

Addis Ababa
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BUSINESS FAILURE PREDICTION (BFP)

An Empirical Study on Ethiopian Private Enterprises

A thesis submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Masters of Business Administration (MBA in Finance)

By: Kisi Tafa Fufa

Advisor: Abebe Y. (Asst. Prof)

Addis Ababa University

College of Informatics, Management and Economic sciences

School of Business and Public Administration

MBA program

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Approved by the board of examiners

Advisor

Signature

Examiner

Signature

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Abstract

This study is an attempt to test and develop business failure prediction model for enterprises in Ethiopia using multivariate analyses. The study looked at the financial statements using a sample of ten failed and ten non-failed enterprises matched by industry and asset size from the recent 2005-2009 period and used five different financial ratios from liquidity, solvency, leverage, and profitability categories as classifying variables. It applied a revised Altman model developed for private companies to the sample and found that the performance of the model was not strong with successful classification rates of 70% and 65% one and two years prior to failure event respectively. Finally, using a stepwise MDA methodology, the study developed a new model that deemed to suitable in Ethiopian context and found that the model achieved considerable improvement in the successful classification rate that reached 85% and 70% one and two years prior to failure respectively.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

The prediction of company financial failure is of critical importance to all stakeholders. Each of those stakeholders, given their various roles would have somewhat different agendas but with the common objective being that the company has the best possible state of health and continues as a going concern into foreseeable future:

- **Creditors**- are interested in the company's ability to settle outstanding accounts.
- **Customers** – are interested in the company's ability to make future deliveries.
- **Investors**-are interested in the company's ability to provide expected return.
- **Employees**- are interested in the company's ability to provide stable employment.
- **Managements**- are interested in “ knowing what problems they are about to face”.(Eidleman 1995)

All these parties and others interested in continuous interest of building models that are meant to help predicting failure and thus alleviating its consequences on those groups and on the society at large. Hence, a model that could accurately predict business failure

in time would be quite useful to company stakeholders and it would be useful in aiding companies to determine their next strategy and future course of action. The widely used models for business failure prediction are:

- The linear probability model,
- The logit model,
- The probit model, and
- The multiple discriminant analysis.

The most popular of these models is Altman's model developed in 1968 and updated continuously (Altman, 2000). Practitioners as well as academicians are using this model throughout the world.

Altman's model is continuously developed and adjusted to suit current environment as well as the needs of the industry in which the research is conducted. The model has proven to be a reliable tool for failure prediction in variety of contexts and in different countries. However, such a study is little in Ethiopia.

Thus, it would be a worthwhile to look at how the widely used model originated in developed economy extends in less developed ones particularly in Ethiopia, and whether the models need modification in order to fit in the Ethiopian context.

1.2 Statement of the Problem

Currently there are numerous enterprises that have failed and are failing in Ethiopia. These events have a negative influence, both socially and economically on the country and the company as well.

Financial failure may take the form of bankruptcy or insolvency. Insolvency refers to where a firm is unable to meet its current obligations as and when they fall due. Financial statements are normally used to gauge the performance of the firm and its management. From the financial statements, various ratios can be calculated to assess the current performance and future prospects of the concerned firm. A research done by Odipo (2003) indicated that most financial institutions rely on almost exclusively on subject analyses to assess the credit risk on corporate loans. Bankers largely used subjective judgment to assess the current performance and future prospects of the concerned firm using traditional ratio analysis.

Failure prediction models have been proven necessary to obtain a more accurate assessment of a firm's financial situation. Although one could expect that independent auditors or other decision makers are able to make a correct assessment concerning the financial health of firms ('going concern'), research has shown that, in practice, they do not

perform as well as failure prediction models in classifying companies as failing (Altman and Saunders, 1998).

In the same way, almost all lending institutions in Ethiopia use subjective judgment to know the current status of debtor and manage the credits in progress or grants new credits meeting the demand of enterprises and its situation. One of the special financial institutions is Development Bank of Ethiopia (DBE). It is one of the government owned bank offers long term loans for economic and social activities at complete lending rates to both public and private sectors. The total loan provided the bank in the agriculture and industry private sector was 0.27 million Birr, and 0.72 million Birr for the years 2008/09 respectively. The total loan channeled into the agriculture sector increased to 2.51 million birr and loan channeled into the industry sector decreased to 0.47 at the end of year 2009/2010 as it can be seen from table 1.

Table 1: loan disbursement

Sector	2007/08	2008/09	2009/10	2010/11,plan
Agriculture:				
Public	207,249	8,528	131,255	750,000
Private	173,260	177,495	2,288,843	914,330
Cooperative	92,638	82,040	90,569	92,089
Sub total	473,147	268,063	2,510,666	1,756,419
Industry :				
Pubic	16,113	13,225	-	-
Private	220,968	705,671	47,758	1,549,330
micro enterprises	1,298	2,429	2,031	-
Sub total	238,379	721,325	49,789	1,549,330
Other service :				
public	-	-	-	-
private	175,658	158,990	98,696	96,082
RUFIP Micro	17,293	155,662	90,559	109,919
Sub total	192,951	314,652	189,255	206,001
Grand total	904,477	1,304,040	2,749,710	3,511,750

Source: DBE, loan disbursement: 2010/11 Operational plan

As illustrated in Table 1, the amount of fund that has been channeled into both sectors has expanded enormously as indicated (plan) in 2011.

Since the total loan provided in both sectors is huge, hence, any default in the repayment may result in a financial adversity impact in the country and on bank in particular. Default in payment may result from insolvency of these sectors/firms that undertake the loans. Though the creditors such as the banks and financial institutions have option to take legal actions against those firms, such as foreclosing on collateral, the actions entail much time and expenses. Therefore, the availability of an effective method that enables the creditors like banks to predict the failure of firms/debtors is necessary to help avoid huge loan losses.

The discriminant analysis model (MDA) is the most widely used model that help to identify future failure provide early warnings of future financial distress (Dragan, Ilija and Svetlana, 2011). Altman's model is continuously developed and adjusted to suit current environment as well as the needs of the industry in which the research is conducted. However, such a study is little in Ethiopia. Hence the fact that such study is not there in Ethiopia and the non-existence of model suitable to the Ethiopian context has pressed the start of this research work.

1.3 Research Hypothesis

H₀: Altman's z- score model is a strong model for predicting financial failure of private Enterprises in Ethiopia

H₁: Altman's z-score model is not a strong model for predicting financial failure of private enterprises in Ethiopia

1.4 Research Questions

This research seeks to investigate answers to following issues that are related to the main subject of the subject matter under study.

- Is Altman's z- score model a strong model for predicting financial failure of private enterprises in Ethiopia?
- Do the results of the model for the failed enterprises show similarity with what is obtained for non-failed enterprise?
- Which financial ratios are more related to financial failure?
- Does the model discriminate between failed and non-failed enterprises?

1.5 Objective of the Study

The general objectives of this study is to look at how the widely used model originated in developed economy extends in less developed ones particularly in Ethiopia, and to see whether the models need modification in order to fit in the Ethiopian context. The specific objectives are:

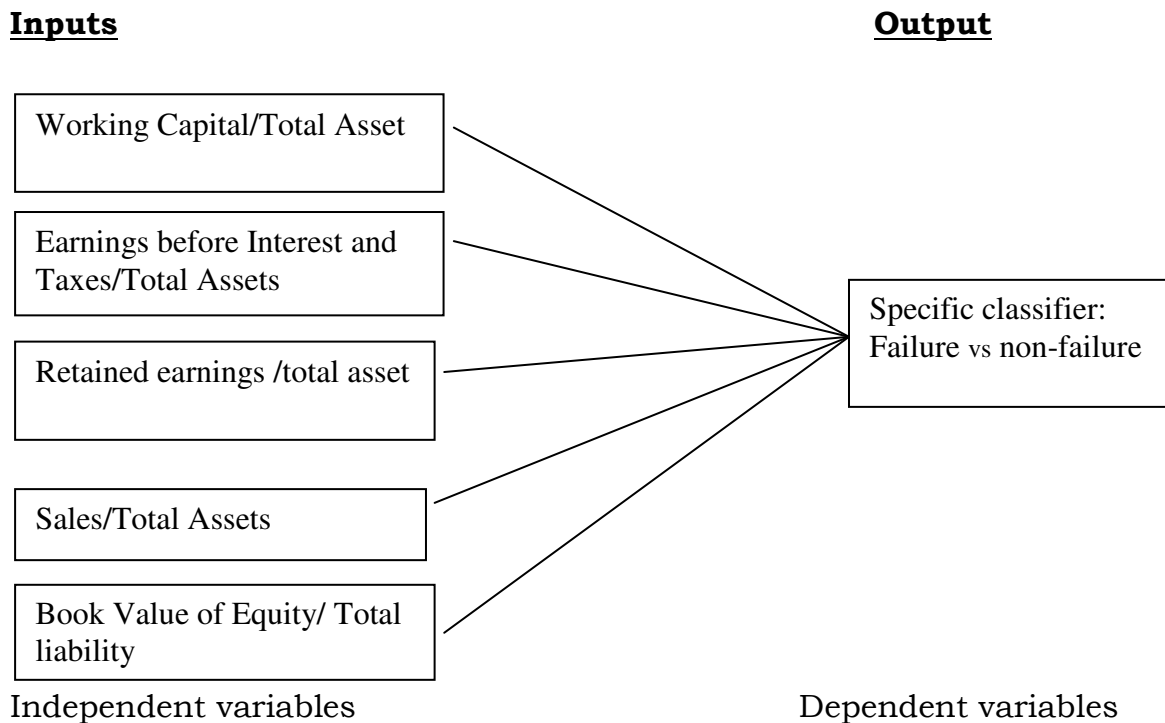
- ✓ To test the widely used model - Multiple Discriminant Analysis (MDA), z- score model using data from DBE for selected private enterprises in Addis Ababa.
- ✓ To develop a failure prediction model using Discriminant function Analysis using financial ratios that is applicable in the Ethiopian context.
- ✓ To see the relevant financial ratio(s) as the best predictor(s) in prediction of corporate failure in the context of Ethiopian selected private enterprises.

1.6 Research Framework

To achieve the objectives of this study, the data required are those of the discriminating variables that include: 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 (BV/TL) and sales to total asset (S/TA). These are obtained

from the annual audited financial statement and reports of DBE for each enterprise under assessment.

The relationship between the independent and dependent variables is shown as follows:



1.7 Definition of Terms

Corporate Failure: Several terms can be used to describe firms that appear to be in a fragile financial state. Different authors, such as Brealey (2001) and Ross et al (2002), describe distress, bankruptcy, or corporate failure as when:

1. The market value of assets of the firm is less than its total liabilities;
2. The firm is unable to pay debts when they come due;

3. The firm continues trading under court protection

Of these the inability to pay debts when they are due, has been the main concern in the majority of the early bankruptcy literature. However, the second definition of bankruptcy/failure is used for purpose this study.

Multiple Discriminant Analysis: is a statistical technique that classifies an observation into one of several groups; the latter representing the different states of the discrete response variable. Each group consists of a multivariate equation that is made up of one or more independent predictor variables, but with different co-efficient, that “best” discriminates between the groups.

Paired sample: is a sample in which a non-failed company is matched in asset size and industry classification to that of a failed company.

Step wise regression: performs regression by removing and adding variables, in order to identify a useful subset of the predictors. Three commonly used procedures are: standard stepwise (adds and removes variables), forward selection (adds variables), and backwards elimination (removes variables).

Test sample: is a sample of companies that is used to test the predictive accuracy of the model and to develop the statistical equation for the model.

1.8 Significance of the Study

The prediction of insolvency of future private enterprises is expected to provide a means to benefit the following groups. The output of the study is expected to draw pointed attention to managers, government, lending institutions, suppliers, employees and community at large while assessing the predictive accuracy of Altman's z score model and using the new model (that to be developed in the Ethiopian context). Particularly, lenders-who will normally have separately assessed the value of the enterprises comprising the security for their lending, and who will be using this prediction to form a view on the continued financial viability of the borrower and the continuing adequacy of the security.

Moreover, the researcher also believes that this study can potentially serve as a stepping stone for further research in the area.

1.9 Delimitation and Limitations of the Study

Although Private enterprises are scattered all over the country this study considers only those operating in Addis Ababa. The data set is limited to audited financial statements of 20 private enterprises 10 failed and 10 non- failed for the time period 2005-2009. The study is based on key financial ratios, as required by the Altman's z-score model, without considering such qualitative

factors as related to management, labor, market conditions and other macroeconomic and technical conditions that have an impact on enterprise performance.

This study is limited by a number of constraints. One, the objectivity of the data and information extracted from the financial statements. Two, in this study a relative small sample size is used. This is due to the problem of obtaining and getting access to financial data which in most cases are confidential. Third, all the steps involved in this research process will be completed within a short periods of time. These place a limit on the overall magnitude of the study.

1.10 Organization of the Study

In addition to the introductory chapter which tries to provide the overall about the study, this report consists of five chapters. In Chapter two, review literature that identifies empirical evidence and history of bankruptcy prediction models is addressed. This chapter will be concluded with some limitations and suggested improvements of the discussed techniques. Chapter three is the methodology chapter and is divided into two main sections. The first section describes the procedures used to test Altman's Z-score model and the second section is deals with the steps used to develop new model which deemed to be suitable to Ethiopian context.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The prediction of bankruptcy arising from financial difficulties has been of interest to many researchers in the past. The use of financial ratios as predictors of corporate bankruptcy was first given a serious thought by Beaver (1966). Beaver's study using univariate statistics of financial ratios concluded that ratios distribution of failed firms begins to deteriorate at least five years before failure. Like Beaver, Altman (1968) had used multivariate discriminate analysis to assess predictive power of ratio analysis and concluded five financial ratios (Working Capital to Total Asset, Retained Earning to Total Asset, Earning Before Interest and Tax to Total Asset, Market Value of Equity to Book value debt, and Sales to Total Asset), possesses high predictive power in bankruptcy prediction context.

After Beaver (1966) and Altman (1968) there are numerous studies in the area of corporate bankruptcy and corporate failure. They are Moyer (1977), Deakin (1972), Libby (1975), Dambolene and Khoury, (1980), Coats and Fant,(1993)and others. These studies

were conducted for development of statistical models and determine the predictive power of financial ratios that are useful in prediction of corporate bankruptcy in developed countries.

2.2 Altman's Model

Altman was the first person to develop a multivariate model, which was subsequently popularized by later bankruptcy studies. Altman set out to combine a number of ratios and developed an insolvency prediction model - the Z-Score model. This formula was developed for public manufacturing firms and eliminated all firms with assets less than \$1 million. This original model was not intended for small, non-manufacturing, or non-public companies, yet many credit granters today still use the original Z score for all types of customers. Twenty two variables were selected based on their popularity in the literature and relevance to his study. These variables were classified into five categories: liquidity, profitability, leverage, solvency and activity. z- Score model has under gone a number of variations at improving the predictive accuracy of the model and to cater non-manufacturing and private firms, since it was first introduced in 1968, Altman (1968).

Altman used a statistical methodology called Multiple Discriminant Analysis (MDA) which predicts the relationship between mainly dichotomous response variables and one or more independent predictor variables by determining a set of discriminant coefficients which 'best' results in mutually exclusive response variables, to generate his model. Financial statement data one year prior to bankruptcy was used to develop the following five- variable model Altman (1968):

$$Z = 1.2 X1 + 1.4X2 + 3.3 X3 + 0.6 X4 + .999 X5$$

$$X1 = \text{Working Capital / Total Assets}$$

$$X2 = \text{Retained Earnings/ Total Assets}$$

$$X3 = \text{Earnings before Interest and Taxes / Total Asset}$$

$$X4 = \text{Market Value of Equity / Book value of total Debt}$$

$$X5 = \text{Sales / Total Assets}$$

A z-score > 2.99 indicates the company would succeed, with a score below 1.81 indicates probable failure. A zone of ignorance, where misclassifications are likely to occur, exist between 1.81 to 2.99.

X1: Working Capital/Total Assets: Working capital is the difference between current asset and liability. This ratio is a measure of net liquid WC/TA indicates liquidity problems. Ordinarily, a firm experiencing consistent operating losses will have shrinking current assets in relation to total assets. Likewise a firm with negative working capital usually has

problems meeting its short term obligation as there are not enough current assets to cover them.

X2: Retained Earnings/Total Assets. This is a leverage ratio and firms with high retained earnings usually finance the business through accumulated profits. This ratio captures the age of the firm because established firms tend to have high retained earnings over the life of the business as compared to young firms. Altman noted that this ratio does not discriminate against young firms. In the real world, younger firms are more likely to enter bankruptcy compared to older firms. Therefore, it may be argued that the young firm is somewhat discriminated against in this analysis, and its chance of being classified as bankrupt is relatively higher than another, older firm, *ceteris paribus*. But, this is precisely the situation in the real world.

X3: Earnings before Interest and Taxes/Total Assets. *EBIT* is a measure of a firm's profitability that excludes interests and taxes. It is obtained by subtracting operating expenses from revenue. This ratio measures management's ability to squeeze profits out of its available assets. Since a firm's ultimate existence is based on the earning power of its assets, this ratio appears to be particularly appropriate for studies dealing with corporate failure.

X4: Market Value of Equity/ Book Value of Debt: This ratio shows how much the firm's assets decline in value before the liability exceeds

the assets and the firms becomes insolvent. Firms with high debt to equity ratio tend to move towards insolvency if earnings do not support the interest expenses.

X5: Sales/Total Assets: This ratio measures management efficiency in generating sales from available assets. It also measures the firm's competitive ability, as it relates to sales of products.

The model was tested up to five prior to bankrupt and the predictive accuracy of the model is shown in the table 2:

Table 2: predictive accuracy of Altman's model

Year prior to failure	Predictive accuracy
Year-1	95%
Year-2	72%
Year-3	48%
Year-4	29%
Year-5	36%

Sources :(Naidoo 2006, pp 19)

The model has good predictive accuracy one year prior to bankruptcy (year-1), the predictive accuracy decrease markedly over the five years period. This suggest that the model is better suited to predicting bankruptcy in the last year (year -1) and

perhaps the second last year (year -2), where the predictive accuracy is high and misclassification less likely to occur.

2.3 Altman's Revised Z-Score Model

The original model has been demonstrated to be quite reliable in a variety of context and in different countries. However, it is not designed to be used in every situation. For the enterprises whose stock is not publicly traded, one has to use the revised model. Rather than simply inserting a proxy variable into an existing model to calculate the Z-Scores Altman advocated for a complete re-estimation of the model, substituting the book values of equity for the Market value in X4. This resulted in a change in the coefficients and in the classification criterion and related cut-off scores. The revised Z score model took the following form: Altman (1993).

$$\mathbf{Z' = 0.717X1 + 0.847X2 + 3.107X3 + 0.420X4 + 0.998X5}$$

Where:

$$X1 = (\text{Current Assets}-\text{Current Liabilities}) / \text{Total Assets}$$

$$X2 = \text{Retained Earnings} / \text{Total Assets}$$

$$X3 = \text{Earnings before Interest and Taxes} / \text{Total Assets}$$

$$X4 = \text{Book Value of Equity} / \text{Total Liabilities}$$

$$X5 = \text{Sales} / \text{Total Assets}$$

This model used in this study and it is similar with original model described earlier except the X4 term and the coefficient of the terms. If firm's stock is not publicly traded the X4 which is Market of Equity/Market value of Debt in the original model cannot be calculated. Rather, the X4 term is computed using Book value of Equity/ Book value of liability. This resulted in a change in the coefficients and in the classification criterion and related cut-off scores. The coefficient of the X_is indicates the relative impact of each independent variable on the overall z-score. The higher the coefficient of the independent variable the stronger the impact of the variable on the overall z-score and vice versa and the z-score is a discriminant value computed for prediction purpose. A higher z-score indicates a better financial health and lower z-score implies a relatively weak financial health.

The revised model z-score was developed for use with private companies. The weighting of the various ratios is different for this model as well as the overall predictability scoring. In addition, while the original score used the market value of equity to calculate the equity to debt formula, the revised model used shareholder's equity on the balance sheet. Although computerized

statistical modeling would aid in determining the weighting of each ratio, common sense helps us understand the purpose of each ratio.

The Altman study was replicated by Deakin (1972) with the exception that financial ratios used by Beaver were adopted instead of the ones suggested by Altman. The study showed a significant improvement over the results reported by Altman. Dambolena and Khoury (1980) took care of the instability of ratios presumed to be associated with failed firms. The study achieved limited success over years far from the event of bankruptcy. Studies by Blum (1974), Moyer (1977) further showed that the model is sensitive to the time period used to develop the model, the size of the firm, or both.

Libby (1975) carried out to study consistency of interpretation of ratios within bank loan officers over time and between bank loan officers. He concluded that the prediction achievement was superior over the random performance because of accurate utilization of information. However, prediction achievement between groups was found no difference and subject predictions do not vary greatly across time.

2.4 Related Literature on Predicting Financial Failure

2.4.1 Beaver (1966)

Beaver's study tested the predictive ability of financial ratios to determine failure on a univariate basis. Study of Beaver (1966) selected thirty financial ratios based on their frequent appearance and performance in prior studies and categorized them into the following six groups: cash flows ratios, net income ratios, debt to total asset ratios, liquid asset to total asset ratios, liquid asset to current debt ratios and turnover ratios. According to Beaver classification test was used to predict whether a company was failed or non-failed. This involved the computation of the ratio means for bankrupt and non-bankrupt companies for each of the five years prior to failure, arranging the ratios in ascending order and visually inspecting them to determine an optimal cut-off point to minimize misclassification. He concluded that ratios distribution of failed firms begins to deteriorate at least the five years before failure. Although ratio analysis provides useful information, no all ratios can predict well equally.

Another group of prediction models came into existence to overcome the restrictive assumptions that must hold in order for Altman model to achieve valid and unquestionable results as indicated by study done by

Joy and Tollefson, (1975) cited by Eljelly et al (2001). These assumptions include random sampling, independent population for each of the groups and absence of cross-correlation among the chosen variables. These studies used Probit and logit techniques instead of the multiple discriminant analysis. Logit is a variant of regression analysis where the dependent variable takes one discrete value and the predicted value is interpreted as the log of the odd ratio.

A relatively new group of studies have sought solutions for the MDA problems in the use of a type of artificial intelligence known as neural network that is free from the requirements of discriminant analysis. This computing method does not require or assume linearly separable or independent variables. A study by Coats and Fant (1993) compared the classification performance of MDA and neural networks based on Altman's Z score ratios and found that the two methods perform comparably. In short the neural network method does not compensate for its complexity and what the authors suggest is to admit the neural network method in integrated models with discriminant analysis techniques.

More recently some studies sought to improve upon the predictive ability of discriminant analysis by incorporating variables or incremental information over that contained in financial ratios. For example, Laitinen and Laitinen (1998) introduced corporate model (inventory cash management model), and Bardos (1998) combined industry and individual company variables. These studies, on a whole, traced improved classification accuracy.

To sum up, after Beaver (1966) and Altman (1968), there are numerous studies in the area of corporate bankruptcy and corporate failure. Many statistical techniques found financial variables or ratios useful in predicting corporate failure and solve many other business issues.

Furthermore, all the aforementioned failure prediction models are based on different assumptions. Though there are a number of models for predicting financial failure, impressive evidence exists about the strong predictive accuracy of Altman's model. However, no such study has been carried out in the context of Ethiopia using statistic model of financial ratios for prediction of corporate of bankruptcy of bankrupt and non- bankrupt enterprises. Hence, this study attempts to apply the financial ratios, as individual predictors, and as groups in a relevant statistical model on a sample of private companies in the Ethiopia to test predictive accuracy of the chosen model and develop a new model suitable for Ethiopian private enterprises.

CHAPTER THREE

DATA SOURCE AND METHODOLOGY

3.1 Introduction

This study intends to test the Altman's model -MDA and develop a model to predict financial failure of private enterprises by utilizing discriminant analysis technique. The researcher attempts to adopt and modify accordingly Altman's model so that it is suitable for application to predict possible financial failure in a private enterprises in Ethiopia.

3.2 The nature of sample

The collection of data for failed companies requires a definition of failure and specification of population from which sample is selected. In this study a company is considered to have entered the failure process if it is unable to pay its debts as they come due. The population boundaries are defined by the time period from 2005 to 2009 and that the company must be classified as private enterprises. These are manufacturing firms and operate in industries such as food processing, textile firms, beverage companies, cut flowers, leather, shoe factories, and garment factories.

The initial sample consists of 20 private companies that failed in the previous context during the period of 2005-2009. Because of the inconsistencies in the data, or their unavailability for some years, only 10 of the original sample satisfied the complete data criterion for estimating the variables. The final paired sample consists of 10 failed firms and 10 healthy firms for the time period 2005-2009 were used for this study. The failed companies were paired to the non-failed companies in manner similar to that used by Altman using the following criteria:

- The same industry
- Closest asset size
- Complete data (audited financial statement) for at least three consecutive years.

As the selection process is based upon a paired-sample design, for each failed company in the sample, a non-failed company of the same industry and with the closest asset size is selected. The paired-sample design is one way of compensating for the effects of industry and asset size differences. Companies with the same financial ratios but with different asset sizes may have different probabilities of failure.

Every failed company in the sample is matched to a non-failed one from the same industry and approximately the same asset size. A great difficulty in exact matching of asset size is encountered due to the unavailability of data. Data for the sampled companies is gathered from their audited annual financial reports.

3.3 Procedures Used to Test the Altman's Z score model

The data to test the predictive accuracy of the chosen model are composed of audited financial statements (balance sheet and income statement) of the selected private enterprises for five years (2005-2009) and data for each enterprise in a pair is obtained from DBE dataset. The collected data (two year prior failure) is analyzed using the required financial ratios so that it would be possible to test the predictive accuracy of the chosen model. The result of the analysis is interpreted in such a way that it would prove or disprove the hypothesis proposed in the statement of the problem.

Altman derived several discriminant functions: the first one called Z-score was developed in 1968 using public firms stratified by industry and asset size. This model had high predictive power one and two years prior to failure event. Additionally, two adaptation of the 1968's Z-score model are presented: Z'- score and the Z''-

score. These models were built to apply to privately held firms. Both the revised models substitute the book value of equity for the market value in X4 making these models a little less reliable than the original. The Z'' – score , unlike the Z' ,does not consider the variable X5 in order to minimize the potential industry effect of asset turn over and the effect of different types of assets financing. Altman found that variables X3, X4 and X5 contributed most to the explanation of his results. The most popular Altman's discriminant functions are summarized in the table 3:

Table 3: Discriminant Function and Decision Criteria

Year	Discriminant function	Decision criteria
1968	$Z = 1.2 X_1 + 1.4 X_2 + 3.3 X_3 + 0.6 X_4 + 0.999 X_5$	$Z < 1.81$ failed $Z > 2.67$ non- failed $Z = 1.81$ to 2.67 gray area
1993	$Z' = 0.717 X_1 + 0.847 X_2 + 3.107 X_3 + 0.420 X_6 + 0.998 X_5$	$Z' < 1.23$ failed $Z' > 2.90$ non-failed $Z' = 1.23$ to 2.90 gray area
1993	$Z'' = 6.56 X_1 + 3.26 X_2 + 6.72 X_3 + 1.05 X_6$	$Z'' < 1.10$ failed $Z'' > 2.6$ non-failed $Z'' = 1.10$ to 2.60 gray area

Where,

X1 = Working Capital to Total Assets

X2 = Retained Earnings to Total Assets

X3 = Earnings before Interest and Taxes to Total Asset

X4* = Market Value of Equity to Book value of total Debt

X5 = Sales to Total Assets

X6 = Book value of equity to total liabilities

* indicates X4 is replaced by X6

Since all companies in this study are private, the researcher considered it more appropriate to use Altman's revised model.

To test the predictive accuracy of the Altman's model the following procedures are used.

The z -score for each private enterprises is computed for each of the two years reporting periods using Altman's revised model z-score model presented in the literature. Based on their z -score the enterprise is classified as failed and non-failed using the following classification of result format (Wondim 2003).

Table 4: Classification of result format

Actual-group membership	# of cases	Predicted group membership by score	
		Failed	non failed
Failed	10	C	I1
Non failed	10	I2	C

Where,

Cs = stands for correct classifications

Is = stands for the miss classification

I1 = represents type I error

I2 = represents type II error

The sum of the Cs equals the total correct classification and when it is divided into the total number of the enterprises examined, it yields the measure of the predictive accuracy of the chosen model.

The classification and predictive power of a model is evaluated by determining the hits (correct classifications) and misses (incorrect classification).

In order to get a clearer picture of the prediction accuracy of the models, it is helpful to define type 1 and type 2 errors. Type 1 error takes place when a company goes bankrupt but is predicted to be non-bankrupt and type 2 errors takes place when a company

is non-bankrupt but is predicted to be bankrupt. It is obvious that type 1 and type 2 error rates depend on the number of firms that are predicted to go bankruptcy. For investors, banks and the government the most serious and expensive mistakes is to consider a firm as healthy when actually it will failed soon. Therefore, type I error represent real losses for the shareholders, banks and other stakeholders. On the hand, type II error can be seen as an opportunity cost, an investor can lose the opportunity to make a good investment, a bank can lose the opportunity to lend money to the good customer or supplier can lose the opportunity to make an additional sell.

3.4 New Model Development

To develop a new financial failure prediction model the following steps were used for this study.

First, the Altman original Z score model is replicated, retaining all its variables and estimated coefficients. Second, Altman original Z score model variables are retained but their coefficients are re-estimated. Third, a new model is estimated where both its variables and coefficients are computed from the sample.

Since all companies in this study are private, the revised Z-score model recommended by Altman for private company application

seems appropriate. Altman's version of the private firms is specified as:

$$\mathbf{Z} = \mathbf{0.717 X1} + \mathbf{0.847 X2} + \mathbf{3.107 X3} + \mathbf{0.420 X4} + \mathbf{.998 X5}$$

Where: X1 = working capital/total asset; X2 = retained earnings/total asset; X3 = earnings before interest and tax/total asset; X4 = book value of equity/ total liabilities; X5 = sales/total asset; and Z = overall index.

The next step is to retain the Altman's Z score model variables but re-estimate its parameters from selected sample data using stepwise- by removing and adding variables, in order to identify a useful subset of the predictor.

The final step is to use the sample to develop a model that may fit the sample data better than Altman variables. Thus, to eliminate any presupposed importance for any of the variables the SPSS DISCRIMINANT procedure and after many computer runs over different ratios profiles five ratios were found to give the best predictive ability. The final discriminant function arrived is (pp-44). This function or model is used to classify an enterprise as either failed or non-failed on the basis of a single cutoff point which is determined from the new model based on z- score of actual failed and non-failed enterprises.

CHAPTER FOUR

DISCUSSION OF THE RESULTS

4.1 Introduction

The empirical examination in this Section proceeds as follows: First section, tests the predictive accuracy of Altman's z-score model. Second, the Altman's revised model is replicated; retaining all its variables and estimating coefficients. Third, Altman's revised model score model variables are retained but their coefficients are re-estimated. Finally, a new model is developed where both its variable and coefficients are computed from the sample. These objectives are met using a sample ten failed and ten non-failed private enterprises.

The data used in the continuing analysis of this study come from a paired sample of 10 failed and 10 non-failed enterprises during the 2005-2009. The paring was made on the basis of industry and asset size in a manner similar to that used by the Altman. Data for each firm in a pair were recorded from DBE annual report for the five years prior to the failed firm's failure.

Altman's revised discriminant function for one year prior failure was estimated as:

$$Z' = 0.717X1 + 0.847X2 + 3.107X3 + 0.420X4 + 0.998X5$$

Where:

X1 = working capital / Total Assets

X2 = Retained Earnings / Total Assets

X3 = EBIT / Total Assets

X4 = Book Value of Equity / Total Liabilities

X5 = Sales/ Total Assets

4.2 Testing the validity of Altman's predictive accuracy

Before discussing the results, it might be useful to present the revised Altman's z-score model calculated two years (2008) and one year (2009). This is shown in table x and the name of the enterprises are not given in this research to preserve confidentiality. Rather a code is given to each enterprise for easier identification. Z-value in the table is computed based on the Xi values for independent variables –for each enterprise two years and one year prior to failure (appendix A).

Table 5: Classification results two years prior to failure

Actual-group membership	# of cases	Predicted group membership by score	
		Failed	non failed
Failed	10	6 (60%)	4(40%)
Non failed	10	3(30%)	7(70%)

Table 6: Classification results one year prior to failure

Actual-group membership	# of cases	Predicted group membership by score	
		Failed	non failed
Failed	10	8* (80%)	2 (20%)
Non failed	10	4(40%)	6** (60%)

*Failed enterprise with z-score less than 2.06-correctly classified

** Non-failed enterprise with z-score greater than 2.06 correctly classified.

Altman's model classified firms with a discriminant z -score of greater than 2.90 as non- failing and firms with a score of less than 1.23 as failing .The range 1.23- 2.90 was considered a gray or zone of ignorance where it was difficult to effectively discriminate. This z value is used to discriminate failed enterprise from non- failed.

The classification and predictive power of the model is evaluated by determining the hits (correct classification) and misses (incorrect classification). In order to get a clearer picture of the prediction accuracy of the model, it is helpful to define the two types of misses- type 1 and type 2 errors. Type 1 error takes place when a company goes bankrupt but is predicted to be non-bankrupt and type 2 errors takes place when a company is non-bankrupt but is predicted to be bankrupt.

Using the data compiled two years and one year prior to failure the following classification table x is generated for each enterprise on the basis the Altman's revised model.

Table 7: Altman’s revised z-score model applied to private enterprises (Ethiopia)

$$(Z = 0.717X1 + 0.847X2 + 3.107X3 + 0.420X4 + 0.998X5)$$

Group membership	Code	z-score:2 years prior to failure (2008)	z-score :1 year prior to failure (2009)
Failed	AA	0.212	0.97
	BB	2.801	1.21
	CC	3.208	0.510
	DD	0.859	0.664
	EE	2.673	2.39
	FF	0.384	0.786
	GG	1.505	2.188
	HH	2.103	0.887
	II	0.851	0.717
	JJ	0.857	0.712
Non-failed	AA1	2.26	2.422
	BB1	1.982	0.799
	CC1	2.816	1.776
	DD1	0.653	1.915
	EE1	2.254	2.964
	FF1	2.475	2.391
	GG1	2.107	2.360
	HH1	0.062	0.577
	II1	2.286	2.396
	JJ1	2.53	3.406

The following zones of discrimination: $Z > 2.9$ -“Safe” Zone, $1.23 < Z < 2.9$ -“Grey” zone and $Z < 1.23$ -“Distress” Zone. 2.06 used as appropriate cutoff point to minimize the misclassification. The enterprises which have a Z score below 2.06 were classified as enterprise in a distress zone, while those enterprises which had a Z score above 2.06 were classified as enterprise in a safe zone.

From the table 5, it can be seen that 6 (60%) failed and 7(70%) non-failed enterprises are correctly classified based on the Altman’s revised model. Type I errors (classifying failing as non-failing) and type II errors (classifying non-failing as failing) are 40% and 30% respectively. This shows that Altman’s revised model has 65% probability of predicting failure event within two years applied in the Ethiopia context. However, this result is not exactly the same as with the one required by the model (72% two years prior to failure). Similarly ,it can also be seen that 8(80%) failed and 6(60%)non-failed enterprises are correctly classified, yielding 70% probability of predicting failure event within one year applied in the Ethiopian context as compared to Altman’s predictive accuracy (95% one year prior to failure). The study replicates Altman Multiple Discriminant Analysis (MDA) to the sample and achieved a satisfactory failure prediction rate which is not similar to those obtained in the developed and developing economies .Hence; Altman’s z- score model is not

strong enough for predicting financial failure of private enterprises in Ethiopia.

4.3 Model development

The new model, which is supposed to be suitable to the Ethiopian context, is developed using the financial ratios discussed in the literature. Ratios selected for this study have been found to be significant predictors of business failure in previous empirical research.

As mentioned in the methodology part to develop a new financial failure prediction model first, the Altman original Z score model is replicated, retaining all its variables and estimated coefficients. Second, Altman original Z score model variables are retained but their coefficients are re-estimated. Finally, a new model is estimated where both its variables and coefficients are computed from the sample.

The revised Z-score model recommended by Altman for private company application is used in this study. Altman's version of the private firms is specified as:

$$Z = 0.717 X_1 + 0.847 X_2 + 3.107 X_3 + 0.420 X_4 + .998 X_5$$

Where: X_1 = working capital/total asset; X_2 = retained earnings/total asset; X_3 = earnings before interest and tax/total

asset; X4 = market value of equity/ book value of debt; X5 = sales/total asset; and Z = overall index.

The next step is to retain the Altman's Z score model variables but re-estimate its parameters from selected sample data. Using stepwise- this performs regression by removing and adding variables, in order to identify a useful subset of the predictor.

Using step wise procedure and Altman's revised z-score model variables the following discriminant function is shown as giving the best classification results:

$$\mathbf{Z^* = .097 + .144 X1 + .136 X2 + .982 X3 + .054 X4 + .170 X5}$$

The variables are as specified above.

Given that the Altman model doesn't exactly fit for the context of Ethiopian enterprises, the final step is to use the sample and develop a model that fit for the context of Ethiopian enterprises.

The coefficients and significance level of independent variables in table 8 are obtained using the SPSS DISCRIMINANT procedure and average ratios (appendix c).

Table 8: coefficients and significance level of independent variables for the new model

Independent variables	Coefficient	S.E
X1	0.4545*	0.84
X2	0.4056**	0.95
X3	2.2872*	0.55
X4	0.0660***	0.45
X5	0.4648*	0.35

***, **, and * indicate significance level at 1%, 5% and 10%, respectively.

Having determined the coefficients of the independent variables the following final discriminant function arrived at is as follows:

$$\mathbf{Z^{**}\text{-Score} = 0.019 + 0.4545X1 + 0.4056X2 + 2.2872X3 + 0.0660X4 + 0.4648X5}$$

Where:

X1 = working capital / Total Assets

X2 = Retained Earnings / Total Assets

X3 = EBIT / Total Assets

X4 = Book Value of Equity / Total Liabilities

X5 = Sales/ Total Assets

This function or model is used to classify an enterprise as either failed or non-failed on the basis of a single cutoff point which is developed new model based on z- score of actual failed and non-failed enterprises. As it can be seen from table 8, Variables Earing before interest and tax to total asset, sales to total asset and working capital to total asset are more related to financial failure.

To determine the cutoff point, the actual scores for the sample enterprises for each of the two years were computed. Lists the actual score for the sample enterprise in ascending order is given in (appendix D). The cutoff point used to separate the groups is the point which minimizes total misclassification errors of both types I and II. Accuracy of prediction is measured by percentage of correct classification, i.e. correct prediction of failure plus correct prediction of non-failure.

Analysis is made about the distribution of z score for both failed and non-failed groups. By rearranging the actual scores in ascending order (appendix D), it is obvious that 0.784 is most approximate cutoff point for the new model. Thus any enterprise with a score greater than 0.784 is classified as having a profile similar to continuing entities and those with a score less than 0.784 as having characteristics similar to entities which experienced problem. Having determined cutoff point, let see the results of two and one year prior to failure even

4.3.1 Results two years and one year prior to failure

Table9: New Model:

$$Z^{**}\text{Score}=0.019+0.4545X1+0.4056X2+2.2872X3+0.0660X4+0.4648X5$$

Actual group membership	Enterprise Code	z-score :1 years prior to failure	z-score : 2 year prior to failure
Failed	AA	0.524	0.469
	BB	1.472	1.272
	CC	0.234	1.605
	DD	0.398	0.512
	EE	0.591	0.646
	FF	0.509	0.252
	GG	0.784	1.625
	HH	0.490	0.546
	II	0.337	0.504
	JJ	0.547	0.809
non-failed	AA1	3.405	3.050
	BB1	1.322	1.277
	CC1	2.340	1.164
	DD1	0.192	0.749
	EE1	3.893	2.953
	FF1	3.325	3.299
	GG1	3.374	3.587
	HH1	0.718	0.275
	II1	1.928	1.643
	JJ1	4.826	3.587

The enterprises which have a Z score below 0.784 are classified as enterprise in a distress zone, while those enterprises which have a Z score above 0.784 are classified as enterprise in a safe zone.

4.3.2 Classification Accuracy of New Model

Table 10: Classification results **one** year prior to failure

Actual-group membership	# of cases	Predicted group membership by score	
		Failed	non failed
Failed	10	9* (90%)	1 (10%)
Non failed	10	2(20%)	8** (80%)

*failed enterprise with z-score less than 0.784-correctly classified

** Non-failed enterprise with z-score greater than 0.784 correctly classified.

Table 11: Classification results **two** years prior to failure

Actual-group membership	# of cases	Predicted group membership by score	
		Failed	non failed
Failed	10	6* (60%)	4(40%)
Non failed	10	2(20%)	8** (80%)

*Failed enterprise with z-score less than 0.784-correctly classified

** Non-failed enterprise with z-score greater than 0.784 correctly classified.

From the table 10, it can be seen that 9 (90%) failed and 8(80%) non-failed enterprises are correctly classified based on the new model. Type I errors (classifying failing as non-failing) are 10% and type II errors (classifying non-failing as failing) are 20%. Of the 20 enterprises in the overall samples, 6 are misclassified, yielding an overall accuracy of 85% one year prior to failure. This result is almost the same as with the one required by the model (95% one year prior to failure). Similarly from table 11, it can be understood that 6(60%) failed and 8(80%)non-failed enterprises are correctly classified, yielding 70% probability of predicting failure event within one year which is comparable with Altman's predictive accuracy (72% two years prior to failure).

Hence, the new model developed for the Ethiopian context correctly classifies 85% of the enterprise one year prior to failure and as much as 70% two year prior to failure event. These results are quite impressive since they indicated that the predictive accuracy is almost similar to the predictive accuracy of Altman's model (95% one year prior and 72% two year prior to failure event respectively). Even more impressive result could be obtained by increasing the sample size and employing more tough validation testing techniques.

4.4 Comparison of the predictive capability of the two models in Ethiopian context

Table 12: Comparison of predictive accuracy of the two discriminant models

Year prior to failure	Altman's revised model		New model	
	Failed	non-failed	Failed	non-failed
1(2009)	80%	60%	90%	80%
2(2008)	60%	70%	60%	80%
3(2007)	35%	40%	40%	45%
4(2006)	20%	30%	20%	35%
5(2005)	-	-	-	-

Table 12 shows the results of comparing the two models over the four years prior to failure. Both the revised Altman Z model and the new model show high accuracy rates one and two years prior to failure, with the new model outperforming the revised Z model in both years. The model has good predictive accuracy one year prior to bankruptcy (year-1), the predictive accuracy decrease markedly over the four years period.

4.5 Major Findings

Table 13: Summary of Findings (z- score for one & two years respectively)
Failed firms.

Firms	AA	BB	CC	DD	EE	FF	GG	HH	II	JJ
z-Score	0.524	1.472	0.234	0.398	0.591	0.509	0.784	0.490	0.337	0.547
	0.469	1.272	1.605	0.512	0.646	0.252	1.625	0.546	0.504	0.809
State	Dis	Safe	safe	Dis	Dis	Dis	safe	Dis	Dis	Dis

From the above table, it can be realized the new model developed for the Ethiopian context correctly classifies 70% of the failed enterprise one year prior to failure. Similarly, from table 14, it can also be realized the new model correctly classifies 80% of the non-failed enterprise one year prior to failure.

Table 14: Summary of Findings (z- Score for one &2 years respectively)
non-failed firms

Firms	AA1	BB1	CC1	DD1	EE1	FF1	GG1	HH1	III	JJ1
z-Score	3.405	1.322	2.340	0.192	3.892	3.325	3.374	0.718	1.928	4.826
	3.050	1.277	1.164	0.749	2.953	3.299	3.587	0.275	1.648	3.587
State	Safe	Safe	Safe	dis	Safe	safe	safe	dis	safe	safe

CHAPTER FIVE

5.1 Conclusions and Recommendation

The purpose of this study has been to examine the characteristics of a sample of failed and non-failed private enterprises in the Ethiopia, in order to develop an early warning system to serve as a tool for identifying problematic enterprises.

In order to achieve this objective the paper has attempted to apply various methodologies to predict failure. The study first applied a version of Altman Z-score model developed for private companies to the sample and found that the performance of the model was not strong with successful classification rates of 70% and 65 % one and two years prior to failure respectively and the predictive accuracy decrease markedly over the four years period. Using a stepwise MDA the study developed a new model that deemed to be suitable to the Ethiopian context and the model achieved considerable improvement in the successful classification rate that reached 85 % and 70% one and two years prior to failure respectively.

Besides, the paper compares the two models in terms of their successful classification ability, failed enterprises identification, and non-failed enterprise's accurate classification. The results show that the model

developed in this study outperforms Altman revised Z-score models in its overall classification rate one and two years prior to failure, while showing comparable results to that of the best of Altman models three and four years prior to failure.

In light of this, the implication and application of models designed for assessing the potential for financial failure are many. If a model, such as the one developed in this study, is used to identify potential problems, then in many cases preventive or rehabilitative action can be taken.

Finally, it is important to mention that the topic of the applicability of financial failure prediction models and testing their accuracy are surely worthy of the continued study. It is the belief of the researcher that further study of these topics would yield new and interesting results.

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