misclassification rate is expected (ACCA, 2008).

### 2.1.2 Ethiopian-Based Models of Bankruptcy Prediction

The literature review noted that two studies were made with the aim of developing a model for business failure prediction in Ethiopian Context. The studies were made by Aderajew

Wondim in the year 2003 and by Kisi Tafa Fufa in 2011, who have developed two prediction models by customizing the Altman's Z'- score model based on financial data of Ethiopian companies. The following sections explain these two localized models.

**Wondim's Model of Business Failure Prediction**

Wondim (2003) utilized Altman's revised business failure prediction model in classifying and predicting serious financial problem of Ethiopian Public manufacturing enterprise in the sectors of: food processing, textile, beverage, leather and shoe, garment, metal processing and chemical processing. To test the predictive accuracy of Altman's Z' score model, the study used audited financial statements of the sampled public enterprises for the two years of 1994 and 1995. By comparing a sample of 15 enterprises that were in serious financial problem, with the same number of healthy enterprises, the study found out that Altman Z' score model successfully classified 80% of the enterprises one year prior to serious financial problems; and as much as 70% accuracy two years prior.

Furthermore, using the five financial ratios that are used by Altman's Z' score model, the study formulated the following new model for predicting business failure for Ethiopian companies.

$$\mathbf{Z = 0.0165\ X_1 + 0.0229\ X_2 + 0.0344\ X_3 + 0.0068\ X_4 + 0.0032\ X_5}$$

where,

Z = Overall Index

$X_1$ = Working Capital / Total Assets

$X_2$ = Retained Earnings / Total Assets

$X_3$ = Earnings before Interest and Taxes / Total Assets

$X_4$ = Book Value of Equity / Book Value of Total Liabilities

$X_5$ = Sales / Total Assets

The model developed by Wondim (2003) correctly classified non-failure of companies with 87% accuracy for prediction made one year prior to the failure year predicted, and achieved 73% accuracy for prediction made two years prior to the failure year. For predicting failed

companies, the accuracy rate is 80% and 87%, for one and two years before the failure event, respectively.

**Fufa's Model of Business Failure Prediction**

The validity of the revised Altman's Z' score prediction model was tested Fufa (2011), and the result shows that the revised Z' score model was not strong enough to predict business failure, as the successful classifications of non-failed companies are 60%, 70%, 40 % and 30% for one, two, three and four years prior to the year prediction is made for, which is year 2010, respectively. Therefore, in searching for a more accurate way of identifying financially distressed enterprises in Ethiopian Context, and referring to the research of Wondim (2003), Fufa (2011) developed a new prediction model for Ethiopian Private Enterprises using a stepwise methodology of MDA for the study period of 2005-2009, and with a sample of ten failed and ten non-failed enterprises that are matched by industry and asset size. The new model has the following form:

$$\mathbf{Z = 0.019+0.4545X_1+0.4056X_2+2.2872X_3+0.0660X_4+0.4648X_5}$$

where:

$X_1$ = Working Capital / Total Assets

$X_2$ = Retained Earnings / Total Assets

$X_3$ = EBIT / Total Assets

$X_4$ = Book Value of Equity / Total Liabilities

$X_5$ = Sales/ Total Assets

The cut-off point of the new model is 0.784. Thus, enterprises with a Z score greater than 0.784 are considered as continuing entity, and those with a score less than 0.784 are in financial distress. The new model has achieved a better prediction accuracy that reached 80% accuracy in identifying non-failed companies in both one and two years prior to the year prediction was made, while the accuracy dropped to 45% and 35% for prediction on the third and fourth year prior to year of prediction, respectively.

## 2.2 Empirical Studies on Prediction of Business Failure

Numerous empirical studies have been made in several countries and industries, using the various bankruptcy prediction models. This section presents the review of empirical studies in four sections. The first part presents selected foreign researches that compared two or more prediction models, while all accessed local empirical studies made on bankruptcy prediction are presented in the second part. In the third section, researches that support and challenge the suitability of prediction models to a particular industry are highlighted, and the final section discusses researches that focused on identifying appropriate bankruptcy prediction model for the insurance business.

### 2.2.1 Global Studies on Business Failure Prediction

A number of studies have been made both in developed and developing countries that use two or more prediction models in predicting business failures for a particular environment, some of which are highlighted as follows.

In identifying insolvency of firms, Gunathilaka (2014) applied MDA to test the Z score models of Altman and Springate. The study was made in the period of 2008 to 2012, on 82 companies listed on the Colombo Stock Exchange that are sampled from several industries. The result indicates that the solvency test does not profoundly discriminate solvent and insolvent firms, and Altman's and Springate's Z-score models yield similar predictive accuracy; although Altman's Z-Score demonstrated a higher degree of accuracy for the immediate year prior to the distress.

Oniga (2016) studied the applicability of classical bankruptcy prediction models for Romanian insurance companies, using four models of business failure prediction; namely, the Altman Z-score model, the adjusted Altman's Z'' model, the Springate model and the model used to determine insolvency probability for the emerging markets. The study was conducted on financial statement of the insurance companies for the years of 2011 to 2013. The result shows that the highest accuracy rate was achieved by Altman's Z"-Score model with 63% of correct prediction, while the other three models exhibit prediction accuracy of lower than 16%, based on which the researcher suggested other more accurate prediction

models be used that are appropriate to the developing economy of Romania and its insurance sector.

Gulsun and Umit (2010) have developed and tested a statistical early warning model to identify companies that have experienced deteriorating financial health in Turkey. The study examined 45 insurance companies operating in non-life elementary branches for the period of 1992 to 2006, and developed a logit model. To predict the performance of insurance companies in 2007, the study has also compared the ability of logit, discriminant and regression analyses on predicting business failure in the insurance industry, by using data for the period of 2003 to 2006. The result indicated that the logit model has slightly better prediction ability than the other models.

Gizem (2015) studied the effect of solvency requirements of the regulator on financial stability of 41 insurance companies operating in Turkey in the period of 1998 to 2012. The four early warning models used in the study are Linear Regression, Multiple Discriminant Analysis, Logistic and Bayesian Regression. Based on the empirical results, Bayesian Regression is selected as the best early warning model for Turkish insurance companies with 90.2% of Coefficient of Determination, $R^2$. The selected model is also used to predict business failure of Turkish insurance companies for the year 2013.

In a research on life insurance industry of the USA, Carson (1995) provided empirical evidence on the strength of three types of bankruptcy detection models: Multiple Discriminant Analysis, Logistic Regression, and Recursive Partitioning. The study utilizes financial data for the two years of 1989 and 1990 from the National Association of Insurance Commissioners for samples taken from solvent and insolvent insurers in the years 1990 and 1991. Results indicate that the empirical models do reasonably well in classifying solvent and insolvent insurers, as significant differences arise between solvent and insolvent insurers depending on the variables examined. Furthermore, the study identifies several important variables in early identification of financially distressed insurance companies.

In predicting financial distress in Information Technology and Service-providing companies of South Africa, Kidane (2004) investigated the applicability of the two Z score models:

Altman (1968) and Springate (1978). Financial statements and the respective Z-score were used for a sample of 86 (24 failed and 62 non-failed) Services-giving and Information Technology companies listed on the Johannesburg Security Exchange from 1999 to 2003. The results of the empirical study indicate that both models failed to predict failure and non-failure amongst South African Service-giving and Information Technology sample companies and their subsectors. While further comparing the two models, it was indicated that the Altman model is better in classifying failed companies correctly than the Springate model; while, Springate model is better in correctly classifying non-failed companies. Total prediction accuracy of Springate model is relatively better in the first and second years, but it is weaker in the other years. The study concluded that the Altman and Springate bankruptcy prediction models are not justifiable to be applied to predict bankruptcy in the South African Service-providing and Information Technology sectors and sub-sectors.

For listed companies of Germany and Belgium, Mareike (2014) tested the accuracy rate of three accounting-based bankruptcy prediction models that use different financial ratios: Altman (1968), Ohlson (1980), and Zmijewski (1984) models. The study covered three years of 2008 to 2013, with samples of 5646 active and 140 bankrupt companies in Belgium, and a sample of 1432 active and 21 bankrupt companies in Germany. The results indicate that different prediction ability of the three models is found in the two countries—the accuracy rate on German listed companies are lower than on Belgium listed companies, as explained by the low ratio of bankrupt to non-bankrupt companies. For the three years of investigation, the accuracy rates for Belgian listed companies on Altman (1968), Ohlson (1980), and Zmijewski (1984) are 68.3 %, 68.0 % and 67.9 %, while that of listed companies in Germany are 52.1 %, 53.1 % and 52.0 %, respectively. Furthermore, Ohlson´s logit model (1980) is found to be the most accurate model of the three models studied, and the prediction ability of the three bankruptcy prediction models decline towards the year of bankruptcy.

Sajjan (2016) applied of the two versions of Altman's bankruptcy model (Z score, and adjusted Z'' score) to assess the financial soundness of selected manufacturing and non-manufacturing firms in India. The study sampled three companies from each sector and used financial statements of the companies for five years (2011 to 2016). The assessment indicated

that most of the firms are in Distress Zone, which implied that these firms may go bankrupt in near future, and it was recommended that effective strategies should be designed by the top management to improve the resource management and operational performance of the companies.

The applicability of USA based model of Fulmer H-Score (1984) and Canadian based model of Springate Z-score (1978) in predicting solvency of Non-Banking Financial Institutions in India is tested by Arasu, Balaji, Kumar, and Thamizhselv (2013). The study concluded that, although models of Fulmer and Springate have been developed based on manufacturing firms, the models are very much useful for predicting solvency of financial firms, and can be applied to predict solvency in India using recent period financial information.

Jacobi and Lifschutz (2010) studied the Applicability of Altman's Z-score Model (1968) and customized model of Altman's Model developed to the context of Israel by Ingbar (1994). Using a sample of 40 publicly traded companies that operated in the period of 2000 to 2007, the two models are tested whether they can achieve a minimum bankruptcy prediction accuracy of 80 % – which is considered as the threshold accuracy rate in determining the ability of model to predict business failure, one year prior to bankruptcy. The result of the research shows that the localized model of Ingbar is more powerful than Altman's model in predicting bankruptcy with 95% and 85 % accuracy rates, one year and two years prior to bankruptcy, respectively.

### 2.2.2 Local Studies on Business Failure Prediction

Apart from the study of Wondim (2003) and Fufa (2011) that tested applicability of Altman's business failure prediction model to Ethiopian context, there are few empirical studies made in Ethiopia on business failure prediction, most of which focused on non-financial sectors, as summarized below, in their order of time precedence.

Ephrem (2015) used the adjusted Altman's Z'' score model and estimated determinants of financial distress in private commercial banks of Ethiopia. The researcher analyzed bank-specific factors affecting firm's financial distress, using panel data for the period of 2002/03

to 2011/12 on six private banks operating in the country. The results of the study show that Capital to Loan ratio, and Net Interest Income to Total Revenue ratio have statistically significant positive influence, whereas the Nonperforming Loan ratio has statistically significant negative influence on the financial health of the sample banks.

To investigate the determinants of financial distress of manufacturing firms in Ethiopia, Andualem (2015) investigated the role of Financial Distress on Debt Service Ratio, using Panel data of 11 Ethiopian manufacturing firms for the period of 1999 to 2005. The result shows that liquidity, profitability, and efficiency have positive and significant influence, and Leverage has negative and significant influence on Debt Service Coverage; while, the size of firm is not a significant factor in affecting both Debt Service Coverage and Financial Distress.

Yohannes (2014) investigated determinants of financial distress on manufacturing share companies in Addis Ababa, Ethiopia. The explanatory variables selected by the study are: efficiency, economic growth, inflation, firm size, leverage, liquidity, solvability and profitability; while Debt service Leverage is taken as the dependent variable, as a measure of financial distress. The study used quantitative methods of research on annual report of a sample of twelve manufacturing share companies for five years period of 2009 to 2013. Panel data model with its random effect estimate is used to test the hypotheses. Based on the descriptive statistics and panel data regression analysis, the study indicated that solvability, firm size, economic growth and liquidity have positive and significant influences on Debt Service Coverage as a proxy of financial distress; while leverage has a negative and significant relation with Debt Service Coverage. The study also noted that other variables, such as efficiency, profitability, and inflation, have statistically insignificant relationship with financial distress of Ethiopian manufacturing share companies.

In addition to his latest study (Andualem, 2015), Andualem (2011) had conducted a research aimed at identifying determinants of financial distress in selected beverage and metal manufacturing firms in Ethiopia. Using panel data regression of sample companies for the period of 1999 to 2005, analysis was made on some internal and external factors that

determine financial distress, The results show that profitability, firm age, liquidity and efficiency have positive and significant influences, while Leverage has a negative and significant relation with Debt Service Coverage, which is taken a proxy of financial distress. It is also concluded that variables such as Operational Viability and Good Corporate Governance have an insignificant impact on financial distress.

Using both qualitative and quantitative data, Gebre (2011) attempted to identify the causes of failures of floriculture investment in Ethiopia, on a research conducted on a sample of seven fully operational floriculture investments in eight years period of 2004 to 2011. The study indicated that poor management is the major cause for failure of floriculture investment in Ethiopia. It also identified other causes of business failure in the sector that are categorized as: management-related, finance-related, economic related and marketing-related causes.

### 2.2.3 Applicability of Existing Prediction Models to Different Environments

After Edward Altman developed the Z-Score model in 1968 to help predict the financial distress of manufacturing firms in the United States, a number of researches have been made that utilized Altman's model in predicting financial distress in countries outside of USA, and for different industries. For example, Gunathilaka (2014) applied the Z-score models of Altman and Springate to predict financial distress in Sri Lanka; Diakomihalis (2012) employed all the three versions of Altman's model to study their applicability in bankruptcy predictions in different classes of hotels in Greece; Bardia (2012) applied Altman's Z score on two leading steel manufacturing companies in India; and Kpodoh (2009) used the adjusted Altman's Z'' score model on Mobile Telecom Industry of Ghana.

Researches made on suitability of prediction models to a particular environment have provided different conclusions. Some of the studies ascertained that the models can successfully predict business failures while others have indicated that the models have failed to provide the required accuracy in prediction. For instance, the following studies have not supported the prediction models tested. Kidane (2004) examined the applicability of Altman and Springate models in predicting financial distress in South Africa, and the results indicated that both models failed to predict failure and non-failure amongst Service-giving

and Information Technology companies in South Africa. Upon testing the predictive power of Altman's model in Jordan, Alareeni and Branson (2013) noted that the model could not provide indicators to differentiate between failed and non-failed Service-giving companies, though the model is appropriate for manufacturing companies. Similarly, by applying the four classic models (Altman's Z-Score and Z"-score models, Springate's model and the Emerging Markets model) on insurance companies of Romania, Oniga (2016) indicated that the prediction ability of the four models is found to be insignificant to Romanian insurance companies.

On the other hand, a number of literatures have indicated that the corporate business failure prediction models are capable of identifying distressed companies prior to the occurrence of bankruptcy, as the following examples illustrate. The prediction power of the initial Altman's model and Ohlson's model are tested on Iranian listed companies and the results show that both models can adequately predict bankruptcy in Iran (Moghadam, Zadeh, & Fard, 2010). Johansson and Kumbaro (2011) applied the Z score and adjusted Z'' score models of Altman, and concluded that the models could predict bankrupt of firms in the USA one and two reporting periods prior to bankruptcy. Mohammed , Mostafa, and Soon (2014) also indicated that Altman's Z- score is able to differentiate between failed and non-failed companies of the trading services sector of Malaysia. Hassan and Samarakoon (2003) have tested the three versions of Altman's model (Z, Z', and Z'') on listed firms of Sri Lanka and indicated that the models scored a remarkable degree of accuracy, of which Z'' score achieved 81% accuracy.

### 2.2.4 Business Failure Prediction for Insurance Companies

The literature review highlighted that accuracy of bankruptcy prediction model would be improved when the models are developed for, or applied to, specific industries, time horizons or samples (Mareike, 2014; Platt & Platt, 1990) . Furthermore, Altman and Hotchkiss (2006) have recommended that Altman's models would be more relevant for assessing financial distress of like-industry firms when the models are developed to specific industries of non-manufacturing businesses, such as, retailing, telecoms, and airlines companies.

Thus, many researches have been made focusing on distinct industries, some of which include: Altman (1977) focused on savings and loan institutions, Altman and Loris (1976) focused on broker-dealer industry, Shrieves and Stevens (1979) studied educational entities; and Pinches and Trieschmann (1974) dealt with the insurance industry.

For the insurance business, business Failure prediction model was first developed by Pinches and Trieschmann (1974) in the United States of America. Subsequent researches made on insurance sector include: the study of Kramer (1996) on property-liability insurers of the Netherlands, and the research of Chen and Wong (2004) on the property-liability and life insurers of Japan, Singapore, Malaysia and Taiwan. Recent studies on insurance industry include a prediction model developed for German insurers by Berry-Stölzle, Koissi, and Shapiro (2010), and the work of Jannes and Sabine (2015) that used company-level data of German property- liability insurers to identify factors that affect the insurer's regulatory solvency ratio.

Hence, the literature review indicates that the different types of bankruptcy prediction models include Univariate models, Qualitative Response models, Multiple Discriminant Analysis models, and Non-parametric Discriminant models, and the models can be applied to the insurance business, as confirmed by BarNiv and McDonald (1992) that has also highlighted that MDA models are the more robust bankruptcy prediction models.

### 2.3 Summary of the Literature Review and Knowledge Gap

The literatures review revealed that most of the empirical studies have been conducted with the aim of prediction of business failures in developed countries. Furthermore, controversial conclusions have been reached by the studies on the applicability of prediction models when applied to different countries and samples.

Many of the empirical studies conducted in Ethiopia have aimed at developing new models of prediction of financial distress, whereas global literatures on the subject recommended that researches focus more on validating the existing business failure prediction models, instead of trying to develop additional prediction models. Furthermore, the researchers conducted in

Ethiopian context have focused on a single prediction model whereas many researches made in foreign countries have made comparison of two or more prediction models and identified the most appropriate model for a specific country or industry. The literature review has also shown that a prediction model is considered applicable to a specific sample when the minimum prediction accuracy achieved by the model, prior to the event of bankruptcy or non-bankruptcy, is 80 %.

Though a few studies were made on business failure prediction of various economic sectors of Ethiopia, to the knowledge of the researcher, the suitability of theoretical business bankruptcy prediction models to the context of the insurance sector of Ethiopia has not been researched. Besides, from the literatures that studied the applicability of the existing models, only a few have dwelt upon two or more models that could be relevant to the sample studied.

Hence, in filling the knowledge gap, this study has focused on the insurance sector of Ethiopia aiming at identifying business failure (non-failure) prediction models appropriate to insurance companies of Ethiopia. Besides, the research is broader than the reviewed studies as it assesses the accuracy and suitability of four different existing bankruptcy prediction models (i.e., the Adjusted Altman's Z'' score model, the Springate's model, and the two customized models of Wondim and Fufa) that are expected relevant to the insurance sector of Ethiopia.

### 2.4 Variables and Conceptual Framework

The data required to achieve objectives of the study are related to the discriminating variables identified from the conceptual framework and reviewed literatures. The relationship between the dependent and independent variables of the prediction models is highlighted in Table 2-1. The dependent variable represent the dichotomous event named as "bankruptcy" or "non – bankruptcy", while the independent variables are the various commonly used financial ratios of each prediction model. The variables that explain the four selected models are: Working Capital to Total Assets (WC/TA), Retained Earnings to Total Asset (RE/TA), Earning before Interest and Tax to Total Asset (EBIT/TA), Book Value of Equity to Total liabilities (BVE/TL), Sales to Total Asset (S/TA), and Earnings before Tax / Current Liabilities

(EBT/CL). The data is obtained from the annual audited financial statements of the insurance companies and the related information obtained from the National Bank of Ethiopia.

**Table 2-1: Relationship between Dependent variable and Independent variables of sample models**

| **INPUTS**<br>**[Independent Variables]** | **OUTPUT**<br>**[Dependent Variable]** |
|---|---|
| • Working Capital / Total Assets<br>• Retained Earnings / Total Assets<br>• Earnings before Interest and Taxes / Total Assets<br>• Book Value of Equity / Book Value of Total Liabilities<br>• Sales / Total Assets<br>• Earnings before Tax / Current Liabilities | Z – Score<br>[as Specific Classifier of Bankruptcy/Non-bankruptcy] |

Description of the variables included in the four models is provided as follows.

Working Capital / Total Assets (WC/TA): The ratio measures the net liquid asset of a company to the total capitalization as represented by the relationship of working capital to total assets (WC/TA). The variable includes liquidity and size of a firm into the equation; Working Capital being defined the difference between Current Assets and Current Liabilities.

Retained Earnings / Total Assets (RE/TA): Retained Earnings represents the reinvested earnings and/or losses of a firm and measures cumulative profitability over the life of the company, and reflects the age of a company. The RE/TA ratio also measures the leverage of a firm, where a high RE relative to TA shows that a firm's assets are through retention of profits, compared to debt financing.

Earnings before Interest and Taxes to Total Assets (EBIT/ TA): It measures the productivity of the firm's assets, independent of tax or leverage factors. Insolvency occurs when the total liabilities exceed the fair value of the firm's assets, and the fair value is determined by the earning power of the asset.

Book Value of Equity/Book Value of Total Liabilities (BVE/TL): The measure shows how much the firm's assets can decline in value (measured by book value of equity plus debt) before the liabilities exceed the assets and the firm becomes insolvent. Equity is measured by net worth book value of all shares of stock, preferred and common, while Total Liability represents the sum of current and long-term obligations.

Sales/Total Assets (S/TA): It is the assets turnover ratio that measures sales generating capacity of a company's assets. Management's capacity in dealing with competitive conditions is also measured by this ratio.

Earnings before Tax / Current Liabilities (EBT/CL): It is a liquidity ratio included in the Springate's model, and measures the number of times a firm's Earnings could cover the Current Liabilities.

The study focuses on testing the applicability of the four selected business failure prediction models to correctly predict non-bankruptcy of all Ethiopian insurance companies for the year 2017, using the predetermined theoretical accuracy rate of the respective models that are listed in Table 2-2.

**Table 2-2: Theoretical Accuracy Rate on prediction of Non-bankrupt Companies**

| PREDICTION MODEL | YEAR OF PREDICTION | THEORETICAL ACCURACY OF PREDICTION MODELS |
|---|---|---|
| **ALTMAN** | One year prior to non-bankruptcy (year 2016) | 97.00% |
| | Two years prior to non-bankruptcy (year 2015) | 93.90% |
| **SPRINGATE** | One year prior to non-bankruptcy (year 2016) | 92.50% |
| **WONDIM** | One year prior to non-bankruptcy (year 2016) | 87.00% |
| | Two years prior to non-bankruptcy (year 2015) | 73.00% |
| **FUFA** | One year prior to non-bankruptcy (year 2016) | 80.00% |
| | Two years prior to non-bankruptcy (year 2015) | 80.00% |
| | Three years prior to non-bankruptcy (year 2014) | 45.00% |
| | Four years prior to non-bankruptcy (year 2013) | 35.00% |

Source: Compiled by the Author from the results of respective theoretical models

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1 Research Design

Explanatory research design is adopted in this study to establish the cause and effect relationship between the derived Z scores of the prediction models and the failure or non-failure status of the sampled insurance companies. A bankruptcy prediction model is considered more powerful if it has the capability of accurately predicting bankruptcy/non-bankruptcy earlier than other models (Bellovary, Giacomino, & Akers, 2007). The literature review also indicates that prediction accuracy of Z-score models diminish beyond five years prior to the year of bankruptcy/ non-bankruptcy. Therefore, the models in this study are tested using five years data of the insurance companies, similar to the methodology used by Beaver (1966) and by Albzour and Alkhatib (2011). Furthermore, to test the applicability of models on the current status of Ethiopian insurance companies, a sample of the most recent five years data is selected that covers the period of 2012 to 2016.

Previous studies in Ethiopia conducted to test and/ or develop business failure prediction models include the research made on Ethiopian Public Enterprises by Wondim (2003), on Ethiopian Private Enterprises by Fufa (2011), on manufacturing share companies by Yohannes (2014), and on Ethiopian commercial banks by Ephrem (2015). However, to the best knowledge of the researcher, no study has been made on business failure prediction of the insurance sector of Ethiopia. Furthermore, unlike the other Ethiopian researches that dealt with a single bankruptcy prediction model, this study has tested four different models in selecting the most appropriate model(s)..

## 3.2 Model Selection

The literature review shows that a number of corporate business failure prediction models are used by practitioners and researchers, including: the various versions of Alman's model,

Springate's Model, Logit Analysis, Recursive Portioning Algorithm, Genetic Algorithms, Neural Network models, Artificial Intelligence Systems, Option/contingent Claims, and Hybrid models (Altman & Hotchkiss, 2006). From the pool of models available, statistical models, and particularly MDA, are proved to be the dominant methods used by researchers of the subject (Sajjan, 2016; Kpodoh, 2009), which has initiated this study to focus on testing MDA prediction models.

The inconsistent findings of previous researches on the appropriateness of prediction models require an initial testing to be made on existing prediction models, before applying the models to a particular country and/ or industry. Prior validation of the existing models is also supported by Bellovary et al. (2007) who suggested, based on a review of 150 related researches made for 70 years, that future studies focus more on the use of existing bankruptcy prediction models, instead of developing new models. Thus, this study has focused on verifying the applicability of the existing prediction models.

Even though a number of prediction models have been applied to the insurance industry, due to lack of firm-level data required for market-based variables of market-based models, only the following accounting-based bankruptcy prediction models are selected for this study.

a) Altman's Adjusted Z'' score model of 1993: it is developed for non-manufacturing companies, including the insurance business.
b) Springate's Z score mode of 1978: although it was initially developed for manufacturing companies, its suitability to non-manufacturing companies is confirmed by many subsequent researches (such as, Arasu et al., 2013; Karmozi et al., 2016).
c) Wondim's Z score model of 2003: it is developed on Ethiopian Public Enterprises, by customizing Altman's revised Z'-score model to the context of Ethiopian companies.
d) Fufa's Z score model of 2010: it is specifically developed on Ethiopian Private Enterprises, by customizing the revised Z'-score model of Altman to the context of Ethiopian companies.

### 3.3 Data Type

Secondary sources are used in the study, mainly of quantitative financial data from the audited financial statements of the sampled insurance companies

Panel data collected from financial statements for five years are used to test the predictive ability of the prediction models, as Panel data is more effective than pure cross-sections or pure time-series as it involves pooling of observations on a cross-section of units over several time periods.

### 3.4 Data Source

To ensure higher level of relevance and reliability of data source and to prevent researcher bias, the study used secondary sources of data from the audited financial statements of the insurance companies. Financial statement of the insurance companies in the country are subject to mandatory audit by certified audit firms, and they are required to be publicized to the general public with appropriate media of communication.

Furthermore, to conduct relevant and appropriate review of literatures, various printed and online sources of information are used, including international Journals, research theses, and text books on finance and business management.

### 3.5 Population and Sample

Up to year 2016, the number of insurance companies that were operating in Ethiopia was 17. As the research is made to test applicability of models on latest financial data of the country, and because the accuracy of Z-score models diminishes significantly beyond five years prior to bankruptcy, the most recent five years financial data for the period of 2012 to 2016 is sampled, similar to the methodology used by Kidane (2004), Sajjan (2016), and Kpodoh (2009). The sample of companies for the study is the 14 Ethiopian insurance companies that have been in operation for the five year sampled period (list of sampled companies is provided in Appendix A). As the Ethiopian budget year falls in two calendar years, for simplicity purpose, the second part of the budget year is used in this study to describe the

sampled year; for example, budget year 2011/2012 is designated as 2012, and 2015/16 is designated as 2016.

### 3.6 Data Collections Method

The required data for the study is collected from secondary sources, mainly by reviewing the audited financial statements of the sampled insurance companies. Related financial information of the insurers is also collected from the National Bank of Ethiopia, the regulatory body of the country's insurance sector.

### 3.7 Data Analysis Methods

As the four models under study are developed in different economic environment, time horizon, countries and / or industries, a statistical analysis is used to evaluate the suitability each model in identifying non-bankruptcy of Ethiopian insurance companies for 2017. Panel linear regression data analysis is employed to test the hypotheses and to identify the relationship between the dependent and independent variables in explaining the financial situation of the insurers.

To determine the accuracy of each model, Z score results are calculated for each of the five years, and the percentage of correct predictions is determined by dividing the number of correct predictions of a model in a year to the total number of predictions made for the year. Microsoft Excel spreadsheet is used to compute Z scores, to analyze the information obtained, and to interpret results with appropriate Graphs and Tables.

# CHAPTER FOUR

# DATA ANALYSIS AND INTERPRETATION

In this part of the study, the financial data is analyzed and the statistical tests conducted for each of the four models and on the three hypotheses are presented. In interpreting the results of the data analysis, it is noted that none of the insurance companies in Ethiopia has gone bankrupt in all the five sampled years of 2012 to 2016; and the same is true for year 2017—which is the year prediction is made for.

Testing the accuracy of the models of Altman (1993) and Springate (1978), Wondim (2003), and Fufa (2011) is made by calculating the values of financial ratios of each model, and by computing Z-scores for each of the sampled insurance companies. Z-scores are computed for the Xi values that represent the independent variables in the formula of the respective models. Appendix B shows Z-scores computed for each sampled company of the five years.

The accuracy of each model is assessed by comparing the classification results obtained from the data analysis against the actual status of the sampled insurance companies. Therefore, considering that no bankruptcy is declared in the insurance sector of the country, all models are expected to predict non-bankruptcy of the 14 sampled insurance companies. Summary of classification results obtained from the four models is provided in Appendix C, and data analysis of each model is discussed in the following sections.

## 4.1 Altman's model

Different from the other three models studied, Altman's model has three categories in predicting the status of companies; namely, 'Non-bankrupt' state, 'Uncertain' (or Gray Area) state, and 'Bankrupt' state. However, Altman (2000) has recommended that the lower limit of the Gray Area be taken as a cut-off point in the classification of bankrupt and non-bankrupt companies. Therefore, in this study, companies whose Altman's Z''-scores lie in the Gray Area are predicted as 'Non-bankrupt' companies.

The Z''- score of Altman's model are calculated for each year, details of which are annexed in Appendix B (Table B-1 to Table B-5), and summary of the scores is provided in Table 4-1. The shaded scores indicate that the insurance company is predicted as 'bankrupt', as the Z'' score achieved is lower than 1.1, which is the cutoff point of Altman's Adjusted Z''-score model.

**Table 4-1: Adjusted Z'' scores of Altman's Model for the Sampled Insurance Companies for Five Years**

| Insurance Company | Five years Prior to Failure (2012) | Four years Prior to Failure (2013) | Three years Prior to Failure (2014) | Two years Prior to Failure (2015) | One year Prior to Failure (2016) |
|---|---|---|---|---|---|
| EIC | 0.86 | 2.46 | 3.20 | 2.42 | 7.78 |
| Awash | 0.81 | 2.16 | 1.81 | 1.50 | 1.51 |
| Global | 0.35 | 2.45 | 3.50 | 4.27 | 6.12 |
| Nile | 2.27 | 2.50 | 2.73 | 2.64 | 0.84 |
| Nice | 2.13 | 2.63 | 1.63 | 4.36 | 1.42 |
| Africa | (0.19) | (1.03) | 0.48 | (1.11) | (1.35) |
| Nib | 0.99 | 1.56 | 2.16 | 1.90 | 3.06 |
| Nyala | 3.53 | 2.98 | 3.13 | 2.82 | 2.39 |
| UNIC | 3.08 | 3.66 | 2.12 | 1.74 | 1.57 |
| Oromia | 1.31 | 2.00 | 2.16 | 2.42 | 1.77 |
| Lion | 1.31 | 2.24 | 0.83 | 0.43 | (0.56) |
| Abbay | (0.03) | (0.08) | 3.40 | 3.72 | 3.70 |
| Birhan | (0.65) | (1.08) | 1.05 | 2.81 | 1.65 |
| Tsehay | 4.92 | (1.68) | 3.36 | 3.82 | 3.72 |

Source: Author's computation from the financial statements.

Table 4-2 shows the classification results of Altman's adjusted Z''-score model, and the followings are the prediction accuracy of the model to correctly identify non-failed Ethiopian insurance companies in the period of 2012 to 2016.

- 78.57 % accuracy, one year prior to the year of prediction (in year 2016)
- 85.71 % accuracy, two years prior to the year of prediction (in year 2015)
- 78.57 % accuracy, three years prior to the year of prediction (in year 2014)

- 71.43 % accuracy, four years prior to the year of prediction (in year 2013)
- 50.00 % accuracy, five years prior to the year of prediction (in year 2012)

**Table 4-2: Accuracy of Prediction Achieved by Altman's model**

| Z score | 2012 | | 2013 | | 2014 | | 2015 | | 2016 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Success | 3 | Total | 3 | Total | 6 | Total | 9 | Total | 6 | Total |
| Gray Area | 4 | | 7 | | 5 | | 3 | | 5 | |
| | 7 | **50 %** | 10 | **71.43%** | 11 | **78.57%** | 12 | **85.71%** | 11 | **78.57%** |
| Fail | 7 | | 4 | | 3 | | 2 | | 3 | |
| **Total** | **14** | | **14** | | **14** | | **14** | | **14** | |

Source: Author's computation based on Z- score calculated for the model

### 4.2 Sprinagate's Model

The cutoff point of Springate's model is 0.862, and a company that has a score below this amount is classified as bankrupt, and it is non-bankrupt, otherwise. Z scores calculated for the five sampled years is provided in Appendix B (Table B-6 to Table B-10).

**Table 4-3: Z scores of Springate's Model for the Sampled Insurance Companies for Five Years**

| | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| EIC | 0.426 | 0.750 | 0.880 | 0.833 | 0.880 |
| Awash | 0.310 | 0.657 | 0.509 | 0.506 | 0.379 |
| Global | 0.062 | 0.778 | 0.945 | 0.960 | 0.788 |
| Nile | 0.554 | 0.603 | 0.655 | 0.553 | 0.153 |
| Nice | 0.805 | 0.761 | 0.556 | 1.923 | 0.528 |
| Africa | 0.050 | (0.083) | 0.207 | (0.114) | (0.188) |
| Nib | 0.342 | 0.557 | 0.595 | 0.442 | 0.325 |
| Nyala | 0.955 | 0.837 | 0.777 | 0.668 | 0.656 |
| UNIC | 0.727 | 0.955 | 0.641 | 0.508 | 0.311 |
| Oromia | 0.378 | 0.578 | 0.508 | 0.653 | 0.374 |
| Lion | 0.517 | 0.602 | 0.316 | 0.252 | 0.009 |
| Abbay | (0.161) | (0.044) | 1.106 | 0.926 | 0.946 |
| Birhan | (0.429) | 0.242 | 0.245 | 0.454 | 0.042 |
| Tsehay | (0.254) | (0.681) | 0.373 | 0.586 | 0.446 |

Source: Author's computation from the financial statements.

As shown in Table 4-3 that summarizes the model's Z-scores, from the total sixty Z-scores calculated in the sample period, only eleven have a value above the cut-off point. The classification accuracy of Springate's model to correctly identify non-failed Ethiopian insurance companies in the period of 2012 to 2016 is as follows (Table 4-4):

- 14.29 % accuracy, one year prior to the year of prediction (in year 2016)
- 28.57 % accuracy, two years prior to the year of prediction (in year 2015)
- 21.43 % accuracy, three years prior to the year of prediction (in year 2014)
- 7.14 % accuracy, four years prior to the year of prediction (in year 2013)
- 7.14 % accuracy, five years prior to the year of prediction (in year 2012)

**Table 4-4: Accuracy of Prediction Achieved by Springate's Model**

| Years of Prior Bankruptcy | Total Sample | Number of Correct Classification | Number of Incorrect Classification | **Correct Classification (Percentage)** | **Incorrect Classification (Percentage)** |
|---|---|---|---|---|---|
| 1◦ (year 2016) | 14 | 2 | 12 | 14.29% | 85.71% |
| 2◦ ( year2015) | 14 | 4 | 10 | 28.57% | 71.43% |
| 3◦ ( year2014) | 14 | 3 | 11 | 21.43% | 78.57% |
| 4◦ ( year2013) | 14 | 1 | 13 | 7.14% | 92.86% |
| 5◦ ( year2012) | 14 | 1 | 13 | 7.14% | 92.86% |

Source: Author's computation based on Z- score calculated for the model

### 4.3 Wondim's Model

Wondim's model is a local bankruptcy prediction model developed on Ethiopian public enterprises. As the model has a cutoff point of 0.016, the prediction would be interpreted as a correct prediction when the Z- score calculated for the sample insurance company is above 0.016. From the total of 70 Z-scores computed for the samples, only 13 Z scores are above the cutoff point, which shows that Wondim's model achieved a 19 % total prediction accuracy (Appendix B, Table B-11 to B-15).

As indicated by the shaded scores of Table 4-5, from the fourteen sampled insurance companies, eight companies are incorrectly predicted to be bankrupt throughout the five years studied. On the other hand, considering the companies that achieved a score higher than the cutoff point, the model became more accurate in the recent three years of the sample

period, as it has correctly identified non-bankruptcy of three of insurance companies in the successive years of 2014 to 2016, which are indicated by the non-shaded Z-scores of the model (Table 4-5).

**Table 4-5: Z scores of Wondim's Model for the Sampled Insurance Companies for Five Years**

| | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| EIC | 0.006 | 0.013 | 0.015 | 0.012 | 0.014 |
| Awash | 0.005 | 0.012 | 0.010 | 0.009 | 0.008 |
| Global | 0.004 | 0.013 | 0.017 | 0.019 | 0.037 |
| Nile | 0.012 | 0.012 | 0.013 | 0.012 | 0.005 |
| Nice | 0.012 | 0.013 | 0.009 | 0.023 | 0.009 |
| Africa | 0.003 | 0.001 | 0.006 | 0.002 | 0.002 |
| Nib | 0.006 | 0.008 | 0.011 | 0.009 | 0.013 |
| Nyala | 0.018 | 0.015 | 0.015 | 0.013 | 0.012 |
| UNIC | 0.014 | 0.017 | 0.013 | 0.012 | 0.011 |
| Oromia | 0.006 | 0.010 | 0.010 | 0.011 | 0.008 |
| Lion | 0.007 | 0.011 | 0.007 | 0.006 | 0.002 |
| Abbay | (0.001) | (0.001) | 0.016 | 0.017 | 0.017 |
| Birhan | (0.003) | 0.004 | 0.006 | 0.012 | 0.006 |
| Tsehay | 0.004 | 0.023 | 0.019 | 0.020 | 0.020 |

Source: Author's computation from the financial statements.

Details of classification accuracy of Wondim's model to identify bankrupt and non-bankrupt Ethiopian insurance companies are provided in Table 4-6. In predicting the fact that none of the insurance companies operating in Ethiopia has gone bankrupt in the year 2017, the maximum accuracy by the model is 28.57%, while the minimum accuracy is 7.14 %. The followings are correct predictions made by the model for the five years sampled.

- 21.43 % accuracy, one year prior to the year of prediction (in year 2016)
- 28.57 % accuracy, two years prior to the year of prediction (in year 2015)
- 21.43 % accuracy, three years prior to the year of prediction (in year 2014)
- 14.29 %accuracy, four years prior to the year of prediction (in year 2013)
- 7.14 % accuracy, five years prior to the year of prediction (in year 2012).

**Table 4- 6: Accuracy of Prediction Achieved by Wondim's Model**

| Years of Prior Bankruptcy | Sample | Number of Correct Classification | Number of Incorrect Classification | **Correct Classification (Percentage)** | **Incorrect Classification (Percentage)** |
|---|---|---|---|---|---|
| 1◦ (year 2016) | 14 | 3 | 11 | 21.43% | 78.57% |
| 2◦ ( year2015) | 14 | 4 | 10 | 28.57% | 71.43% |
| 3◦ ( year2014) | 14 | 3 | 11 | 21.43% | 78.57% |
| 4◦ ( year2013) | 14 | 2 | 12 | 14.29% | 85.71% |
| 5◦ ( year2012) | 14 | 1 | 13 | 7.14% | 92.86% |

Source: Author's computation based on Z- score calculated for the model

### 4.4 Fufa's Model

The model developed by Fufa was based on Private enterprises of Ethiopia, and it has a cut-off point of 0.784. Hence, companies that have a score of 0.784 and above are classified as non-bankrupt, and scores below the cutoff point predict bankruptcy. The Z-scores calculated for Fufa's model in the five years is provided in Appendix B (Table B-15 to B-20), and the model predicted that all the sample companies are in the state of bankruptcy, as all the Z scores calculated for Fufa's model are below the cut-off point of 0.784 (Table 4-7) .

**Table 4-7: Z scores of Fufa's Model for the Sampled Insurance Companies for Five years**

| | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| EIC | 0.368 | 0.541 | 0.619 | 0.557 | 0.588 |
| Awash | 0.243 | 0.477 | 0.361 | 0.359 | 0.292 |
| Global | 0.111 | 0.546 | 0.636 | 0.623 | 0.497 |
| Nile | 0.419 | 0.441 | 0.463 | 0.401 | 0.173 |
| Nice | 0.587 | 0.534 | 0.482 | 1.267 | 0.485 |
| Africa | 0.118 | 0.073 | 0.219 | 0.063 | 0.032 |
| Nib | 0.285 | 0.391 | 0.434 | 0.330 | 0.817 |
| Nyala | 0.654 | 0.588 | 0.536 | 0.468 | 0.485 |
| UNIC | 0.496 | 0.641 | 0.486 | 0.419 | 0.305 |
| Oromia | 0.262 | 0.421 | 0.357 | 0.461 | 0.271 |
| Lion | 0.370 | 0.436 | 0.297 | 0.270 | 0.118 |
| Abbay | (0.088) | (0.016) | 0.765 | 0.627 | 0.639 |
| Birhan | (0.220) | 0.215 | 0.219 | 0.339 | 0.064 |
| Tsehay | (0.053) | (0.157) | 0.389 | 0.499 | 0.415 |

Source: Author's computation from the financial statements.

For all the five years tested, the classification accuracy of Fufa's model to correctly identify non-failed Ethiopian insurance companies is 0.00 % (Table 4-8). The result is incomparable with the theoretical accuracy of the model that expects 80% accuracy in identifying non-failed companies in each of the two years prior to prediction.

**Table 4- 8: Accuracy of Prediction Achieved by Fufa's Model**

| Years of Prior Bankruptcy * | Sample | Number of Correct Classification | Number of Incorrect Classification | **Correct Classification (Percentage)** | **Incorrect Classification (Percentage)** |
|---|---|---|---|---|---|
| 1◦ (year 2016) | 14 | 0 | 14 | 0 % | 100 % |
| 2◦ ( year2015) | 14 | 0 | 14 | 0 % | 100 % |
| 3◦ ( year2014) | 14 | 0 | 14 | 0 % | 100 % |
| 4◦ ( year2013) | 14 | 0 | 14 | 0 % | 100 % |
| 5◦ ( year2012) | 14 | 0 | 14 | 0 % | 100 % |

Source: Author's own computation based on Z-scores calculated.

### 4.5 Summary and Interpretation on Results of Data Analysis

Further analysis on the accuracy of the four prediction models for the Ethiopian insurance sector in each of the five years sampled are discussed as follows.

For prediction made one year prior to failure/non failure event, Altman's model predicted non-failure of the companies with 78.57% accuracy, while accuracy of Springate and Wondim is 14.29% and 21.43%, respectively. Fufa's model has 0.00% accuracy, as it has totally failed to correctly predict non-bankruptcy (Table 4-9).

**Table 4-9: Summary of Prediction Accuracy of the four models in predicting non-bankruptcy of Ethiopian insurance companies**

| **The year prior to Year of prediction** | **Altman's Model** | **Springate's Model** | **Wondim's Model** | **Fufa's Model** |
|---|---|---|---|---|
| 1○ (year 2016) | 78.57% | 14.29% | 21.43% | 0.00% |
| 2○ ( year2015) | 85.71% | 28.57% | 28.57% | 0.00% |
| 3○ ( year2014) | 78.57% | 21.43% | 21.43% | 0.00% |
| 4○ ( year2013) | 71.43% | 7.14% | 14.29% | 0.00% |
| 5○ ( year2012) | 50.00 % | 7.14% | 7.14% | 0.00% |
| Average Score | **72.86%** | **15.71%** | **18.57%** | **0.00%** |

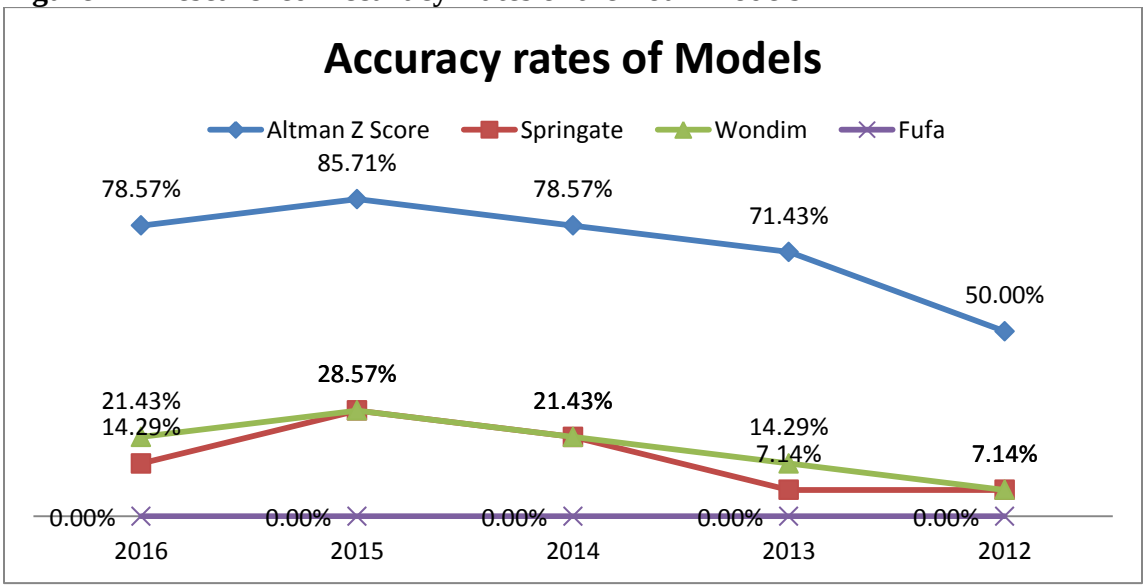
Source: Author's own computation based on Z-scores calculated.

Of the five years study period, as Figure 4-1 shows, the highest accuracy rates are achieved in the prediction made two years prior to non-failure event (in year 2015), where Altman's model scored 85.71%, while the models of Springate and Wondim have scored 28.57% each. Fufa's model totally failed to correctly predict the non-bankrupt insurance companies, thus 0.00% accuracy is achieved.

For the third year prior to bankruptcy/non-bankruptcy, the prediction accuracy of Altman's Z''- score is lower by 8.3 % to reach 78.57%, while that of Springate and Wondim decline by 25%, which resulted in 21.43% accuracy. Again, Fufa's model could not predict non-bankruptcy of the companies, having 0.00% accuracy.

In the fourth year prior to year of prediction, the prediction accuracy of Alman's Z score further declined to 35.71% while that of Springate and Wondim models has improved to 28.57%. The accuracy of Fufa's model was 0.00% for this year, as well. Altman's model was able to predict non-bankruptcy status of companies in the fifth year prior to the predicted year by 57.14%, while the same year predictions of the model of Springate, Wondim, and Fufa were 14.29%, 21.43%, and 0.00%, respectively.

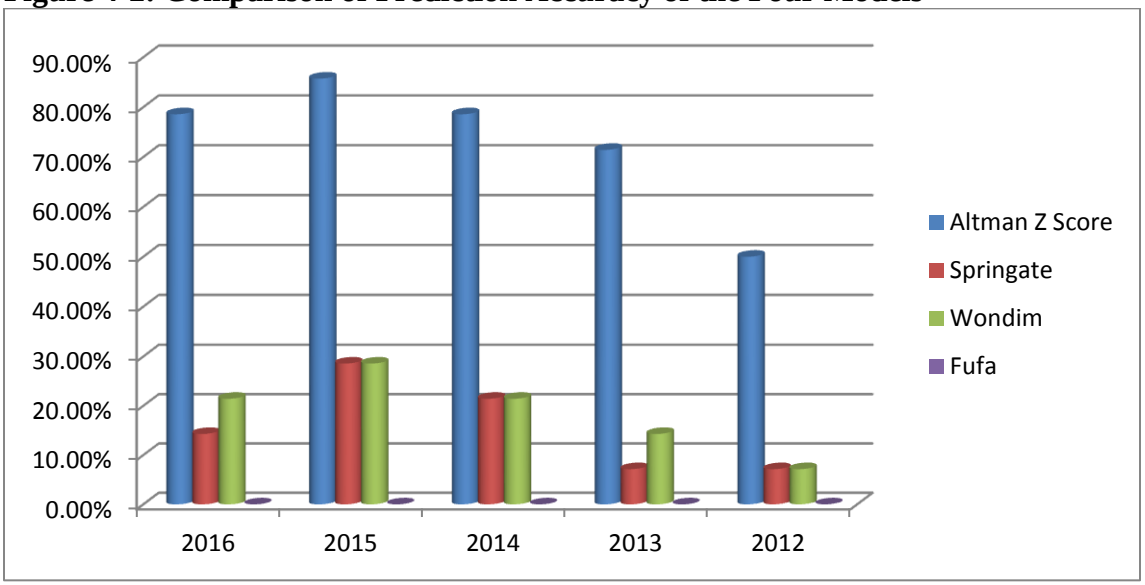
**Figure 4-1 Researched Accuracy Rates of the Four Models**




Source: Author's own illustration based on Z-scores calculated.

In general, over the five years sample period, the prediction accuracy of the models ranges from 0.00% to 85.71%. The highest prediction accuracy is achieved by Altman's model prediction of 2015 which predicted that 85.71% insurance companies in Ethiopia will not go bankrupt in 2017. On the other hand, Fufa's model is the least effective, having zero percent prediction accuracy in all the five years sampled, as it has totally failed to predict the non-bankruptcy status of the sampled Ethiopian insurance companies. The other two prediction models (Springate and Wondim) have exhibited low prediction accuracy that ranges from 7.14% to 28.57%. Differences amongst the four models in correctly predicting non-bankruptcy of the insurance companies for 2017 is graphically depicted in Figure 4-2.

**Figure 4-2: Comparison of Prediction Accuracy of the Four Models**




Source: Author's own illustration based on Z-scores calculated.

### 4.6 Testing of Hypotheses and Discussion of Results

Three hypotheses have been developed by this study that expected high effectiveness in accuracy of the four prediction models; better performance from models developed for Ethiopian context; and improved prediction accuracy from more recent financial data.

This Section tests each of the three hypotheses and the results are assessed in line with objective of the study. Additional findings collected during the data analysis are also discussed.

### 4.6.1 Effectiveness of the Four Models in Prediction Accuracy

The first hypothesis anticipated that the four models sampled will effectively predict that none of the Ethiopian insurance companies would go bankrupt in the year 2017, with the minimum accuracy rate predetermined in the respective theoretical models. The models' effectiveness is measured by dividing the accuracy rate of the prediction models obtained in the study by the predetermined accuracy rate expected from the models.

**Table 4-10: Effectiveness of Sampled Models in Predicting Non-bankruptcy of Ethiopian Insurance Companies for year 2017**

| PREDICTION MODEL | YEAR OF PREDICTION | EXPECTED ACCURACY | RESEARCHED ACCURACY | EFFECTIVENESS OF MODEL | AVERAGE EFFECITVENESS |
|---|---|---|---|---|---|
| ALTMAN | 2016 | 97.00% | 78.57% | 81.00% | **86.4%** |
| | 2015 | 93.90% | 85.71% | 91.28% | |
| SPRINGATE | 2016 | 92.50% | 14.29% | 15.44% | **15.44%** |
| WONDIM | 2016 | 87.00% | 21.43% | 24.63% | **31.89%** |
| | 2015 | 73.00% | 28.57% | 39.14% | |
| FUFA | 2016 | 80.00% | 0.00% | 0.00% | **0.00%** |
| | 2015 | 80.00% | 0.00% | 0.00% | |
| | 2014 | 45.00% | 0.00% | 0.00% | |
| | 2013 | 35.00% | 0.00% | 0.00% | |

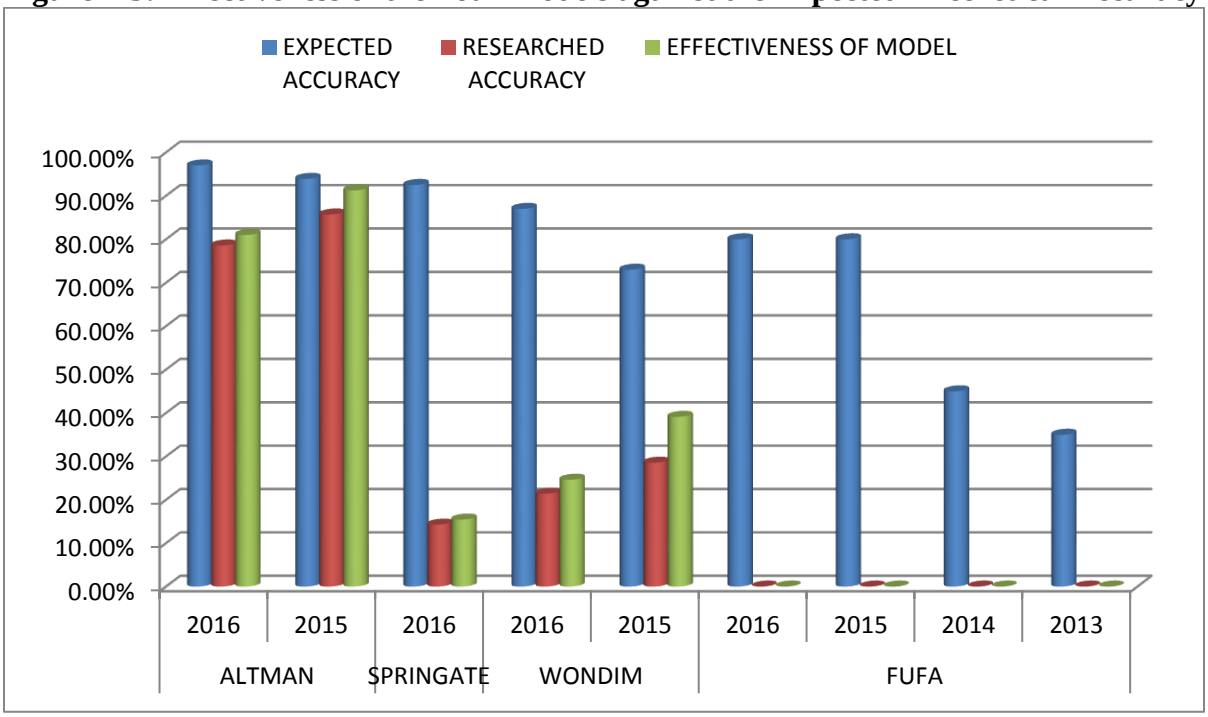
Source: Author's own computation based on Z-scores calculated.

As shown in Table 4-10, the average effectiveness researched are 86.4%, 15.44%, 31.89%, and 0% for the models of Altman, Springate, Wondim and Fufa, respectively. The performance of each model against the expected prediction accuracy for each prediction year is discussed as follows.

The Expected accuracy rates of adjusted Altman's Z''-model for non-bankrupt companies are 97% and 93.9% for the first and second years prior to the year that prediction is made. Accordingly, the Altman Model applied to the sample companies for the one-year and two-years prior to the year of prediction are lower than the expected classification rate by 18.43% and 8.19 %, respectively.

Compared to the expected classification accuracy of the Springate's model, which is 92.5 %, the accuracy of the model for the Ethiopian insurance sector for the sample year is only 14.29%. Although the Springate Model has no predetermined accuracy rate for only one year prior to prediction, this study has noted that Springate's model has a lower accuracy of prediction on earlier years, and the accuracy reached as low as 7.14% for the fourth and fifth years' of prediction, and the average prediction accuracy for the five years is 15.71%.

**Figure 4-3: Effectiveness of the Four Models against the Expected Theoretical Accuracy**




Source: Author's own illustration based on Z-scores calculated.

The model of Wondim expects 87 % and 73 % of theoretical prediction accuracy when non-failure predictions are made on the first and second years prior to year of prediction, respectively (Wondim, 2003). However, the data analysis shows that the model was not effective in predicting non-failure of Ethiopian insurance companies in the two immediate years prior to 2017, as the accuracy of Wondim's model was 21.43% and 28.57%, which is lower from the expected rate of accuracy by 75% and 61%, respectively. The accuracy goes less accurate in the third year, and it achieved the lowest accuracy of 7.14 % in the fifth year prior to prediction year.

Fufa's Model expects prediction accuracy of 80%, 80%, 45% and 35% on non-failure of Ethiopian companies for the first, second, third and fourth years that precede the year of prediction (2017), respectively (Fufa, 2011). Nevertheless, effectiveness of Fufa's model for Ethiopian insurance companies is zero percent in all the five years.

The bar chart of Figure 4-3 provides pictorial comparison of the accuracy rate expected according to the theoretical models, the accuracy rate calculated based on the financial information of the sampled Ethiopian insurance companies, and the success level of each model in achieving the targeted theoretical accuracy rate.

**Table 4-11: Variances Analysis in Accuracy Rate of the Four Models**

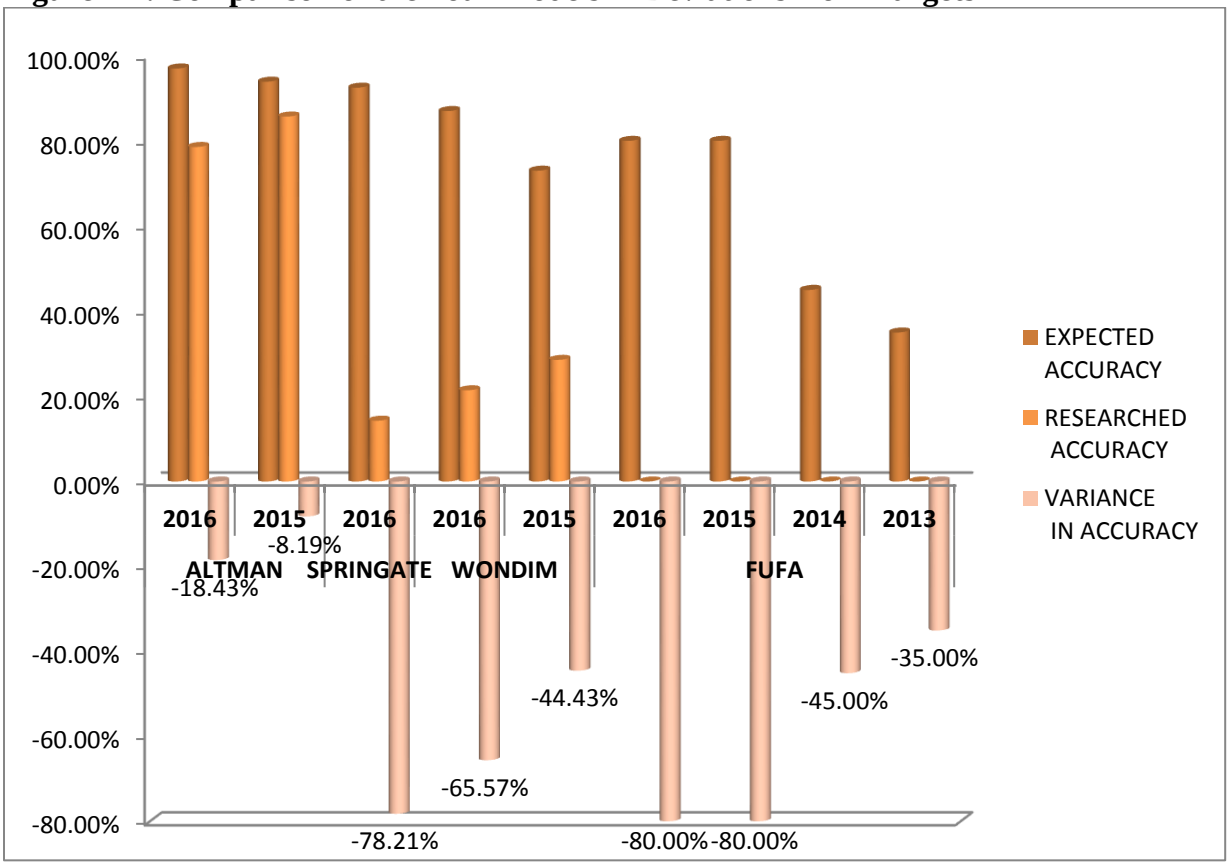
| PREDICTION MODEL | YEAR OF PREDICTION | THEORETICAL ACCURACY | RESEARCHED ACCURACY | VARIANCE IN ACCURACY |
|---|---|---|---|---|
| ALTMAN | 2016 | 97.00% | 78.57% | -18.43% |
| | 2015 | 93.90% | 85.71% | -8.19% |
| SPRINGATE | 2016 | 92.50% | 14.29% | -78.21% |
| WONDIM | 2016 | 87.00% | 21.43% | -65.57% |
| | 2015 | 73.00% | 28.57% | -44.43% |
| FUFA | 2016 | 80.00% | 0.00% | -80.00% |
| | 2015 | 80.00% | 0.00% | -80.00% |
| | 2014 | 45.00% | 0.00% | -45.00% |
| | 2013 | 35.00% | 0.00% | -35.00% |

Source: Author's own computation based on Z-scores calculated.

Of the four models studied, the most effective model in achieving the expected rate of accuracy is Altman's model which has attained 91.28% and 81.00% of the targeted accuracy rate for 2015 and 2016, respectively. Wondim's localized model is the second effective model to meet the prediction accuracy, and it achieved 39.14% and 24.63% of the target prediction accuracy for the years of 2015 and 2016, respectively. The Springate Model is the third in effectiveness of prediction with only 15.44% of the targeted accuracy achieved in the year 2016. Finally, the localized model of Fufa stands to be the least effective with zero percent accuracy of prediction in all the five years of the study.

To depict how far the models have deviated from their expected accuracy rate, the variance in accuracy is calculated by subtracting the accuracy rate obtained from this study from the theoretical accuracy rate set by the four models (Table 4-11). The lowest variance in accuracy for the sampled years is achieved Altman's model which deviated by -8.19% in year 2015. The highest variance is that of Fufa's model which falls short of its expectation by 80% in the two years of 2015 and 2016. Springate's and Wondim's models are the second and third least effective models with a negative deviation of 78.21% and 65.57%, respectively.

**Figure 4-4: Comparison of the Four Models in Deviations from Targets**




Source: Author's own illustration based on Z-scores calculated.

The bar chart in Figure 4-4 pictorially depicts how far each of the models has fallen short of their theoretical targets, where the models of Fufa and Springate scored the highest deviation with -80% and 78.21%, respectively, while the lowest deviation is achieved by Altman's model with -8.19%.

### 4.6.2 Performance of Customized models for Ethiopian Context

The second research hypothesis expected that, being developed specifically for Ethiopian companies, bankruptcy prediction models developed by Wondim (2003) and Fufa (2011) would have higher accuracy than the other two global models, in predicting non-bankruptcy of Ethiopian insurance companies for year 2017.

To test the hypothesis, comparison of the accuracy rate of each of the two localized models (Wondim and Fufa) should be compared with each of the other two global prediction models (Altman and Fufa). However, the two global models have two sets of accuracy rates to compare with; the first target rate is the theoretical prediction rate determined when the models were initially developed, while the other target rate is the 'Researched' prediction accuracy obtained by this very study during demonstration of the two global models with financial data of Ethiopian insurance companies in the sample years. Thus, each localized model is assessed with two sets of targeted prediction accuracy rates of the two global models, results of which are discussed in the following sections.

#### *I. Comparison of Wondim's Localized Model with the two International models*

On average, Wondim's model is less accurate than the theoretical accuracy of Altman by 70.45%; and it is also less accurate than the Researched accuracy rate of Altman's model, by 57.14% (Table 4-12).

**Table 4-12: Comparison of the Accuracy of Wondim's Model with Altman's Model**

| The year Prior to prediction Year | Researched Accuracy of Wondim's Model | Theoretical Accuracy Altman's Model | Variance with Theoretical Accuracy of Altman | Researched Accuracy of Altman for the Insurance Sector | Variance with Researched Accuracy of Altman |
|---|---|---|---|---|---|
| 1° (year 2016) | 21.43% | 97.00% | -75.57% | 78.57% | -57.14% |
| 2° (year 2015) | 28.57% | 93.90% | -65.33% | 85.71% | -57.14% |
| Average | | | **-70.45 %** | | **-57.14 %** |

Compared with the Researched accuracy of Springate's model, Wondim's model has a slightly higher accuracy for prediction made one year prior to the year of non-bankruptcy, where it improved the prediction accuracy by 7.14%. However, the accuracy of Wondim's model is much lower than the theoretical prediction accuracy of the Springate's model, as it is lower by 71.07% (Table 4-13).

**Table 4-13: Comparison of the Accuracy of Wondim's Model with Springate's Model**

| The year Prior to prediction Year | Researched Accuracy of Fufa's Model | Theoretical Accuracy Altman's Model | Variance with Theoretical Accuracy of Springate | Researched Accuracy of Springate for the Insurance Sector | Variance with Researched Accuracy of Springate |
|---|---|---|---|---|---|
| 1° (year 2016) | 21.43% | 92.50% | -71.07% | 14.29% | 7.14% |

### *II. Comparison of Fufa's Localized Model with the two International models*

The zero percent prediction accuracy of Fufa's model for Ethiopian insurance sector in all the five sampled years has made it the least effective, when compared with the international prediction models. For prediction made one year prior to the year of non-bankruptcy (in 2016), the average prediction accuracy of Fufa's model is lower than the theoretical accuracy Altman's model by 95.5%, while it is lower by 82.14% from the Researched accuracy rate of Altman's model (Table 4-14).

**Table 4-14: Comparison of the Accuracy of Fufa's Model with Altman's Model**

| The year Prior to prediction Year | Fufa's Model Results | Altman's Theoretical Accuracy | Difference from Theoretical Accuracy of Altman | Altman's Accuracy Researched for the Insurance Sector | Difference From Researched Accuracy of Altman |
|---|---|---|---|---|---|
| 1° (year 2016) | 0.00% | 97.00% | -97.00% | 78.57% | -78.57% |
| 2° (year 2015) | 0.00% | 93.90% | -93.90% | 85.71% | -85.71% |
| Average Accuracy | | | **-95.5 %** | | **- 82.14 %** |

As shown in Table 4-15, when Fufa's model is compared with that of Springates's, prediction accuracy of the former is lower by 92.50% and by 14.29%, while compared to the theoretical accuracy and the Researched accuracy of the latter, respectively.

**Table 4-15: Comparison of the Accuracy of Fufa's Model with Springate's Model**

| The year Prior to prediction Year | Fufa's Model Results | Springate's Theoretical Accuracy | Difference from Theoretical Accuracy of Springate | Springate's Accuracy Researched for the Insurance sector | Difference from Researched Accuracy of Springate |
|---|---|---|---|---|---|
| 1° (year 2016) | 0.00% | 92.50% | -92.50% | 14.29% | -14.29% |

In summary, the hypothesis that the two sampled localized bankruptcy prediction models of Ethiopia will have higher level of prediction accuracy than the two international models in predicting non-bankruptcy of Ethiopian insurance for year 2017 is not supported by the empirical research, except the slight improvement of Wondim's Model by 7.14% in year 2016 than the low-performing Springate's model.

### 4.6.3 Trends in Prediction Accuracy Rates

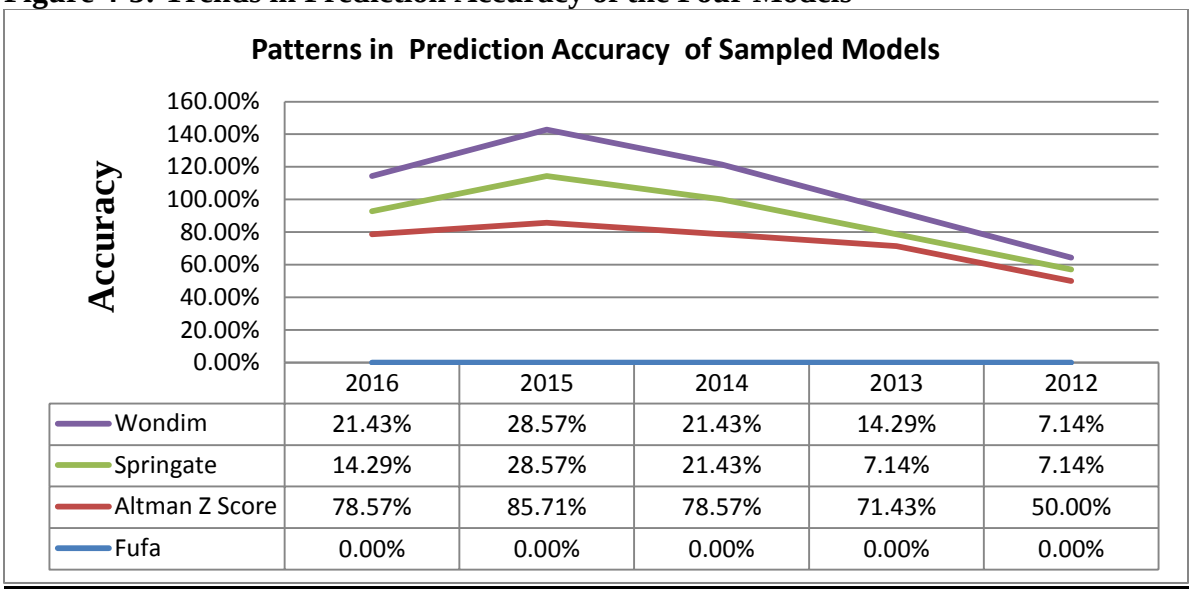
The third hypothesis states that the more recent the year of prediction, the higher will be the prediction accuracy obtained from the four models in correctly anticipating non-bankruptcy of Ethiopian insurance companies in the sample period of 2012 to 2016.

The data analysis shows that the prediction accuracy of the models of Altman, Springate and Wondim have similar patterns. As depicted in Figure 4-5, the prediction accuracy of the three models increased for four years of the prediction period, and suddenly declined when prediction is made with the most recent financial data of 2016. On the other hand, Fufa's model has a constant prediction accuracy of 0% for all the prediction years, which contradicts with the hypothesis.

Thus, the hypothesis holds true only for the three models the three consecutive years of 2012 to 2015, as the prediction accuracy has generally achieved an increasing trend. However, this

trend fails to continue when the latest prediction is made on financial data of year 2016, where the prediction accuracy of the three models went down.

**Figure 4-5: Trends in Prediction Accuracy of the Four Models**




| | 2016 | 2015 | 2014 | 2013 | 2012 |
|---|---|---|---|---|---|
| Wondim | 21.43% | 28.57% | 21.43% | 14.29% | 7.14% |
| Springate | 14.29% | 28.57% | 21.43% | 7.14% | 7.14% |
| Altman Z Score | 78.57% | 85.71% | 78.57% | 71.43% | 50.00% |
| Fufa | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

Source: Author's own illustration based on Z-scores calculated.

Furthermore, although the three models have similar patterns for predictions made earlier than year 2016, they differ in the magnitude at which the accuracy of each model declines in each consecutive year of prediction. By taking year 2016 as a base year for calculating the change in accuracy, Table 4-16 provides the magnitude and direction of percentage changes in prediction accuracy of the models. Comparison of prediction accuracy with each successive year starts from year 2015, which is the second year prior to the year 2017 that prediction is made for, which is denoted by '2 °'.

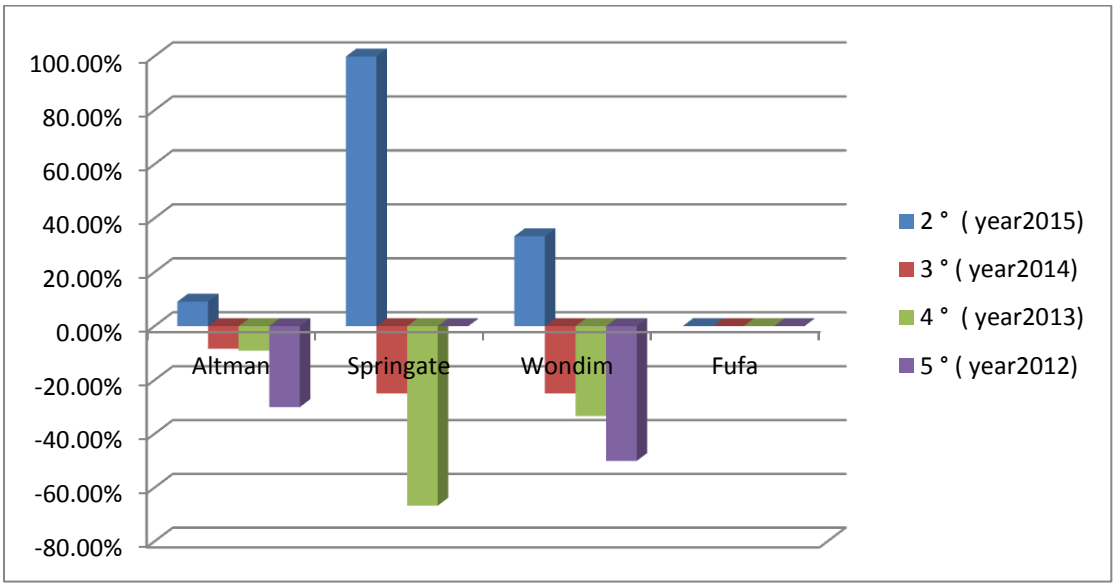
**Table 4-16: Percentage Changes in Accuracy of models Compared to the Preceding Year**

| The year prior to Year of prediction | Altman | Springate | Wondim | Fufa |
|---|---|---|---|---|
| 2 ° ( year2015) | + 9.09% | + 99.93% | + 33.32% | 0.00% |
| 3 ° ( year2014) | -8.33% | -24.99% | -24.99% | 0.00% |
| 4 ° ( year2013) | -9.09% | -66.68% | -33.32% | 0.00% |
| 5 ° ( year2012) | -30.00% | 0.00% | -50.03% | 0.00% |

Source: Author's own computation based on Z-scores calculated.

Pictorial representation of the changes in prediction accuracy of the four models is provided in Figure 4-6, which shows that, compared to the earlier years' prediction accuracy, the highest drop in accuracy is that of springate's, amounting -66.8% in year 2013. The lowest drop in accuracy is –8.33% achieved in year 2014 by Altman's model.

**Figure 4-6: Comparison of Magnitude of Changes in Accuracy of Models in Consecutive Years**




Source: Author's own illustration based on Z-scores calculated.

## 4.7 Additional Issues Collated from the Data Analysis

In addition to determining the total percentage of prediction accuracy of the four models in predicting bankruptcy/non-bankruptcy of insurance companies in Ethiopia, a closer look is made on the individual insurance companies identified as non-bankrupt to assess whether the models have similar result in specifying the names of predicted non-bankrupt companies.

The analysis shows that except Fufa's model, which has failed to identified any non-bankrupt companies, the other three models have selected the same insurance companies in the years of 2012 and 2013, details of which is provided in Appendix C. However, there are some differences in the remaining three years of 2014 to 2016, discussion of which is provided as follows.

For prediction made in 2014, the three models of Altman, Springate and Wondim have common results, where the same two companies (i.e., Global and Abbay) are correctly identified as non-bankrupt companies (Table 4-17). However, the models of Springate and Wondim differ in identifying the other non-bankrupt company, because the former selected EIC as a non-bankrupt company for the year, while the latter selected Tsehay.

**Table 4-17: Differences of Models in Identification of Individual Non-Bankrupt Insurance Companies for Year 2014**

| Insurance Company | Altman | Springate | Wondim | Fufa |
|---|---|---|---|---|
| EIC | **Healthy** | **Healthy** | Bankruptcy | Bankruptcy |
| Awash | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Global | **Healthy** | **Healthy** | **Healthy** | Bankruptcy |
| Nile | **Healthy** | Bankruptcy | Bankruptcy | Bankruptcy |
| Nice | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Africa | Bankruptcy | Bankruptcy | Bankruptcy | Bankruptcy |
| Nib | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Nyala | **Healthy** | Bankruptcy | Bankruptcy | Bankruptcy |
| UNIC | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Oromia | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Lion | Bankruptcy | Bankruptcy | Bankruptcy | Bankruptcy |
| Abbay | **Healthy** | **Healthy** | **Healthy** | Bankruptcy |
| Birhan | Bankruptcy | Bankruptcy | Bankruptcy | Bankruptcy |
| Tsehay | **Healthy** | Bankruptcy | **Healthy** | Bankruptcy |

Source: Author's own illustration based on Z-scores calculated.

For year 2015, all the three models have selected the same three companies (Global, Nice, and Abbay) as non-bankrupt companies. However, similar to the year 2014, Springate and Wondim differ in identifying the other non-bankrupt company, as the former selected EIC, while the latter selected Tsehay (Table 4-18).

For year 2016, all the three models have correctly identified Abbay insurance company as non-bankrupt, and EIC is identified by the models of Altman and Springate. However, considering Wondim's model has higher accuracy than Springate's model, it can be noted

that the Wondim's model has selected at least one other company (i.e., Global or Tsehay) that is not selected by Springate's model (Table 4-19).

**Table 4- 18: Differences of Models in Identification of Individual Non-Bankrupt Insurance Companies for Year 2015**

| Insurance Company | Altman's | Springate | Wondim | Fufa |
|---|---|---|---|---|
| EIC | **Healthy** | **Healthy** | Bankruptcy | Bankruptcy |
| Awash | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Global | **Healthy** | **Healthy** | **Healthy** | Bankruptcy |
| Nile | **Healthy** | Bankruptcy | Bankruptcy | Bankruptcy |
| Nice | **Healthy** | **Healthy** | **Healthy** | Bankruptcy |
| Africa | Bankruptcy | Bankruptcy | Bankruptcy | Bankruptcy |
| Nib | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Nyala | **Healthy** | Bankruptcy | Bankruptcy | Bankruptcy |
| UNIC | **Gray Area** | **Bankruptcy** | Bankruptcy | Bankruptcy |
| Oromia | **Healthy** | Bankruptcy | Bankruptcy | Bankruptcy |
| Lion | Bankruptcy | Bankruptcy | Bankruptcy | Bankruptcy |
| Abbay | **Healthy** | **Healthy** | **Healthy** | Bankruptcy |
| Birhan | **Healthy** | Bankruptcy | Bankruptcy | Bankruptcy |
| Tsehay | **Healthy** | Bankruptcy | **Healthy** | Bankruptcy |

Source: Author's own illustration based on Z-scores calculated.

In general, Springate's and Wondim's models showed dissimilar results in detecting non-bankrupt companies in the prediction years of 2014 to 2016, as the non-bankrupt insurance companies identified by the two models are different.

The literature review has not revealed whether there are differences amongst models in naming the specific companies selected as bankrupt or non-bankrupt, as the emphasis is made on the total prediction accuracy of models. In meeting the information needs of stakeholders of the insurance companies, and to take appropriate preventive or corrective action, the financial status of each company need to be correctly identified by the relevant prediction model. Thus, caution should be taken not only in assessing the total accuracy of prediction models, but also in selecting the specific companies that the prediction models classify as bankrupt or non-bankrupt.

**Table 4-19: Differences of Models in Identification of Individual Non-bankrupt Insurance Companies for year 2016**

| Insurance Company | Altman's | Springate | Wondim | Fufa |
|---|---|---|---|---|
| EIC | **Healthy** | **Healthy** | Bankruptcy | Bankruptcy |
| Awash | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Global | **Healthy** | Bankruptcy | **Healthy** | Bankruptcy |
| Nile | Bankruptcy | Bankruptcy | Bankruptcy | Bankruptcy |
| Nice | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Africa | Bankruptcy | Bankruptcy | Bankruptcy | Bankruptcy |
| Nib | **Healthy** | Bankruptcy | Bankruptcy | Bankruptcy |
| Nyala | **Healthy** | Bankruptcy | Bankruptcy | Bankruptcy |
| UNIC | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Oromia | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Lion | Bankruptcy | Bankruptcy | Bankruptcy | Bankruptcy |
| Abbay | **Healthy** | **Healthy** | **Healthy** | Bankruptcy |
| Birhan | **Gray Area** | Bankruptcy | Bankruptcy | Bankruptcy |
| Tsehay | **Healthy** | Bankruptcy | **Healthy** | Bankruptcy |

Source: Author's own illustration based on Z-scores calculated.

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATIONS

## 5.1 Conclusion

Business failure affects many stakeholders, including, creditors, suppliers, shareholders, managers, employees, governments, rating agencies and customers. Hence, identifying early warning models that enable to predict business failure of companies would be essential to take appropriate preventive and corrective actions.

A number of bankruptcies have occurred in the insurance business operating all over the world. Unlike the manufacturing industry for which most global bankruptcy prediction models are developed, the insurance business is not extensively studied to develop specifically tailored business prediction models.

The Ethiopian insurance sector has faced various challenges, including a fall in total profit of the insurance companies in the recent years. The literature review indicates that prediction models tailored to the insurance sector of Ethiopia have not been introduced, though some of the international business failure prediction models have been tested for other financial institutions, and two customized models are developed for Ethiopian public and private enterprises.

From the business failure prediction models used globally, the simplest and most practiced models include Z-Score models of Altman and Springate. Nevertheless, as the models of Altman and Springate are developed based on the economic environment of a foreign country and business sector, the objective of the study was to determine the applicability of the two international models to the insurance companies of Ethiopia and to compare the results with the accuracy of the two localized prediction models.

The results of the study have showed that, from the four models researched, the adjusted Altman's Z''-score model can be a suitable model for Ethiopian insurance sector, as it has correctly predicted non-bankruptcy of the insurance companies with accuracy rate of 85.71%, two years prior to the year prediction is made for. This is consistent with the research of Hassan and Samarakoon (2003), Moghadam et al. (2010), and Mohammed et al. (2014) which have tested different prediction models and realized that Altman's model is effective in predicting business failure of companies operating in Sri Lanka, Iran and Malaysia, respectively. Furthermore, compared to the expected accuracy of the theoretical model, the effectiveness achieved by Altman's Z'' score model is 91.28% and 81.00%, two years and one year prior to the year of prediction, respectively.

On the other hand, the maximum prediction accuracy achieved by the other three models is less than 29%. Thus, the applicability of the two domestically developed prediction models of Wondim and Fufa, and the globally used model of Springate to Ethiopian insurance sector is not supported by the research findings for the sampled period.

### 5.2 Recommendations

Based on the study findings and the issues raised during hypotheses testing, the following recommendations are made.

i. As the study has found out that Adjusted Z'' score of Altman has identified non-failed insurance companies in Ethiopia with high accuracy, it is recommended that the model be used in assessing business failure risk of insurance firms in the country. However, as the model is a quantitative model that uses a one-moment ratio analysis, it could be relevant for the short term classification. Thus, the model should be used with the necessary caution, which may require inclusion of the followings.
    - Additional techniques, such as Situational Analysis on external business environment variables, can be included in interpreting the results produced by Altman's Z''-score model.

- Altman's adjusted Z''-score model can be used in combination with other prediction models so as to build confidence on the prediction accuracy achieved on insurance companies.

ii. Considering the existing knowledge and researches made in the country on bankruptcy prediction models, the followings are areas suggested for future research.

a. Lack of previous documented studies on bankruptcy prediction models for the insurance sector of Ethiopia made it difficult to identify and utilize the appropriate prediction models. Hence, enhanced efforts should be made by researchers and practitioners to develop prediction models that are tailored to the insurance business of the country.

b. Although audited financial statements are used for the study, the insurance companies have not used uniform accounting and financial reporting systems, as GAAP is used by some insurance companies while others use IFRS. Hence, some differences in recognition, measurement, presentation and disclosure of financial information of the two systems could affect the Z-scores calculated for the sampled insurance companies. This limitation is expected to be circumvented after year 2019, as the country has adopted IFRS and uniform reporting system is to be implemented according to Proclamation No. 847/2014 "Financial Reporting Proclamation". Thus, the prediction accuracy of the four models studied should also be further tested and verified with subsequent years' financial information of the insurance companies.

c. Contrary to the research hypothesis, the two localized models developed in Ethiopia exhibited very low prediction accuracy for the insurance sector. Factors that resulted in low performance of the localized models may include: inadequate sample size taken in developing the local models, inappropriate methods used in data analysis and interpretation, and differences in the corporate environment of the sampled industries with that of the insurance sector. Thus, factors that could

improve localized models of the insurance sector need to be further examined so that future domestic researches on the subject can achieve improved results.

d. In the three recent years of predictions made (2014 to 2016), the models of Springate and Wondim have produced different results in naming the specific insurance companies that should be classified as 'non-bankrupt' companies. Factors that caused inconsistent results, where a particular company predicted as 'bankrupt' or 'non-bankrupt' by a model is classified as otherwise by the other model, require further examination so as to fine-tune the existing models.

e. According to the theoretical literatures, the performance of prediction models is expected to increase when the most recent data is used for prediction. The data analysis showed that, except Fufa's model that scored 0% accuracy rate in all the sample period, the accuracy rate of the other three models have not exhibited the expected trend of accuracy for successive years. The models exhibited increasing trend from the second to the fifth years prior to year prediction is made for. However, the accuracy rate has unexpectedly fallen for prediction made one year prior to year 2017. Since the hypothesis is only partially supported by the three sampled models, factors that caused the unexpected decline in prediction accuracy need to be further researched so as to fine-tune the models for future usage.

# REFERENCES


ACCA. (2008). *Predicting Corporate Failure.* Retrieved January 27, 2017, from www.accaglobal.com/content/dam/Acca/global/pdf.students/2012/sa_jj08_mpogue.pdf

Alareeni, B., & Branson, J. (2013). Predicting Listed Companies' Failure in Jordan using Altman Models: a case study. *International Journal of Business and Management*, 8 (1).

Albzour, A., & Alkhatib , K. (2011). Predicting Corporate Bankruptcy of Jordanian Listed Companies: Using Altman and Kida Models. *International Journal of Business and Management*, 6 (3). E-ISSN 1833-8119.

Altman, E. I. (1968). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. *Journal of Finance*, 23(3), 580- 609.

Altman, E. I. (1977). Predicting Performance in the Savings and Loan Association Industry. *Journal of Monetary Economics*, 3 (4), pp. 443-466.

Altman, E. I. (1983). *Corporate Financial Distress.* New York: John Wiley & Sons.

Altman, E. I. (1993). *Corporate Financial Distress and Bankruptcy.* (2nd edn.) New York: John Wiley & Sons.

Altman, E. I. (2000). Predicting Financial Distress of Companies: Revisiting the Z-score and Zeta® models . Retrieved April 8, 2017, from http://www.stern.nyu.edu/~ealtman/Zscores.pdf.

Altman, E., & Hotchkiss, E. (2006). *Corporate Financial Distress and Bankruptcy* . (3rd edn). New Jersy: John Wiley & Sons, Inc.

Altman, E., & Loris, B. (1976). A Financial Early Warning System for Over-The-Counter Broker-Dealers. *The Journal of Finance*, 31. doi:10.1111/j.1540-6261.1976.tb01969.x.

Andualem, U. (2011). *Determinants of Financial Distress in Selected Beverage and Metal Industries in Ethiopia.* Unpublished Master's Thesis, Addis Ababa University, Ethiopia.

Andualem, U. (2015). Determinants of Financial Distress in Manufacturing Firms of Ethiopia . *Research Journal of Finance and Accounting*, 6(71).

Arasu, R., Balaji, C., Kumar, S., & Thamizhselv, N. (2013). Applicability of Fulmer and Springate Models for Predicting Financial Distress of Firms in the Finance Sector—an Empirical Analysis. *ELK Asia Pacific Journal of Finance and Risk Management*, 4 (1). ISSN 2349-2325.

Argenti, J. (1976). *Corporate Collapse: The Causes and Symptoms.* Newyork: McGraw Hill.

Azize, T. (2015). *Challenges and opportunities of Insurance Business in Ethiopia. Unpublished Master's Thesis.* Saint Marry University, Addis Ababa, Ethiopia. Retrieved January 5, 2017, from: respository.smuc.edu.et/bitstream/123456789/1657/1/TEMESGEN AZIZE.pdf.

Bardia, S. C. (2012). Predicting Financial Distress and Evaluating Long-Term Solvency: An Empirical Study. *The IUP Journal of Accounting Research & Audit Practices*, XI (1), 47-61.

BarNiv , R., & McDonald , B. J. (1992). Identifying Financial Distress in the Insurance Industry: A Synthesis of Methodological and Empirical Issues. *The Journal of Risk and Insurance*, 59 (4), 543-573.

Beaver, W. (1966). Financial ratios as predictors of failure. Emperical Research in Accounting: Selected Studies. *Journal of Accounting Research, 4*, 71-111.

Bellovary, J. L., Giacomino, D. E., & Akers, M. D. (2007). A review of bankruptcy prediction studies: 1930 to present. *Journal of Financial Education*, 33(4), 1-43.

Berhane, S. (2017, May). Insurers' Profit Dives Despite Surge in Premiums. *Addis Fortune, 17*(890).

Berry-Stölzle, R. T., Koissi, C. M., & Shapiro, A. (2010). Detecting fuzzy relationships in regression models: The case of insurer solvency surveillance in Germany. *Insurance: Mathematics and Economics*, 46(3): 554–567.

Bhattacharya, K., Hart, D., Hawes, W., Law, D., Massy, R., Shaw, R., et al. (2003). *Insurance Company Failure.* Retrieved March 21 2017, from http://www.imf.org /external/pubs/ft/wp/2003/wp03138.pdf.

Business Dictionary. (n.d.). Retrieved October 24, 2016, from http://www.businessdictionary.com/definition/bankruptcy.html

Carson, M. (1995). *Financial Distress in the Life Insurance Industry: An Empirical Examination.* Illinois University, U.S.A. Retrieved February 20, 2017, from www.actuaries.org/AFIR/colloquia/Orlando/carson.pdf.

Chen, R., & Wong, A. K. (2004). The determinants of financial health of Asian insurance companies. *The Journal of Risk and Insurance*, 71 (3): 469–499.

Diakomihalis, M. (2012). The accuracy of Altman's models in predicting hotel bankruptcy . *International Journal of Accounting and Financial Reporting*.

Ephrem, G. (2015). Determinants of Financial Distress Conditions of Commercial Banks in Ethiopia: A Case study of Selected Private Commercial Banks. *Journal of Poverty, Investment and Development.*, Vol.13. ISSN 2422-846X.

Fufa, T. (2011). *Business Failure Prediction: An Empirical Study on Ethiopian Private Enterprises.* Unpublished Master's Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Gebre, S. (2011). *Underlying Causes of Business Failure of Floriculture Investment in Ethiopia.* . Unpublished Master's Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Gizem, O. (2015). *An Early Warning Model for Turkish Insurance Companies.* Unpublished Master's Thesis, Middle East Technical University, Turkey.

Gulsun, I. , & Umit, G. (2010). Early warning model with statistical analysis procedures in Turkish insurance companies. *African Journal of Business Management*, 4(5), pp. 623-630.

Gunathilaka, C. (2014). Financial Distress Prediction: A Comparative Study of Solvency Test and Z-Score Models with Reference to Sri Lanka. *The IUP Journal of Financial Risk Management,*, 11(3), 40-50.

Gunathilaka, C. (2014). Financial Distress Prediction: A Comparative Study of Solvency Test and Z-Score Models with Reference to Sri Lanka . *The IUP Journal of Financial Risk Management*, XI(3), 40-50.

Hassan, T., & Samarakoon, L. P. (2003). Altman's Z-Score Models of Predicting Corporate Distress: Evidence from the Emerging Sri Lankan Stock Market. *Journal of Academy of Finance*.

IMF. (2003). *Insurance and Issues in Financial Soundness. WP/03/138.* IMF.

Ingbar, Y. (1994). *Analysis of financial statements.* Israel Institute of Productivity.

Jacobi, A., & Lifschutz, S. (2010). Predicting Bankruptcy: Evidence from Israel. *International Journal of Business and Management*, 5(4).

Jannes , R., & Sabine , W. (2015). Solvency Prediction for Property-Liability Insurance Companies: Evidence from the Financial Crisis. *The Geneva Papers* , 40, 47–65. doi:10.1057/gpp.2014.16.

Johansson , T., & Kumbaro, J. (2011). *Predicting corporate default- an assessment of the Z score model on the U.S. market 2007-2010.* School of Economics and Management, Lund University.

Kidane, H. (2004). *Predicting Financial Distress in IT and Services Companies in South Africa* . Unpublished Master' Thesis. University of the Free State, South Africa.

Kirui, L. K. (2012). The Applicability of Altman's Failure Prediction models in the Insurance companies in Kenya. Unpublished Master's Thesis: University of Nairobi, Kenya.

Kpodoh, B. (2009). *Bankruptcy and Financial Distress Prediction in the Mobile Telecom Industry, The case of MTN-Ghana, Millicom Ghana and Ghana Telecom.* Unpublished Master's Thesis. School of Management, Blekinge Institute of Technology, Ghana.

Kramer, B. (1996). An Ordered Logit Model for the Evaluation of Dutch Non-life Insurance Companies . *De Economist*, 144(1): 79–91.

Mada, M., & Tilahun, A. (2009). *Bankrupcty Law.* (Teaching Material). Addis Ababa:Justice and Legal System Research Institute. Retrieved January 9,2017 from http://chilot.files.wordpress.com/2016/bankrupcty-law.pdf.

Mareike, K. (2014). *Comparison of accounting-based bankruptcy prediction models of Altman (1968), Ohlson (1980), and Zmijewski (1984) to German and Belgian listed companies during 2008 – 2013.* Unpublished Master's Thesis. University of Twente. The Netherlands.

Moghadam, A. G., Zadeh, N. F., & Fard, M. (2010). Review of the Prediction Power of Altman and Ohlson Models in Predicting bankruptcy of Listed Companies in Tehran Stock Exchange. Ferdowsi University of Mashhad.

Mohammed , A., Mostafa, M. R., & Soon, N. K. (2014). Using Altman's Z-Score Model to Predict the Financial Hardship of Companies Listed In the Trading Services Sector of Malaysian Stock Exchange. *Aust. J. Basic & Applied Science*, 8(6): 379-384.

NBE. (2012, November). Insurance and Insurance Supervision in Ethiopia: An Overview. *Birritu, Vol.112*. Addis Ababa: NBE.

Nyala Insurance S.C. (2016). *Annual Report for 2015/16.* Nyala Insurance S.C. Addis Ababa, Ethiopia.

Odipo , M., & Sitati , A. (2008). *Evaluation of applicability of Altman's revised model in prediction of Financial Distress: A case of companies quoted in Nairobi Stock Exchange.* Unpublished Master's Thesis. University of Nairobi, Kenya.

Oniga, A. (2016). Classic Insolvency Prediction Models Tested On Romanian Insurance Companies. *European Scientific Journal*, 12 (13). ISSN 1857- 7431.

Patrick, P. (1932). A comparison of Ratios of successful industrial enterprises with those of failed firms. *Certified Public Accountant*, 598-731.

Patrick, P. (1932). A comparison of ratios of successful industrial enterprises with those of failed firms . *Certified Public Accountant*, 598-731.

Pinches, E. G., & Trieschmann, S. J. (1974). A multivariate model for predicting financially distressed P-L insurers. *The Journal of Risk and Insurance*, 40(3): 327–338.

Platt, D. H., & Platt , B. M. (1990). Development of a class of stable predictive variables: The case of bankruptcy prediction. *Journal of Business Finance & Accounting*, 17(1): 31-51.

Sajjan, R. (2016). Predicting Bankruptcy of Selected Firms by Applying Altman's Z-score Model. *International Journal of Research Granthaalayah*, 4 (4). ISSN- 2350-0530(0).

Springate, G. (1978). *Predicting the possibility of failure in a Canadian firm.* Unpublished Master's Thesis. Simon Fraser University, Canada.

Wondim, A. (2003). In *Financial failure prediction: An empirical study on Ethiopian Public Enterprise.* Unpublished Master's Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Wondim, A. (2003). *Financial failure prediction: An empirical study on Ethiopian Public Enterprise.* Unpublished Master's Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Yohannes, T. (2014). *The Determinants of Financial Distress in the Case of Manufacturing Share Companies in Addis Ababa-Ethiopia.* Unpublished Master's Thesis, Addis Ababa University, Ethiopia.

# APPENDICES

# APPENDIX A

**TABLE A.1: LIST OF SAMPLED ETHIOPIAN INSURANCE COMPANIES**

| S/N | NAME OF INSURANCE COMPANY | ABBREVIATION | YEAR OF ESTABLISHMENT |
|---|---|---|---|
| 1 | Ethiopian Insurance Company | EIC | 1975 |
| 2 | National Insurance Company of Ethiopia | NICE | 1994 |
| 3 | Awash Insurance Company | Awash | 1994 |
| 4 | Africa Insurance Company | Africa | 1994 |
| 5 | Nyala Insurance Company | Nyala | 1995 |
| 6 | Nile Insurance Company | Nile | 1995 |
| 7 | Global Insurance Company | Global | 1997 |
| 8 | The United Insurance Company | United | 1997 |
| 9 | NIB Insurance Company | Nib | 2002 |
| 10 | Lion Insurance Company | Lion | 2007 |
| 11 | Oromia Insurance Company | Oromia | 2009 |
| 12 | Abbay Insurance Company | Abbay | 2010 |
| 13 | Birhan Insurance Company | Birhan | 2011 |
| 14 | Tsehay Insurance SC | Tsehay | 2012 |

Source: Website of NBE

# APPENDIX B
## Z SCORES OF THE FOUR MODELS

### 1. ALTMAN'S Z'' SCORE

**Table B-1: Z'' Score of Altman's Model for year 2012**

| INSURANCE COMPANY | WCTA | 6.56 *(WCTA) | RETA | 3.26 *(RETA) | GETA ( EBIT to TA) | 6.72* (GETA) | EQTL | 1.05 * (EQTL) | ALTMAN'S Z'' SCORE |
|---|---|---|---|---|---|---|---|---|---|
| EIC | (0.06) | (0.37) | 0.08 | 0.27 | 0.11 | 0.74 | 0.17 | 0.18 | **0.86** |
| Awash | (0.03) | (0.18) | 0.002 | 0.01 | 0.07 | 0.49 | 0.41 | 0.44 | **0.81** |
| Global | (0.05) | (0.36) | 0.02 | 0.05 | 0.02 | 0.16 | 0.47 | 0.49 | **0.35** |
| Nile | 0.10 | 0.67 | 0.09 | 0.29 | 0.09 | 0.63 | 0.65 | 0.68 | **2.27** |
| Nice | 0.04 | 0.26 | 0.11 | 0.36 | 0.17 | 1.17 | 0.33 | 0.35 | **2.13** |
| Africa | (0.16) | (1.03) | 0.04 | 0.14 | 0.05 | 0.32 | 0.36 | 0.37 | **(0.19)** |
| Nib | 0.001 | 0.01 | 0.05 | 0.16 | 0.07 | 0.49 | 0.32 | 0.33 | **0.99** |
| Nyala | 0.17 | 1.13 | 0.11 | 0.37 | 0.16 | 1.08 | 0.91 | 0.95 | **3.53** |
| UNIC | 0.21 | 1.37 | 0.07 | 0.24 | 0.11 | 0.73 | 0.71 | 0.74 | **3.08** |
| Oromia | 0.09 | 0.59 | 0.00 | 0.00 | 0.06 | 0.43 | 0.27 | 0.28 | **1.31** |
| Lion | 0.05 | 0.32 | 0.00 | 0.00 | 0.10 | 0.68 | 0.29 | 0.31 | **1.31** |
| Abbay | 0.05 | 0.32 | (0.08) | (0.25) | (0.06) | (0.38) | 0.27 | 0.28 | **(0.03)** |
| Birhan | (0.01) | (0.05) | (0.11) | (0.37) | (0.11) | (0.74) | 0.49 | 0.51 | **(0.65)** |
| Tsehay | 0.34 | 2.25 | 0.00 | 0.00 | (0.11) | (0.73) | 3.23 | 3.40 | **4.92** |

**Table B-2: Z'' Score of Altman's Model for year 2013**

| INSURANCE COMPANY | WCTA | 6.56 *(WCTA) | RETA | 3.26 *(RETA) | GETA ( EBIT to TA) | 6.72 *(GETA ) | EQTL | 1.05 *(EQTL) | ALTMAN'S Z'' SCORE |
|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.149 | **0.98** | 0.11 | **0.37** | 0.13 | **0.88** | 0.50 | **0.52** | **2.46** |
| Awash | 0.06 | **0.41** | 0.09 | **0.29** | 0.13 | **0.87** | 0.36 | **0.37** | **2.16** |
| Global | 0.08 | **0.54** | 0.09 | **0.31** | 0.15 | **1.03** | 0.54 | **0.57** | **2.45** |
| Nile | 0.13 | **0.84** | 0.09 | **0.30** | 0.10 | **0.67** | 0.65 | **0.68** | **2.50** |
| Nice | 0.14 | **0.92** | 0.09 | **0.31** | 0.14 | **0.94** | 0.45 | **0.47** | **2.63** |
| Africa | (0.31) | **(2.04)** | 0.05 | **0.17** | 0.05 | **0.36** | 0.45 | **0.47** | **(1.03)** |
| Nib | 0.06 | **0.41** | 0.00 | **0.00** | 0.11 | **0.72** | 0.41 | **0.43** | **1.56** |
| Nyala | 0.14 | **0.92** | 0.11 | **0.35** | 0.15 | **0.99** | 0.68 | **0.72** | **2.98** |
| UNIC | 0.22 | **1.46** | 0.10 | **0.34** | 0.15 | **1.03** | 0.79 | **0.83** | **3.66** |
| Oromia | 0.10 | **0.67** | 0.08 | **0.26** | 0.11 | **0.72** | 0.34 | **0.36** | **2.00** |
| Lion | 0.13 | **0.87** | 0.07 | **0.24** | 0.10 | **0.68** | 0.42 | **0.44** | **2.24** |
| Abbay | 0.01 | **0.09** | (0.06) | **(0.19)** | (0.02) | **(0.13)** | 0.14 | **0.14** | **(0.08)** |
| Birhan | (0.00) | **(0.01)** | (0.17) | **(0.56)** | (0.14) | **(0.97)** | 0.44 | **0.47** | **(1.08)** |
| Tsehay | (0.01) | **(0.06)** | (0.21) | **(0.67)** | (0.17) | **(1.17)** | 0.20 | **0.21** | **(1.68)** |

**Table B-3: Z'' Score of Altman's Model for year 2014**

| INSURANCE COMPANY | WCTA | 6.56 *(WCTA) | RETA | 3.26 *(RETA) | GETA ( EBIT to TA) | 6.72*(GETA) | EQTL | 1.05*(EQTL) | ALTMAN'S Z'' SCORE |
|---|---|---|---|---|---|---|---|---|---|
| **EIC** | 0.183 | 1.20 | 0.13 | 0.43 | 0.15 | 1.02 | 0.53 | 0.55 | **3.20** |
| **Awash** | 0.06 | 0.41 | 0.00 | 0.01 | 0.09 | 0.63 | 0.72 | 0.76 | **1.81** |
| **Global** | 0.19 | 1.24 | 0.12 | 0.38 | 0.16 | 1.09 | 0.75 | 0.79 | **3.50** |
| **Nile** | 0.16 | 1.02 | 0.09 | 0.30 | 0.11 | 0.71 | 0.68 | 0.71 | **2.73** |
| **Nice** | 0.09 | 0.59 | 0.06 | 0.18 | 0.07 | 0.47 | 0.36 | 0.38 | **1.63** |
| **Africa** | (0.11) | (0.69) | 0.05 | 0.17 | 0.07 | 0.46 | 0.52 | 0.54 | **0.48** |
| **Nib** | 0.10 | 0.67 | 0.08 | 0.25 | 0.11 | 0.73 | 0.48 | 0.51 | **2.16** |
| **Nyala** | 0.18 | 1.21 | 0.10 | 0.31 | 0.13 | 0.85 | 0.72 | 0.76 | **3.13** |
| **UNIC** | 0.01 | 0.04 | 0.10 | 0.31 | 0.13 | 0.90 | 0.82 | 0.87 | **2.12** |
| **Oromia** | 0.15 | 0.98 | 0.06 | 0.19 | 0.08 | 0.55 | 0.42 | 0.44 | **2.16** |
| **Lion** | (0.09) | (0.56) | 0.07 | 0.22 | 0.09 | 0.59 | 0.55 | 0.58 | **0.83** |
| **Abbay** | 0.18 | 1.19 | 0.12 | 0.39 | 0.20 | 1.38 | 0.42 | 0.44 | **3.40** |
| **Birhan** | 0.05 | 0.35 | (0.00) | (0.01) | 0.03 | 0.21 | 0.47 | 0.49 | **1.05** |
| **Tsehay** | 0.11 | 0.69 | (0.07) | (0.24) | 0.05 | 0.34 | 2.45 | 2.57 | **3.36** |

**Table B-4: Z'' Score of Altman's Model for year 2015**

| INSURANCE COMPANY | WCTA | 6.56*(WCTA) | RETA | 3.26*(RETA) | GETA ( EBIT to TA) | 6.72*(GETA) | EQTL | 1.05 *(EQTL) | ALTMAN'S Z'' SCORE |
|---|---|---|---|---|---|---|---|---|---|
| **EIC** | 0.16 | 1.02 | 0.04 | 0.12 | 0.15 | 1.00 | 0.52 | 0.55 | **2.42** |
| **Awash** | 0.05 | 0.32 | 0.00 | 0.01 | 0.10 | 0.65 | 0.35 | 0.37 | **1.50** |
| **Global** | 0.29 | 1.92 | 0.10 | 0.32 | 0.14 | 0.93 | 1.05 | 1.10 | **4.27** |
| **Nile** | 0.17 | 1.13 | 0.07 | 0.21 | 0.08 | 0.51 | 0.75 | 0.78 | **2.64** |
| **Nice** | 0.14 | 0.92 | 0.09 | 0.29 | 0.39 | 2.65 | 0.48 | 0.50 | **4.36** |
| **Africa** | (0.36) | (2.37) | 0.05 | 0.15 | 0.06 | 0.40 | 0.67 | 0.70 | **(1.11)** |
| **Nib** | 0.10 | 0.63 | 0.06 | 0.19 | 0.07 | 0.48 | 0.56 | 0.59 | **1.90** |
| **Nyala** | 0.16 | 1.06 | 0.09 | 0.28 | 0.11 | 0.74 | 0.70 | 0.74 | **2.82** |
| **UNIC** | (0.06) | (0.38) | 0.08 | 0.26 | 0.11 | 0.76 | 1.05 | 1.11 | **1.74** |
| **Oromia** | 0.14 | 0.93 | 0.08 | 0.27 | 0.11 | 0.77 | 0.42 | 0.45 | **2.42** |
| **Lion** | (0.13) | (0.84) | 0.07 | 0.23 | 0.08 | 0.55 | 0.48 | 0.50 | **0.43** |
| **Abbay** | 0.27 | 1.74 | 0.10 | 0.34 | 0.14 | 0.94 | 0.67 | 0.70 | **3.72** |
| **Birhan** | 0.25 | 1.62 | 0.03 | 0.09 | 0.03 | 0.23 | 0.83 | 0.87 | **2.81** |
| **Tsehay** | 0.18 | 1.18 | 0.03 | 0.10 | 0.08 | 0.56 | 1.89 | 1.99 | **3.82** |

**Table B-5: Z'' Score of Altman's Model for year 2016**

| INSURANCE COMPANY | WCTA | 6.56 *(WCTA) | RETA | 3.26 *(RETA) | GETA ( EBIT to TA) | 6.72 *(GETA) | EQTL | 1.05 *(EQTL) | ALTMAN'S Z'' SCORE |
|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.441 | 2.90 | 0.19 | 0.62 | 0.35 | 2.34 | (0.30) | (0.32) | 7.78 |
| Awash | 0.01 | 0.08 | 0.00 | 0.01 | 0.07 | 0.50 | 0.78 | 0.81 | **1.51** |
| Global | 0.07 | 0.49 | 0.03 | 0.09 | 0.04 | 0.26 | 5.03 | 5.28 | **6.12** |
| Nile | 0.004 | 0.03 | 0.03 | 0.09 | 0.03 | 0.20 | 0.49 | 0.52 | **0.84** |
| Nice | 0.05 | 0.35 | 0.06 | 0.21 | 0.07 | 0.46 | 0.38 | 0.40 | **1.42** |
| Africa | (0.41) | (2.70) | 0.05 | 0.15 | 0.05 | 0.36 | 0.78 | 0.82 | **(1.35)** |
| Nib | 0.25 | 1.64 | 0.20 | 0.66 | 0.21 | 1.39 | (0.59) | (0.62) | **3.06** |
| Nyala | 0.14 | 0.93 | 0.07 | 0.21 | 0.10 | 0.65 | 0.57 | 0.60 | **2.39** |
| UNIC | (0.05) | (0.33) | 0.07 | 0.23 | 0.07 | 0.48 | 1.13 | 1.19 | **1.57** |
| Oromia | 0.13 | 0.84 | 0.05 | 0.15 | 0.06 | 0.38 | 0.38 | 0.40 | **1.77** |
| Lion | (0.22) | (1.44) | 0.05 | 0.15 | 0.05 | 0.34 | 0.37 | 0.39 | **(0.56)** |
| Abbay | 0.25 | 1.62 | 0.11 | 0.34 | 0.15 | 1.00 | 0.71 | 0.74 | **3.70** |
| Birhan | 0.19 | 1.27 | (0.04) | (0.13) | (0.04) | (0.27) | 0.75 | 0.78 | **1.65** |
| Tsehay | 0.16 | 1.03 | 0.05 | 0.17 | 0.06 | 0.43 | 1.98 | 2.08 | **3.72** |

## 2. SPRINGATE'S Z SCORE

**Table B-6: Z Score of Springate's Model for year 2012**

| INSURANCE COMPANY | WC/TA | 1.03*(WC/TA) | EBIT/TA | 3.07*(EBIT/TA) | EBT/ C L | 0.66 *( EBT/ C L ) | Sales/ TA | 0.4 *( Sales/ TA ) | SPRINGATE'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|
| EIC | (0.06) | **(0.06)** | 0.11 | **0.33** | 0.13 | **0.08** | 0.17 | **0.07** | **0.43** |
| Awash | (0.03) | **(0.03)** | 0.07 | **0.23** | 0.11 | **0.07** | 0.10 | **0.04** | **0.31** |
| Global | (0.05) | **(0.06)** | 0.02 | **0.07** | 0.03 | **0.02** | 0.06 | **0.02** | **0.06** |
| Nile | 0.10 | **0.10** | 0.09 | **0.29** | 0.15 | **0.10** | 0.15 | **0.06** | **0.55** |
| Nice | 0.04 | **0.04** | 0.17 | **0.54** | 0.23 | **0.15** | 0.19 | **0.08** | **0.80** |
| Africa | (0.16) | **(0.16)** | 0.05 | **0.15** | 0.07 | **0.04** | 0.05 | **0.02** | **0.05** |
| Nib | 0.001 | **0.001** | 0.07 | **0.223** | 0.10 | **0.063** | 0.14 | **0.054** | **0.342** |
| Nyala | 0.17 | **0.18** | 0.16 | **0.49** | 0.30 | **0.20** | 0.22 | **0.09** | **0.96** |
| UNIC | 0.21 | **0.21** | 0.11 | **0.33** | 0.18 | **0.12** | 0.15 | **0.06** | **0.73** |
| Oromia | 0.09 | **0.09** | 0.06 | **0.20** | 0.08 | **0.05** | 0.09 | **0.03** | **0.38** |
| Lion | 0.05 | **0.05** | 0.10 | **0.31** | 0.13 | **0.09** | 0.17 | **0.07** | **0.52** |
| Abbay | 0.05 | **0.05** | (0.06) | **(0.18)** | (0.08) | **(0.05)** | 0.04 | **0.02** | **(0.16)** |
| Birhan | (0.01) | **(0.01)** | (0.11) | **(0.34)** | (0.17) | **(0.11)** | 0.07 | **0.03** | **(0.43)** |
| Tsehay | 0.34 | **0.35** | (0.10) | **(0.31)** | (0.46) | **(0.30)** | 0.01 | **0.00** | **(0.25)** |

**Table B-7: Z Score of Springate's Model for year 2013**

| INSURANCE COMPANY | WC/TA | 1.03*(WC/TA) | EBIT/TA | 3.07(EBIT/TA) | EBT/C L | 0.66 (EBT/C L ) | Sales/TA | 0.4 ( Sales/TA ) | SPRINGATE'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.15 | **0.15** | 0.13 | **0.40** | **0.20** | **0.13** | 0.17 | **0.07** | **0.75** |
| Awash | 0.06 | 0.06 | 0.13 | 0.40 | 0.20 | 0.13 | 0.15 | 0.06 | 0.66 |
| Global | 0.08 | 0.08 | 0.15 | 0.47 | 0.25 | 0.17 | 0.14 | 0.05 | 0.78 |
| Nile | 0.13 | 0.13 | 0.10 | 0.31 | 0.17 | 0.11 | 0.13 | 0.05 | 0.60 |
| Nice | 0.14 | 0.14 | 0.14 | 0.43 | 0.20 | 0.13 | 0.14 | 0.06 | 0.76 |
| Africa | (0.31) | (0.32) | 0.05 | 0.17 | 0.08 | 0.05 | 0.05 | 0.02 | (0.08) |
| Nib | 0.06 | 0.06 | 0.11 | 0.33 | 0.15 | 0.10 | 0.16 | 0.07 | 0.56 |
| Nyala | 0.14 | 0.14 | 0.15 | 0.45 | 0.25 | 0.16 | 0.19 | 0.08 | 0.84 |
| UNIC | 0.22 | 0.23 | 0.15 | 0.47 | 0.27 | 0.18 | 0.19 | 0.07 | 0.96 |
| Oromia | 0.10 | 0.10 | 0.11 | 0.33 | 0.14 | 0.09 | 0.12 | 0.05 | 0.58 |
| Lion | 0.13 | 0.14 | 0.10 | 0.31 | 0.15 | 0.10 | 0.14 | 0.06 | 0.60 |
| Abbay | 0.01 | 0.01 | (0.02) | (0.06) | (0.02) | (0.01) | 0.04 | 0.01 | (0.04) |
| Birhan | (0.002) | (0.002) | 0.04 | 0.13 | 0.06 | 0.04 | 0.18 | 0.07 | 0.24 |
| Tsehay | (0.01) | (0.01) | (0.17) | (0.53) | (0.21) | (0.14) | 0.00 | 0.00 | (0.68) |

**Table B-8: Z Score of Springate's Model for year 2014**

| INSRUANCE COMPANY | WC/TA | 1.03*(WC/TA) | EBIT/TA | 3.07(EBIT/TA) | EBT/ C L | 0.66 ( EBT/ C L ) | Sales/TA | 0.4 ( Sales/TA) | SPRINGATE'S SCORE |
|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.18 | 0.19 | 0.15 | 0.46 | 0.24 | 0.16 | 0.18 | 0.07 | **0.88** |
| Awash | 0.06 | 0.06 | 0.09 | 0.29 | 0.16 | 0.10 | 0.13 | 0.05 | **0.51** |
| Global | 0.19 | 0.20 | 0.16 | 0.50 | 0.30 | 0.20 | 0.13 | 0.05 | **0.94** |
| Nile | 0.16 | 0.16 | 0.11 | 0.32 | 0.18 | 0.12 | 0.12 | 0.05 | **0.65** |
| Nice | 0.09 | 0.09 | 0.07 | 0.22 | 0.09 | 0.06 | 0.46 | 0.19 | **0.56** |
| Africa | (0.11) | (0.11) | 0.07 | 0.21 | 0.10 | 0.07 | 0.09 | 0.04 | **0.21** |
| Nib | 0.10 | 0.10 | 0.11 | 0.33 | 0.16 | 0.11 | 0.13 | 0.05 | **0.59** |
| Nyala | 0.18 | 0.19 | 0.13 | 0.39 | 0.22 | 0.14 | 0.14 | 0.06 | **0.78** |
| UNIC | 0.01 | 0.01 | 0.13 | 0.41 | 0.24 | 0.16 | 0.16 | 0.06 | **0.64** |
| Oromia | 0.15 | 0.15 | 0.08 | 0.25 | 0.11 | 0.08 | 0.07 | 0.03 | **0.51** |
| Lion | (0.09) | (0.09) | 0.09 | 0.27 | 0.14 | 0.09 | 0.11 | 0.04 | **0.32** |
| Abbay | 0.18 | 0.19 | 0.20 | 0.63 | 0.29 | 0.19 | 0.26 | 0.10 | **1.11** |
| Birhan | 0.05 | 0.06 | 0.03 | 0.10 | 0.04 | 0.03 | 0.16 | 0.06 | **0.24** |
| Tsehay | 0.11 | 0.11 | 0.05 | 0.16 | 0.07 | 0.05 | 0.16 | 0.06 | **0.37** |

**Table B-9: Z Score of Springate's Model for year 2015**

| INSRUANCE COMPANY | WC/TA | 1.03*(WC/TA) | EBIT/TA | 3.07*(EBIT/TA) | EBT/ C L | 0.66* ( EBT/ C L ) | Sales/TA | 0.4 *(Sales/TA ) | SPRINGATE'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.16 | 0.16 | 0.15 | 0.46 | 0.23 | 0.15 | 0.17 | 0.07 | **0.83** |
| Awash | 0.05 | 0.05 | 0.10 | 0.30 | 0.16 | 0.11 | 0.12 | 0.05 | **0.51** |
| Global | 0.29 | 0.30 | 0.14 | 0.42 | 0.29 | 0.19 | 0.10 | 0.04 | **0.96** |
| Nile | 0.17 | 0.18 | 0.08 | 0.23 | 0.13 | 0.09 | 0.13 | 0.05 | **0.55** |
| Nice | 0.14 | 0.15 | 0.39 | 1.21 | 0.58 | 0.38 | 0.46 | 0.18 | **1.92** |
| Africa | (0.36) | (0.37) | 0.06 | 0.18 | 0.10 | 0.07 | 0.02 | 0.01 | **(0.11)** |
| Nib | 0.10 | 0.10 | 0.07 | 0.22 | 0.11 | 0.08 | 0.12 | 0.05 | **0.44** |
| Nyala | 0.16 | 0.17 | 0.11 | 0.34 | 0.17 | 0.11 | 0.12 | 0.05 | **0.67** |
| UNIC | (0.06) | (0.06) | 0.11 | 0.35 | 0.23 | 0.15 | 0.17 | 0.07 | **0.51** |
| Oromia | 0.14 | 0.15 | 0.11 | 0.35 | 0.16 | 0.11 | 0.12 | 0.05 | **0.65** |
| Lion | (0.13) | (0.13) | 0.08 | 0.25 | 0.12 | 0.08 | 0.14 | 0.06 | **0.25** |
| Abbay | 0.27 | 0.27 | 0.14 | 0.43 | 0.23 | 0.15 | 0.17 | 0.07 | **0.93** |
| Birhan | 0.25 | 0.25 | 0.03 | 0.11 | 0.06 | 0.04 | 0.13 | 0.05 | **0.45** |
| Tsehay | 0.18 | 0.18 | 0.08 | 0.26 | 0.13 | 0.08 | 0.15 | 0.06 | **0.59** |

**Table B-10: Z Score of Springate's Model for year 2016**

| INSRANCE COMPANY | WC/TA | 1.03* (WC/TA) | EBIT/TA | 3.07* (EBIT/TA) | EBT/ C L | 0.66 * (EBT/C L) | Sales/TA | 0.4* ( Sales/TA ) | SPRINGATE'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.19 | **0.19** | 0.15 | **0.46** | **0.24** | **0.16** | 0.16 | **0.07** | **0.88** |
| Awash | 0.01 | 0.01 | 0.08 | 0.23 | 0.13 | 0.09 | 0.11 | 0.04 | **0.38** |
| Global | 0.23 | 0.23 | 0.12 | 0.36 | 0.24 | 0.16 | 0.08 | 0.03 | **0.79** |
| Nile | 0.00 | 0.00 | 0.03 | 0.08 | 0.05 | 0.03 | 0.09 | 0.03 | **0.15** |
| Nice | 0.05 | 0.05 | 0.07 | 0.21 | 0.09 | 0.06 | 0.51 | 0.20 | **0.53** |
| Africa | (0.41) | (0.42) | 0.05 | 0.17 | 0.10 | 0.06 | 0.01 | 0.00 | **(0.19)** |
| Nib | 0.06 | 0.07 | 0.05 | 0.16 | 0.09 | 0.06 | 0.10 | 0.04 | **0.32** |
| Nyala | 0.14 | 0.15 | 0.10 | 0.30 | 0.15 | 0.10 | 0.28 | 0.11 | **0.66** |
| UNIC | (0.05) | (0.05) | 0.07 | 0.22 | 0.15 | 0.10 | 0.11 | 0.04 | **0.31** |
| Oromia | 0.13 | 0.13 | 0.06 | 0.17 | 0.08 | 0.05 | 0.05 | 0.02 | **0.37** |
| Lion | (0.22) | (0.23) | 0.05 | 0.15 | 0.07 | 0.05 | 0.09 | 0.04 | **0.01** |
| Abbay | 0.25 | 0.25 | 0.15 | 0.46 | 0.25 | 0.17 | 0.17 | 0.07 | **0.95** |
| Birhan | 0.19 | 0.20 | (0.04) | (0.12) | (0.07) | (0.05) | 0.03 | 0.01 | **0.04** |
| Tsehay | 0.16 | 0.16 | 0.06 | 0.20 | 0.10 | 0.06 | 0.05 | 0.02 | **0.45** |

## 3. WONDIM'S Z SCORE

**Table B-11: Z Score of Wondim's Model for year 2012**

| INSRUANCE COMPANY | WCTA | 0.0165 (X1) | RETA | 0.0229 (X2) | GETA ( EBIT to TA) | 0.0344 (X3) | EQTL | 0.0068 (X4 | Sales/ TA | 0.0032 (X5) | WONDIM'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EIC | (0.06) | (0.001) | 0.1058 | 0.002 | 0.1074 | 0.004 | 0.1684 | 0.001 | 0.17 | 0.001 | **0.007** |
| Awash | (0.03) | (0.00) | 0.002 | 0.00 | 0.07 | 0.00 | 0.41 | 0.00 | 0.09 | 0.0003 | **0.005** |
| Global | (0.05) | (0.00) | 0.02 | 0.0004 | 0.02 | 0.001 | 0.47 | 0.003 | 0.06 | 0.0002 | **0.004** |
| Nile | 0.10 | 0.002 | 0.09 | 0.002 | 0.09 | 0.003 | 0.65 | 0.004 | 0.14 | 0.0004 | **0.012** |
| Nice | 0.04 | 0.001 | 0.11 | 0.002 | 0.17 | 0.01 | 0.33 | 0.002 | 0.19 | 0.001 | **0.012** |
| Africa | (0.16) | (0.003) | 0.04 | 0.001 | 0.05 | 0.002 | 0.36 | 0.00 | 0.05 | 0.0002 | **0.003** |
| Nib | 0.001 | 0.00002 | 0.05 | 0.001 | 0.07 | 0.003 | 0.32 | 0.00 | 0.13 | 0.0004 | **0.006** |
| Nyala | 0.17 | 0.003 | 0.11 | 0.003 | 0.16 | 0.01 | 0.91 | 0.01 | 0.19 | 0.001 | **0.018** |
| UNIC | 0.21 | 0.003 | 0.07 | 0.002 | 0.11 | 0.004 | 0.71 | 0.005 | 0.13 | 0.0004 | **0.014** |
| Oromia | 0.09 | 0.001 | 0.00 | 0.00 | 0.06 | 0.002 | 0.27 | 0.002 | 0.09 | 0.0003 | **0.006** |
| Lion | 0.05 | 0.001 | 0.00 | 0.00 | 0.10 | 0.003 | 0.29 | 0.002 | 0.17 | 0.001 | **0.007** |
| Abbay | 0.05 | 0.001 | (0.08) | (0.002) | (0.06) | (0.002) | 0.27 | 0.002 | 0.04 | 0.0001 | **(0.001)** |
| Birhan | (0.01) | (0.0001) | (0.11) | (0.003) | (0.11) | (0.004) | 0.49 | 0.003 | 0.07 | 0.00 | **(0.003)** |
| Tsehay | 0.34 | 0.01 | 0.00 | 0.00 | (0.11) | (0.004) | 0.31 | 0.002 | 0.01 | 0.00002 | **0.004** |

**Table B-12: Z Score of Wondim's Model for year 2013**

| INSURANCE COMPANY | WCTA | 0.0165 (X1) | RETA | 0.0229 (X2) | GETA ( EBIT to TA) | 0.0344 (X3) | EQTL | 0.0068 (X4) | Sales/ TA | 0.0032 (X5) | WONDIM'S SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.149 | 0.002 | 0.114 | 0.003 | 0.131 | 0.004 | 0.495 | 0.003 | 0.166 | 0.001 | **0.013** |
| Awash | 0.063 | 0.001 | 0.089 | 0.002 | 0.130 | 0.004 | 0.592 | 0.004 | 0.126 | 0.0004 | **0.012** |
| Global | 0.082 | 0.001 | 0.095 | 0.002 | 0.154 | 0.005 | 0.544 | 0.004 | 0.136 | 0.0004 | **0.013** |
| Nile | 0.128 | 0.002 | 0.092 | 0.002 | 0.100 | 0.003 | 0.652 | 0.004 | 0.117 | 0.0004 | **0.012** |
| Nice | 0.140 | 0.002 | 0.095 | 0.002 | 0.139 | 0.005 | 0.445 | 0.003 | 0.140 | 0.0004 | **0.013** |
| Africa | (0.312) | (0.005) | 0.053 | 0.001 | 0.054 | 0.002 | 0.450 | 0.003 | 0.043 | 0.0001 | **0.001** |
| Nib | 0.062 | 0.001 | 0.00 | 0.00 | 0.107 | 0.004 | 0.411 | 0.003 | 0.155 | 0.0005 | **0.008** |
| Nyala | 0.141 | 0.002 | 0.108 | 0.002 | 0.148 | 0.005 | 0.683 | 0.005 | 0.169 | 0.001 | **0.015** |
| UNIC | 0.223 | 0.004 | 0.105 | 0.002 | 0.153 | 0.005 | 0.787 | 0.005 | 0.163 | 0.001 | **0.017** |
| Oromia | 0.102 | 0.002 | 0.078 | 0.002 | 0.107 | 0.004 | 0.342 | 0.002 | 0.121 | 0.000 | **0.010** |
| Lion | 0.132 | 0.002 | 0.073 | 0.002 | 0.102 | 0.004 | 0.423 | 0.003 | 0.142 | 0.000 | **0.011** |
| Abbay | 0.014 | 0.000 | (0.057) | (0.001) | (0.019) | (0.001) | 0.136 | 0.001 | 0.036 | 0.0001 | **(0.001)** |
| Birhan | (0.002) | (0.00004) | (0.035) | (0.001) | 0.043 | 0.001 | 0.391 | 0.003 | 0.185 | 0.001 | **0.004** |
| Tsehay | (0.009) | (0.0001) | (0.205) | (0.005) | (0.174) | (0.006) | 4.943 | 0.034 | (0.037) | (0.0001) | **0.023** |

**Table B-13: Z Score of Wondim's Model for year 2014**

| INSURANCE COMPANY | WCTA | 0.0165 (X1) | RETA | 0.0229 (X2) | GETA ( EBIT to TA) | 0.0344 (X3) | EQTL | 0.0068 (X4) | Sales/ TA | 0.0032 (X5) | WONDIM'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.183 | **0.003** | 0.131 | **0.003** | 0.151 | **0.005** | 0.525 | **0.004** | **0.179** | **0.000** | **0.015** |
| Awash | 0.062 | 0.001 | 0.004 | 0.000 | 0.094 | 0.003 | 0.722 | 0.005 | 0.108 | 0.000 | **0.010** |
| Global | 0.189 | 0.003 | 0.115 | 0.003 | 0.163 | 0.006 | 0.755 | 0.005 | 0.134 | 0.000 | **0.017** |
| Nile | 0.155 | 0.003 | 0.091 | 0.002 | 0.106 | 0.004 | 0.675 | 0.005 | 0.108 | 0.000 | **0.013** |
| Nice | 0.091 | 0.001 | 0.056 | 0.001 | 0.070 | 0.002 | 0.358 | 0.002 | 0.463 | 0.001 | **0.009** |
| Africa | (0.105) | (0.002) | 0.051 | 0.001 | 0.068 | 0.002 | 0.517 | 0.004 | 0.079 | 0.000 | **0.006** |
| Nib | 0.101 | 0.002 | 0.078 | 0.002 | 0.109 | 0.004 | 0.484 | 0.003 | 0.121 | 0.000 | **0.011** |
| Nyala | 0.184 | 0.003 | 0.096 | 0.002 | 0.126 | 0.004 | 0.721 | 0.005 | 0.126 | 0.000 | **0.015** |
| UNIC | 0.007 | 0.000 | 0.096 | 0.002 | 0.134 | 0.005 | 0.825 | 0.006 | 0.138 | 0.000 | **0.013** |
| Oromia | 0.150 | 0.002 | 0.059 | 0.001 | 0.081 | 0.003 | 0.416 | 0.003 | 0.071 | 0.000 | **0.010** |
| Lion | (0.086) | (0.001) | 0.069 | 0.002 | 0.088 | 0.003 | 0.554 | 0.004 | 0.110 | 0.000 | **0.007** |
| Abbay | 0.181 | 0.003 | 0.121 | 0.003 | 0.205 | 0.007 | 0.420 | 0.003 | 0.257 | 0.001 | **0.016** |
| Birhan | 0.054 | 0.001 | (0.004) | (0.0001) | 0.032 | 0.001 | 0.471 | 0.003 | 0.158 | 0.001 | **0.006** |
| Tsehay | 0.105 | 0.002 | (0.073) | (0.002) | 0.051 | 0.002 | 2.445 | 0.017 | 0.160 | 0.001 | **0.019** |

**Table B-14: Z Score of Wondim's Model for year 2015**

| INSURANCE COMPANY | WCTA | 0.0165 (X1) | RETA | 0.0229 (X2) | GETA ( EBIT to TA) | 0.0344 (X3) | EQTL | 0.0068 (X4) | Sales/ TA | 0.0032 (X5) | WONDIM'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.156 | 0.003 | 0.036 | 0.001 | 0.149 | 0.005 | 0.522 | 0.004 | 0.168 | 0.000 | **0.012** |
| Awash | 0.049 | 0.001 | 0.003 | 0.000 | 0.097 | 0.003 | 0.716 | 0.005 | 0.102 | 0.000 | **0.009** |
| Global | 0.293 | 0.005 | 0.098 | 0.002 | 0.138 | 0.005 | 1.048 | 0.007 | 0.098 | 0.000 | **0.019** |
| Nile | 0.172 | 0.003 | 0.065 | 0.001 | 0.076 | 0.003 | 0.747 | 0.005 | 0.116 | 0.000 | **0.012** |
| Nice | 0.141 | 0.002 | 0.090 | 0.002 | 0.394 | 0.014 | 0.475 | 0.003 | 0.462 | 0.001 | **0.023** |
| Africa | (0.361) | (0.006) | 0.047 | 0.001 | 0.060 | 0.002 | 0.669 | 0.005 | 0.017 | 0.000 | **0.002** |
| Nib | 0.097 | 0.002 | 0.059 | 0.001 | 0.072 | 0.002 | 0.467 | 0.003 | 0.102 | 0.000 | **0.009** |
| Nyala | 0.162 | 0.003 | 0.086 | 0.002 | 0.110 | 0.004 | 0.572 | 0.004 | 0.110 | 0.000 | **0.013** |
| UNIC | (0.058) | (0.001) | 0.078 | 0.002 | 0.113 | 0.004 | 1.053 | 0.007 | 0.142 | 0.000 | **0.012** |
| Oromia | 0.142 | 0.002 | 0.082 | 0.002 | 0.115 | 0.004 | 0.425 | 0.003 | 0.116 | 0.000 | **0.011** |
| Lion | (0.128) | (0.002) | 0.070 | 0.002 | 0.081 | 0.003 | 0.476 | 0.003 | 0.138 | 0.0004 | **0.006** |
| Abbay | 0.265 | 0.004 | 0.103 | 0.002 | 0.140 | 0.005 | 0.669 | 0.005 | 0.174 | 0.001 | **0.017** |
| Birhan | 0.246 | 0.004 | 0.028 | 0.001 | 0.035 | 0.001 | 0.830 | 0.006 | 0.134 | 0.000 | **0.012** |
| Tsehay | 0.179 | 0.003 | 0.029 | 0.001 | 0.084 | 0.003 | 1.892 | 0.013 | 0.150 | 0.0005 | **0.020** |

**Table B-15: Z Score of Wondim's Model for year 2016**

| INSRUANCE COMPANY | WCTA | 0.0165 (X1) | RETA | 0.0229 (X2) | GETA ( EBIT to TA) | 0.0344 (X3) | EQTL | 0.0068 (X4) | Sales/ TA | 0.0032 (X5) | WONIDM'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.189 | 0.003 | 0.056 | 0.001 | 0.149 | 0.005 | 0.632 | 0.004 | 0.165 | 0.000 | 0.014 |
| Awash | 0.013 | 0.0002 | 0.002 | 0.0001 | 0.076 | 0.003 | 0.735 | 0.005 | 0.092 | 0.000 | 0.008 |
| Global | 0.075 | 0.001 | 0.027 | 0.001 | 0.039 | 0.001 | 5.026 | 0.034 | 0.027 | 0.000 | 0.037 |
| Nile | 0.004 | 0.000 | 0.027 | 0.001 | 0.030 | 0.001 | 0.491 | 0.003 | 0.085 | 0.000 | 0.005 |
| Nice | 0.053 | 0.001 | 0.064 | 0.001 | 0.068 | 0.002 | 0.390 | 0.003 | 0.506 | 0.002 | 0.009 |
| Africa | (0.411) | (0.007) | 0.047 | 0.001 | 0.054 | 0.002 | 0.783 | 0.005 | 0.010 | 0.000 | 0.002 |
| Nib | 0.250 | 0.004 | 0.201 | 0.005 | 0.206 | 0.007 | (0.589) | (0.004) | 0.365 | 0.001 | 0.013 |
| Nyala | 0.141 | 0.002 | 0.066 | 0.002 | 0.097 | 0.003 | 0.568 | 0.004 | 0.249 | 0.001 | 0.012 |
| UNIC | (0.050) | (0.001) | 0.070 | 0.002 | 0.072 | 0.002 | 1.131 | 0.008 | 0.091 | 0.000 | 0.011 |
| Oromia | 0.128 | 0.002 | 0.047 | 0.001 | 0.056 | 0.002 | 0.384 | 0.003 | 0.046 | 0.000 | 0.008 |
| Lion | (0.220) | (0.004) | 0.046 | 0.001 | 0.050 | 0.002 | 0.368 | 0.003 | 0.088 | 0.0003 | 0.002 |
| Abbay | 0.247 | 0.004 | 0.106 | 0.002 | 0.149 | 0.005 | 0.705 | 0.005 | 0.168 | 0.001 | 0.017 |
| Birhan | 0.193 | 0.003 | (0.041) | (0.001) | (0.040) | (0.001) | 0.746 | 0.005 | 0.033 | 0.000 | 0.006 |
| Tsehay | 0.158 | 0.003 | 0.053 | 0.001 | 0.064 | 0.002 | 1.978 | 0.013 | 0.054 | 0.000 | 0.020 |

## 4. Z SCORE OF FUFA'S MODEL

**Table B-16: Z Score of Fufa's Model for year 2012**

| INSURANCE COMPANY | WCTA | 0.4545 (X1) | RETA | 0.4056 (X2) | GETA ( EBIT to TA) | 2.2872 (X3) | EQTL | 0.0660 (X4) | Sales/ TA | 0.4648 (X5) | FUFA'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EIC | (0.056) | (0.025) | 0.106 | 0.043 | 0.107 | 0.246 | 0.168 | 0.011 | 0.165 | 0.077 | **0.368** |
| Awash | (0.027) | (0.012) | 0.002 | 0.001 | 0.074 | 0.169 | 0.414 | 0.027 | 0.090 | 0.042 | **0.243** |
| Global | (0.055) | (0.025) | 0.016 | 0.006 | 0.024 | 0.055 | 0.467 | 0.031 | 0.058 | 0.027 | **0.111** |
| Nile | 0.102 | 0.046 | 0.089 | 0.036 | 0.094 | 0.215 | 0.646 | 0.043 | 0.136 | 0.063 | **0.419** |
| Nice | 0.039 | 0.018 | 0.109 | 0.044 | 0.174 | 0.399 | 0.331 | 0.022 | 0.189 | 0.088 | **0.587** |
| Africa | **(0.157)** | (0.071) | 0.042 | 0.017 | 0.048 | 0.110 | 0.356 | 0.024 | 0.048 | 0.022 | **0.118** |
| Nib | 0.001 | 0.001 | 0.050 | 0.020 | 0.073 | 0.166 | 0.318 | 0.021 | 0.129 | 0.060 | **0.285** |
| Nyala | 0.173 | 0.078 | 0.113 | 0.046 | 0.160 | 0.366 | 0.908 | 0.060 | 0.187 | 0.087 | **0.654** |
| UNIC | 0.208 | 0.095 | 0.075 | 0.030 | 0.108 | 0.247 | 0.706 | 0.047 | 0.130 | 0.060 | **0.496** |
| Oromia | 0.090 | 0.041 | 0.000 | 0.000 | 0.064 | 0.147 | 0.270 | 0.018 | 0.086 | 0.040 | **0.262** |
| Lion | 0.049 | 0.022 | 0.000 | 0.000 | 0.101 | 0.232 | 0.292 | 0.019 | 0.173 | 0.080 | **0.370** |
| Abbay | 0.049 | 0.022 | (0.077) | (0.031) | (0.057) | (0.131) | 0.269 | 0.018 | 0.038 | 0.018 | **(0.088)** |
| Birhan | (0.008) | (0.004) | (0.113) | (0.046) | (0.110) | (0.252) | 0.488 | 0.032 | 0.071 | 0.033 | **(0.220)** |
| Tsehay | 0.343 | 0.156 | 0.000 | 0.000 | (0.109) | (0.248) | 0.309 | 0.020 | 0.006 | 0.003 | **(0.053)** |

**Table B-17: Z Score of Fufa's Model for year 2013**

| INSURANCE COMPANY | WCTA | 0.4545 (X1) | RETA | 0.4056 (X2) | GETA ( EBIT to TA) | 2.2872 (X3) | EQTL | 0.0660 (X4) | Sales/ TA | 0.4648 (X5) | FUFA'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.149 | 0.068 | 0.114 | 0.046 | 0.131 | 0.299 | 0.495 | 0.033 | 0.166 | 0.077 | **0.541** |
| Awash | 0.063 | 0.029 | 0.089 | 0.036 | 0.130 | 0.296 | 0.592 | 0.039 | 0.126 | 0.059 | **0.477** |
| Global | 0.082 | 0.037 | 0.095 | 0.039 | 0.154 | 0.352 | 0.544 | 0.036 | 0.136 | 0.063 | **0.546** |
| Nile | 0.128 | 0.058 | 0.092 | 0.037 | 0.100 | 0.229 | 0.652 | 0.043 | 0.117 | 0.055 | **0.441** |
| Nice | 0.140 | 0.064 | 0.095 | 0.038 | 0.139 | 0.319 | 0.445 | 0.029 | 0.140 | 0.065 | **0.534** |
| Africa | (0.312) | (0.142) | 0.053 | 0.022 | 0.054 | 0.124 | 0.450 | 0.030 | 0.043 | 0.020 | **0.073** |
| Nib | 0.062 | 0.028 | 0.00 | 0.00 | 0.107 | 0.245 | 0.411 | 0.027 | 0.155 | 0.072 | **0.391** |
| Nyala | 0.141 | 0.064 | 0.108 | 0.044 | 0.148 | 0.337 | 0.683 | 0.045 | 0.169 | 0.078 | **0.588** |
| UNIC | 0.223 | 0.101 | 0.105 | 0.042 | 0.153 | 0.351 | 0.787 | 0.052 | 0.163 | 0.076 | **0.641** |
| Oromia | 0.102 | 0.046 | 0.078 | 0.032 | 0.107 | 0.245 | 0.342 | 0.023 | 0.121 | 0.056 | **0.421** |
| Lion | 0.132 | 0.060 | 0.073 | 0.030 | 0.102 | 0.233 | 0.423 | 0.028 | 0.142 | 0.066 | **0.436** |
| Abbay | 0.014 | 0.006 | (0.057) | (0.023) | (0.019) | (0.044) | 0.136 | 0.009 | 0.036 | 0.017 | **(0.016)** |
| Birhan | (0.002) | (0.001) | (0.035) | (0.014) | 0.043 | 0.099 | 0.391 | 0.026 | 0.185 | 0.086 | **0.215** |
| Tsehay | (0.009) | (0.004) | (0.205) | (0.083) | (0.174) | (0.398) | 4.943 | 0.326 | (0.037) | (0.017) | **(0.157)** |

**Table B-18: Z Score of Fufa's Model for year 2014**

| INSURANCE COMPANY | WCTA | 0.4545 (X1) | RETA | 0.4056 (X2) | GETA ( EBIT to TA) | 2.2872 (X3) | EQTL | 0.0660 (X4) | Sales/ TA | 0.4648 (X5) | FUFA'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.183 | 0.083 | 0.131 | 0.053 | 0.151 | 0.346 | 0.525 | 0.035 | 0.179 | 0.083 | **0.619** |
| Awash | 0.062 | 0.028 | 0.004 | 0.001 | 0.094 | 0.214 | 0.722 | 0.048 | 0.108 | 0.050 | **0.361** |
| Global | 0.189 | 0.086 | 0.115 | 0.047 | 0.163 | 0.372 | 0.755 | 0.050 | 0.134 | 0.062 | **0.636** |
| Nile | 0.155 | 0.071 | 0.091 | 0.037 | 0.106 | 0.242 | 0.675 | 0.045 | 0.108 | 0.050 | **0.463** |
| Nice | 0.091 | 0.041 | 0.056 | 0.023 | 0.070 | 0.161 | 0.358 | 0.024 | 0.463 | 0.215 | **0.482** |
| Africa | (0.105) | (0.048) | 0.051 | 0.021 | 0.068 | 0.156 | 0.517 | 0.034 | 0.079 | 0.036 | **0.219** |
| Nib | 0.101 | 0.046 | 0.078 | 0.032 | 0.109 | 0.249 | 0.484 | 0.032 | 0.121 | 0.056 | **0.434** |
| Nyala | 0.184 | 0.084 | 0.096 | 0.039 | 0.126 | 0.288 | 0.721 | 0.048 | 0.126 | 0.059 | **0.536** |
| UNIC | 0.007 | 0.003 | 0.096 | 0.039 | 0.134 | 0.307 | 0.825 | 0.054 | 0.138 | 0.064 | **0.486** |
| Oromia | 0.150 | 0.068 | 0.059 | 0.024 | 0.081 | 0.186 | 0.416 | 0.027 | 0.071 | 0.033 | **0.357** |
| Lion | (0.086) | (0.039) | 0.069 | 0.028 | 0.088 | 0.201 | 0.554 | 0.037 | 0.110 | 0.051 | **0.297** |
| Abbay | 0.181 | 0.082 | 0.121 | 0.049 | 0.205 | 0.468 | 0.420 | 0.028 | 0.257 | 0.119 | **0.765** |
| Birhan | 0.054 | 0.024 | (0.004) | (0.002) | 0.032 | 0.073 | 0.471 | 0.031 | 0.158 | 0.073 | **0.219** |
| Tsehay | 0.105 | 0.048 | (0.073) | (0.030) | 0.051 | 0.116 | 2.445 | 0.161 | 0.160 | 0.074 | **0.389** |

**Table B-19: Z Score of Fufa's Model for year 2015**

| INSURANCE COMPANY | WCTA | 0.4545 (X1) | RETA | 0.4056 (X2) | GETA ( EBIT to TA) | 2.2872 (X3) | EQTL | 0.0660 (X4) | Sales/ TA | 0.4648 (X5) | FUFA'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.156 | 0.071 | 0.036 | 0.015 | 0.149 | 0.340 | 0.522 | 0.034 | 0.168 | 0.078 | **0.557** |
| Awash | 0.049 | 0.022 | 0.003 | 0.001 | 0.097 | 0.222 | 0.716 | 0.047 | 0.102 | 0.047 | **0.359** |
| Global | 0.293 | 0.133 | 0.098 | 0.040 | 0.138 | 0.317 | 1.048 | 0.069 | 0.098 | 0.046 | **0.623** |
| Nile | 0.172 | 0.078 | 0.065 | 0.026 | 0.076 | 0.174 | 0.747 | 0.049 | 0.116 | 0.054 | **0.401** |
| Nice | 0.141 | 0.064 | 0.090 | 0.036 | 0.394 | 0.901 | 0.475 | 0.031 | 0.462 | 0.215 | **1.267** |
| Africa | (0.361) | (0.164) | 0.047 | 0.019 | 0.060 | 0.137 | 0.669 | 0.044 | 0.017 | 0.008 | **0.063** |
| Nib | 0.097 | 0.044 | 0.059 | 0.024 | 0.072 | 0.165 | 0.467 | 0.031 | 0.102 | 0.048 | **0.330** |
| Nyala | 0.162 | 0.074 | 0.086 | 0.035 | 0.110 | 0.252 | 0.572 | 0.038 | 0.110 | 0.051 | **0.468** |
| UNIC | (0.058) | (0.026) | 0.078 | 0.032 | 0.113 | 0.259 | 1.053 | 0.069 | 0.142 | 0.066 | **0.419** |
| Oromia | 0.142 | 0.065 | 0.082 | 0.033 | 0.115 | 0.262 | 0.425 | 0.028 | 0.116 | 0.054 | **0.461** |
| Lion | (0.128) | (0.058) | 0.070 | 0.028 | 0.081 | 0.186 | 0.476 | 0.031 | 0.138 | 0.064 | **0.270** |
| Abbay | 0.265 | 0.121 | 0.103 | 0.042 | 0.140 | 0.320 | 0.669 | 0.044 | 0.174 | 0.081 | **0.627** |
| Birhan | 0.246 | 0.112 | 0.028 | 0.012 | 0.035 | 0.080 | 0.830 | 0.055 | 0.134 | 0.062 | **0.339** |
| Tsehay | 0.179 | 0.082 | 0.029 | 0.012 | 0.084 | 0.192 | 1.892 | 0.125 | 0.150 | 0.070 | **0.499** |

**Table B-20: Z Score of Fufa's Model for year 2016**

| INSURANCE COMPANY | WCTA | 0.4545 (X1) | RETA | 0.4056 (X2) | GETA ( EBIT to TA) | 2.2872 (X3) | EQTL | 0.0660 (X4) | Sales/ TA | 0.4648 (X5) | FUFA'S Z SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EIC | 0.189 | 0.086 | 0.056 | 0.023 | 0.149 | 0.342 | 0.632 | 0.042 | 0.165 | 0.076 | **0.588** |
| Awash | 0.013 | 0.006 | 0.002 | 0.001 | 0.076 | 0.175 | 0.735 | 0.048 | 0.092 | 0.043 | **0.292** |
| Global | 0.075 | 0.034 | 0.027 | 0.011 | 0.039 | 0.089 | 5.026 | 0.332 | 0.027 | 0.013 | **0.497** |
| Nile | 0.004 | 0.002 | 0.027 | 0.011 | 0.030 | 0.069 | 0.491 | 0.032 | 0.085 | 0.039 | **0.173** |
| Nice | 0.053 | 0.024 | 0.064 | 0.026 | 0.068 | 0.155 | 0.390 | 0.026 | 0.506 | 0.235 | **0.485** |
| Africa | (0.411) | (0.187) | 0.047 | 0.019 | 0.054 | 0.124 | 0.783 | 0.052 | 0.010 | 0.005 | **0.032** |
| Nib | 0.250 | 0.114 | 0.201 | 0.081 | 0.206 | 0.472 | (0.589) | (0.039) | 0.365 | 0.170 | **0.817** |
| Nyala | 0.141 | 0.064 | 0.066 | 0.027 | 0.097 | 0.222 | 0.568 | 0.037 | 0.249 | 0.116 | **0.485** |
| UNIC | (0.050) | (0.023) | 0.070 | 0.028 | 0.072 | 0.164 | 1.131 | 0.075 | 0.091 | 0.042 | **0.305** |
| Oromia | 0.128 | 0.058 | 0.047 | 0.019 | 0.056 | 0.128 | 0.384 | 0.025 | 0.046 | 0.021 | **0.271** |
| Lion | (0.220) | (0.100) | 0.046 | 0.019 | 0.050 | 0.115 | 0.368 | 0.024 | 0.088 | 0.041 | **0.118** |
| Abbay | 0.247 | 0.112 | 0.106 | 0.043 | 0.149 | 0.340 | 0.705 | 0.047 | 0.168 | 0.078 | **0.639** |
| Birhan | 0.193 | 0.088 | (0.041) | (0.017) | (0.040) | (0.090) | 0.746 | 0.049 | 0.033 | 0.015 | **0.064** |
| Tsehay | 0.158 | 0.072 | 0.053 | 0.021 | 0.064 | 0.147 | 1.978 | 0.131 | 0.054 | 0.025 | **0.415** |

# APPENDIX C

## SUMMARY OF CLASSIFICATION RESULTS OF THE FOUR MODELS

**Table C-1: Summary of Prediction Results of the four models on Ethiopian Insurance Companies for the Period of 2012 to 2016**

| Sampled Insurance Companies | Alman | | | | | Springate | | | | | Wondim | | | | | Fufa | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 2015 | 2014 | 2013 | 2012 | 2016 | 2015 | 2014 | 2013 | 2012 | 2016 | 2015 | 2014 | 2013 | 2012 | 2016 | 2015 | 2014 | 2013 | 2012 |
| EIC | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | No | No | No | No | No | No | No | No | No | No | No | No |
| Awash | Yes | Yes | Yes | Yes | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Global | Yes | Yes | Yes | Yes | No | No | Yes | Yes | No | No | Yes | Yes | Yes | No | No | No | No | No | No | No |
| Nile | No | Yes | Yes | Yes | Yes | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Nice | Yes | Yes | Yes | Yes | Yes | No | Yes | No | No | No | No | Yes | No | No | No | No | No | No | No | No |
| Africa | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Nib | Yes | Yes | Yes | Yes | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Nyala | Yes | Yes | Yes | Yes | Yes | No | No | No | No | Yes | No | No | No | No | Yes | No | No | No | No | No |
| UNIC | Yes | Yes | Yes | Yes | Yes | No | No | No | Yes | No | No | No | No | Yes | No | No | No | No | No | No |
| Oromia | Yes | Yes | Yes | Yes | Yes | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Lion | No | No | No | Yes | Yes | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Abbay | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No | No | No | No | No | No | No |
| Birhan | Yes | Yes | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Tsehay | Yes | Yes | Yes | No | Yes | No | No | No | No | No | Yes | Yes | Yes | Yes | No | No | No | No | No | No |

Note: 'Yes' denotes that the model has correctly predicted non-bankruptcy of companies; and 'No' denotes that the model has incorrectly predicted that the companies would not continue to operate in 2017.

Source: Compiled by the author, based on the Z score computed for each model.