

# APPLICABILITY OF ALTMAN Z-SCORE IN BANKRUPTCY PREDICTION OF BSE PSUs

Arpita Agarwal\*, Ity Patni\*\*

**Abstract** Prediction of bankruptcy is a critical task. Firms can be hedged from bankruptcy situation by solvency recognition at inceptive stage which may avoid enormity in the near prospective. There are lots of techniques available for measuring the financial health of a business firm wherein Altman's Z-score is one of the prominent measures for predicting bankruptcy. The study is based on the fundamentals of the companies using financial ratios by taking companies of PSU index listed on Bombay Stock Exchange across different sectors over a period of 6 years from 2013-2018. The finding reveals that Altman's Z-score model has a remarkable degree of accuracy in predicting distress using financial ratios. The results may be useful for the managers for financial decision making, the stakeholders to choose investment options & others to look after their interest in the concerned manufacturing and non-manufacturing companies.

**Keywords:** Bankruptcy Projection, Financial Competence, Altman Z-score Model, Financial Distress

## BACKGROUND OF THE STUDY & INTRODUCTION

Bankruptcy is a rough game and it moves fast. Elevated unpredictable scenario has taken away the surety of quiddity from firms. For all the business houses, longevity of the firm becomes the prime issue of concern. Most of the organizations exist with an objective of profit maximization and to achieve this objective various internal and external support factors are required. Bankruptcy of the organization results due to the failure in these support systems such as effective utilization of funds, material, labor, economic, political, socio-cultural conditions and many more (Sajjan, 2016). For maintaining the financial soundness these factors must be handled in an efficient and integrated manner, the absence of which leads in bankruptcy of the organization (Adukia, 2017; Shilpa, 2013). The state of bankruptcy can be defined as a situation where the total liability of the company exceeds its total assets or wherein the company or the person is not able to repay the creditors the debt amount (Rao, Atmanathan, Shankar & Ramesh, 2013).

In the span of globalization, prophecy of financial soundness is of great importance. Over the last 35 years, the topic of company failure prediction has developed to a major research domain in corporate finance (Argenti, 2003; Beaver & William, 1968; Bilanas & Harris, 2004). In the process of

decision making, prediction of corporate distress also has critical influence on investors (Pradhan, 2016). (O'Leary, 2001) argued that prediction of bankruptcy probably is one of the most important business decision making problems. The literature shows that the financial stability of companies is at the stake. For forecasting the performance of the company's, researchers are conducting continuous researches to find an optimal solution for bankruptcy prediction.

Financial stability of the companies has been always of great concern for investors. This shared interest creates persistent investigation and continuing attempts to answer an incessant question that how financial distress can be predicted or what reveals the credit risks of firms.

Multiple prediction models have been developed all over the world for predicting corporate failure based on various types of modeling techniques (Aldrich & Nelson, 2007). In the past research, bad or poor management, rapid technological changes, fraud and inexperienced management styles etc. has been stated as the major reason for business failures (Ahn, 2000). Financial failures may take the form of bankruptcy or insolvency (Bruton, 2008; Bryant, 1997; Carrol, 2008; Charitou, tam & Cheung, 2000).

There have been many methods developed and used across the industries to evaluate the credit worthiness of the companies. One among them is Altman's Z-score model. In 1968, Z-score formula was published by the Altman. The

\* Research Scholar, Department of Business Administration, Manipal University Jaipur, Rajasthan, India.  
Email: arpita1292@yahoo.com

\*\* Associate Professor, Department of Business Administration, Manipal University Jaipur, Rajasthan, India.  
Email: ity.patni@jaipur.manipal.edu

Z-score for predicting bankruptcy is a multivariate formula for a measurement of the financial health of a company & a powerful diagnostic tool that forecasts within two years, the probability of a company entering into bankruptcy. This study focused on Altman's Z-score model to evaluate the credibility of the firms. Financial statements are normally used to gauge the performance of the firm & its management (Ohlson, 1980). The financial statements commonly used are Profit & Loss statements, Balance sheets & Cash Flow statements. From the financial statements, various ratios can be calculated to assess the current performance future prospects of the concerned firm (Milkette, 2001; Millihni, 2003).

The paper is an attempt to predict the bankruptcy using Altman's Z-score model on 53 BSE-PSUs manufacturing and non-manufacturing companies for a period of 6 years from 2013-2018. It reflects company's probability of bankruptcy i.e Z-score and the probabilistic approach of predicting bankruptcy. The Altman's Z-score is a widely used measure that applies an algorithm that has been found to have useful predictive value on the likelihood of a business going bankrupt (Sanesh, 2016).

The purpose of our research is to study the suitability of Altman's Z-score prediction model by applying it to manufacturing and non-manufacturing sector. The outcome of this piece of research can be considered as caution bell of any future financial distress for BSE PSUs.

## REVIEW OF LITERATURE

Bankruptcy is a state of insolvency where a company cannot meet, or has difficulty paying off its official obligations to its creditors (Sofat & Hiro, 2015; Rao & Shanker, 2013). The early prediction of financial distress is essential for investors or lending institutions. To develop the method through which the risk of running into bankruptcy can be prior predicted is of great importance. Since 1930, several theories, models & techniques were proposed by researchers aiming to predict whether a firm is about to face bankruptcy (Bellovary, Giacomino & Akers, 2007). There are lots of techniques available for assessing the financial health of a business firm. It is also crucial that the method is easily understandable, applicable across industries and compatible in predicting financial distress.

Bankruptcy prediction is important for the various stakeholders of the company as well as the society on the whole. In 1968, Altman (1968) developed and presented the Z-score formula in order to provide a more effective financial assessment tool to assist risk analysts and lenders in their estimations.

The Z-score model was originally developed for publicly held manufacturing firms. Later, model is edited by Altman for being applicable on privately held firms (the Altman Z'-score) and Non-manufacturing firms (the Z''-score). Altman's Z-score formulas are used in a variety of contexts and countries. Depending on the nature of the enterprises assessed the Z-score formula varies (Altman, 1968; Altman, 1977; Altman, 1993; Altman, 2000).

Altman identified five common accounting ratios that significantly predict default (Harrington, 2009; Bardia, 2012; Hayes et al., 2010; Hull & John, 2015; Pam, 2013). This model uses a statistical technique of multiple discriminant analysis to obtain a predictor that is considered to be a linear function of multiple explanatory variables. This predictor identifies the likelihood of Bankruptcy if any. Studies measuring the effectiveness of the Z-score have shown that the model has 70% - 80% reliability (Taffler, 2011; Thynne, 2006). With the help of the score the probability of default by the company's due to the financial distress can be predicted based on its current financial statistics of the company. The case study of Raysutt cement manufacturing company SAOG & its subsidiaries were considered (Mohammed, 2016). The Z-score gained wide acceptance by auditors, management accountants, courts and database systems used for loan evaluation (Eidleman, 2003). The model has been proven to be a reliable tool across the globe.

(Mulla, 2002; Aiyabei, 2002; Ugurlu & Hakan, 2006; Awais et.al. 2015; Muthukumar & Sekar, 2014), evaluated the financial performance of the firms using Z Score model respectively in textile mills, small business firms, manufacturing companies, textile firms, automobile companies. It was observed that Z-score is the best tool to predict financial viability. (Pradhan, 2011) suggests that the model is able to forecast the financial health of a company for the situation of loan value enhancement & repayment period extension effective in policy designing related to credit viability.

The first research on bankruptcy prediction was carried out by (Woodlock, 1900). (Clure, 2004) has confirmed the Z score model through his research study and concluded that investors should consider checking their companies Z score on a regular basis. (Harvankolayee & Kadkhodayee, 2003) concluded that researchers have presented multivariate models for bankruptcy prediction by combining these ratios which are practically among the most successful academic products & decision making tools. (Mehrani, Bahramfar, & Qayoor, 2005) an early warning of possible bank enables the management and investors to take predictive measures & distinguish favorable investment opportunities from unfavorable ones.

## ALTMAN'S Z-SCORE

Z-score model is used to predict the probability of a firm that it will go into bankruptcy in the near future. The Z-score Formula for the manufacturing & non-manufacturing companies are shown in Table 1.

**Table 1: Z-Score Formula for Manufacturing & Non-Manufacturing Companies**

Z-score Formula for the Manufacturing Companies	Z-score Formula for the Non-Manufacturing Companies
$Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 1.0X5$ Where: X1 = Working Capital / Total Assets X2 = Retained Earning / Total Assets X3 = Earnings before Interest and Tax / Total Assets X4 = Market Value of Equity / Total Liability X5 = Sales / Total Assets	$Z = 6.56X1 + 3.26X2 + 6.72X3 + 1.05 X4$ Where: X1 = Working capital / Total Assets X2 = Retained Earning / Total Assets X3 = Earnings before Interest and Tax / Total Assets X4 = Book Value of Equity / Total Liability

### X1- Working Capital/Total Assets

The ratio is termed as the liquidity ratio. In relation to firm's size, the purpose of this ratio is to measure the liquidity of the assets. Size and Liquidity characteristics are explicitly considered.

In studies of corporate problems, the working capital/Total assets ratio is frequently found. The difference between current assets and current liabilities is termed as working capital.

### X2- Retained Earnings/Total Assets

X2 ratio indicates the efficiency of the management in manufacturing, sales, administration and other activities.

This ratio is an indicator of the 'cumulative profitability' of the firm. This ratio implicitly considers the age of a firm.

### X3- Earnings before Interest and Taxes/Total Assets

By dividing the total assets of a firm into its earnings before interest and tax reductions the X3 ratio is calculated. It is a measure of firm's productivity which is crucial for the long term survival of the company. The overall enterprise existence is depended on its earning power. It measures how effectively resources are been utilized by firms.

### X4- Market Value of Equity/Book Value of Total Debt

The ratio defines how the market views the company. The market is able to determine the worth of the company on the basis of information being transmitted by the company to market. Market value dimension is added by the ratio which other failure studies did not consider. By combined market value of all shares of stock, equity is measured, while debt includes both current and long-term. The measure shows how much the firm's assets can decline in value before the liabilities exceed the assets and the concerns become insolvent.

### X5- Sales/Total Assets

The ratio is defined as a 'measure of management ability to compete'. The sales to total assets ratio adorns the firm assets ability to generate sales. In competitive conditions it is one of the measures which show management's capability.

## THE ZONE OF DISCRIMINATION

Altman (1983) presented three zones of discrimination for the model for manufacturing and non-manufacturing companies which is explained in Table 2.

**Table 2: Zones of Discrimination for Manufacturing & Non-Manufacturing Companies**

Manufacturing Companies			Non-Manufacturing Companies		
Scores	Zone	Result	Scores	Zone	Result
$Z > 2.99$	SAFE	Protected	$Z > 2.6$	SAFE	Protected
$1.81 < Z < 2.99$	GREY	Stable	$1.1 < Z < 2.6$	GREY	Stable
$Z < 1.81$	DISTRESS	Likely to be bankrupt	$Z < 1.1$	DISTRESS	Likely to be bankrupt

Note: If a company's Z-score is less than 1.81 the chances of that company going bankrupt within two years is high.

Note: If a company having Z-score less than 1.1, the chances of that company going to be bankrupt within two years is high.

## RESEARCH METHODOLOGY

The methodology that has been followed in this study is based on a Z-score model by Altman. The related literature have proved that Z-score has accuracy and works as a robust tool in assessing the performance of the company for potential distress of the firms. The approach determined in this study is to evaluate the financial statements of Manufacturing & Non-Manufacturing companies listed on Bombay Stock Exchange under the index of BSE-PSU (Public Sector Undertakings). The sampling frame consists of 53 BSE-

PSUs out of which 14 are manufacturing companies and 39 are non-manufacturing companies.

The sample size taken for the study is 53 firms for six years from 2013-18 with an idea of measuring the overall financial performance as well as the likelihood of bankruptcy of BSE-PSUs to aware investors and other stakeholders. The data are collected from the authenticated websites such as: Bombay Stock Exchange, Money Control and Stock Screener. The extracted data were then put into the formula given by Edward Altman for Manufacturing and Non-manufacturing Company to arrive at the Altman Z-score. The sample reference is shown in Table 3.

**Table 3: Name of Manufacturing & Non-Manufacturing Companies (BSE PSUs)**

14 Manufacturing companies (BSE PSUs Index)		39 Non-Manufacturing companies (BSE PSUs Index)				
Steel Authority of India Ltd	Bharat Earth Movers Ltd	Punjab National Bank	State Bank of India	Container corporation of India Ltd	Jammu Kashmir Bank Ltd	Bank of Maharashtra
Bharat Petroleum Corporation Ltd	Indian Oil Corporation Ltd	Industrial development Bank of India	Bank of Baroda	Canada Bank	Indian Overseas Bank	Neyveli Lignite Corporation of India Ltd.
Hindustan Petroleum Corporation Ltd	Bharat Heavy Electricals Ltd	Power Finance Corporation Ltd	Power Grid Corporation of India Ltd	Bank of India	Oil India Ltd	Gujarat Mineral Development Corporation Ltd
Gail India Ltd	Metals and Minerals Trading Corporation of India Ltd	Union Bank	Indian Bank	National Hydro-electric Power corporation	Manganese Ore India Ltd	Dena Bank
Mangalore refinery Petrochemical Ltd	Balmer Lawrie corporation Ltd	Rural Electrification Corporation Ltd.	Oriental Bank of Commerce	Coal India	Corporation Bank	Industrial Finance Corporation of India Ltd
Rashtriya Chemicals fertilizers Ltd	National Buildings Construction Corporation of India Ltd.	Oil and Natural Gas corporation Ltd	Allahabad Bank	Engineers India Ltd	Satluj Jal Vidyut Nigam Ltd	UCO Bank
Bharat Electronics Ltd	Chennai Petroleum corporation Ltd	National Aluminium Corporation Ltd	Syndicate Bank	Hindustan Copper Ltd	Vijaya Bank	Central Bank of India
		Andhra bank	National Thermal Power Corporation Ltd.	Shipping Corporation of India Ltd	National Mineral Development Corporation Ltd.	

## OBJECTIVE

The objective of this study was to test and evaluate the strength & accuracy of Altman’s Z-score model and its suitability to be used for predicting imminent threats of

financial distress in manufacturing & non-manufacturing sector.

## DATA ANALYSIS AND INTERPRETATION

Z-score formula applied on 14 manufacturing companies taken from the list of BSE PSUs shown in Table 4.

**Table 4: Data & Z-score of BSE PSUs Manufacturing Companies Over the Period 2013-2018 Along with Their Interpretation**

SR No.	Company	Z-Score						Interpretation
		2013	2014	2015	2016	2017	2018	
1	SAIL	1.354	1.213	1.048	0.519	0.504	0.754	Distress
2	BEML	1.603	2.081	2.088	2.088	2.120	2.170	Grey
3	BPCL	4.088	4.268	4.141	3.401	2.914	3.070	Safe
4	IOC	2.475	2.413	2.532	2.298	2.121	2.152	Grey
5	HINDPETRO	2.987	3.349	3.688	3.194	3.093	3.103	Safe
6	BHEL	2.165	1.898	1.712	1.497	1.693	1.643	Distress
7	GAIL	2.102	2.232	2.077	1.967	2.120	2.244	Grey
8	BEL	1.731	1.923	2.078	1.886	1.898	1.797	Distress
9	CHENNPETRO	2.853	3.735	3.512	2.826	3.012	2.757	Grey
10	RCF	2.104	2.313	2.376	1.893	2.041	2.043	Grey
11	NBCC	1.751	2.378	2.280	2.071	1.934	1.571	Distress
12	MRPL	2.652	2.094	1.434	1.197	2.589	2.486	Grey
13	BALMLAWRIE	3.798	3.550	3.644	2.825	2.709	2.689	Grey
14	MMTC	5.272	6.280	4.309	4.104	2.519	3.630	Safe

The Z-score is calculated by multiplying each of several financial ratios by an appropriate coefficient & then summing the results.

Z-score formula applied on 39 non-manufacturing companies taken from the list of BSE PSUs in Table 5

**Table 5: Data & Z-score of BSE PSUs Non-Manufacturing Companies Over the Period 2013-2018 Along with Their Interpretation**

SR No.	Company	Z-Score						Interpretation
		2013	2014	2015	2016	2017	2018	
1	PNB	6.519	6.430	6.470	6.319	6.246	6.004	Safe
2	SBIN	6.227	6.295	6.233	5.781	5.823	5.562	Safe
3	IDBI	5.672	5.798	5.829	5.057	5.096	4.592	Safe
4	BANKBARODA	6.631	6.542	6.598	6.355	6.472	6.097	Safe
5	CANBK	6.672	6.559	6.576	6.384	6.249	6.080	Safe
6	PFC	1.582	1.209	1.150	1.361	1.304	0.979	Distress
7	POWERGRID	0.621	0.626	0.504	0.589	0.635	0.701	Distress
8	BANKINDIA	6.395	6.206	6.433	6.020	6.146	6.058	Safe
9	UNIONBANK	6.511	6.460	6.394	6.319	29.800	5.952	Safe
10	INDIANB	6.878	6.755	6.848	6.769	6.369	6.259	Safe
11	RECLTD	0.763	0.890	0.838	1.441	1.365	0.694	Distress
12	ORIENTBANK	6.827	6.823	6.840	6.523	6.171	6.232	Safe
13	COALINDIA	3.524	3.176	2.805	2.354	1.492	0.942	Distress
14	ONGC	2.940	2.699	2.575	2.809	2.774	2.173	Grey
15	ALBK	6.747	6.688	6.638	6.292	6.348	5.895	Safe
16	ENGINERSIN	6.185	6.648	6.157	6.002	5.708	4.408	Safe
17	NATIONALUM	4.078	4.232	5.556	4.712	3.874	4.474	Safe
18	SYNDIBANK	6.565	6.396	6.356	6.292	6.507	6.077	Safe
19	HINDCOPPER	5.659	5.734	4.553	2.795	2.452	1.910	Grey
20	IFCI	2.746	1.075	1.268	0.871	0.997	0.561	Distress
21	ANDHRABANK	6.583	6.466	6.481	6.622	6.573	6.021	Safe

SR No.	Company	Z-Score						Interpretation
		2013	2014	2015	2016	2017	2018	
22	NTPC	2.844	2.425	1.784	1.461	1.297	1.358	Grey
23	SCI	1.375	1.237	1.528	1.676	1.071	1.137	Grey
24	CONCOR	6.438	5.936	5.775	4.186	3.936	5.001	Safe
25	J&KBANK	7.054	6.996	6.870	6.516	6.437	6.519	Safe
26	NMDC	9.724	9.858	9.103	6.977	5.474	5.430	Safe
27	NHPC	1.917	1.703	2.029	2.029	1.916	2.014	Grey
28	VIJAYABANK	6.567	6.706	6.639	6.294	6.223	6.165	Safe
29	CENTRALBK	6.435	6.237	6.281	6.371	6.306	6.195	Safe
30	UCOBANK	6.589	6.307	6.641	6.019	6.176	5.837	Safe
31	MOIL	9.379	9.619	9.397	8.689	8.896	8.351	Safe
32	DENABANK	6.455	6.653	6.732	6.199	6.223	6.065	Safe
33	OIL	7.016	3.526	4.421	4.584	3.519	3.171	Safe
34	GMDCLTD	5.026	4.874	5.019	4.656	4.287	4.528	Safe
35	IOB	6.327	6.338	6.550	6.109	6.240	5.965	Safe
36	NLCINDIA	4.577	4.560	4.573	3.530	1.894	1.946	Grey
37	CORPBANK	6.617	6.615	6.728	6.256	6.474	5.699	Safe
38	SJVN	2.924	2.941	4.050	4.313	4.450	4.205	Safe
39	MAHABANK	6.183	6.524	6.446	6.388	6.245	6.235	Safe

## ANALYSIS AND INTERPRETATION

From the Z-score result tables 4 & 5 of PSUs manufacturing and non-manufacturing companies, it infers following things:

- Majority of company's i.e 31 companies are in SAFE zone.
- 9 companies are in Distress zone, there is more probability for financial embarrassment.
- 13 companies are in Gray zone, which means they require more special attention to remain financially sound.

**Table 6: 9 Distressed Firms: Problems & Possible Solutions**

Distress Firms	Problem	Recommendation	Supporting Literature
<b>Steel Authority of India Ltd.</b>	Liquidity position deteriorated during the study period due to negative working capital. Asset turnover of the company is lower than industry average. Market value of the company is declining.	<ul style="list-style-type: none"> <li>• Liquidity is the area where sincere attention is required. Current Liabilities must be reduced or Current Assets must be increased by the company up to a reasonable level.</li> <li>• The company must maintain adequate amount of liquid assets in order to meet short-term commitments and emergency requirements.</li> <li>• Proper utilization of resources must be there and company may increase its market value with the help of innovations.</li> </ul>	(Bardia, 2012)
<b>Bharat Heavy Electricals Ltd</b>	Improper management of receivables, inadequate diversification and increasing competitiveness in emerging market leads to the decline in the power sector. The companies X3 ratio i.e EBIT/ TA shows the declining trend during the study which is the negative sign for financial health of the company that means company is unable to utilize its fixed assets to earn profits.	The company should focus on increasing its X3 ratio i.e EBIT/TA by increasing profits or decreasing total asset of the company.	(Balachandran, 2017), (Geete, 2016), (CAG, 2017), (Kalbag & Menon, 2013)

Distress Firms	Problem	Recommendation	Supporting Literature
<b>Bharat Electronics Ltd</b>	Continuous downfall in the ratios i.e working capital to Total assets and market value of the equity to total liability during the study states negative sign for the financial health of the company which means liquidity position of the company is quite poor.	The company should stop storing unproductive assets. Analyze overhead and look for cost savings. Study all areas of business to see where you can save money and free up funds to bolster your firm's liquidity.	
<b>National Buildings Construction Corporation of India Ltd.</b>	The principle problem faced by the company is the poor management of cash flow. Low sales and high cost reduces its earnings ratio.	Before it's too late take proactive steps to address the problems. Each month perform a budget variance analysis to see whether the company is on track with the revenue and expense projections. Cash flow statements must be created monthly and updated as money received and bills paid to ensure you don't temporarily drain your bank account or max out your credit, bringing your business to a standstill.	(Edmunds, 2016)
<b>Power Finance Corporation Ltd</b>	The working capital to total asset of the company is declining during the study and in the year 2018 it becomes negative which states that company is in-efficient to recover its debts. Further declining Sales to Total assets ratio signifies company's inability to utilize its assets to generate sales.	The company can improve its X1 i.e working capital / Total Assets ratio by earning profits, issuing common stock, replacing its short term debts with the long term.	(Babla, 2018), (Animesh, 2014) (Averkamp, 2018)
<b>Power Grid Corporation of India Ltd.</b>	The company's working capital to Total Asset is negative throughout the study period which means major part of its working capital is financed through debt. The company is unable to pay its short term debt which shows the poor liquidity position of the company.	The company should dispose off its unproductive assets for whatever they are worth. Removal of short-term debt from the balance sheet will allow having better Quick and Current ratios, and to save some of the liquidity in the near term and put it to better use.	(Sanesh, 2016) (Kumaran, 2015)
<b>Rural Electrification Corporation Ltd.</b>	The current ratio of company is showing decreasing trend or are in negative figures. It shows the inability of the company to pay its short term debts. Major part of its working capital is financed through debt and there is an increase in sundry debtors throughout the study period.  Further the down fall in EBIT ratio shows company is not able to retain more earnings which means that efficiency of the company to accumulate its profit to finance its total assets is declining.	Effective Management of Information systems. The company needs to frame strong budgeted development practices.	(Ishwarbharath, 2018)
<b>COAL INDIA</b>	Company's short-term assets are not enough to meet its current debt obligations if the current ratio is below one. A low inventory turnover of the company implies excess inventory and weak sales. Deteriorating net profit margins mean very high expenses. Further decline in cash flow indicates company is unable to generate enough cash to support the business.	Overhead expenses of the company should be controlled. The company should cut back its expenses on professional fees, rent, labor, marketing and so on. This will automatically bring downfall in short-term expenses of the company. It will also increase cash retain in the business. Soon, company's Current and Quick ratios start looking mighty impressive.	(Sanesh, 2016) (Thanawala, 2016)
<b>Industrial Finance Corporation of India Ltd</b>	Major drawback of the company is that it is not yet developed fully. It fails to provide risk capital in adequate quantity. Company is unable to recover its debts which are stated by negative figures of X1 ratio in year 2016.	<ul style="list-style-type: none"> <li>• The domestic sources of finance need to be strengthened and expended</li> <li>• Setting up new institutions and expanding the existing ones will help in diversifying the source of finance. For smooth flow of foreign capital arrangement must be made.</li> </ul>	(Sethy, 2016), (Rajadhyaksha, 2018)

## FINDINGS

Altman's Z-score is considered by many scientists & finance professionals as an effective and suitable tool for predicting corporate failures. The study shows that Z-score is able to predict that a firm might get into a state of distress at least two years prior to the situation occurring. Companies which have a Z-score of 0.8 or less for two consecutive years have a very high probability of filing for bankruptcy in the third or fourth year. The Z-score model is user friendly, anyone with financial knowledge and statistical skills can easily use it. Appendix 1 shows the ratios of distress firms separately.

## LIMITATIONS & FURTHER SCOPE OF THE STUDY

The study is limited to 53 BSE PSUs Manufacturing and Non-manufacturing companies based on the published data of financial statements of the company of six years taken from 2013-2018. The Altman Z-score model has its own limitations as it is not suitable for small companies. It only provides two outcomes, likely or not likely, the gray area is unsatisfying. Further studies can be extended using alternative modeling techniques, assessing & comparing the outcome of different models by taking multiple samples at the same time.

## CONCLUSION

This is one of the few studies focused on the Indian business arena, specifically consisting of PSUs index of the Bombay stock exchange. This study investigated the applicability of the Altman's Z-score bankruptcy model to examine the financial soundness of the firms belonging to manufacturing and non-manufacturing sector. The study covers 53 companies & six years of time frame from 2013-2018.

According to the findings, Altman Z score is a likely hood and not a prediction. From the company's financial, it may look likely that bankruptcy looms, but the management may well succeed in improving matters. Though, for rational investor, it's astute to have prudence for company's solvency. The Z-score model is not projected to forecast when a firm will actually file for legal bankruptcy. It is as an alternative for how closely a firm look's like other firms that have filed in the bankruptcy.

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## APPENDIX 1

### Ratio Analysis of List of Distress Companies

SR No.	Company	Year	WC/TA	RETAINED EARNINGS/TA	EBIT/TA	MARKET VALUE OF EQUITY/ TL	SALES/TA
1	SAIL	2013	0.060	0.431	0.047	0.011	0.519
		2014	-0.015	0.411	0.045	0.016	0.498
		2015	-0.059	0.387	0.038	0.005	0.450
		2016	-0.136	0.329	-0.044	0.008	0.363
		2017	-0.182	0.279	-0.020	0.020	0.386
		2018	-0.111	0.256	0.017	0.014	0.466
2	BHEL	2013	0.329	0.426	0.136	0.045	0.698
		2014	0.363	0.446	0.071	0.100	0.545
		2015	0.384	0.490	0.033	0.030	0.441
		2016	0.373	0.484	-0.013	0.042	0.389
		2017	0.369	0.516	0.015	0.031	0.458
		2018	0.326	0.496	0.030	0.016	0.450
3	BEL	2013	0.375	0.429	0.077	0.006	0.421
		2014	0.417	0.476	0.081	0.100	0.430
		2015	0.453	0.511	0.096	0.088	0.448
		2016	0.386	0.480	0.095	0.059	0.402
		2017	0.307	0.422	0.118	0.083	0.498
		2018	0.238	0.407	0.105	0.052	0.562
4	NBCC	2013	0.236	0.223	0.081	0.036	0.867
		2014	0.244	0.240	0.085	0.842	0.963
		2015	0.265	0.254	0.091	0.632	0.927
		2016	0.251	0.258	0.075	0.153	1.069
		2017	0.216	0.229	0.075	0.241	0.962
		2018	0.208	0.214	0.066	0.055	0.771

SR No.	Company	Year	WC/TA	RETAINED EARNINGS/TA	EBIT/TA	MARKET VALUE OF EQUITY/ TL	SALES/TA
5	PFC	2013	0.071	0.1315	0.1006	0.0081	0.1020
		2014	0.007	0.1342	0.1061	0.0134	0.1098
		2015	0.0009	0.1351	0.1042	0.0053	0.1089
		2016	0.0313	0.1397	0.1036	0.0033	0.1117
		2017	0.0470	0.1309	0.0834	0.0069	0.1045
		2018	-0.0077	0.1299	0.0891	0.0028	0.0927
6	POWER GRID	2013	-0.0736	0.1885	0.0698	0.0185	0.1113
		2014	-0.0728	0.2043	0.0638	0.0111	0.1064
		2015	-0.0856	0.2025	0.0597	0.0049	0.1056
		2016	-0.0827	0.2089	0.0663	0.0084	0.1119
		2017	-0.0907	0.2190	0.0759	0.0107	0.1264
		2018	-0.0857	0.2189	0.0804	0.0166	0.1324
7	RECLTD	2013	-0.052	0.126	0.102	0.009	0.104
		2014	-0.041	0.129	0.108	0.014	0.112
		2015	-0.046	0.130	0.105	0.007	0.111
		2016	0.041	0.134	0.108	0.007	0.115
		2017	0.020	0.150	0.108	0.014	0.115
		2018	-0.049	0.136	0.084	0.003	0.091
8	COAL INDIA	2013	0.117	0.380	0.225	0.017	0.615
		2014	0.089	0.344	0.219	0.034	0.673
		2015	0.076	0.306	0.194	0.029	0.666
		2016	0.039	0.250	0.191	0.026	0.732
		2017	0.020	0.156	0.127	0.022	0.714
		2018	0.002	0.106	0.086	0.010	1.006
9	IFCI	2013	0.235	0.148	0.096	0.054	0.105
		2014	0.004	0.142	0.080	0.048	0.100
		2015	0.046	0.124	0.080	0.019	0.093
		2016	-0.013	0.121	0.080	0.019	0.104
		2017	0.035	0.127	0.048	0.029	0.087
		2018	0.016	0.110	0.010	0.012	0.097