Relevance of Ratios in Z-score Model for Predicting Bankruptcy- Study of Nifty PSES

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ABSTRACT

The current study is undertaken to predict bankruptcy of Nifty PSEs using z-score model and investigate relevance of the financial ratios in predicting the bankruptcy. The Z-score model is applied for a sample of 20 Nifty PSE companies listed in National Stock Exchange for the period from 2014-15 to 2018-19. The study reveals that nearly half of the companies chosen for the study are financially distressed companies and they are bound to bankruptcy in the near future. In case of manufacturing companies all ratios are positively correlated with the z-score value but highest correlation is found in the third and fourth ratios. In case of non-manufacturing companies also all four ratios are positively correlated with the z-score value but highest correlation is found only in the third ratio. It is observed in the analysis that there is a significant relationship between all the five ratios and financial distress of the manufacturing companies. Hence, it is inferred that the ratios used for determining z-score are relevant in case of manufacturing companies. However, there is no significant relationship between the ratios and financial distress of the non-manufacturing companies. Hence, it is inferred that the ratios used for determining z-score are irrelevant in case of non-manufacturing companies.

KEY WORDS: Bankruptcy, financial distress, manufacturing companies, Nifty PSEs, z-score model

INTRODUCTION

Every company has to monitor continuously its financial soundness to detect financial distress. If financial distress is not detected at early stage the company is likely to be bankruptcy and the resultant costs of the bankruptcy are enormous. Many researchers have proposed several models to predict likelihood of bankruptcy of financial distressed companies such as financial statement analysis, ratio analysis, logit model, linear model, KMV-Merton distance to default model, Altman z-score model etc. Altman z-score model is the first one using multiple discriminant analysis to predict financial distress with a high degree of accuracy, hence it is also called as multiple discriminant analysis model (MDA). Altman used multivariate analysis along with traditional ratio analysis to construct the model. The model has been applied in several studies and has given satisfactory results.

Altman Z-score model was developed by Edward Altman, a finance professor in Leonard N. Stern school of Business, New York in 1967. The probability of bankruptcy of the companies due to financial distress is based on the current financial statistics of the company. It is defined as a linear combination of four to five financial ratios weighted by coefficients. Originally the model was developed only for manufacturing companies but updated version model known as Altman Z-score plus was developed in 2012 which can be used for non-manufacturing companies and later on one more model was developed which is used for private firms.

Z-score model:

Public sector firms: Mfg.	$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5$	(Equation-1)
Non-Mfg	$Z = 6.56X_1 + 3.26X_2 + 6.72R_3 + 1.05X_{4*}$	(Equation-2)
Private sector firms:	$Z = 0.717X_1 + 0.847X_2 + 3.107R_3 + 0.42X_{4*} + 0.998X_5$	(Equation-3)

Where: Z = Z-score

X_1 = Working capital ÷ Total assets

X_2 = Retained earnings ÷ Total assets

X_3 = Operating profit ÷ Total assets

X_4 = Market capitalisation ÷ Total liabilities

X_{4*} = Book value of Equity ÷ Total liabilities

X_5 = Sales ÷ Total assets

Based on z-scores the firms are classified as safe, gray and distressed zones as follows.

Zones	Public sector firms		Private sector firms
	Mfg.	Non-Mfg.	
Safe zone	Z > 2.99	Z > 2.6	Z > 2.99
Gray zone	1.81 < Z < 2.99	1.1< Z < 2.6	1.23< Z < 2.99
Distressed zone	Z < 1.81	Z < 1.1	Z < 1.23

Safe zone implies that a firm is financial sound and is not likely to become bankrupt. Grey zone indicates that the firm is at the risk of financial distress and distress zone implies that the firm is more likely to become bankrupt in the near future (i.e. within next two years).

The model uses five ratios for manufacturing firms such as working capital to total assets, retained earnings to total assets, operating profit to total assets, market capitalisation to total liabilities and sales to total assets. However, only the first four ratios are used for non-manufacturing firms with different weightages and sales to total assets ratio is not used.

Working capital to total assets ratio measures liquid assets position in relation to size of a company. A company with lower working capital to total assets or a company with negative working capital indicates insufficient current assets leading to problems in meeting its short term obligations.

Retained earnings to total assets measures profitability that reflects the company's age and earning power. It also measures financial leverage of a company. A company with lower ratio implies that major portion of the profit is distributed to the shareholders in the form of dividend and capital expenditures are financed through external borrowings. Contrarily higher ratio represents less profit is distributed to the shareholders to retain more which enables the firm to face bad years of losses.

Operating profit to total assets measures operating efficiency of a firm resulting from efficient utilization of its total assets. It measures a firm's ability to earn profit from the assets before deducting non-operating expenses such as interest and taxes.

Market value of equity/total liabilities ratio tests the degree to which a company's market value would decline when it declares bankruptcy before the value of liabilities exceeds the value of assets in the balance sheet. A greater market value of equity to total liabilities implies larger investor confidence in the company's financial strength.

Total assets turnover ratio measures efficient utilization of the assets to generate sales revenue. It means it measures revenue generating ability of the company's assets.

REVIEW OF LITERATURE

The researcher has conducted an exhaustive survey of literature on the topic chosen for the current study, some of which are presented below.

Abdullah et al. (2008)[1] conducted a study to predict likelihood of bankruptcy of Malaysian financial distressed firms using three different models such as hazard model, multiple discriminant analysis and the logistic regression. The study revealed that the hazard model estimate was most accurate amongst all three models that was used with accuracy level of 94.9%. **Gerantonis et al. (2009)[2]** investigated financial distress of Greece companies using Altman Z-score model and the study revealed that the ability of Z-score model to predict financial failure was 66% in the first year which decreased to 52% in the second year, 39% in the third year and 20% in the fourth year prior bankruptcy. **Pathan (2009)[3]** investigated prediction of bankruptcy of US banking companies over the period of 1997-2004 using Altman model and found that the small board size and the boards that are not controlled by the CEO lead to additional bank risk. **Hayes, Hodge and Hughes (2010)[4]** investigated efficiency of Altman z-score model by applying it to a sample of 17 US retail firms in contemporary times and found that the model correctly predicted bankruptcy at a level of 94%. **Al-Khatib and Al-Bzour (2011)[5]** examined the financial distress of Jordanian listed companies using Altman and Kaida models. A sample of companies was taken representing both the manufacturing and non-manufacturing sectors for the period 1990-2006 and found that the results of Altman model were 93.8% accuracy and Keda 69% accuracy. **Alareeni and Branson (2012)[6]** examined accuracy of Altman model in the prediction of corporate bankruptcy for Jordanian companies. The study revealed that accuracy of the Z-score was 73.40% in the first year, 74.46% in the second year and 70.21% in the third year.

Gunathilaka (2014)[7] studied the financial distress of 82 Srilankan companies listed on the Colombo Stock Exchange using the Z-Score model of Altman and Springate. The study used financial data of the companies for the period from 2008 to 2012 and found no difference in the results of the two models. **Ahuja and Singhal (2014)[8]** investigated financial soundness of a sample of 15 companies in Indian textile industry using Altman Z-score model and identified probable bankruptcy of the companies. The study suggested that the results can be used by the banks for devising various strategies in their credit policies. **Shyamsunder Chitta, Ravikumar Jain and Sriharsha R.(2019)[9]** examined financial distress of 8 Maharatnas (public sector units of government of India) for the period from 2014 to 2018 using Altman model and found that 4 companies were under distress zone, 4 companies under grey zone and only 2 companies under safe zone.

RESEARCH GAP

Though various studies have been conducted on the prediction of corporate bankruptcy, no study was conducted on the prediction of bankruptcy of Nifty PSEs. Hence the researcher feels that there is a little gap in the research conducted till now and which provides ample scope for further research. In view of this research gap the researcher felt the need for further research and chosen the topic of the current study.

OBECTIVE OF THE STUDY

1.   To investigate financial distress of Nifty PSE companies using Altman Z-Score model.

2.   To investigate relevance of ratios in the Z–score model for the prediction of bankruptcy of the companies

DATA AND METHODOLOGY

The current study is considered to be descriptive and explanatory study. The data considered for the research is secondary in nature which is collected from the official website of valuresearchonline.com and moneycontrol.com. The Z-score model is applied for a sample of 20 Nifty PSE companies listed in National Stock Exchange which are given below.

List of Nifty PSEs-Industry-wise

Sl.No.	Company	Industry
Manufacturing companies		
1	Bharat Electronics Ltd. (BEL)	Engg & Electronic equ
2	Bharat Heavy Electricals Ltd. (BHEL)	Engg & Electrical mach
3	Bharat Petroleum Corpn. Ltd. (BPCL)	Energy
4	Coal India Ltd. (COL)	Energy
5	Gas Authority of Indi Ltd. (GAIL)	Energy
6	Hindustan Petroleum Corpn. Ltd (HPCL)	Energy
7	Indian Oil Corpn. Ltd. (IOC)	Energy
8	National Aluminum Co. Ltd. (NAL)	Metals
9	National Hydroelectric Power Corpn. Ltd. (NHPC Ltd.)	Electricity generation
10	National Mineral Development Corpn. Ltd. (NMDC)	Metals & Minerals
11	National Thermal Power Corpn Ltd. (NTPC)	Energy
12	Oil India Ltd. (OIL)	Energy
13	Oil and Natural Gas Corpn . Ltd (ONGC)	Energy
14	Steel Authority of India Ltd. (SAIL)	Metal
Non-manufacturing companies		
15	Container Corpn. of India Ltd. (CONCOR)	Transport service
16	General Insurance Corpn. of India Ltd.(GICRE)	Finance
17	The New India Assurance Co. Ltd. (NIACL)	Finance
18	Power Finance Corpn. Ltd. (PFC)	Finance
19	Power Grid Corpn. of India Ltd. (POWERGRID)	Energy
20	Rural Electrification Corpn. Ltd. (REC)	Finance

Out of the sample of 20 companies, 14 are manufacturing and 6 are non-manufacturing companies. The time frame of data being collected is set for 5 years from 2014-15 to 2018-19.

HYPOTHESES

The researcher has set the following five hypotheses to investigate relevance of ratios in predicting bankruptcy using Z-score model.

H_{a1}: There is a significant relationship between working capital to total assets ratio and financial distress of the companies

H_{a2}: There is a significant relationship between retained earnings to total assets ratio and financial distress of the companies

H_{a3}: There is a significant relationship between operating profit to total assets ratio and financial distress of the companies

H_{a4}: There is a significant relationship between market capitalisation (or book value of capital) to total liabilities ratio and financial distress of the companies

H_{a5}: There is a significant relationship between sales to total assets ratio and financial distress of the companies.

LIMITATIONS OF THE STUDY

- The current study is confined only to Nifty PSEs

- The current study is based on the data of only five years period from 2014-15 to 2018-19 and hence it may not hold good for the other period as the financial conditions differ from year to year.

- As the study is based on secondary data, there is possibility of unauthenticated information due to window dressing. The researcher is unable to prove the fairness and correctness of the data used in the study.

RESULTS AND DISCUSSION

Table-1: Table showing Z-score values and Mean Z-Score

Sl.No.	Company	2019	2018	2017	2016	2015	Mean Z-Score
	Manufacturing companies						
1	BEL	2.512	3.162	3.407	3.126	7.442	3.930
2	BHEL	1.311	1.481	1.698	1.180	1.997	1.533
3	BPCL	3.073	3.052	2.905	3.419	3.815	3.253
4	COL	2.638	2.173	2.877	3.423	4.009	3.024
5	GAIL	3.772	3.626	3.313	2.557	2.146	3.083
6	HPCL	3.215	3.308	3.257	3.375	3.008	3.233
7	IOC	2.126	2.219	2.281	2.155	2.455	2.247
8	NAL	3.070	3.193	3.160	2.879	3.603	3.181
9	NHPC	0.915	0.948	1.196	1.140	1.106	1.061
10	NMDC	3.065	3.442	3.480	2.818	4.265	3.414
11	NTPC	0.854	1.092	1.119	1.107	1.225	1.079
12	OIL	1.240	1.124	1.257	1.708	2.043	1.474
13	ONGC	1.697	1.551	1.510	1.446	1.834	1.608
14	SAIL	0.958	0.718	0.377	0.253	0.861	0.633
	Non-Manufacturing companies						
15	CONCOR	7.347	9.129	9.754	9.245	8.976	8.890
16	GIRCE	-0.476	-0.229	-0.006	5.203	5.688	2.036
17	NICL	-1.072	-0.597	-0.957	-0.851	-0.474	-0.790
18	PFC	6.902	6.784	1.059	1.143	0.954	3.368
19	POWERGRID	0.562	0.565	0.749	0.547	0.558	0.596
20	REC	6.761	7.056	1.132	1.229	0.655	3.367

Source: Author's calculation using excel

Table-2: Table showing the companies covered by different zones

Zones	Mfg	Non-Mfg	Total
Safe zone	7	3	10
Gray zone	1	1	2
Distress zone	6	2	8
Total	14	6	20

As shown in the table-2, out of 20 public sector companies chosen for the study, fourteen are manufacturing and six are non-manufacturing companies. Out of twenty companies, ten companies (i.e. 50%) are in safe zone, two are in grey zone and eight (i.e. 40%) are in distressed zone. In case of manufacturing sector seven companies (i.e. 50%) are safe and six companies (i.e. 40%) are in distressed zone. In case of non-manufacturing sector three companies (i.e. 50%) are safe and two companies (i.e. 33%) are in distressed zone. It is inferred from the above analysis that nearly half of the companies chosen for the study are financially distressed companies and they are bound to bankruptcy in the near future. The companies with different zones are given below.

	Manufacturing Companies	Non-Manufacturing Companies
Safe zone	BEL, BPCL, COL, GAIL, HPCL, NAL, NMDC	CONCOR, PFC, REC
Gray zone	IOC, NTPC, OIL,ONGC,SAIL	GIRCE
Distress zone	BHEL, NHPC,	NICL & POWERGRID

Table-3: Table Showing Correlation between the Ratios and Z-Score Values

Ratios	Mfg	Relationship	Non-Mfg	Relationship
X_1	0.430932	Weak positive	0.479666	Weak positive
X_2	0.476794	Weak positive	0.26518	Very weak positive
X_3	0.736714	Strong positive	0.848631	Strong positive
X_4	0.711027	Strong positive	0.450404	Weak positive
X_5	0.440263	Weak positive	-	-

Source: Author's calculation using excel

As shown in the table-3, Z-score value is calculated with all five ratios in case of manufacturing companies and only the first four ratios are used in case of non-manufacturing companies. In case of manufacturing companies all ratios are positively correlated with the z-score value but highest correlation is found in the third and fourth ratios. In case of non-manufacturing companies also all four ratios are positively correlated with the z-score value but highest correlation is found only in the third ratio.

Table-4: ANOVA Results of Manufacturing Companies

Regression Statistics:					
Multiple R	1				
R-Square	1				
Adjusted R-Square	1				
Standard Error	2.57E-16				
No. of Observations	14				

ANOVA:					
	df	SS	MS	F	Significance F
Regression	5	15.11991	3.023982	4.58E+31	1.3E-125
Residual	8	5.28E-31	6.6E-32		
Total	13	15.11991			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-1.1E-15	1.72E-16	-6.45259	0.000198	-1.5E-15	-7.1E-16
Variable X_1	1.2	7.69E-16	1.56E+15	3.2E-119	1.2	1.2
X_2	1.4	4.7E-15	2.98E+14	1.8E-113	1.4	1.4
X_3	3.3	1.31E-15	2.52E+15	6.9E-121	3.3	3.3
X_4	0.6	1.17E-16	5.13E+15	2.3E-123	0.6	0.6
X_5	0.999	1.17E-16	8.52E+15	4E-125	0.999	0.999

Source: Author's calculation using excel

From the table-4, it is known that for variable-X_1, p-value is less than 0.05 (i.e. 3.2E-119) and which implies that null hypothesis is rejected and alternative hypothesis (i.e. H_{a1}) is accepted. Hence it is inferred that there is a significant relationship between working capital to total assets ratio and financial distress of the companies.

For variable-X_2, p-value is less than 0.05 (i.e. 1.8E-113) and which implies that null hypothesis is rejected and alternative hypothesis (i.e. H_{a2}) is accepted. Hence it is inferred that there is a significant relationship between retained earnings to total assets ratio and financial distress of the companies.

For variable-X_3, p-value is less than 0.05 (i.e. 6.9E-121) and which implies that null hypothesis is rejected and alternative hypothesis (i.e. H_{a3}) is accepted. Hence it is inferred that there is a significant relationship between operating profit to total assets ratio and financial distress of the companies.

For variable-X_4, p-value is less than 0.05 (i.e. 2.3E-123) and which implies that null hypothesis is rejected and alternative hypothesis (i.e. H_{a4}) is accepted. Hence it is inferred that there is a significant relationship between market capitalisation (or book value of capital) to total liabilities ratio and financial distress of the companies.

For variable-X_5, p-value is less than 0.05 (i.e. 4E-125) and which implies that null hypothesis is rejected and alternative hypothesis (i.e. H_{a5}) is accepted. Hence it is inferred that there is a significant relationship between sales to total assets ratio and financial distress of the companies.

Hence, it is inferred from the above analysis that the ratios used for determining z-score are relevant in case of manufacturing companies. It is also observed that he adjusted R of Z-score in the manufacturing companies is 1, which implies that 100% accuracy in the prediction of bankruptcy can be achieved with the help of financial ratios. Hence, this model is considered to be a best tool for the prediction of bankruptcy.

Table-5: ANOVA Results of Non-Manufacturing Companies

Regression Statistics:						
Multiple R	0.968097					
R-Square	0.937211					
Adjusted R-Square	0.686055					
Standard Error	1.875005					
No. of Observations	6					
ANOVA						
	df	SS	MS	F	Significance F	
Regression	4	52.47573	13.11893	3.731586	0.367999	
Residual	1	3.515645	3.515645			
Total	5	55.99137				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-0.68005	1.599358	-0.4252	0.744051	-21.0018	19.64171
Variable X_1	12.01579	7.244354	1.658641	0.345399	-80.0325	104.064
X_2	20.50075	41.9503	0.488691	0.710618	-512.528	553.5298
X_3	32.7597	11.18331	2.929339	0.209429	-109.338	174.8571
X_4	-2.30147	1.416343	-1.62494	0.351206	-20.2978	15.69488

Source: Author's calculation using excel

From the table-5, it is known that; for variable-X_1, p-value is more than 0.05 (i.e. 0.345399) and which implies that null hypothesis is accepted and alternative hypothesis (i.e. H_{a1}) is rejected. Hence it is inferred that there is no significant relationship between working capital to total assets ratio and financial distress of the companies.

For variable-X_2, p-value is more than 0.05 (i.e. 0.710618) and which implies that null hypothesis is accepted and alternative hypothesis (i.e. H_{a2}) is rejected. Hence it is inferred that there is no significant relationship between retained earnings to total assets ratio and financial distress of the companies.

For variable-X_3, p-value is more than 0.05 (i.e. 0.209429) and which implies that null hypothesis is accepted and alternative hypothesis (i.e. H_{a3}) is rejected. Hence it is inferred that there is no significant relationship between operating profit to total assets ratio and financial distress of the companies.

For variable-X_4, p-value is more than 0.05 (i.e. 0.351206) and which implies that null hypothesis is accepted and alternative hypothesis (i.e. H_{a4}) is rejected. Hence it is inferred that there is no significant relationship between market capitalisation (or book value of capital) to total liabilities ratio and financial distress of the companies.

Hence, it is inferred from the above analysis that the ratios used for determining z-score are irrelevant in case of non-manufacturing companies. It is also known that adjusted R of Z-score in the manufacturing companies is 0.686055, which implies that 69% accuracy in the prediction of bankruptcy can be achieved with the help of financial ratios.

CONCLUSION

Out of the total twenty companies chosen for the study, ten companies (i.e. 50%) are in safe zone, two are in grey zone and eight (i.e. 40%) are in distressed zone. It is inferred from the analysis that nearly half of the companies chosen for the study are financially distressed companies and they are bound to bankruptcy in the near future. In case of manufacturing companies all ratios are positively correlated with the z-score value but highest correlation is found in the third and fourth ratios. In case of non-manufacturing companies also all four ratios are positively correlated with the z-score value but highest correlation is found only in the third ratio. It is observed in the analysis that there is a significant relationship between all the five ratios and financial distress of the manufacturing companies. Hence, it is inferred that the ratios used for determining z-score are relevant in case of manufacturing companies. However, there is no significant relationship between the ratios and financial distress of the non-manufacturing companies. Hence, it is inferred that the ratios used for determining z-score are irrelevant in case of non-manufacturing companies.

RESEARCH IMPLICATIONS

The model can be used by the investors to measure financial strength of a company before taking investment decision. It can also be used by the banks and financial institutions to predict financial distress of its corporate clients for detecting early signs of corporate bankruptcy. It also helps the companies to predict their financial distress and undertake precautionary measures to overcome the problem of bankruptcy in early stage.

SCOPE FOR FURTHER STUDY

The current study is conducted only for Nifty PSEs and hence it can be extended to other PSEs of the central and state governments. The study can be extended to the same set of companies for a longer period of ten years instead of five years to get more accurate results. The prediction of bankruptcy can also be undertaken using different models such as logit model and linear model and compared between them to find out accuracy of prediction. The prediction of bankruptcy can also be undertaken for other PSEs and private and start-up companies.

REFERENCES

1. **Abdullah, NAH, Halim, A., Ahmad, H., Rohani, Md. Rus (2008).** Predicting corporate failure of Malaysia's listed companies-Comparing multiple discriminant analysis, logistic regression and the hazard model. International Journal of Finance and Economics, 15(1): 201-217.

2. **Gerantonis, N., Vergos, K., and Christopoulos, A.(2009)**. Can Altman Z-score models predict business failure in Greece?. International Journal of Economics and Finance, 10(8): 189-201.

3. **Pathan, S. (2009).(2009).** Strong boards, CEO power and bank risk-taking. Journal of Banking and Finance. 33(7): 1340-1350.

4. **Hayes, S. K., Hodge, K. A., and Hughes, L. W.(2010)**. A Study on the efficiency of Altman's Z to predict specialty retail firms doing business in contemporary times. Economics and Business Journal: Inquiries & Perspectives, 3(1): 130-134.

5. **Al-khatib, K., and Al-Bzour, A. (2011).** Predicting corporate bankruptcy of Jordanian listed companies: Using Altman and kida models. International Journal of Business and Management, 6(3).208.

6. **Alareeni, B., and Branson, J.(2013).** Predicting listed companies' failure in Jordan using Altman model: A case study. International Journal of Business and Management, 8(1).

7. **Gunathilaka, C.(2014)**. Financial distress prediction: A comparative study of solvency test and Z-Score model with reference to Sri Lanka. The IUP Journal of Financial Risk Management, 11(3): 40-50.

8. **Ahuja, B.R., and Singhal, N.(2014) .** Assessing the financial soundness of companies with special reference to the Indian textile sector: An application of the Altman Z score model. Indian Journal of Finance, 8(4): 38-48.

9. **Shyamsunder Chitta, Ravikumar Jain and Sriharsha R.(2019).** Financial soundness of Maharatna companies: Application of Altman Z-score model. Indian Journal of Finance, 13(10): 22-33.