Original Research Article

Financial distress owing to profitability tribulations: Cases of public sector engineering undertakings in Kerala

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Abstract

Financial distress is a situation where a company is not able to meet or face difficulty to pay off its financial obligations. According to RBI's definition negative working capital, cash loss and negative net worth are the factors influencing Distresses. There are lots of causes of corporate failure which includes Profitability, Liquidity and solvency complications. Bankruptcy prediction models are among the techniques and tools for predicting future status of companies which can estimate the bankruptcy probability by compounding a set of financial ratios. This research paper has attempted to device models for predicting probability of financial distresses among the PSUs working under the Engineering sector in Kerala. Multiple Logistic Regression tool is applied for evaluate the ratios that can influence group status and quantify their relationships and strength among the variables.

Keywords: Financial distress, Logistic regression, Profitability tribulations, Networth, Cash flow, Cash profit, Cash loss

1. Introduction

Financial Distress is a situation where a company cannot meet or face difficulty to pay off its financial obligations to the creditors. When a company is deemed to be under financial distress and does not take necessary actions to improve its performance or when the situation is not administered properly, the company may experience bankruptcy or be forced to liquidation. In addition to that, financial distress may bring bad reputation for the company because investors would see the company as an incompetent firm for making profit.[1]

While an extensive literature on financial distress prediction has emerged, many commonly used technique would rate as primitive dated in other fields of social science especially in accounting research. . In order to evaluate the ratios that can influence group status and quantify their influence, Multiple Logistic Regression analysis tool is applied. The main uses of logistic regression are that prediction of group membership and provide knowledge of the relationships and strength among the variables.[3]

2. Review of Literature

Fitz Patrick analyzed ratios for failed and non-failed firms, at three years period to failure, by selecting 19 companies randomly which had failed during the period of 1920-1929, and choosing a matching sample of 19 successful companies using financial soundness, asset size, sales volume, product line and physical year as matching criteria. Arthur Winker and Raymond F. Smith examined 183 firms, which failed between 1923 and 1931 for 10 years prior to the year of failure.[11] The prior 10 years trends of the means of 21 ratios of failed firms were analyzed.[6] M. Tamaris (1956-1960) was the first multivariate study in which weighted composite of several ratios were used to indicate the possibility of failure.[24] W. H. Beaver for the first time in 1966 attempted to demonstrate that the failure of an enterprise could be predicted reliably through the combined utilization of sophisticated quantitative techniques and financial ratio analysis.[4,5] Altman is known for the development of the Z-Score formula, which he published in 1968.[1,13] The Z-Score for predicting Bankruptcy is a multivariate formula for a

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measurement of the financial health of a company and a powerful diagnostic tool that forecasts the probability of a company entering bankruptcy within a 2 year period.[1] David Ewert investigated in 1968 on the basis of information supplied in the Dun and Bradstreet credit reports that ratio can predict non repayment of receivables, keeping 82% accuracy.[14] In 1969 Mare P. Blum constructed a theoretical model based on accounting and financial market data, which was designed to discriminate between failing and non-failing firms. In 1970, Meyer and Pifer attempted to build up a model of prediction of bank failure.[19] Their study indicated the factors affecting bank failure. Such factors were divided into 4 groups, local economic conditions, general economic conditions, quality of management, and integrity of employees.[21] Edminister in 1971 found that using a ratio function could make good predictions. Edward Deakin searched for the linear combination of the 14 ratios used by Beaver which best predicts potential failure in each of five years prior to failure.[6] In 1978 at St. Francisco University by Gordon L.V. Springate, following procedures developed by Altman in the U.S.[1] Springate used step-wise multiple discriminate analysis to select four out of 19 popular financial ratios that best distinguished between sound business and those that actually failed.[23] Fulmer (1984) used step-wise multiple discriminate analysis to evaluate 40 financial ratios applied to a sample of 60 companies - 30 failed and 30 successful. The average asset size of these firms was $455,000.[16]

3. Objective of the Study

1. To identify the financially distressed and non-distressed stage of companies on account of profitability tribulations.
2. To quantify the determinants influencing financial distress on account of profitability tribulations.

3.1. Hypothesis

The following hypothesis is framed:

H_0: There is no significant difference between the mean of independent variables of financially distressed and non-distressed stages.

H_1: There is significant difference between the mean of independent variables of financially distressed and non-distressed stages.

4. Materials and Methods

4.1. Population

The population of the study consists of PSUs working under the administration of Industries Department in Kerala. As per the Economic Review 2023 published by Government of Kerala, there are 51 units working under the Industries Department.

4.2. Units selected for the study

Out of 51 PSUs working under the Industries Department, 6 units were working under engineering sector. The sample size is arrived based on the following additional criteria.

1. The units are established after the year1985 are excluded from the sample size though the data covering 1985-86 to 2022-23.
2. Inactive/merged/transferred/liquidated/closed during the year 2022-23 are excluded.(SAIL-SCL Kerala Limited).

The sample units are limited to 5 and given in the **Table 1**

4.3. Observations

To study about financial distress, units are classified into financially distressed and financially non-distressed based on the basis of the sickness definition given by RBI as " one which has incurred cash losses for one year and, in the judgment of the financing bank, is likely to incur cash losses for the current as well as the following year, and/or there is an imbalance in the unit's financial structure ,that is, the current ratio is less than 1:1 and debt/equity ratio (total outside liabilities as a ratio of net worth) is worsening".[22] Observations based on financial distress indicators are listed in the **Table 1**.

Table 1: Lists of Units selected for the Study and Observations

Company	Distressed stage (1)	Non-distressed state (0)	Total
Autokast limited	37	1	38
Kerala automobiles limited	25	13	38
The metal industries limited	27	11	38
Steel industries kerala limited	25	13	38
Steel and industrial forgings limited	12	26	38
Total	126	64	190

*presence of cash losses is considered as Distressed Stage and Cash Profit as Non-Distressed stage.

4.4. Period of the study

To investigate the financial distress of PSUs in Kerala, the duly audited secondary data from 1984-85 to 2022-23 were collected. The justification for selecting the base year as 1984-85 is that there was no uniform accounting policies followed by these undertakings while preparing and presenting their annual accounts before 1984-85 and also to ensure normality in behaviour of the variables selected for the study. This study facilitates the evaluation of financial distress of PSUs in the long run as it covers data of 38 years.

4.5. Collection of Data

For the purpose of the study secondary data has been used. Secondary data is collected from the annual reports published by respective units. Apart from accounting statements from annual review reports of State Level Public Enterprises (SLPEs) published by Bureau of Public Enterprise, Government of Kerala. To support this research, information also used from Report of the Comptroller and Auditor General of India, Economic Review of Kerala by Planning and Development Board, Public Sector Restructuring and Internal Audit Board (RIAB), Office of the Ministry of Industries department etc.[9]

4.6. Variables used in the analysis

Independent variables under this study comprises of 18 financial ratios from four specific groups like Liquidity ratios, Cash Flow ratios, Profitability ratios and Solvency ratios. As a problem of a lack of theoretical underpinning as a guide to variable selection has been covered earlier, the use of the independent variables under this study is based on the popularity of the ratios from past research and their past performance in reviewed literature. The selected variables are listed in the **Table 2.**

5. Empirical findings

In this study, financially distressed or non-distressed on account of profitability tribulations is based on the RBI's definition.

Enterprise experiencing financial distress is classified according to the criteria fixed by RBI. According to RBI, if an enterprise incurs cash losses, it is a fit candidate for reckoning it as a distressed enterprise. Cash profit can be computed from the financial statements as follows:

Cash profit = Operating Profit+ depreciation +other non-cash expenses.

In this analysis, a company which shows cash loss coded as '1' and which shows cash profit is coded as '0'. The details of companies showing financial distress on account of profitability tribulations are given in **Table 1.**

Table 1

Table 3 illustrated the descriptive of variables in distressed and non-distress stage on account of profitability tribulations. The mean values of CACL, WCS, and WCTA in their distressed stages are 1.3080, -0.9380, and -0.4979 respectively and in their non-distressed stages are 2.1744, 0.4035 and 0.2676 respectively.

A positive cash flow is an asset to the company. Looking the cash flow ratios, in their financially distressed stages, the mean values are negative among the variables CFTD, CFS and CFCL. The mean values of CFTD, CFS and CFCL in their distressed stages are -0.1490, -0.4326 and -0.2114 respectively and in their non-distressed stages are .2062, 0.1044 and 0.3629 respectively.

On account of Profitability tribulations, the mean values of NPTA, ROE and ROCE indicated negative values in their distressed stages. Negative values of these ratios indicated that these firms had suffered significant losses during the distressed period.[10]

When the company is distressed due to profitability problem, their TDTA (2.3474) is significantly larger than when it is in non-distressed stage (0.8877). Capitalisation ratio (TDR) indicated that their usage of debt is 89 % out of total capital. Networth ratios (NWTD, NWCL and NWFA) indicated negative values, which is a signal of distresses.

Table 2: Lists of ratios used for analysis

Ratio	Acronym	Symbol
Liquidity ratios		
Current assets to current liabilities	CACL	X_1
Working capital to sales	WCS	X_2
Current assets to total asset	CATA	X_3
Working capital to total assets	WCTA	X_4
Cash flow ratios		
Cash flow to total debt	CFTD	X_5
Cash flow to sales	CFS	X_6
Cash flow to current liabilities	CFCL	X_7
Profitability ratios		
Net profit to total assets	NPTA	X_8
Return on invested capital	ROIC	X_9
Return on equity	ROE	X_{10}
Return on capital employed	ROCE	X_{11}
Solvency ratios		
Total debt to total assets	TDTA	X_{12}
Total debt ratio	TDR	X_{13}
Networth to total debt	NWTD	X_{14}
Networth to current liabilities	NWCL	X_{15}
Networth to fixed assets	NWFA	X_{16}
Shareholders fund to total assets	SFTA	X_{17}

Table 3: Descriptive of Variables in the Financially Distressed and Non-distressed stage on account of Profitability Tribulation

Variables	Symbol	Group Status	N	Mean	Median	Std. deviation	Minimum	Maximum
				Liquidity ratios				
CACL	X_1	0	64	2.1744	1.7850	2.5300	0.1793	19.4611
		1	126	1.3080	0.8972	2.7340	0.0849	28.4637
WCS	X_2	0	64	0.4035	0.3776	0.4803	-2.1867	1.8011
		1	126	-0.9380	-0.2332	2.5174	-14.9197	2.6415
CATA	X_3	0	64	0.7586	0.7896	0.1574	0.3523	0.9604
		1	126	0.6421	0.6097	0.2317	0.1141	0.9674
WCTA	X_4	0	64	0.2676	0.3488	0.4354	-2.9296	0.6225
		1	126	-0.4979	-0.0988	1.0488	-4.1167	0.6208
				Cash flow ratios				
CFTD	X_5	0	64	0.2062	0.1324	0.2527	0.0063	1.4325
		1	126	-0.1490	-0.0468	0.3199	-2.0533	0.0588
CFS	X_6	0	64	0.1044	0.0974	0.0686	0.0083	0.4503
		1	126	-0.4326	-0.1881	0.7086	-4.0405	0.1303
CFCL	X_7	0	64	0.3629	0.2156	0.7059	0.0114	5.4125
		1	126	-0.2114	-0.1311	0.3639	-2.0996	0.2198
				Profitability ratios				
NPTA	X_8	0	64	0.0547	0.0240	0.0717	-0.0187	0.2876
		1	126	-0.3349	-0.1826	0.4351	-3.1223	0.1125
ROIC	X_9	0	64	0.1101	0.0596	0.1430	-0.0502	0.6272
		1	126	0.1037	-0.1133	2.0042	-7.1300	9.7368
ROE	X_{10}	0	64	0.1251	0.0434	0.1804	-0.0525	0.7806
		1	126	-0.5639	-0.1835	1.7209	-10.6033	1.5570
ROCE	X_{11}	0	64	0.1202	0.0951	0.1187	-0.0226	0.4807
		1	126	-0.3805	-0.0547	1.7916	-10.6033	3.9340
				Solvency ratios				
TDTA	X_{12}	0	64	0.8877	0.6198	1.0589	0.1608	8.6004
		1	126	2.3474	1.2067	2.7828	0.0919	14.3200
TDR	X_{13}	0	64	0.5965	0.5921	0.1789	0.1097	0.8748
		1	126	0.8961	0.7746	1.1296	-3.0507	5.0030
NWTD	X_{14}	0	64	0.7122	0.6136	1.0288	-0.8837	5.2170
		1	126	-0.1991	-0.3178	0.8869	-2.4507	2.3385
NWCL	X_{15}	0	64	1.5024	0.8509	3.7715	-2.1291	21.2982
		1	126	-0.5302	-0.3919	2.7301	-9.2621	16.8996
NWFA	X_{16}	0	64	1.6168	2.0241	4.2540	-22.8991	7.7868
		1	126	-3.0582	-0.2202	8.2798	-32.2427	13.2732
SFTA	X_{17}	0	64	0.5414	0.5046	0.2942	0.1407	2.0060
		1	126	0.1131	0.4887	1.5688	-5.8625	2.3232

Source: Computed from Secondary data

Note: Non-distressed group distinguished by status 0 and distressed group by status 1

Table 4: Test results of ANOVA

Variables	Symbol	ANOVA		df	Mean Square	F	P Value
		Sum of Squares					
CACL	X_1	Between Groups	31.863	1	31.863	4.478	.036*
		Within Groups	1337.606	188	7.115		

				df		F	Sig.
		Total	1369.468	189			
WCS	X_2	Between Groups	76.377	1	76.377	17.799	.000*
		Within Groups	806.728	188	4.291		
		Total	883.106	189			
CATA	X_3	Between Groups	.577	1	.577	13.109	.000*
		Within Groups	8.270	188	.044		
		Total	8.846	189			
WCTA	X_4	Between Groups	24.870	1	24.870	31.289	.000*
		Within Groups	149.430	188	.795		
		Total	174.300	189			
CFTD	X_5	Between Groups	5.353	1	5.353	59.856	.000*
		Within Groups	16.813	188	.089		
		Total	22.166	189			
CFS	X_6	Between Groups	12.237	1	12.237	36.478	.000*
		Within Groups	63.067	188	.335		
		Total	75.304	189			
CFCL	X_7	Between Groups	14.001	1	14.001	54.903	.000*
		Within Groups	47.944	188	.255		
		Total	61.945	189			
NPTA	X_8	Between Groups	6.441	1	6.441	50.472	.000*
		Within Groups	23.993	188	.128		
		Total	30.434	189			
ROIC	X_9	Between Groups	.002	1	.002	.001	.980
		Within Groups	503.413	188	2.678		
		Total	503.415	189			
ROE	X_{10}	Between Groups	20.147	1	20.147	10.175	.002*
		Within Groups	372.229	188	1.980		
		Total	392.375	189			
ROCE	X_{11}	Between Groups	10.638	1	10.638	4.973	.027*
		Within Groups	402.130	188	2.139		
		Total	412.768	189			
TDTA	X_{12}	Between Groups	90.426	1	90.426	16.367	.000*
		Within Groups	1038.661	188	5.525		
		Total	1129.087	189			
TDR	X_{13}	Between Groups	3.811	1	3.811	4.436	.037*
		Within Groups	161.530	188	.859		
		Total	165.341	189			
NWTD	X_{14}	Between Groups	35.245	1	35.245	40.153	.000*
		Within Groups	165.020	188	.878		
		Total	200.265	189			
NWCL	X_{15}	Between Groups	175.337	1	175.337	18.035	.000*
		Within Groups	1827.792	188	9.722		
		Total	2003.129	189			
NWFA	X_{16}	Between Groups	927.586	1	927.586	17.960	.000*
		Within Groups	9709.00	188	51.646		
		Total	10637.033	189			
SFTA	X_{17}	Between Groups	7.784	1	7.784	4.674	.032*
		Within Groups	313.096	188	1.665		
		Total	320.880	189			

Source: Computed, * 5% level of significance

Taking into account of all these factors, we would therefore expect that the differences between the two groups are significant. ANOVA test is sued to test the following hypothesis:

H_0 : There is no significant difference between the mean of independent variables of financially distressed and non-distressed stages.

H_1 : There is significant difference between the mean of independent variables of financially distressed and non-distressed stages.

Looking at the ANOVA test statistics of the **Table 4.** Suggested that there is a significant difference in ratios (CACL, WCS, WCTA, CFTD, CFS, CFCL, NPTA, ROE, ROCE, TDTA, TDR, NWTD, NWCL, NWFA, SFTA) between distressed and non-distressed groups at 5% level of significance. These ratios would be a good predictor of financial distress on account of liquidity problems.

5.1. Logistic regression analysis: Model - 1

A Multiple Logistic Regression has more than one independent variable (also referred to as predictor variables or covariates). As such, it is analogous to the multiple

regression models in the case in which the dependent (response) variable is binary. In binary coding, a variable can take only one out of two values. It is common practice to code those variables using 0 and 1 values. In this study, financially distressed is coded as 1 and financially non-distressed is coded as 0.

The complete results of the Multiple Logistic Regression Analysis of Manufacturing companies are displayed in

Table 5. According to Wald statistics, the deemed predictors influencing financial distress are WCS, CATA and NWTD at 5 % level of significance. The negative co-efficient value observed for CATA, WCTA, CFTD, CFS, CFCL, NPTA, ROIC, ROE, ROCE, NWTD, NWFA and SFTA indicates an inverse relationship with financial distress. Holding other variables are constant, one unit increases in CATA, WCTA, CFTD, CFS, CFCL, NPTA, ROIC, ROE, ROCE, NWTD, NWFA and SFTA, the log odds of the firm being reclassified from distress to non-distressed decreases by 6.15, .0.853 70.698, 23.694, 15.859, 153.74, 15.687, 18.837, 5.879, 2.250, 0.91 and 0.859 respectively. The variable CCC is having positive relationships with financial distress. For a one unit increase in CACL, WCS, TDTA,, TDR and NWCL, the log odds of the firm being

reclassified as distressed to non-distressed increases by 0.133, 1.493, 0.006, 0.781 and 0.112 respectively.

The relative importance of the variables can be interpreted through odds ratio (Exp(B)). For WCS, the odds ratio is approximately 4.452. When other variables are controlled, for every unit increase in WCS, the logit analysis argues that the odds distress occurring is approximately 4.5 times more likely to be a member of distressed group.

Where P is the probability and if the value of P is greater than 0.5, then the company belongs to a financially distressed group.

Model summary part of the table indicated that the model is statistically significant [-2log likelihood (104.25), chi-square value = 138.53, p<0.000 with df 17]. The goodness-of-fit of the model as measured by Nagelkerke R Square (0.718) indicated that a moderately perfect strong relationship exists between prediction and grouping.[20] Classification part of the table suggested that prediction success overall was 87.1% and 78.1% in Non-distressed group and 92.1% in distressed group. As the theoretical probability for being a distress or a non-distress is greater than or less than 0.50, therefore the cut off value is taken as 0.50.

Table 5: Logistic regression results of variables influencing profitability tribulations

Variables	Symbol	B	S.E.	Wald	df	Sig.	Exp(B)
CACL	X_1	.133	.416	.103	1	.749	1.143
WCS	X_2	1.493	.587	6.475	1	.011*	4.452
CATA	X_3	-6.152	1.467	17.582	1	.000*	.002
WCTA	X_4	-.853	1.367	.390	1	.532	.426
CFTD	X_5	-70.698	8046.536	.000	1	.993	.000
CFS	X_6	-23.694	1749.652	.000	1	.989	.000
CFCL	X_7	-15.859	3859.323	.000	1	.997	.000
NPTA	X_8	-153.749	10643.237	.000	1	.988	.000
ROIC	X_9	-15.687	881.507	.000	1	.986	.000
ROE	X_{10}	-18.837	4993.542	.000	1	.997	.000
ROCE	X_{11}	-5.879	3553.341	.000	1	.999	.003
TDTA	X_{12}	.006	.452	.000	1	.989	1.006
TDR	X_{13}	.781	.569	1.885	1	.170	2.184
NWTD	X_{14}	-2.250	.805	7.808	1	.005*	.105
NWCL	X_{15}	.112	.441	.064	1	.800	1.118
NWFA	X_{16}	-.091	.100	.831	1	.362	.913
SFTA	X_{17}	-.859	.601	2.044	1	.153	.423
Constant	β_0	5.220	1.518	11.816	1	.001*	184.878
Model summary							
-2 Log likelihood		104.25		Chi-square			138.539
Cox & Snell R Square		.518		df			17
Nagelkerke R Square		.718		P-value			.000
Classification table							
Observed			Predicted				
			Non-Distressed		Distressed	Percentage Correct	

			0	1	
Non-Distressed	0		50	14	78.1
Distressed	1		10	116	92.1
Overall percentage					87.1
Cut value :0.5					

*significant at 5% level

5.2. Logistic regression analysis: MODEL-2

Beginning with 17 variables, Model 2 uses Stepwise regression with a p-value equal to .05 which automatically determines which variables should be added or dropped from the model. It is useful particularly for exploratory purpose. As our study on the factors influencing financial distress lack a theoretical underpinning to guide research, stepwise regression allows us to explore possible relationships.[25] The results depicted that based on the stepwise procedure, factors deemed significant predictors of financial distress as per Wald statistics at 5% level of significance are CATD and NWTD Look at the **Table 6** and all variables have negative co-efficient values and indicated an inverse relationship with the dependent variable. Similarly one unit increase in the negative value of B coefficients decrease the probability of financial distress because they contributed to the value of e^y closer to zero.

The modified equation would be:

$$P = \left[\frac{e^{1.704+(-46.626X_6)+(-36.743X_9)+(-0.321X_{16})}}{1 + e^{1.704+(-46.626X_6)+(-36.743X_9)+(-0.321X_{16})}} \right]$$

Where P is the probability, X_3 is CATA, and X_{14} is NWTD and if the value of P is greater than 0.5, then the company belongs to a financially distressed one.

Table 6: Logistic regression results of modified variables influencing profitability tribulations

Variables in the equation							
Variables	**Symbol**	**B**	**S.E.**	**Wald**	**Df**	**Sig.**	**Exp(B)**
CATA	X_3	-5.088	1.036	24.142	1	.000*	.006
CFTD	X_5	-18.154	6645.133	.000	1	.998	.000
CFCL	X_7	-18.858	5276.307	.000	1	.997	.000
NWTD	X_{14}	-2.212	.395	31.308	1	.000*	.109
Constant	β_0	5.459	1.023	28.490	1	.000*	234.773
Model summary							
-2 Log likelihood		133.612		Chi-square			109.177
Cox & Snell R Square		.437		df			4
Nagelkerke R Square		.606		P-value			.000
Classification table							
Observed			Predicted				
			Non-Distressed	Distressed	Percentage Correct		
			0	1			
Non-Distressed	0		34	30	53.1		
Distressed	1		5	121	96		
Overall percentage					81.6		
Cut value :0.5							

Model summary part of the table indicated that the model is statistically significant (Chi-square value = 109.17, p<0.001 with df 4). The goodness-of-fit of the model as measured by Nagelkerke R Square (0.606) indicated that a moderate relationship exists between prediction and grouping. Classification part of the table suggested that prediction success over all was 81.6% and 96 % in Non-distressed group and 53.1% in distressed group. As the theoretical probability for being a distress or a non-distress is greater than or less than 0.50, therefore the cut off value is taken as 0.50.[26]

6. Conclusion

As we review back the results of the logistic regression analysis, the variables are discriminate distressed and non-Distressed stage of companies are based on their liquidity, profitability and solvency positions. The study found that CATA and NWTD are the proxies and these variables discriminate the financially distressed and non-distressed

company with predictive accuracy of 81.6 %. These proxy variables are having inverse relationships with financial distress. One unit decrease of predictive variables leads to the likelihood of distress and findings of this study adhere to the literature relating to the financial distress definition given by RBI.

7. Conflict of Interest

None.

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