THINK INDIA JOURNAL

ISSN:0971-1260

Vol-22-Issue-10-November-2019

Efficiency Of Altman's Score In Predicting Distress Of Manufacturing Firms In India

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Abstract

The present study tests the predictive accuracy of three different Altman's scores in predicting distress on manufacturing companies in India considering registered bankrupt in BIFR (Board for Industrial and Financial Reconstruction) during the year 2014 to 2016. The finding from the study shows that on an average the original model of Altman i.e. (Edward I. Altman, 1968) is the most efficient distress prediction model as it is able to identifying higher number of distress firms in two to five year bracket before the distress takes place. Next is the revised Z score (1983) model. For predicting and identifying distress firms one year prior to distress (Altman E.I., 1983) seems to be the best models compared to the rest. The revised Z score (1995) model showed least predictive accuracy as it is able to identify less number of distress firms taken in this study, one of the sole reason for such outcome could be the exclusive design of this model solely for the non-manufacturing firms and as all the samples in our firms are manufacturing, for which the revised Z score (1995) showed less efficient compared to the rest. The findings of study could be useful for managers, investors and various stake holders.

JEL: G33, C53

***Keywords**:* Altman's Z scores, predictions, manufacturing firms.

Introduction: Financial distress in companies means a situation where the firm are unable to meet its obligations due to poor financial performance. The main indicators of financial distress in company are reduction in revenues, low profitability, under-utilization of assets and poor working capital management etc. Financial distress gradually leads the company to default in payment to lenders, creditors, employees and government. This may lead a company to probable bankruptcy. Bankruptcy of company

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will adversely affect all the stakeholders. Stakeholders of company include investors, suppliers, creditors, employees etc. So, it will affect the whole economy. A financially distressed company can improve its condition itself by taking remedial measures at appropriate times. The models for predicting Financial distress helps companies to take appropriate decisions and measures by enabling them to identify the possibility of going insolvent.

The present study tries to concentrate on manufacturing firms in India given its importance with launch of important movement like "Make in India" in order to boost and stimulate the growth of manufacturing sector in India. But in spite of such initiative by the government of India; most of the companies registered with BIFR for the last five years were manufacturing companies. Such, financial distress in manufacturing companies could invariably affect the stake holders and economy as a whole. Therefore, it is important to correctly identify and use appropriate models to sense the possibility of the firms going to become financial distress, so that appropriate measures could be adopted and implemented for improving the financial health of these companies.

Researchers from different fields like accounting, finance, computer science etc.are continuously working for the improvement of this model in order to accurately predict and identify the financial health of the firms. The researchers on financial distress prediction led to new directions like hybrid approach, using both statistics and machine learning approach to predict the financial distress of the firms. Beaver, (1966)study is considered as the pioneer in the field of bankruptcy prediction. He introduced univariate model for financial distress prediction by analyzing different ratios of bankrupt and non-bankrupt companies to identify single ratio for predicting the bankruptcy of the firms. Then further led to extension by(Edward I. Altman, 1968)i.e. Z score model for bankruptcy prediction; He used 22 financial ratios as explanatory variables in his study and finally identified that five financial ratios can be used as discriminant variable in the model for identifying bankrupt firms. Till 1980's discriminant analysis was considered as the most reliable model for bankruptcy prediction. Ohlson, (1980)used logistic regression to find out the possibilities of a company facing financial distress. After 1990s with the advancement in computer technology; hybrid models were developed using soft computing techniques in the field of financial distress. Distress prediction models like using both statistics and machine learning paved a way for many improved models in this area, such as decision tree (DT) Analysis(Sun & Li, 2008), "case-based reasoning" (CBR)(Li & Sun, 2008), "Artificial Neural Networks" (ANNs)(Edward I. Altman, Marco, & Varetto, 1994)(Odom & Sharda, 1990), "Evolutionary Genetic Algorithm" (GA); "Support Vector Machine" (SVM)(Min, Lee, & Han, 2006) etc. The comparative studies show that the predictive accuracy of these models changes based on the different factors like the number of explanatory variables, Years of analysis etc.

ISSN:0971-1260

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Out of the several models that are proposed by various researchers, Altman's bankruptcy prediction model still tends to be one of the most widely used model due to its simplicity. Hence, this study keeping in mind the important of timeworn statistical approach attempt to study the efficiency of Altman's bankruptcy prediction models on financially distressed manufacturing companies in India. The result of this study could serve as a guide to the stakeholders of the company to identify the financial health of manufacturing companies in India.

Materials and Methods:

The data pertaining to companies registered with BIFR[2] for bankruptcy were collected from BIFR website and financial ratios of those companies that were registered as bankrupt were collected from Bloomberg database. Firms were regarded as financial distress from the year in which companies were registered with BIFR. Only those companies that have 5 years' data record prior to date on which they were registered with BIFR; were considered in this study. The details of which are given in table 1 below:

Table 1: Data Summary

The table shows the summary of the total number of firms registered with BIFR from 2014 to 2016. It also shows the total number of manufacturing firms registered with BIFR. The table also shows the number of firms along with the period for which data were available prior to the year of registration with BIFR.

Year	2016	2015	2014	Total
Number of companies registered with BIFR	127	186	91	404
Number of Manufacturing companies	73	89	50	212
Companies for which 5 years data were available before registration				
One Year before	2	4	5	11
Two Years before	4	7	9	20
Three Years before	6	19	9	34
Four Years before	5	22	11	38
Five Years before	6	19	9	34

[2]BIFR represents "The Board for Industrial and Financial Reconstruction" set up by the Government of India in January, 1987; that functions under the Department of Financial Services of the Ministry of Finance with the objective of determining sickness of companies and to help in recovering the sickness if possible or to recommend for liquidation.

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Altman's models of bankruptcy prediction: In this study we test the accuracy of 3 different Altman's models using MDA in accurately predicting and identifying the financial distress of manufacturing firms in India. The summary of three different Altman's Z Score viz. (Edward I. Altman, 1968), (Altman E.I., 1983),(Altman, E. I., Hartzell, J., & Peck, 1995) are given below in Table 2:

Table 2: Summary of three different Altman's Scores

The table shows three different Altman's scores considered in this study, and the criteria for classifying the financial distress of the firms, w_1 represents the predefined weights by the proponents and X_1 represents the firm specific variables chosen for the study. The total weight and coefficients derived are than compared against the criteria laid down by the proponents to segregate the firms into three different categories as highly distress, unpredictable and non-distress firms or healthy firms.

Altman	w_1	X_1	w_2	X_2	w_3	X_3	w_4	X_4	w_5	X_5	Criteria
1968	1.21	$\frac{WC}{TA}$	1.41	$\frac{RE}{TA}$	3.3	$\frac{PBIT}{TA}$	0.6	$\frac{MVE}{BVD}$	0.999	$\frac{SL}{TA}$	≤1.81 HDF 2.99 ≥1.8 UP ≥ 3.0 NDF
1983	0.717	$\frac{WC}{TA}$	0.84	$\frac{RE}{TA}$	3.107	$\frac{PBIT}{TA}$	0.42	$\frac{BVE}{BVL}$	0.998	$\frac{SL}{TA}$	≤1.23 HDF 2.9 ≥1.23 UP ≥ 2.9 NDF
1995	6.56	$\frac{WC}{TA}$	3.26	$\frac{RE}{TA}$	6.72	$\frac{PBIT}{TA}$	1.05	$\frac{BVE}{BVL}$	------	------- --	≤1.10 HDF 2.60 ≥1.10UP ≥ 2.6 NDF

***Note**: WC- represents the "working capital" of the firms, "TA-total assets", RE-retained earnings, PBIT- " profit before earnings and tax", MVE- " market value of equity", BVD- "Book value of debt", BE- " book value of equity", SL-sales, BVL-book value of liabilities. Under criteria HDF- represents highly distress firms, UP-unpredictable firms, NDF-non distress firms.*

In order to test the efficiency of various Altman's scores, "Multivariate Discriminant Analysis" (MDA)have been used. The sole reason for using MDA model is that, in the area of bankruptcy prediction' MDA helps to identify the significant independent variables which discriminates an in solvent company from a solvent company. The dependent variable is event of bankruptcy and the independent variables are financial ratios. The Discriminant function was developed using the coefficients of the significant variables to classify the cases into bankrupt and non-bankrupt groups. The classification accuracy determines the predictive strength of the discriminant function, which is modeled as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \ldots \ldots \beta_k X_k$$

Where Y = dependent variable; $\beta_0 \ldots . \beta_k$represents the coefficients of independent variables and $X_1 \ldots . X_k$as independent variables (various financial ratios).

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Results and Discussions:

The result obtained by comparing three different Altman's models viz. Altman's Z Score(Edward I. Altman, 1968);(Altman E.I., 1983);Altman, E. I., Hartzell, J., & Peck, (1995)to test the efficiency of these models in accurately identifying the distressed manufacturing firms in India for varying time period using MDA as shown in table 3 below:

Table 3: Comparison of predictive accuracy of Altman's models

The table shows the efficiency of three different Altman's models in correctly identifying the distressed manufacturing firms registered with BIFR in India for different period, 1st Year represents how accurately the models identify one year before the distress takes place and 5th years means, how accurately the model identifies five years before the distress takes place.

Models/Time frame	1st year	2nd year	3rd year	4th Year	5th Year
Total distressed companies	11	20	34	38	34
Z Score (1968)	10 (91)	16 (80)	29(85)	27(71)	23(68)
Z' Score (1983)	11(100)	15 (75)	19(56)	23(60)	18(53)
Z" Score (1995)	10 (91)	10 (50)	15(44)	15(39)	13(38)

Note: figure in the parenthesis indicates the percentage

The results show that out of the three different Altman's models, for one year before the distress takes place Altman E.I., (1983) is able to correctly predict or identify all the distressed firms that is eleven out of eleven firms whereas other models like(Edward I. Altman, (1968); Altman, E. I., Hartzell, J., & Peck, (1995)are able to identify only ten out of eleven firms; this shows less efficiency of this models for identifying distress firms one year before its bankruptcy when compared to revised model likeAltman E.I., (1983). But for identifying distressed firms two, three, four and fifth year before the bankruptcy takes place (Edward I. Altman, (1968) model outperforms the other two models viz. Altman E.I., (1983);Altman, E. I., Hartzell, J., & Peck, (1995) as it is able to correctly identify more number of distressed firms than the other two models. Of all the models considered in this study we can see that Altman, E. I., Hartzell, J., & Peck, (1995) model is not much efficient and feasible in identifying the distressed firms in India compared to other two models as it is able to predict and identify only few distressed firms.

Conclusion:

Since Beaver, (1966) and an extended model of Bankruptcy prediction model by(Edward I. Altman, (1968)has gained its momentum. It has become one of the most widely used distress prediction models by various academicians and stakeholders to assess the financial health of the firms. Several changes and improvements were also made in the models by Altman himself by adding different parameters to meet

ISSN:0971-1260

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various institutions and different time frames for example(E. I. Altman, 2002; Altman, E. I., Hartzell, J., & Peck, 1995; Altman E.I., 1983). Edward I. Altman in his study used 33 distress and non- distressed manufacturing companies from different industries. He considered 22 financial ratios classified as leverage, activity, profitability, solvency and efficiency ratios. The original model was than modified (Altman, 1983); the equity's market value was totally reassessed and the market value of equity was replaced by equity's book value. Then again it was revised in 1995 to capture distress in non-manufacturing and non-Us companies as the first two models were applicable only for manufacturing companies. The only difference in the model was exclusion of ratio of sales to total assets. Since than these models have become the most influential and widely used models for predicting the distress.

Using similar approach this paper also attempts to analyze and identify the predictive accuracy of above three models taking into consideration financially distressed Indian manufacturing companies registered with BIFR during the years 2014 to 2016. The result shows that on an average Z score model(1968) is the most efficient model for predicting financial distresses it has highest predictive accuracy for identifying distress two to five year before the distress takes place. Next is the revised Z score (1983) model when compared to the original Z score model. For predicting and identifying distress firms one year prior to distress (Altman E.I., 1983) seems to be the best models compared to the rest. The revised Z score (1995) model showed least predictive accuracy as it is able to identify less number of distress firms taken in this study, one of the sole reason for such outcome could be the exclusive design of this model solely for the non-manufacturing firms and as all the samples in our firms are manufacturing, for which the revised Z score (1995) showed less efficient compared to the rest. Thus we conclude by saying that in case of manufacturing firms in India original Altman's Z score model continues to be the best and most efficient in analyzing the financial health of manufacturing companies in India and can serve as a useful model for stakeholders and policy makers assess the financial health of manufacturing companies in India.

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