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Assessing the Probability of Failure by Using Altman's Model and Exploring its Relationship with Company Size: An Evidence from Indian Steel Sector

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Abstract

Corporate failure is the situation when a firm becomes unable to pay debts when they come due and the market value of assets becomes lower than its total liabilities. The purpose of the paper is to explore the relationship between firm size and probability of failure for Indian steel sector companies by employing regression model. Altman's Z-score model has been used to derive the firm's probability of failure, whereas total assets and total sales are utilized as indicators for firm's size. The results indicate that size is inversely related to the probability of failure. With an increase in the size of the firm; probability of failure decreases and vice-versa.

JEL Classification codes:

Keywords*: corporate failure, Altman's model, probability of failure.*

INTRODUCTION

The recent bankruptcies of the big corporations worldwide created the strong need for prediction of failure of the companies. "Failure is defined as inability of a firm to pay its financial obligations as they mature. Operationally, a firm is said to have failed when any of the following events have occurred: bankruptcy, bond default, an overdrawn bank account or non payment of preferred stock dividend." (Beaver, 1966). Predicting failure of the companies is the emerging area of corporate finance. Failure prediction has greater importance for creditors and investors in evaluating the probability of the company to become bankrupt. Before becoming bankrupt the financial status of the company, often become distressed. Financial distress is the situation when the company will be unable to pay its financial obligations as and when they become due. Li *et al.,* (2014) stated that financial distress can arise in two different stages such as mild distress which may arise because of temporary cash flow problem and serious financial distress which may result into corporate failure or bankruptcy. In other words, financial distressed companies face the problem of cash inflows. Financial distress can be considered as the mismatch between the payment obligation and the available liquid assets which can be rectified either

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by converting illiquid assets into liquid or by debt restructuring or by using both. Financial distress may also results into reduction in market value and the cancellation of orders by the customers. Corporate failure is very important economic phenomenon which adversely affects the investors, shareholders and society. Thus, prediction of corporate failure plays an important role in today's society. Altman (1968) introduced a Z-score model to predict probability of failure of the companies. Z-score model is a multivariate discriminant analysis (MDA) tool based on five accounting ratios. Altman's Z-score model analyses company's profitability, liquidity, growth capacity and leverage and produce a single distress score known as Z-sore. This score indicates whether the company is distressed or not. Altman's model has higher failure predictive power and it can be used as an early warning tool before going to be failure. After the development of the Altman's model many authors or researchers developed their own models by using different variables and methodology. Many studies like Agarwal and Taffler (2005), Sarbapriya (2011), Rayalaseema and Muhammad (2012), Anjum (2012), Karamzadeh (2013), Altman et al. (2014), Celli (2015) etc. tested the predictive accuracy of the Altman's model by applying it to the recent time period and it was found that Altman's model is still a powerful tool to predict the bankruptcy. As Altman's model is pioneer study in the area of bankruptcy prediction and commonly used by researchers and is found to be an effective model for bankruptcy prediction. Hence, our study followed the Altman's model to evaluate the probability of the failure. Indian steel sector is nearly a century old, the first steel plant was set up by Tata Iron and Steel Company in 1907. Debt financing is commonly used source of finance by Indian steel companies. Economic slowdown caused sharp decline in steel prices which further leads to increase in debt financing by Indian steel companies. As per the report of Investment Bank Credit Suisse the total debt of major steel industries is 15 times higher than their collective operating profit (Isha Mahajan and Indra Giri, June 9, 2016; www.projectguru.in). More use of debt may results into the problem of financial distress which may lead to future bankruptcy. Hence, it is required to access the financial health of the Indian steel companies from time to time in order to avoid the bankruptcy. The present study is conducted on ten steel companies for which data is available for 5 years from 2010-2014 and commonly used Altman's model is applied to find out the probability of failure. This study also examines the relationship between probability of failure and company size.

ALTMAN'S MODEL

Edward I. Altman integrates financial ratios with Multivariate Discriminant Analysis (MDA) and developed the famous Altman's model of failure

prediction in 1968. At that time, he was an Assistant Professor at New York University. Altman's model is based on sample of 66 publicly traded manufacturing companies listed on London stock exchange, further divided into 33 failed and 33 solvent companies having assets size more than $1 million. Altman's model gives a score which can be used to predict corporate failures. The score produced by the model is referred to as the Z-score, which is reasonably accurate predictor of future bankruptcy. The model given by Altman is as under:

$$\mathbf{Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 0.99X5}$$

Where Z = score, X1 = working capital / total assets, X2 = retained earnings / total assets, X3 = earnings before interest and tax (EBIT) / total assets, X4 = market value of equity / total liabilities, X5 = sales / total assets. Decision criteria's for the original Altman's model is as; $Z>2.99$ = Safe zone, $1.81<Z<2.99$ = Grey zone and $Z<1.81$ = Distress zone. Altman's model can be used as a warning tool before going to be bankrupt because it has higher predictive power (Sarbapriya, 2011). Rayalaseema and Muhammad (2012) reviewed literature and compared different bankruptcy prediction models and revealed that Z-score model is a very powerful tool to predict bankruptcy. Anjum (2012) also validated the same arguments and reported that Altman's model is most powerful tool which can be applied to predict bankruptcy one, two or three years in advance..

REVEIW OF LITERATURE

Beaver (1966) examined the usefulness of financial ratios in predicting financial distress and it was found that financial ratios have power to predict financial distress and cash flow to total debt ratio has higher predictive power than other ratios and can be used to predict the financial distress.

Altman (1968) developed a model by combining the financial ratios with MDA and it was found that overall correct classification rate prior to one and two year of bankruptcy of the model were 96% and 79% respectively, which indicate higher predictive power of the model.

Moyer (1977), tested the validity of Altman's model and it was observed that overall accuracy rate of the original model was 75% prior to one year of default. It was also reported that variables x1 (working capital/total assets), x2 (retained earnings/total assets) and x3 (earnings before interest & taxes/ total assets) were found to be significant and have higher explanatory power. It was concluded that higher explanatory power can be achieved by adding other variables to the model.

Ohlson (1980) developed the logit model of bankruptcy prediction. It was

reported that logit model has higher predictive power because it overcomes the problems of the MDA model like normality issues, etc. It was further reported that size, financial structure, performance and liquidity are the major factors which affects the probability of failure and size is the most important factor amongst these.

Dichev (1998) analyzed the relationship of bankruptcy risk with size and book to market ratio by using widely used models (Altman's model and Ohlson's model) as a measure of bankruptcy risk. It was found that Z-score was positively correlated to size and negatively correlated to book to market ratio which indicate that larger firms having lower book to market ratio must have lower bankruptcy risk. It was concluded that both Z-score model and O-score model can be used to predict the bankruptcy risk.

Grice and Ingram (2001) examined the predictive power of the Altman's model in recent periods and it was found that all the variables of Altman's model significantly differentiates between bankrupt or non-bankrupt companies except variable X4 (market value of equity/ book value of debt). It was concluded that the Altman's model is found to be more predictive in case of financial distress for manufacturing companies than non-manufacturing companies.

Vassalou and Xing (2004) examined the relationship between default risk and equity returns, size and book to market ratio. It was observed that size is negatively related and book to market effect is positively related to default risk which indicates that small firms having high default risk and high book to market ratio earns higher returns. It was concluded that size and book to market ratio both affects the default risk and default risk is systematic risk priced into the returns.

Agarwal and Taffler (2005) tested the predictive power of Altman's Z-score model over the period of twenty five years from 1979 to 2003 in UK. It was observed that the Z-score model has true failure forecasting ability over at least 20 years period since its development and it can be used to predict the corporate failure.

Agarwal and Taffler (2008) compared the performance of accounting based and market based models of bankruptcy prediction. This study revealed that accounting based models outperformed the market based models as banks used Z-score model for making lending decisions has more market share, better credit quality, higher return on assets, and higher returns on risk adjusted assets than the banks used market based model. It was concluded that accounting based models performed better than market based models and higher prediction accuracy can be achieved by using both accounting based and market based variables.

Karamzadeh (2013) compared the predictive accuracy of Altman's model and Ohlson's model and it was observed that Altman model is a better predictor of bankruptcy and outperformed the Ohlson's model because correct classification rate of Altman model was found to be higher than Ohlson's model.

Alareeni and Branson (2013) tested the Altman's Z-score model for manufacturing and non-manufacturing companies. It was concluded that Predictors used by Altman's model showed higher discriminating power in case of manufacturing companies than non-manufacturing companies. Altman's model can be used to discriminate between failed and non-failed in case of manufacturing companies. Non-failed companies showed strong working capital, adequate retained earnings and high liquidity and income.

Thai *et al.* (2014) tested the reliability of ratios used in Altman's Z-score model. It was observed that working capital to total assets is the most significant ratio in classifying companies as bankrupt or non-bankrupt followed by retained earnings to total assets and EBIT to total assets.

Altman et al. (2014) analysed the classification performance of the Z-score model by using the data from different countries. It was found that Z-score performed well with prediction accuracy level of 75% in most of the countries while it was above 90% in some countries. It was concluded that original Z-score model performs well in an international context and its classification accuracy can be enhanced by introducing additional variables.

Celli (2015) verified the distress prediction power of original Z-score model and it was found that Z-score model has high predictive power as shown by overall successful rate 87.3%, 77.5% and 66.6% before one, two and three years of default. It was concluded that Z-score model can predict distress with high level of accuracy and low error rate. It can be used as warning tool before going to be distressed.

OBJECTIVES OF THE STUDY

1. To find out the probability of failure of selected companies by using Altman's Z-score model.
2. To find out the relationship of company size with probability of failure.

DATA AND METHODOLOGY

The present study is based on secondary data collected from *Moneycontrol* financial database and annual reports of the companies. Several variables can be used to measure a company's size such as sales, net profit, share capital and total assets. Out of these total assets and total sales substantially represent overall size of a company as compare to other variables. Thus, total assets

and total sales are used as the measures of company size. We select 10 Indian steel companies as a sample in order to conduct our study on the basis of availability of data on continuous basis. The study covers a period of 5 years ranging from 2009-10 to 2013-2014. Altman's model is pioneer study in the area of bankruptcy prediction and commonly used by researchers and found to be an effective model for bankruptcy prediction. As many studies like Agarwal and Taffler (2005), Sarbapriya (2011), Rayalaseema and Muhammad (2012), Anjum (2012), Karamzadeh (2013), Altman et al. (2014), Celli (2015) etc. tested the predictive accuracy of the Altman's model by applying it to the recent time period it was found that Altman's model is still a powerful tool to predict the bankruptcy. Hence, Altman's Z-score model has been used in order to predict the probability of failure. The model is an internationally recognized method based on five common financial ratios. It can be used by the investors, lenders and analysts to evaluate the financial soundness of the businesses. The formula to calculate the Z-scores is as follows:

$$\mathbf{Z = 1.2A + 1.4B + 3.3C + 0.6D + 1.0E}$$

Where Z = Score, A = working capital/ total assets, B = retained earnings/ total assets, C = EBIT/ total assets, D = market value of equity/ total liabilities, E = sales/ total assets. Company's financial health may be assessed on the basis of Z-score as follows:

SITUATION	Z-SCORE	ZONE	COMMENT
1.	Below 1.8	Distress (Red)	Future failure or bankrupt
2.	Between 1.8 to 2.99	Unpredictable (Grey)	Unpredictable future position
3.	Above 2.99	Safe (Green)	Future success or non- bankrupt

Firstly, we have calculated the five financial ratios used by Altman's model and the overall score known as Z-score is obtained. Then we transformed the Altman's Z-score into the probability of failure by using logistic transformation. In order to measure the company size we used two different measures that are assets size and sales volume which represents the overall size of the company. Then ANOVA is used to test the following hypotheses:

H0 (1): There is no significant difference between the assets size of the companies.

H0 (2): There is no relationship of assets size with probability of failure.

H0 (3): There is no significant difference between the sales of the companies.

H0 (4): There is no relationship of sales with probability of failure.

RESULTS AND ANALYSIS

Table 1: Z-SCORE of selected steel companies

Company	2014	2013	2012	2011	2010	Avg.	S.D.
TATA Steel	1.80	1.82	1.93	1.66	1.87	1.82	.101
Steel Authority of India	1.93	2.32	2.34	2.47	2.33	2.28	.204
JSW Steel	1.91	2.13	2.34	2.20	2.66	2.25	.278
Bhushan Steel	.90	1.21	1.27	1.26	1.93	1.31	.376
VISA Steel	.40	.45	.35	1.24	1.93	.874	.794
Bajaj Steel Industries	4.88	3.98	5.28	4.88	5.36	4.88	.548
Good Luck Steel Tube	4.23	4.40	3.93	4.46	4.28	4.26	.206
Indian Steel Works	.68	1.04	3.82	4.27	3.97	2.76	1.74
Jindal Steel & Power	1.86	1.91	1.88	1.79	1.59	1.81	.128
Kalyani Steels	4.49	4.46	3.85	3.30	4.24	4.07	.500

Altman's Z-scores as calculated above (table-1) represent that Bajaj Steel, Good Luck Steel Tube, and Kalyani Steel remain in safe zone from 2009-2010 to 2013-2014. Steel Authority of India and JSW steel remain in grey zone for all the five years from 2009-10 to 2013-14. Bhushan steel and VISA steel were in financial distress because these companies are in distress zone continuously from 2010-11 to 2013-14, whereas on the other hand, TATA Steel remained in distress zone for two years from 2010-2011 to 2013-2014. Indian Steel remains in safe zone for three years from 2011-12 to 2013-14, after facing financial distress in 2009-2010. Jindal Steel & Power remains in grey zone for four years. On the basis of average Z-score, Bhushan Steel and VISA steel were in distress zone while TATA Steel, Steel Authority of India, JSW Steel, Indian Steel Works and Jindal Steel and Power were in grey zone and Bajaj Steel, Good Luck Steel tube and Kalyani Steels were in safe zone for five years from 2009-10 to 2013-14.

Table 2: Probability of failure on basis of Z-score as calculated above.

Company	2014	2013	2012	2011	2010	Avg.
TATA Steel	.1416	.1393	.1282	.1597	.1334	0.8600
Steel Authority of India	.1282	.0893	.0876	.0779	.0884	0.8631
JSW Steel	.1289	.1063	.0876	.0999	.0645	0.8745
Bhushan Steel	.2893	.2296	.2187	.2212	.1282	0.8832

VISA Steel	.4012	.3895	.4135	.2242	.1282	0.8989
Bajaj Steel Industries	.0079	.0186	.0052	.0075	.0049	0.9070
Good Luck Steel Tube	.0148	.0118	.0194	.0114	.0138	0.9067
Indian Steel Works	.3364	.2609	.0214	.0137	.0186	0.9034
Jindal Steel & Power	.1349	.1289	.1327	.1431	.1694	0.9034
Kalyani Steels	.0109	.0115	.0206	.0356	.0142	0.8986

The Z-score obtained by Altman's model does not represent the probability of failure but it can be transformed into probability of failure by using logistic transformation (table-2).

Table 3: Assets size of selected companies (in crores)

Company	2014	2013	2012	2011	2010	Avg.
TATA Steel	87274.77	81121.19	76315.18	73092.81	62407.95	76042
Steel Authority of India	66933.05	62525.21	55908.53	56125.27	49827.95	58264
JSW Steel	49259.16	36481.16	30799.71	27972.60	21291.44	33161
Bhushan Steel	40992.31	35945.20	27595.95	21339.91	15395.78	28253
VISA Steel	2690.73	2729.93	1437.66	1518.47	1457.44	1967
Bajaj Steel Industries	136.94	109.9	106.09	101.04	92.33	109
Good Luck Steel Tube	411.38	381.18	325.20	229.41	227.62	315
Indian Steel Works	222.21	197.72	196.42	207.15	178.75	200
Jindal Steel & Power	35731.24	31849.01	25217.87	20131.04	15129.26	25612
Kalyani Steels	582.96	554.39	531.06	546.97	489.90	541

Source: Money Control Database

The above numbers report asset sizes of the respective companies with effect from year 2010 to 2014 (table-3). The numbers are taken in their raw sense in order to have a glimpse of wide variations in their distribution. For instance, TATA steel registers highest size of average assets, whereas Bajaj Steel

Industries witness lowest size of average assets across the sample years. The rest of the values lie in the continuum between the highest and lowest values.

Test of H0 (1): There is no significant difference between the assets size of the companies. To test whether the assets size of the companies is significantly different or not, we use ANOVA test and the results are as follows:

Table 4: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.002	1	.002	16.464	.004*[b]
	Residual	.001	8	.000		
	Total	.003	9			
a. Dependent Variable: prob						
b. Predictors: (Constant), logassets * Significant at 5 percent level						

According to above ANOVA table-4, calculated value is higher than the table value. Thus, it is proved that there is a significant difference between the respective asset sizes of the companies. Hence, we rejected the null hypothesis.

Test of H0 (2): There is no relationship of assets size with probability of failure. In order to examine the relationship of assets size with probability of failure we conduct regression based analysis. Results of regression analysis are as follows (table-5):

Table 5: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.820[a]	.673	.632	.0110409
a. Predictors: (Constant), logassets				

Table 6: Coefficients

Model B		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		Std. Error	Beta			
1 (Constant) .938 .012					76.582	.000*
	logassets	-.006	.001	-.820	-4.058	.004*
a. Dependent Variable: prob * Significant at 5 percent level						

From above analysis we can draw the following regression equation:
Y = .938 + (-.006)X
Here, Y = dependent variable (probability of failure)
X = independent variable (log assets owing to existence of wide variations)

Test for significance:

The statistical significance of linear relationship between X and Y may be tested by t-statistic value. Because the calculated value is larger than the critical value (table value), the null hypothesis {H0 (2)} is rejected (table-6). Hence there is significant relationship between assets size of the companies and probability of failure at 5 percent significance level. As shown in above equation, Beta coefficient is negative thus it can be concluded that assets size of the companies is negatively related to the probability of failure. The strength of association is measured by R Square; which is .673. It signifies the total variation in Y (probability of failure) that is accounted for by the variation in X (assets size). Above results indicates that as the assets size increases probability of default decreases and vice versa.

Table 7: Sales of selected companies (in crores)

Company	2014	2013	2012	2011	2010	Avg.
TATA Steel	41711.03	38199.43	33933.46	29396.35	24940.65	33616
Steel Authority of India	46698.41	44598.26	46341.79	43307.36	40595.90	44308
JSW Steel	45297.72	35491.81	32122.66	23367.11	10167.46	29289

Company	2014	2013	2012	2011	2010	Avg.
Bhushan Steel	9675.83	107442.7	9941.41	7000.46	5621.77	27936
VISA Steel	1029.96	515.76	1365.91	1323.64	1157.11	1078
Bajaj Steel Industries	406.94	285.23	313.39	204.20	210.88	284
Good Luck Steel Tube	975.43	953.24	679.05	560.82	485.86	731
Indian Steel Works	613.23	724.86	601.37	299.60	102.17	468
Jindal Steel & Power	14594.02	14954.70	13333.95	9574.17	7347.44	11961
Kalyani Steels	1115.99	809.07	989.54	1236.82	1058.25	1042

Source: Money Control Database

On a similar note, table-7 report average sales of the undertaken companies across the sample years. Highest levels of average sales are observed in case of Steel Authority of India, whereas Bajaj Steel Industries registers lowest average sales.

Test of H0 (3): There is no significant difference between the sales of the companies. To test whether the sales of the companies is significantly different or not, we use ANOVA test and results are as follows:

Table 8: ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.002	1	.002	20.572	.002*[b]
	Residual	.001	8	.000		
	Total	.003	9			
a. Dependent Variable: prob						
b. Predictors: (Constant), logsales * Significant at 5 percent level						

According to above ANOVA table-8, calculated value is higher than the table value. Thus, it is proved that there is a significant difference between average sale sizes of the companies. Hence, we rejected the null hypothesis.

Test of H0 (4): There is no relationship of sales with probability of failure. In order to examine the relationship of sales with probability of failure we

conduct regression analysis. Results of regression analysis are as follows (table-9):

Table 9: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.849[a]	.720	.685	.0102165
a. Predictors: (Constant), logsales				

Table 10: Coefficients

Model B		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		Std. Error	Beta			
1 (Constant) .953 .014					66.553	.000*
	Logsales	-.008	.002	-.849	-4.536	.002*
a. Dependent Variable: prob						
* Significant at 5 percent level						

From above analysis we can draw the following regression equation:
Y = .953 + (-.008)X
Here, Y = dependent variable (probability of failure)
X = independent variable (log sales owing to wide variations)

Test for significance

The statistical significance of linear relationship between X and Y may be tested by t-statistic value. Because the calculated value is larger than the critical value (table value), the null hypothesis {H0 (2)} is rejected (table-10). Hence there is significant relationship between assets size of the companies and probability of failure at 5 percent significance level. As shown in above equation, Beta coefficient is negative thus it can be concluded that assets size of the companies is negatively related to the probability of failure. The strength of association is measured by R Square; which is .720. It signifies the total

variation in Y (probability of failure) that is accounted for by the variation in X (log sales). Above results indicates that as the sales increases probability of default decreases and vice versa.

CONCLUSION

From above study, it is concluded that assets size and sales of the companies are significantly different. It is also observed that assets size and sales of the companies have significant impact on probability of failure. Z-score of the companies is used as a base to find out the probability of failure of the companies. The results indicate that assets size and sales have a negative relationship with probability of failure. Sales have more impact on probability of failure as compare to assets because beta coefficient (-.008) and value of R Square (.720) of sales is more than the beta coefficient (-.006) and value of R Square (.673) of the assets size. Thus it is proved that assets size and sales have significant negative relationship with probability of failure, which indicates that as the assets size and sales of the company increases probability of failure decreases and vice versa. These results are found to be consistent with the findings of Dichev (1998) and Vassalou and Xing (2004). The crux of the argument is that with the increase in scale of operations (asset size and sales), revenue levels start acting as a safety cushion in the context of attenuating financial risks and augmenting solvency positions of the respective companies.

LIMITATIONS AND FURTHER SCOPE FOR RESEARCH

The present study is restricted to the Indian steel sector only and based on the sample of ten steel companies. Another limitation of the study is that only one bankruptcy prediction model is used to obtain the probability of failure. This study can be extended to the different sectors instead of steel sector and a larger sample can be used to check the robustness of the results. Further other bankruptcy prediction models may also be used to obtain the probability of the failure.

ANNEXURE

Companies selected for study

S.NO.	COMPANY	S.NO.	COMPANY
1.	TATA STEEL	6.	BAJAJ STEEL INDUSTRIES
2.	STEEL AUTHORITY OF INDIA	7.	GOOD LUCK STEEL TUBE
3.	JSW STEEL	8.	INDIAN STEEL WORKS
4.	BHUSHAN STEEL	9.	JINDAL STEEL & POWER
5.	VISA STEEL	10.	KALYANI STEELS

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