IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Full Blown Financial Distress: Evidence From Public Sector Undertakings Working Under Engineering Sector 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 networth 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. In order to evaluate the ratios that can influence group status and quantify their connection, Multiple Logistic Regression analysis tool is used. The main uses of logistic regression are that prediction of group membership and provide knowledge of the relationships and strength among the variables.

Key Terms **- Financial Distress, Logistic Regression, Liquidity Tribulations, RBI, Sickness**

I. 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 liquidating its company in the worst case scenario. In addition to that, financial distressed may brings bad reputation for the company because investors would see the company as an incompetent firm.

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 used. The main uses of logistic regression are that prediction of group membership and provide knowledge of the relationships and strength among the variables.

II. 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. The prior 10 years trends of the means of 21 ratios of failed firms were analyzed. M.Tamaris (1956-1960) was the first multivariate study in which weighted composite of several ratios were used to indicate the possibility of failure. 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. Altman is known for the development of the Z-Score formula, which he published in 1968. The Z-Score for predicting

Bankruptcy is a multivariate formula for a 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. 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. 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. 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. 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. In 1978 at St. Francisco University by Gordon L.V. Springate, following procedures developed by Altman in the U.S. 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. 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.

III. OBJECTIVES OF THE STUDY:

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

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.

IV. SAMPLING DESIGN

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.

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 No.1

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". Observations based on financial distress indicators are listed in the Table No. 1

Table No.1

Lists of Units selected for the Study and Observations

Sl.No	COMPANY	DISTRESSED STAGE (1)	NON-DISTRESSED STAGE (0)	TOTAL
1	Autokast Limited	36	2	38
2	Kerala Automobiles Limited	12	26	38
3	The Metal Industries Limited	8	30	38
4	Steel Industries Kerala Limited	3	35	38
5	Steel and Industrial Forgings	7	31	38

	Limited			
Total		66	124	190

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. This study facilitates the evaluation of financial distress of PSUs in the long run as it covers data of 38 years.

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 E nterprises (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.

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 No.2

Table No.2

Lists of Ratios used for Analysis

Variables		
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}
Share holders Fund to Total Assets	SFTA	X_{17}

V. EMPIRICAL FINDINGS

Non-distressed and full-blown distressed cases are identified based on RBI's definition on sickness. If an enterprise suffers from negative working capital, cash losses and negative networth in a particular year, it can be reckoning as a full-blown distressed enterprise. In this analysis, a company showing , negative working capital, cash losses and negative net worth at a time are coded as '1' and positive working capital, cash profit and positive networth at a time are coded as '0'. The details of companies showing financial distress on account of liquidity, profitability and solvency tribulations Table No.1

Table No.3 illustrated the descriptive of variables of full-blown distress stage and non-distress stage. The mean values of CACL, WCS and WCTA are,0.45, -2.25 and -1.10 respectively in their full-blown distressed stage and 2.21, 0.45 and 0.22 respectively in their non-distressed stage. The current assets to total assets (CATA) are 67 % and 68% in their distressed stage and non-distressed stage. The working capital management is quite dreadful in the full-blown distress stage. The liquidity ratios indicate the ratios in distressed stages are significantly different from the non-distressed stage.

Cash flow ratios in full-blown distress stage indicated that they are unable to generate sufficient cash flows in their full-blown distressed stage. The mean values of CFTD, CFS and CFCL in full-blown distressed stages are -0.14, -0.58 and -0.20 respectively and .03, -0.07 and 0.08 respectively in their non-distressed stage. The mean values of ROE and ROCE in their distressed stage are -0.48 and -0.22 and in non-distressed stages -0.25 and -0.21. The negative values indicated that the companies undergo with profitability problem in both distressed and non-distressed stages.

The total debt to total assets in their distressed stage is 357% and 93% in non-distressed stage. Shareholders fund to total assets ratio (SHFTA) disclosed that the owner's claim against the assets of the company is -5% in their distressed stage and 42% in their non-distressed stage. The mean values of TDTA and SHFTA disclosed that there were no sufficient assets to satisfy the claim of both owner and outsider in their full-blown distressed stage. The TDR ratio disclosed that debt in capital structure in their distressed stage and non-distressed stage are 117% and 59%. Networth ratios explored the solvency position of the PSUs in their distressed and non-distressed stage. The mean values of NWTD, NWCL and NWFA in distressed stage are –0.67, --1.48 and -6.92 respectively.

Casting an eye over these ratios, we would expect that the differences between these two stages of affairs 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 No.4 suggested that there is a significant difference in ratios (CACL, WCS,WCTA, CFTD, CFS,CFCL,NPTA, TDTA, TDR, NWTD, NWCL, NWFA, SFTA) between distressed and non-distressed groups @5% level of significance. These ratios would be a good predictor of financial distress on account of liquidity problems.

Table No.3
Descriptive of Variables in the Financially Distressed and Non-distressed stage

Variables	Symbol	Group Status	N	Mean	Median	Std. Deviation	Minimum	Maximum
LIQUIDITY RATIOS								
CACL	X_1	0	124	2.2114	1.6244	3.1642	0.1793	28.4637
		1	66	0.4508	0.4029	0.2609	0.0849	0.9954
WCS	X_2	0	124	0.4521	0.3683	0.5715	-2.1867	2.6415
		1	66	-2.2488	-1.2635	2.8520	-14.9197	-0.0806
CATA	X_3	0	124	0.6825	0.6858	0.1917	0.2161	0.9604
		1	66	0.6792	0.8340	0.2580	0.1141	0.9674
WCTA	X_4	0	124	0.2189	0.2752	0.3503	-2.9296	0.6225

		1	66	-1.1023	-0.7968	1.1370	-4.1167	-0.0121
CASH FLOW RATIOS								
CFTD	X_5	0	124	0.0313	0.0325	0.3512	-2.0533	1.4325
		1	66	-0.1432	-0.0460	0.2957	-1.9664	0.0506
CFS	X_6	0	124	-0.0746	0.0450	0.4804	-3.2555	0.4503
		1	66	-0.5844	-0.2904	0.7413	-4.0405	0.1303
CFCL	X_7	0	124	0.0802	0.0445	0.6541	-2.0996	5.4125
		1	66	-0.2025	-0.1315	0.3008	-1.8333	0.1021
PROFITABILITY RATIOS								
NPTA	X_8	0	124	-0.0460	-0.0114	0.1645	-0.8141	0.2876
		1	66	-0.5000	-0.3493	0.5296	-3.1223	0.1125
ROIC	X_9	0	124	-0.0210	-0.0086	0.6330	-1.9849	5.2339
		1	66	0.3442	0.0785	2.6264	-7.1300	9.7368
ROE	X_{10}	0	124	-0.2523	-0.0203	1.4749	-10.6033	0.7806
		1	66	-0.4813	-0.2478	1.3732	-8.0720	1.5570
ROCE	X_{11}	0	124	-0.2074	0.0096	1.4722	-10.6033	0.4807
		1	66	-0.2203	-0.0484	1.4996	-8.0720	3.9340
SOLVENCY RATIOS								
TDTA	X_{12}	0	124	0.9392	0.7269	0.9523	0.0919	8.6004
		1	66	3.5776	2.6989	3.3229	0.5437	14.3200
TDR	X_{13}	0	124	0.5962	0.6175	0.1902	0.1097	0.9586
		1	66	1.1691	0.8327	1.5026	-3.0507	5.0030
NWTD	X_{14}	0	124	0.5208	0.2878	0.9616	-0.8837	5.2170
		1	66	-0.6679	-0.7575	0.6284	-2.4507	0.7529
NWCL	X_{15}	0	124	1.0219	0.6591	3.6277	-9.2621	21.2982
		1	66	-1.4753	-1.5378	1.3348	-4.1455	1.1122
NWFA	X_{16}	0	124	1.4327	1.1127	3.7798	-22.8991	13.2732
		1	66	-6.9623	-1.4494	9.4820	-32.2427	0.6197
SFTA	X_{17}	0	124	0.4221	0.5029	0.8358	-4.6993	2.0060
		1	66	-0.0521	0.4540	1.8616	-5.8625	2.3232

Source: Computed from Secondary data

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

Table No.4
TEST RESULTS OF ANOVA

ANOVA							
Variables	Symbol	Sum of Squares		df	Mean Square	F	Sig.
CACL	X_1	Between Groups	133.523	1	133.523	20.310	.000*
		Within Groups	1235.945	188	6.574		
		Total	1369.468	189			
WCS	X_2	Between Groups	314.218	1	314.218	103.839	.000*
		Within Groups	568.888	188	3.026		
		Total	883.106	189			
CATA	X_3	Between Groups	.000	1	.000	.010	.921
		Within Groups	8.846	188	.047		
		Total	8.846	189			
WCTA	X_4	Between Groups	75.182	1	75.182	142.599	.000*
		Within Groups	99.119	188	.527		
		Total	174.300	189			
CFTD	X_5	Between Groups	1.312	1	1.312	11.830	.001*
		Within Groups	20.854	188	.111		
		Total	22.166	189			
CFS	X_6	Between Groups	11.191	1	11.191	32.815	.000*
		Within Groups	64.113	188	.341		
		Total	75.304	189			
CFCL	X_7	Between Groups	3.443	1	3.443	11.064	.001*
		Within Groups	58.502	188	.311		
		Total	61.945	189			
NPTA	X_8	Between Groups	8.879	1	8.879	77.439	.000*
		Within Groups	21.555	188	.115		

		Total	30.434	189			
ROIC	X_9	Between Groups	5.746	1	5.746	2.171	.142
		Within Groups	497.669	188	2.647		
		Total	503.415	189			
ROE	X_{10}	Between Groups	2.259	1	2.259	1.089	.298
		Within Groups	390.116	188	2.075		
		Total	392.375	189			
ROCE	X_{11}	Between Groups	.007	1	.007	.003	.954
		Within Groups	412.761	188	2.196		
		Total	412.768	189			
TDTA	X_{12}	Between Groups	299.845	1	299.845	67.979	.000*
		Within Groups	829.241	188	4.411		
		Total	1129.087	189			
TDR	X_{13}	Between Groups	14.136	1	14.136	17.577	.000*
		Within Groups	151.204	188	.804		
		Total	165.341	189			
NWTD	X_{14}	Between Groups	60.871	1	60.871	82.096	.000*
		Within Groups	139.394	188	.741		
		Total	200.265	189			
NWCL	X_{15}	Between Groups	268.608	1	268.608	29.114	.000*
		Within Groups	1734.522	188	9.226		
		Total	2003.129	189			
NWFA	X_{16}	Between Groups	3035.673	1	3035.673	75.080	.000*
		Within Groups	7601.361	188	40.433		
		Total	10637.033	189			
SFTA	X_{17}	Between Groups	9.685	1	9.685	5.851	.017*
		Within Groups	311.195	188	1.655		

		Total	320.880	189			

Source: Computed, *@5% level of significance

Table No.5
Logistic Regression Results of Variables influencing Financial Distress

Variables in the Equation							
Variables	Symbol	B	S.E.	Wald	df	Sig.	Exp(B)
CACL	X_1	-5.030	2.781	3.271	1	.071	.007
WCS	X_2	-4.012	2.135	3.530	1	.060	.018
CATA	X_3	-3.840	1.303	8.681	1	.003*	.021
WCTA	X_4	1.122	1.669	.452	1	.501	3.072
CFTD	X_5	1.663	1.959	.721	1	.396	5.276
CFS	X_6	5.488	4.373	1.575	1	.209	241.758
CFCL	X_7	.569	5.525	.011	1	.918	1.766
NPTA	X_8	-21.355	9.912	4.642	1	.031*	.000
ROIC	X_9	-1.366	.612	4.971	1	.026*	.255
ROE	X_{10}	-1.240	2.651	.219	1	.640	.289
ROCE	X_{11}	1.372	2.610	.276	1	.599	3.941
TDTA	X_{12}	.606	.700	.749	1	.387	1.832
TDR	X_{13}	.533	1.456	.134	1	.714	1.703
NWTD	X_{14}	-1.365	1.512	.814	1	.367	.255
NWCL	X_{15}	1.251	.730	2.937	1	.087	3.494
NWFA	X_{16}	.175	.224	.610	1	.435	1.191
SFTA	X_{17}	-2.545	1.282	3.938	1	.047*	.078
Constant	β_0	6.033	3.261	3.422	1	.064	416.958

Model Summary			
-2 Log likelihood	47.513	Chi-square	197.892
Cox & Snell R Square	.647	df	17
Nagelkerke R Square	.892	P-value	.000

Classification Table				
		Predicted		
		Non-Distressed	Distressed	Percentage Correct
Observed		0	1	
Non-Distressed	0	120	4	96.8
Distressed	1	8	58	87.9
Overall percentage				93.7
Cut value :0.5				

*significant @ 5% level

VI. LOGISTIC REGRESSION ANALYSIS: MODEL-I

Table No.5 illustrates complete results of the Multiple Logistic Regression analysis. According to Wald statistics, the significant variables are CATA, NPTA, ROIC and SFTA @ 5% level of significance. The negative coefficients of the variables indicated that one unit increase in these variables deteriorates the chance of financial distress. All the significant variables, are inversely related with financial distress. For a one unit increases in CATA, NPTA, ROIC and SFTA, the log odds of the firm being reclassified as distressed to non-distressed decreases by 3.84, 21.35, 1.37 and 2.55 respectively.

The relative importance of a predictor variables in explaining the response variable can be interpreted through odds ratio (Exp(B)). The dominant variable is CFS with odds ratio 241.758. When other variables are controlled, one unit increase in the CFS , the logit analysis argues that the odds distress occurring is approximately 241 times more likely to be a member of distressed group. Likewise when other variables are controlled, one unit increase in CFTD, WCTA,ROCE and NWCL, the odds that can be predicted increase by a factor around 5,3, 3.9 and 3 times respectively.

The equation would be:

$$P = \left[\frac{e^{6.003+(-3.840X_3)+(-21.355X_8)+(-1.366X_9)+(-2.545X_{17})}}{1+e^{6.003+(-3.840X_3)+(-21.355X_8)+(-1.366X_9)+(-2.545X_{17})}} \right]$$

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

Model summary part of the table indicated that the model is statistically significant [-2log likelihood (47.513), chi-square value = 197.89, p<0.000 with df 17]. The goodness-of-fit of the model as measured by Nagelkerke R Square (0.892) indicated that a moderately strong relationship exists between prediction and grouping. The classification part of the table indicates that the overall prediction success was 93.7% and for non-distressed and distressed groups are 96.8% and 87.9% respectively. As the theoretical probability for being a distress or a non-distress is greater than or less than 0.50, so the cut off value is taken as 0.50.

Table No.6
Logistic Regression Results of Modified Variables influencing Financial Distress

Variables in the Equation							
Variables	Symbol	B	S.E.	Wald	df	Sig.	Exp(B)
WCS	X_2	-4.808	1.206	15.896	1	.000*	.008
CATA	X_3	-3.550	.899	15.603	1	.000*	.029
WCTA	X_4	1.277	.722	3.126	1	.077	3.585
NPTA	X_8	-9.161	2.962	9.565	1	.002*	.000
ROIC	X_9	-.860	.373	5.323	1	.021*	.423
TDR	X_{13}	1.839	.895	4.223	1	.040*	6.293
Constant	β_0	-1.260	.635	3.938	1	.047	.284

Model Summary			
-2 Log likelihood	65.787	Chi-square	179.618
Cox & Snell R Square	.611	df	6
Nagelkerke R Square	.843	P-value	.000

Classification Table			
	Predicted		
	Non-Distressed	Distressed	Percentage Correct
Observed	0	1	

Non-Distressed	0	119	5	96
Distressed	1	7	59	89.4
Overall percentage				93.7
Cut value :0.5				

*@5% level of significance

VII. LOGISTIC REGRESSION ANALYSIS :MODEL-II

Outset with 17 variables, Model 2 exercises stepwise regression forward likelihood ratio with a p-value equal to .05 to determine which variable should be added or dropped from the model. This step is used for exploratory purpose. The results denoted in the Table No.6, in addition to the CATA, NPTA, ROIC and SFTA, stepwise regression with forward likelihood ratio added 2 more variables are included in the modified model. The variables are WCS and TDR. Wald statistics negated the significance of the variable @ 5% level of significance. The variables having positive relationship with financial distress are WCTA, and TDR. The variables inversely related with financial distresses are WCS,CATA, NPTA and ROIC.

The relative importance of a predictor variables in explaining the response variable can be interpreted through Exp(B). Odds ratio explored that, when other variables are controlled, one unit increase in the TDR and WCTA , the logit analysis argues that the odds distress occurring is approximately 6 and 3 times more likely to be a member of distressed group.

The Modified equation would be as follows:

$$P = \left[\frac{e^{-1.260+(-4.808X_2)+(-3.550X_3)+(-9.161X_8)+(-0.860X_9)+(1.839X_{13})}}{1+e^{-1.260+(-4.808X_2)+(-3.550X_3)+(-9.161X_8)+(-0.860X_9)+(1.839X_{13})}} \right]$$

Where P is the probability, if the value of P is greater than 0.5, then the company is categorized under financially distressed group.

The model summary part of the table highlighted that the model is statistically significant [-2log likelihood (65.787), chi-square value = 179.618, $p<0.000$ with df 6]. Nagelkerke R Square (0.866) indicates a moderately strong relationship exists between prediction and grouping. The classification part of the table indicates that the overall prediction success was 93.7% and for non-distressed and distressed groups are 96% and 89.4% respectively. As the theoretical probability for being a distress or a non-distress is greater than or less than 0.50, so the cut off value is taken as 0.50.

VIII. 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 WCS, CATA and WCTA are the proxies from liquidity and TDTA and SFTA from solvency category and NPTA and ROIC from profitability category. These variables discriminate the financially distressed and non-distressed company with predictive accuracy of 93.7%. These proxy variables except WCTA and TDR are having inverse relationships with financial distress. Explanatory variables with a positive coefficient increase the probability of financial distress because they reduce e^y towards one, with the results that the financial distress probability function approaches 1/1 or 100%. 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.

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