A Descriptive Study of Altman's Z Score Model in Bankruptcy Prediction

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ABSTRACT Many Business undertaking works for the purpose of profit objective. Their financial soundness is of most importance to its stakeholders. What will be the future of the business ,whether it will flourish or will become bankrupt, has caught the attention of the various researchers around the globe and has led to the development of many theories. To be able to predict the financial soundness of a business has led to many research works. Financial ratios are a key indicator of financial soundness of a business. Financial ratios are the tools to determine the operational & financial efficiency of business enterprises. There are a large number of ratios propounded by many authors. Altman developed a z-score model for predicting bankruptcy using ratios as the base. Using Z- Score model, Altman could predict financial efficiency, Bankruptcy up to 2-3 years in advance. The following research paper describes the studies carried out by Altman to predict business bankruptcy. If companies have the ability to improve their financial position during the years then Altman z-score is useful tool to predict failure early so that the company takes measures like debt restructuring or to proceed with a merger with other companies.

KEYWORDS : Profitability, Bankruptcy, Altman's Z-Score Model, Financial Ratios, Financial Soundness.

INTRODUCTION

Many Business undertaking works for the purpose of profit objective. What will be the future of the business ,whether it will flourish or will become bankrupt, has caught the attention of the various researchers around the globe and has led to the development of many theories.

Many leading authors has discussed bankruptcy i,e business failure and has identified the following. Fitzpatrick (1932) identified five stages leading to business failure. They are (1) incubation (2) financial embarrassment, (3) financial insolvency, (4) total insolvency, and (5) confirmed insolvency.

When the company's financials are just developing it is Incubation. when management becomes aware of the firm's distressed condition it is said to. Financial embarrassment. Financial insolvency happens when the firm is unable to acquire the required funds to meet its obligations. Total insolvency happens when the liabilities exceed the physical assets. Finally, insolvency is confirmed when legal steps are taken to protect the firm's creditors or liquidation occurs. (Poston, Harmon, & Gramlich, 1994)

As per the study by Karels and Prakash (1987) a diverse set of definitions has emerged to explain business failure. The set includes negative net-worth, non- payments of creditors, bond defaults, inability to pay debts, over drawn bank accounts, omission of preferred dividends, receivership, etc. Aharony, Jones, and swary (1980) described business failure is an indication of resources misallocation that is undesirable from a social point of view. The term business failure, as per Dun and Bradstreet, describes various unsatisfactory business conditions. Business failure includes businesses that cease operation following assignment or bankruptcy. Secondly, it includes those that cease with loss to creditors after such actions after execution, foreclosure, or attachment. Third, it includes those that voluntarily withdraw or leave unpaid obligations. Fourth, it includes those that have been involved in court actions such as receivership, reorganization, or arrangement. Finally it adds those that voluntarily compromise with creditors (Altman, 1993)

Today Bankruptcy is a very mutual thing among companies and individuals also. Bankruptcy is a severe matter. Bankruptcy is a worldwide problem and widely perceived to be damaging to the economy (Kaufman,1996). In any difficult system, a crisis is a time where the system functions very poorly, affirming an abrupt remedial action. In an economy consequently, a crisis can be defined as the time of miserable economic enactment. Throughout

this time(crisis), the value of institutions, especially financial institutions, drops at extraordinary speed and everything seems like valueless. Production will be low and often fails to meet the level of demand. The IMF and the World Bank (1998) pointed out that the crisis comes from financial vulnerabilities including structural weakness and macroeconomic imbalances that lead to poor investment and excessive risks. Worldwide, a lot of companies are going bankrupt. However, It cannot be said that bankruptcy is an unannounced disaster. There is a way to predict bankruptcy and the way is known as the Altman Z Score. The Altman Z Score is a very powerful and popular bankruptcy predicting tool.

Evolution of Bankruptcy Prediction

Fitzpatrick was the first person who has studied bankrupt and non-bankrupt firms' financial ratios. In his study, he compared 20 companies' financial ratios, and found that there are significant differences between bankrupt and healthy firms, mainly between liquidity, debt, and turnover ratios (Fitzpatrick, 1932).Smith and Winakor (1935) were the first who has studied financial ratios in pairs. Their research was based on 183 bankrupt companies. Beaver (1966) found out that 30 financial ratios are relevant in distinguishing bankrupt companies from non-bankrupt companies, but, in the end, with the use of cash flow and total asset ratio the accuracy of the model was 90% before one year of bankruptcy. His result was based on univariate discriminant analysis, while the sample he used was based on 79 pairs of companies. In this study, Chudson (1945), found out that industry-specific models are more appropriate than general applications across industries.

The first multivariate statistical model was used by Altman in 1968. Altman had the idea of univariate modelling and was sure that it was not enough for predicting bankruptcy. Using multivariable modelling, he created the another model known as the Altman model. Since then, his model became well-known and is used as a benchmark (Bellovary et al., 2007). Altman used 33 pairs of firms (bankrupt and non-bankrupt), studying their financial ratios for 18 years with multivariate discriminant analysis (MDA) (Altman, 1968). The Altman model is based on five financial ratios and has an accuracy of 95%.Altman developed his model, known as ZETA model, which is used even today in predicting financial failure (Altman et al., 1977). The new model contained six financial ratios (from these ratios, one was the size of the firm). The model was based on examining 58 pairs of companies for 16 years, and its accuracy was found to 96%.

Since Altman, many researchers has used the discriminant analysis,

making changes, integrating or substituting new ratios which are significant on different samples and business cultures. Some researchers used corrections with industry averages, and as a result they concluded that these models have better accuracy in predicting bankruptcy. Such well-known models were developed by Deakin in 1972, Blum in 1974, Springate in 1978, and Fulmer in 1984.Deakin used 14 financial ratios, from which four were cash-flow-based ratios. Blums' model used accounting ratios and their change in time.

Z Score Model : Definition

The Altman Z Score model, is a financial model to predict the likelihood of bankruptcy in a company, was created by Edward I. Altman. Altman was a professor at the Leonard N. Stern School of Business of New York University. His aim at predicting bankruptcy began around the time of the great depression, in response to a sharp rise in the incidence of default.

Explanation

To Dr. Altman, z score explained an important issue of the time. For this, he used a weighting system combined with a set of four or five financial ratios to predict a company's probability of failure. Altman created three different Z Score Models that each serve unique purposes. The original Z Score Model was developed in 1968. It was made from the basis of statistical data from public manufacturing companies and eliminated all companies with assets less than $1 million. This original model was not intended for small, non-manufacturing, or private companies. Later, Dr. Altman developed two additional models to the original Z Score Model. In 1983, the Model "A" Z-Score was developed for use with private manufacturing companies. Model "B" was developed for non-public traded general firms and included the service sector. Different models have different variables, weighting and overall predictability scoring systems.

Purpose

The purpose of the Z Score Model is to measure a company's financial health and to predict the probability that a company will collapse within 2 years . It is proven to be very accurate to forecast bankruptcy in a wide variety of contexts and markets. Studies show that the model has 72% – 80% reliability of predicting bankruptcy. However, the Z-Score does not apply to every situation. It can only be used for forecasting if a company being analyzed can be compared to the database.

Formula

1. Original Z-Score formula for public manufacturing companies: Original Z-Score = $1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 0.999X5$

X1= working capital/total Assets. It measures the net liquid asset of a company relative to the total assets.

X2= retained earnings/total Assets. It measures the financial leverage level of a company.

X3= earnings before interests and taxes/total Assets. It measures productivity of a company's total assets.

X4= market value of equity/book value of total liabilities. It measures what portion of a company's assets can decline in value before the liabilities exceed the assets.

X5= sales/total Assets. It measures revenue generating ability of a company's assets.

Altman Z Score: Calculation (Example)

If: Working Capital = 5,000,000 , Retained Earnings =1,000,000 Operating Income = 10,000,000 ,Market Value of Equity = 2,000,000 Book Value of Total Liabilities = 500,000, Sales = 15,000,000 Total Assets = 3,000,000

Working Capital / Total Assets = 5,000,000 / 3,000,000 = 1.67
Retained Earnings / Total Assets = 1,000,000 / 3,000,000 = .33
Operating Income / Total Assets = 10,000,000 / 3,000,000 = 3.33
Market Value of Equity / Book Value of Total Liabilities = 2,000,000 /

500,000 = 4
Sales / Total Assets = 15,000,000 / 3,000,000 = 5
Model A Z-Score = $0.717X1 + 0.847X2 + 3.107X3 + 0.420X4 + 0.998X5$
$= .717(1.67) + .847(.33) + 3.107(3.33) + .420(4) + .998(5) = 18.49321$

Here are the rules for interpreting the **Altman Z score**.
- **When Z is >= 3.0**, the firm is most likely safe based on the financial data.
- **When Z is 2.7 to 3.0**, the company is probably safe from bankruptcy, but this is in the grey area and caution should be taken.
- **When Z is 1.8 to 2.7**, the company is likely to be bankrupt within 2 years.
- **When Z is <= 1.8**, the company is highly likely to be bankrupt.

Testing the Model on Subsequent Distressed Firm Samples

In subsequent tests by (Altman,2002) he examined 86 distressed companies from 1969-1975, 110 bankrupts from 1976-1995 and 120 bankrupts from 1997-1999. He found that the Z Score model, using a cutoff score of 2.675, was between 82% and 96% accurate (see Figure 1). In repeated tests, the accuracy of the Z-Score model on samples of distressed firms has been in the vicinity of 80-90%, based on data from one financial reporting period prior to bankruptcy. The Type II error (classifying the firm as distressed when it does not go bankrupt or defaults), however, has increased substantially in recent years with as much as 25% of all firms having Z-Scores below 1.81. Using the lower bound of the zone-of-ignorance (1.81) gives a more realistic cutoff Z-Score than the 2.675, although the latter resulted in the lowest overall error in the original tests. The model was 100% accurate when scores were below 1.81 or above 2.99.

Figure 1

Classification & Prediction Accuracy
Z-Score (1968) Credit Scoring Model*

Year Prior To Failure	Original Sample (33)	Holdout Sample (25)	1969-1975 Predictive Sample (86)	1976-1995 Predictive Sample (110)	1997-1999 Predictive Sample (120)
1	94% (88%)	96% (92%)	82% (75%)	85% (78%)	94% (84%)
2	72%	80%	68%	75%	74%

*Using 2.67 as cutoff score (1.81 cutoff accuracy in parenthesis)

Gunathilaka (2014) examined the financial distress of 82 companies listed on the Colombo Stock Exchange (CSE) from several industries by way of using the Z-Score models of Altman and Springate. Samples were collected from 2008 to 2012 and analyzed by incorporating Multivariate Discriminant Analysis (MDA). The results were identical, though Altman's Z-Score demonstrated a higher degree of accuracy in predicting the financial distress of the selected Sri Lankan companies at least a year before the distress.

Diakomihalis (2012) utilized all three versions of Altman's model to study the bankruptcy predictions for different classes of hotels in Greece. Z1 (original) model is the most accurate having the accuracy rate of 88.2% in predicting bankruptcy a year ahead of the other two versions of the model, findings reveal. Hence the researcher concluded that Altman model can be applied with considerable success to forecast bankruptcy.

Lakshan and Wijekoon (2013) conducted a study on the use of financial ratios in predicting corporate failure in Sri Lanka. The study utilized publicly available data from annual reports of a sample of 70 failed firms and 70 non-failed firms listed on Colombo Stock Exchange for a period from 2002 to 2008 by way of using logistic regression model. A total of 15 ratios were used as predictor variables of corporate failure. They found that the prediction accuracy of the model was 77.86% one year prior to failure. Moreover, predictive accuracy of the model in all 3 years prior to failure was 72.14%. Hence the model they utilized was robust in obtaining accurate results for up to three years.

WHY IT MATTERS:

The Z-Score is a commonly used metric with wide appeal, though it is just one of many credit scoring models in use today that essentially combine quantifiable financial indicators with a small number of variables in an attempt to predict whether a firm will fail.

Over time, however, the Z-Score has proved to be one of the most reliable predictors of bankruptcy so much so that analysts often equate certain Z-Scores with corresponding bond ratings. In fact, when Altman reevaluated his methods by examining 86 distressed companies from 1969 to 1975 and then 110 bankrupt companies from 1976 to 1995 and later 120 bankrupt companies from 1996 to 1999, the Z-Score was between 82% and 94% accurate. The old "garbage in, garbage out" motto applies, however: if the company financials are misleading or incorrect, the Z-Score will be, too.

It's important to remember that changes in a company's Z-Score are as important, if not more important, than the Z-Score itself. After all, knowing a company is heading down the wrong path is better than learning about it after the fact. For example, Enron's Z-Score gave it the equivalent of a BBB bond rating at year-end 1999, but it had a score equal to a B rating by June 2001 unlike the ratings agencies, which rated Enron as BBB until just before it filed for bankruptcy.

Watch Out

The Z Score is not intended to predict when a firm will actually file for legal bankruptcy. It is instead a measure of how closely a firm resembles other firms that have filed for bankruptcy, i.e. it tries to assess the likelihood of economic bankruptcy. The model has also drawn several statistical objections over the years. The model uses unadjusted accounting data; it uses data from relatively small firms; and it uses data that is around 60 years old. Nevertheless, despite these flaws, the original Z Score model is still the most widely used measure of corporate financial distress.

CONCLUSION

It is very common for companies to go through ups and downs in terms of performance because of the impact of business cycles and other macro economic variables. Measuring the financial health of a firm has been an extremely important need for both managers as well as investors. Several tools were developed to diagnose the financial strength of a Company based on the Financial Statements. Ratio Analysis, and Decision Theory etc., but they indicate the present result not the future. Edward I. Altman's discriminant analysis, which employs a combination of various ratios to form an index of liquidity, profitability, sustainability and feasibility, has been highly accurate in analyzing the present state of financial health of a firm as well as to enable one to predict the future, particularly in terms of probability of bankruptcy. It is proven to be very accurate to forecast bankruptcy in a wide variety of contexts and markets. Studies show that the model has 72% – 80% reliability of predicting bankruptcy. The old "garbage in, garbage out" motto applies, however: if the company financials are misleading or incorrect, the Z-Score will be, too.

Inspite of new models developed and used the Altman's Z score is the most popular and used one, and one of the best tool to be used to predict bankruptcy, and insolvency.

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