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A Study on Financial Distress of Select Companies of Cement & Refineries Industries in India

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ABSTRACT

This study tries toelaborate the possibility of financial distress in Indianpublic listedcompanies from the manufacturing field. The test tool used to forecast bankruptcy wasAltman Z-Score model, developed in 1984, is able to predict possibility of distress inlisted public enterprises, which consists of the ratio of Net Working Capital / TotalAssets (X1), Retained Earnings / Total Assets (X2), Earnings before Interest and Taxes /Total Assets (X3), and Market Value of Equity / Book Value of Total Debt (X4), Sales /Total Assets(X5).This study aims to find out financial distress among select companies using Altman Z-Score Model. The total samples in this study were 10 companies, which include 5 Fertilizers and 5 Refineries Companies for the period2018-2023. Multiple Linear Regression Model,Kolmogorov- Smirnov Normality Test, ANOVA single factor, T-test are used to analyzethe Z-scores and prove the hypotheses. The result of this study shows that among select companies 7 are in safe zone and 3 are in grey zone. Regression Analysis proves that there is a strong relationship between the Altman Z-Score and its 5 independent financial variables. And T-test shows that there is no significant difference between the Altman Z-Score values of select Fertilizers and Refineries companies.

Key Words: Financial distress, Financial Ratios, Altman Z-Score, Bankruptcy prediction.

Introduction

An organization is considered to be in good financial health if it's able to meet all expenses, create profits, distribute certain profits to owners and make investments for the company. Apart from this, it has to take care of other stakeholders such as customers, government, society. It enables a company to preserve the trust of customers, stakeholders and make investments in the company with the goal of fostering future expansion. All businesses, regardless of size or industry, prioritize their financial health. A company's future depends on both the soundness of its business plan and the state of its finances because both require resources and effective resource management. When a company or an individual cannot meet its financial obligations because of a lack of income, it is said to be in financial distress.

Financial distress is a term that is used to describe the condition of a firm that is experiencing financial difficulties. This sometimes occurs as being unable to pay their dividends, not meeting the obligations and even more coming to an end in all operational areas (Beaver, 1966). The prediction of the companies' financial distressposition is crucial for rating

agencies, managers, investors, bankers and also for theshareholders of the company itself and even more the countries' economy at large(Alaka et al., 2018).Insolvency or bankruptcy is typically the result of large fixed costs, outmoded technology, high debt, poor budgeting and poormanagement.

Review of Literature:

1. Prashant Debnath and Chellasam P. (2022) has conducted a study on "*Analysing Financial Health Of Indian IT Sector Companies By Using Modified Altman'S Z Score Model* ". The article aims to study about the financial distress of select 10 Indian IT companies, on the basis of their market capitalisation, for the period 2019 - 2021 by using the Altman Z model. Variables considered under the study are Altman Z Score(dependent variable) and 5 financial ratios (independent variables). The study concludes that all the companies are in safe and healthy zones except Quess Corp Ltd. Despite the company's precarious situation, the author suggests taking some preventative steps, like boosting short-term liquidity, cutting operating expenses, which could increase operating income, and making enough net profit to allow the business to plan to recover maximum earnings for future periods.
2. Arpita Agarwal and Ity Patni (2019) conducted a study on "*Applicability of Altman Z - score in Bankruptcy Prediction of BSE PSUs*", by considering 53 companies listed on BSE PSUs Index covering companies from various sectors, over a period of 6 years, from 2013 to 2018, includes variables such as Altman Z Score (dependent variable) and 5 financial ratios (independent variables) and using Altman Z-Score Model to predict bankruptcy. The study obtained that Altman's Z-Score is highly accurate in predicting financial distress in both manufacturing and non-manufacturing industries atleast two years prior to the distress occurring.
3. Ashok Panigrahi (2019) has conducted a study on "*Validity of Altman's "Z" Score Model in Predicting Financial Distress of Pharmaceutical Companies*" by considering 4 pharmaceutical companies namely Aurobindo Pharma, Lupin Pharma, Dr. Reddy's Laboratories, Sun Pharmaceutical Industries, over a period of 5 years from 2012-2017, includes variables such as Altman Z Score(dependent variable) and 5 financial ratios (independent variables), using Altman Z-Score Model. It has examined the Validity of Altman Z Score Model. It was found that the financial position of the pharmaceutical industry was healthy with an average z-score of 5.90. But author suggested not considering other measures of financial distress potentially influencing the results as one of the limitations of the study conducted. One of the limitation the author specified in his study is not including other measures of financial distress that are influencing the results thereof.
4. Jayashreeben Koshti and Dr. Chetana Marvadi (2023) has conducted a study upon "*Validating Z Score Model for evaluating financial health of selected Indian companies*". Five leading sectors i.e. Automobile, IT, Oil and Gas, Pharmaceutical and Textile of the Indian Economy have been selected and five companies from each of the select sectors have been chosen based on data availability using purposive sampling, for uniform periods of ten years from 2008-09 to 2017-18. They examined corporate bankruptcy and earning manipulation using the Altman Z Score model. The study finds out that retained earnings to total assets ratio and EBIT to total assets are most significant ratios in determining the financial health of select companies. And classified companies according to their distress level and provided valuable suggestions to investors in selection of the companies for investment purposes. It was found that Vijay Textiles Ltd has been classified to be in "distress "zone.
5. Rashmi Rupesh Soni et al. (2021) has examined the" Predicting *Financial Distress In The Indian Textile Sector*" by considering the Altman Z score model to predict the financial distress of companies of the Indian textile sector. The analysis was conducted on 161 listed textile companies in India from 2009 to 2018. Variables of study are Altman Z Score(dependent variable) and 5 financial ratios (independent variables). Altman Z-Score Model, correlation, regression analysis, median split and Kruskal-walls etc tools have been used. The study analysed that based on a 10-year average z score, only 3.72% of the select companies are financially strong and

most of the companies are in the danger zone. And Z-Scores of small, medium and large-scale companies have significant difference between them.

6. Prof. Lakshmi Narasimhan.S et al (2018) has conducted a study on "*Evaluating Client Susceptibility to Insolvency Using Altman Z Score*" by considering 3 companies each from the 3 sectors namely Telecom, Infrastructure and Steel over the period of 3 years from 2016 to 2018, includes variables such as Altman Z Score(dependent variable) and 5 financial ratios (independent variables), using Altman Z-Score Model. It aims to measure the financial efficiency of select companies and evaluate their insolvency status using Altman Z-Score Model. The study proved that the Altman Z-Score Model serves as a good tool for prediction and analysis of financial distress.
7. Thiruchinapalli Srinivas (2023) has conducted a study on "*Using the Altman Z-Score Model to Forecast the Financial Distress of a Subset of NIFTY 50 Companies in the Indian Stock Market*" by considering 39 companies (out of NIFTY50) for the period 2022-23. Variables considered under the study are Altman Z Score (dependent variable) and 5 financial ratios (independent variables) using Altman Z-Score Model. The study discloses that 15 companies are in "too healthy" zone, 15 companies are in "healthy" zone and 9 companies out of 39 chosen companies were in financial "distress" zone.
8. Dr. M. Dhanabhakyam and Saroja A. (2016) has examined the "*Financial Performance of Select Fmcg Companies using 'z' score model*" by considering the Altman Z score model. This study is used to examine the existence of financial distress among select FMCG companies by using dependent variable such as Altman Z-score and independent variables such as 5 financial ratios. This study concludes that during pre-merger period, out of 22 companies selected 64% of the companies are in grey zone and during post-merger period 59% of the companies are in grey zone. Thus, showing merger has some power of overcoming possibility of distress in a company.
9. Chellasamy P. and Kannamudaiyar S. (2021) has conducted a study on" Prediction *of financial distress using altman z score -a study of selected footwear companies in India*" by considering 5 companies on the basis of market capitalization namely Relaxo Footwear, Bata India, Mirza International, Khadim's, Liberty Footwear over a period of 5 years from 2015-16 to 2019-20. The study aims to examine liquidity position, growth rate and identify the financial distress of select companies. Variables considered under the study are Altman Z Score, current ratio, quick ratio (dependent variables) and 5 financial ratios (independent variables). Altman Z-Score Model, liquidity ratio, Compound Annual Growth Rate tools have been used in this study. It was found that Liberty Footwear falls in distress zone with Z-Score of 1.80 and rest of the companies are in safe zone.
10. Amit Sareen and Sudhi Sharma (2021) has conducted a study on "*Assessing Financial Distress and Predicting Stock Prices of Automotive Sector: Robustness of Altman Z-Score*". This study is conducted to examine the financial distress in the automotive sector. This includes the dependent variable Altman Z-score and independent variables 5 ratios of Altman Z-Score. Statistical tools used includes growth models, unit root test, panel data modelling and Altman Z-Score Model. It is observed that the automotive industry is facing challenges due to financial crisis (2008) and the introduction of GST, but the impact on each company varies. The overall Z-score indicates industry-wide difficulties. The article suggests that EBITDA/TA (efficiency in making money compared to assets) and MV/TL (market value compared to debt) are crucial components in predicting stock prices within the auto sector.

Need for the Study:

For financial distress, people generally ratio analysis to predict financial health of a company but there is no single solid ratio that can be applied to all companies simultaneously. But these ratios do not yield any concrete conclusions. Hence there is a need for a standard model for studying financial health of a company and classifying them as financially sound or distressed. Thus, several models have been formulated over years to predict financial distress of a company and

safeguard the interests of various stakeholders before bankruptcy actually occurs. One such model is the Altman Z-Score Model.

Edward I. Altman developed this Z-Score analysis model back in 1968. It uses five ratios, which are then integrated into a single measure Z-Score analysis, to calculate Z-Score. The predictive power of the Altman Z-score in identifying the likelihood of bankruptcy within the following two years for publicly traded manufacturing and even non-manufacturing enterprises has been demonstrated in this study.

Objectives of the Study:

1. To Study the financial health of select Fertilizers companies in India.
2. To examine the financial health of select Refineries companies in India.
3. To identify the financial distressed Companies among the select Fertilizers & Refineries companies in India.

Research Methodology

Data Sources:

The study used the secondary data, collected of select companies, from official NSE website, annual reports of the companies and other scholarly websites to calculate the Z-Scores and make necessary interpretation on their financial health.

Sampling Method:

The sectors for the study are chosen based on non-probability sampling(non-random) method. And the companies within the select sectors are chosen based on their market capitalisation as listed in NSE.

Companies Chosen:

The study has been undertaken on the Select top 5 Indian Fertilizers Companies viz., Fertilizers and Chemicals Travancore Ltd, Coromandel International Limited, Tata Chemicals Limited, Chambal Fertilisers and Chemicals Limited, GNFC and select top 5 Refineries companies viz., Indian Oil Corporation Limited, Bharat Petroleum Corporation Limited, Hindustan Petroleum Corporation Limited, Mangalore Refinery and Petrochemicals Limited, Chennai Petroleum Corporation Limited. The companies have been chosen on the basis of their Market Capitalization as reported from website Money Control.

Period of study:

The study includes the data collected from financial statements of a company for the period of latest 5 years i.e. 2018-2023. The study period also includes pre and post Covid years. This also helps to understand whether there is any impact of Covid on financial health of select companies.

Model used:

The study uses the Altman Z-Score model to analyse the financial health of the select companies.

The model uses five financial ratios to analyse the possibility of distress in a company.

Altman Z-Score Model:

$$Z = 1.2\ X1 + 1.4X2 + 3.3X3 + 0.6X4 + 0.999X5$$

Statistics used

The study uses mainly descriptive studies, descriptive statistics, Multiple Linear Regression model, Kolmogorov Smirnov normality test, ANOVA single factor and t-test: two samples assuming unequal variances to calculate Z-Score and establish hypotheses.

Variables

Dependent Variable:

Altman Z-Score

Independent Variables:

X1= Working Capital/Total Assets

X2= Retained Earnings/Total Assets
X3= Earnings before Interest and Taxes/Total Assets
X4= Market Value of Equity/Book Value of Total Debt
X5= Sales/Total Assets

Hypothesis

Following hypothesis have been formulated for this study:

1. **H0 =** There is no significant relationship between Altman Z-Score and it's 5 independent variables (financial ratios).

H1 = There is significant relationship between Altman Z-Score and it's 5 independents Variables (financial ratios).

2. **H0** = For each one of select companies Altman's Z-score values doesn't exhibit any significant difference between the years for 5 years study period.

H1 = For each one of select companies Altman's Z-score values does exhibits significant difference between the years for 5 years study period.

3. **H0** = There is no significant difference among Altman Z-Score values of select Fertilizers companies.

H1 = There is significant difference among Altman Z-Score values of select Fertilizers companies.

4. **H0** = There is no significant difference among Altman Z-Score values of select Refineries companies.

H1 = There is significant difference among Altman Z-Score values of select Refineries companies.

5. **H0** = There is no significant difference between average Z-Score of select Fertilizers and Refineries companies.

H1 = There is significant difference between average Z-Score of select Fertilizers and Refineries companies.

Scope of Study

This study is confined to select Fertilizers and Refineries companies of India. Only a limited set of top 5 companies as per their market capitalisation are considered from both Fertilizers and Refineries companies. Moreover, this study uses only the Altman Z-Score Model, among several bankruptcy predictive models, to analyse the financial status of select Indian companies for the study period 2018-2023.

Limitations of the Study:

The study is solely based on secondary data. The accuracy and reliability of findings subject to the financial statements of the company.The study is restricted to only top 5 Fertilizers and Refineries companies as per their market capitalization. The study limits itself to the use of Altman Z-Score model and it's related ratios for assessing the financial health of select companies. Therefore, the limitations of Altman Z-Score Model is inhabited in the study.

Objective 1:

To examine the financial health of select Fertilizers companies in India.

The financial analysis of Fertilizers and Chemicals Travancore Ltd, Coromandel International Limited, Tata Chemicals Ltd, Chambal Fertlisers and ChemicalsLimitedand GNFC Ltd from 2018–19 to 2022–23 shows variations in how these Fertilizers companies manage their finances, assets, and market dynamics over the years and have unique financial paths. The Fertilizers companies show positive working capital trends, steady growth in total assets, and generally positive profitability. The market value of equity for these companies has experienced substantial growth, indicating investor confidence. Sales for the companies have consistently increased, reflecting a positive way in revenue generation. The overall financial health and performance of these Fertilizers companies appear robust during the specified period.

Table - 1Average X1, X2, X3, X4, X5 ratios of select Fertilizers companies

Ratios/company	FACT Ltd	Coromandel International Limited	Tata Chemicals Limited	Chambal FertlisersLimited	GNFC Ltd	Average
X1=WC/TA	0.012243	0.278754	0.132004	0.116328	0.270815	0.1602029
X2=RE/TA	-0.289687	0.238587	0.425663	0.342749	0.312283	0.205919
X3=EBIT/TA	0.230118	0.175183	0.061425	0.14374	0.132208	0.148535
X4=MVE/BVTD	1.715479	3.937824	10.427416	1.505464	2.466273	4.010491
X5=Sales/TA	1.009197	1.579111	0.227710	1.252940	0.742690	0.962330

Refer tables under Annexure

X1, *working capital to total assets ratio*, indicates the short-term liquidity position of the company. Fertilizers and Chemicals Travancore Ltd has a relatively low working capital ratio to total assets. Coromandel International Ltd has a higher ratio, indicating a good proportion of working capital to total assets. Tata Chemicals Ltd and Chambal Fertilisers and Chemicals Ltd are both in moderate ratios and Gujarat Narmada Valley Fertilizers and Chemicals Ltd has relatively high ratios.

X2, *Retained Earnings to Total Assets ratio*, depicts the profitability position of the company over years. Fertilizers and Chemicals Travancore Ltd has negative retained earnings to total assets, which might lead to accumulated losses. Coromandel International Limited, Tata Chemicals Ltd, Chambal Fertlisers and ChemicalsLimited, and GNFC Ltd have positive ratios in which it depicts the increase in retained earnings. Tata Chemicals Ltd having the highest among them.

X3, *Earnings before Interest and Taxes to total assets ratio*, depicts the productivity of the company. Fertilizers and Chemicals Travancore Ltd and Coromandel International Limited have higher ratios, indicating a higher level of earnings relative to total assets. Whereas Tata Chemicals Ltd, Chambal FertlisersLimited, and Gujarat Narmada Valley Fertilizers and Chemicals Ltd have lower ratios, making a lower proportion of earnings to total assets.

X4, *Market value of Equity to Book Value of total debt ratio*, depicts the solvency position of the company. Fertilizers and Chemicals Travancore Ltdand Chambal Fertilisers and Chemicals Ltd have low market value of equity to total liabilities ratios. Coromandel International Limited and Gujarat Narmada Valley Fertilizers and Chemicals Ltd have higher ratios, indicating a potentially stronger market position.Tata Chemicals Ltd has the highest ratio, having a significant market value of equity relative to total liabilities.

X5, *Sales to Total Assets ratio*, depicts the capacity of assets to generate revenue. Fertilizers and Chemicals Travancore Ltd, Coromandel International Limited, and Chambal Fertlisers and ChemicalsLimitedhave relatively high ratios, indicating a higher level of sales relative to total assets.Tata Chemicals Ltd and Gujarat Narmada Valley Fertilizers and Chemicals Ltd have lower ratios, having a lower level of sales relative to total assets.

Objective 2:

To eamine the financial health of select Refineries companies in India.

The financial analysis of Bharat Petroleum Corporation Limited (BPCL), Indian Oil Corporation(IOCL), Hindustan Petroleum Corporation Ltd(HPCL), Mangalore Refinery and Petrochemicals Limited (MRPL), and Chennai Petroleum Corporation Ltd(CPCL) spanning 2018–19 to 2022–23 show a complex landscape with shared challenges and divergent financial trajectories.

All companies exhibit negative working capital, a potential red flag for liquidity concerns. BPCL and IOC, however, showcase resilience by overcoming such challenges, with fluctuating but ultimately recovering retained earnings and earnings before interest and taxes (EBIT). HPCL faces increased total liabilities and a dip in EBIT in 2022-23, signalling

financial strain.

MRPL experiences a positive shift, displaying improved working capital and total assets in 2022-23. In contrast, CPCL's financial metrics undergo significant fluctuations, marked by a substantial increase in various indicators in 2021-22 and 2022-23.

These dynamics underscore the oil and gas sector's susceptibility to market volatility, global economic conditions, and regulatory changes. The companies' varying responses to these challenges highlight the dynamic nature of the industry. Despite uncertainties, the firms exhibit adaptability and recovery, evidenced by strategic investments in growth.

Monitoring their future financial performances becomes crucial to discern long-term sustainability. The companies' ability to navigate challenges and capitalize on emerging opportunities in the rapidly evolving energy landscape will shape their success in a sector that demands resilience and strategic foresight.

Table - 2 Average X1, X2, X3, X4, X5 ratios of select Refineries companies

Ratios/company	IOCL	BPCL	HPCL	MRPL	CPCL	Average
X1=WC/TA	-0.120342	-0.077675	-0.155931	-0.071044	-0.208339	-0.126666
X2=RE/TA	0.252941	0.054760	0.226537	0.223210	-0.130128	0.125464
X3=EBIT/TA	0.073778	0.061923	0.048479	0.002643	0.075600	0.052485
X4=MVE/BVTD	0.308369	0.873689	0.375661	0.038004	0.207517	0.360648
X5=Sales/TA	1.855072	2.752992	2.580414	2.481087	3.888188	2.711550

From the table it appears that all select Refineries companies have negative working capital to total assets ratio, indicating potential concerns about short-term liquidity position. Thus, immediate measures are required to be taken upon so as to improve current assets percentage than the current liabilities percentage.

IOC and HPCL show the highest Retained earnings to total assets ratio, indicating better profitability. CPCL has negative retained earnings to total assets, indicating the loss. It has to work on to improve its profitability position.

All the companies have positive earnings before Interest and Taxes to total assets ratio. With CPCL and IOC having better efficiency, followed by BPCL and HPCL. MRPL has relatively low efficiency compared to other companies.

All the select Refineries have better Market value of Equity to Book Value of total debt ratio. BPCL has the highest MVE/BVTD ratio, suggesting better solvency position. This could be due to growth prospects or other factors. However, MRPL has to work on its ratio on par with other companies.

All the companies exhibit positive and better Sales to total assets ratio indicating better capacity of assets in generating revenue. CPCL has the highest Sales to total assets ratio, indicating better efficiency in utilizing assets to generate sales.

Objective 3:

To identify the companies with the financial distress among the select companies with respect to Fertilizers and Refineries sector in India.

Table - 3 Z-Score of Select Fertilizers Companies for 2018 - 2023

Z-Score of Select Fertilizers Companies						
Company/Year	2018-19	2019-20	2020-21	2021-22	2022-23	Average
Fertilizers and Chemicals Travancore Limited	0.60	2.50	2.24	2.90	3.79	2.41
Coromandel International Limited	3.18	3.94	6.71	6.00	6.1	5.19

Tata Chemicals Limited	5.41	3.53	9.23	9.98	9.04	7.44
Chambal Fertlisers and ChemicalsLimited	1.62	1.87	3.92	4.08	4.76	3.25
Gujarat Narmada Valley Fertilizers and Chemicals Ltd	2.79	1.72	2.99	5.35	4.25	3.42

Source: Own Computations

The average Z-Score of Fertilizers and Chemicals Travancore Ltd is 2.41, placing it in the Grey Zone. For 2018-19, Fertilizers and Chemicals Travancore Ltd was in the Distress Zone, indicating immediate financial caution. From 2019-20 onwards, there was continuous increase in Z-Score except in the year 2020-21 there has been a slight fall. Later on it entered the Safe Zone, suggesting a secure financial position.

The average Z-Score of Coromandel International Ltd is 5.19, consistently falling into the Safe Zone. Coromandel International Ltd has consistently been in the Safe Zone over the years, indicating a strong and secure financial position.

The average Z-Score of Tata Chemicals Ltd is 7.44, placing it in the Safe Zone. Over the years, Tata Chemicals Ltd has consistently been in a safe zone and appears to be well positioned financially.

The average Z-Score of Chambal Fertilisers and Chemicals Ltd is 3.25, which falls into the Safe Zone. Chambal Fertilisers and Chemicals Ltd has shown varying Z-Scores over the years, with one year 2018-19 falling into Distress Zone and one year i.e 2019-20, falling into the Grey Zone. Thereby consistently increasing and falling into safe zone.

The average Z-Score of Gujarat Narmada Valley Fertilizers and Chemicals Ltd is 3.42, falling into the Safe Zone.The Altman Z-Score results for Gujarat Narmada Valley Fertilizers and Chemicals Ltd indicate a grey zone in 2018-19 and a distress zone in 2019-20 and safe zones thereon. The Z-Scores has been varying and fluctuating in each year but ultimately in safe zone in 2022-23.

Fertilizers and Chemicals Travancore Ltd, Chambal Fertilisers and Chemicals Ltd and Gujarat Narmada Valley Fertilizers and Chemicals Ltd show varying financial conditions, improving over the years. Coromandel International Ltd and Tata Chemicals Ltd demonstrate consistent strength and solid financial position over the years.

Table – 4 Z-Score of Select Refineries Companies for 2018 - 2023

Z-ScoreofSelect Refineries Companies						
Company/Year	2018-19	2019-20	2020-21	2021-22	2022-23	Average
IndianOilCorporation Limited	2.73	2.25	2.23	2.58	2.68	2.49
BharatPetroleumCorporation Limited	3.86	2.93	3.22	3.56	3.74	3.46
HindustanPetroleumCorporation Limited	3.69	2.92	2.84	3.06	2.95	3.09
MangaloreRefineryandPetrochemicals Limited	3.04	2.53	1.81	2.34	3.97	2.74
ChennaiPetroleumCorporation Limited	3.27	2.32	2.76	3.64	7.14	3.83

Source: Own Computations

The average Z-Score of Indian Oil Corporation Ltd. is 2.49, which falls into the Grey Zone.The company has consistently

shown Z-Scores in the Grey Zone over the specified years, indicating a cautious financial position. Further analysis and monitoring are recommended to assess the financial health and stability of Indian Oil Corporation Ltd.

The average Z-Score of Bharat Petroleum Corporation Ltd. is 3.46, placing it in the Safe Zone. BPCL demonstrated a mixed trend with a Grey Zone score in 2019-20 but has been in the Safe Zone in the remaining years.The average Z-Score of 3.46 suggests a generally secure financial position, but ongoing monitoring is recommended to ensure sustained stability.

The average Z-Score of Hindustan Petroleum Corporation Ltd. is 3.09, placing it in the Safe Zone. HPCL demonstrated a mixed trend with Grey Zone scores in 2019-20, 2020-21, and 2022-23, and Safe Zone scores in 2018-19 and 2021-22.The average Z-Score of 3.09 suggests a generally secure financial position, but it's important to note the variability.

The average Z-Score of Mangalore Refinery and Petrochemicals Ltd. is 2.74, which falls into the Grey Zone. MRPL demonstrated varying Z-Scores over the years, with Grey Zone scores in 2019-20, 2020-21, and 2021-22, but Safe Zone scores in 2018-19 and 2022-23. The average Z-Score suggests a mixed financial position.

The average Z-Score of Chennai Petroleum Corporation Ltd. is 3.83, placing it in the Safe Zone. CPCL demonstrated a mixed trend with Grey Zone scores in 2019-20 and 2020-21 but moved into the Safe Zone in 2021-22 and 2022-23. The average Z-Score suggests a generally secure financial position, with an improvement in recent years.

Overall, while some refineries consistently demonstrate safe financial positions, others exhibit variability. Ongoing monitoring and detailed analysis are crucial for ensuring financial stability.

Classification of select Fertilizers and Refineries into Safe, Grey and Distress Zone

Table– 5Zones of select Fertilizers & Refineries companies for 2018-2023

Type of Zone	FY-19		FY-20		FY-21		FY-22		FY-23		Average	
	No	%	No	%	No	%	No	%	No	%	No	%
Safe	6	60	2	20	5	50	7	70	8	80	7	70
Grey	2	20	7	70	5	50	3	30	2	20	3	30
Distress	2	20	1	10	0	0	0	0	0	0	0	0

Safe Zone:

- In FY-19, 60% (6 companies) were classified as "Safe," indicating a relatively high proportion or healthy condition.
- The percentage classified as "Safe" decreased to 20% (2 companies)in FY-20 but then increased to 50% in FY-21. This suggests some fluctuations in the financial health of entities but with an overall improvement in FY-21.
- FY-22 and FY-23 both show an increase in the percentage in the "Safe" zone, reaching 70% and 80%, respectively. This indicates a positive trend in the financial health of entities over these years.
- On the basis of average Z-Score values of select companies over select study period, 70% (7 companies) can be seen in "Safe" zone.

Grey Zone:

- The percentage classified as "Grey" increased from 20% (2 companies) in FY-19 to 70% (7 companies) in FY-20, indicating a higher proportion of entities facing moderate financial challenges.
- The percentage in the "Grey" zone decreased to 50% in FY-21, indicating some improvement, but then decreased further to 30% in FY-22. This makes a positive trend in addressing financial challenges.
- In FY-23, the percentage in the "Grey" zone decreased to 20%, indicating a potential improvement or stabilization in the financial condition of these entities.
- On the basis of average Z-Score values of companies around 3 companies (30%) are in "grey zone".

Distress Zone: In FY-19, 20% (2 companies) are said to be in "distress" zone which decreased to 10% (1 company) in FY-20, indicating a small proportion of entities facing significant financial challenges.

- However, in FY-21, FY-22 and FY-23, there were no instances classified in the "Distress" zone, suggesting an improvement or resolution of severe financial issues.
- There are no instances of distress on the basis of average Z-Score values.

Testing of Hypothesis

Multiple Linear Regression Model

Multiple Linear Regression Model is a statistical tool used to predict the value of dependent variable based on several independent variable's values. Altman Z-Score Model uses five independent financial variables to measure the solvency, profitability, activity, leverage and liquidity position of a business. Thus, this study uses Multiple Linear Regression Model to analyse the relationship/association between the 5 independent variables symbolically X1, X2, X3, X4 and X5 and dependent variable Altman Z-Score. The test considers average X1, X2, X3, X4, X5 values as independent variables and average Z-Score as dependent variable.

H0 = There is no significant relationship between Altman Z-Score and it's 5 independent ratios.

H1 = There is a significant relationship between Altman Z-Score and it's 5 independent ratios.

Table -6 Results of Multiple Linear Regression Analysis

Model generated: y=2.561E-6 +1.200*X1+1.400*X2+3.300*X3+0.6*X4+0.999*X5

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	1.000	1.000	1.000	0.0000008691

Analysis of Variance Table

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	20.980	5	4.196	5.556E+12	0.000
Residual	0.000	4	0.000		
Total	20.980	9			

Predictor	Unstandardized B	Coefficients Std.Error	StandardizedCoefficientsBeta	t	Sig.
Constant	2.561E-6	0.000		1.128	0.322
X1	1.200	0.000	0.137	318943.958	0.000
X2	1.400	0.000	0.204	507475.069	0.000
X3	3.300	0.000	0.147	327315.772	0.000
X4	0.600	0.000	1.234	4245281.911	0.000
X5	0.999	0.000	0.720	1835275.908	0.000

We can observe, from the above test, p-value of constant is 0.322 which is greater than 0.05. This suggests that constant term is not statistically significant. Predictors X1 to X5 all have p-values of 0.000 lesser than significance level of 0.05 indicating strong statistical significance. Thus, we can reject the null hypothesis i.e. there is no relationship between the altman z-score and 5 independent variables. Moreover, the coefficients generated of X1, X2, X3, X4 and X5 i.e. 1.2, 1.4, 3.3, 0.6 and 0.999 respectively in above analysis corresponds approximately with the Altman Z-Score model developed by Edward Altman. We can conclude that test shows strong relationship and effect of changes in independent variables on dependent variable value i.e. Altman Z-Score. Hence the alternate hypothesis is proved to be true that there is significant relationship between Altman Z-Score and it's 5 independent financial ratios.

Kolmogorov -Smirnov Test (Normality Test)

Kolmogorov-Smirnov test is used to check if a certain data set is normally distributed. The objective of using this tool in present study to check if the altman z-score values of select companies with respect to Fertilizers and Refineries are normally distributed in this 5 years study period. And as a preliminary test for performing the parametric tests such as ANOVA single factor, T-test. The altman z-score values of select Fertilizers and Refineries companies for the 5 years are used to carry on this test.

H0 = For each one of select companies Altman's Z-score values doesn't exhibit any significant difference between the years for the 5 years study period.

H1 = For each one of select companies Altman's Z-score values does exhibits significant differences between the years for 5 years study period.

The test results are shown below:

Table – 7 Results of Kolmogorov-Smirnov test

Fertilizers Companies		**Refineries companies**	
P-Value	**0.1302**	**P-Value**	**0.07624**
D	**0.1542**	**D**	**0.1653**
Sample size (n)	**25**	**Sample size (n)**	**25**
Average	**4.3405**	**Average**	**3.1221**
Median	**3.917**	**Median**	**2.934**
Sample Standard Deviation (S)	**2.4401**	**Sample Standard Deviation (S)**	**1.0089**
Sum of Squares	**142.9036**	**Sum of Squares**	**24.4296**
K	**0.771**	**K**	**0.8266**
Skewness	**0.9153**	**Skewness**	**2.6939**
Skewness Shape	**Asymmetrical**	**Skewness Shape**	**Asymmetrical, right/positive**
Excess Kurtosis	**0.3725**	**Excess Kurtosis**	**10.3268**
KurtosisShape	**Potentially Mesokurtic, normal like tails**	**Kurtosis Shape**	**Leptokurtic, long heavy tails**

The p-value for both Fertilizers (0.1302) andRefineries (0.07624) companies are greater than the significance level of 0.05. Therefore, we can accept the null hypothesis (H0) that the Altman Z-Score values doesn't exhibit any significant difference in this 5-year study period. And the altman z-score values are normally distributed among both select Fertilizers and Refineries companies. Thereafter we can perform the parametric tests since the data distribution is normal.

ANOVA Single Factor Test

The study analysed the Altman'S z-score values for select 10 companies for the period of latest five years 2018-2023. Anova Single Factor test is normally used to check the if there is any significant difference between the means of more than two groups of single factor. In the present study Anova test is conducted to check if there is any significant difference among Altman z-score values of both select Fertilizers and Refineries companies.

For select Fertilizers Companies

The Z-Scores of 5 select Fertilizers companies covering the period from 2018-2023 are taken as input to perform the ANOVA single factor test.

The following hypotheses that have been constituted for Fertilizers Companies

H0: There is no significant difference between the Altman z-score values among select Fertilizers companies i.e. $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5$.

H1: There is significant difference between the Altman z-score values among select Fertilizers companies.

Table – 8 Results of ANOVA single factor test for select Fertilizers companies

Groups	Count	Sum	Average	Variance
Fertilizers and Chemicals Travancore Ltd	5	12.02997	2.405994	1.368371
Coromandel International Ltd	5	25.93428	5.186856	2.344
Tata Chemicals Ltd	5	37.20484	7.440967	7.908932
Chambal Fertilizers and Chemicals Ltd	5	16.24374	3.248748	1.994517
GNFC Ltd	5	17.10085	3.42017	1.972964

ANOVA Single Factor

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	80.55229	4	20.13807	6.459154	1.66E-03	2.866081
Within Groups	62.35514	20	3.117757			
Total	142.9074	24				

From the above table, we can observe p-value (1.66E-03) is less than the significance level 0.05. We know that if p-value is less than significant values and calculated F value if greater than critical F value we have to reject H_0. So, we reject the null hypothesis (H0) i.e. Z-Scores are uniform among the select Fertilizers companies for the study period 2018-2023. Thus, we can say that Altman z-score values of select Fertilizers companies are varying from year to year and significant difference exists between the altman z-score values of select Fertilizers companies.

For select Refineries Companies

The Z-Scores of 5 select refineries companies for latest 5 years 2018-2024 are used to conduct the ANOVA single factor test.

The following hypotheses have been constituted for Refineries Companies

H0: There is no significant difference between the Altman z-score values among select Refineries companies i.e. $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5$.

H1: There is significant differences between the Altman z-score values among select Refineries companies.

Table –9 Results of ANOVA single factor for select Refineries companies

Groups	Count	Sum	Average	Variance
IOCL	5	12.45707	2.491414	0.056821
BPCL	5	17.31127	3.462253	0.144939
HPCL	5	15.46623	3.093246	0.116629
MRPL	5	13.68686	2.737372	0.667829
CPCL	5	19.13051	3.826102	3.674725

ANOVA Single Factor

Source of Variation	SS	df	MS	F	P-value	F critical Value
Between Groups	5.789684879	4	1.447421	1.552713	0.225456916	2.866081
Within Groups	18.64377383	20	0.932189			
Total	24.43345871	24				

The p-value generated from the above test is 0.225 which is less than 0.05 significance level. We accept H_0 if p-value exceeds the significance level of 0.05. Hence we can accept the null hypothesis (H_0) i.e. Z-Scores are uniform among the select Refineries companies for the study period 2018-2023. There is no significant statistical difference among altman z-score values of select Refineries companies for the latest 5 years. On contrast with Fertilizers companies, Refineries companies are showing uniform Altman z-score values throughout the select study years.

T-test:Two samples assuming unequal variances

T-test is an statistical tool that is used to identify the significant difference in means of two different groups. This study employs T-test: Two samples assuming with unequal variances to check if there is any statistically significant difference between the Altman z-score values of both select Fertilizers and Refineries companies. The variances of select Fertilizers and Refineries companies, obtained from Altman's Z-score values of select companies for the latest 5 years, are used to conduct the t-test assuming unequal variances.

H0 = There is no significant difference between average Z-Score of select Fertilizers and Refineries companies.

H1 = There is significant difference between average Z-Score of select Fertilizers and Refineries companies.

The t-test results are depicted below:

Table–10 Results of T-test for select Fertilizers and Refineries companies

	Variable 1	Variable 2
Mean	3.11775681	0.9321886915
Variance	7.296656396	2.410640517
Observations	5	5
Hypothesized Mean Difference	0	
df	6	
t stat	1.568556593	
P(T<=t) one-tail	0.083899911	
t Critical one-tail	1.943180274	
P(T<=t) two-tail	0.167799821	
t Critical two-tail	2.446911846	

The t-statistic value (1.5686) is not statistically significant at 0.05 level for either one-tailed (0.0839>0.05) and two-tailed test (0.1678>0.05). Thus, there is strong evidence to accept null hypothesis (H_0) i.e. there is no significant difference between the altman z-score values of select Fertilizers and Refineries companies. Apart from the differences in size, volume etc of Fertilizers and Refineries business, there has been no significant difference observed in altman z-score values among select Fertilizers and Refineries companies.

FINDINGS:

With respect to Fertilizers companies: -

- Fertilizers and Chemicals Travancore Ltd, with Z-Score of 0.60 in FY-19 has great potential of going into bankruptcy but has recovered drastically into entering grey zone for next 3 years and ultimately into safe zone in FY-23 with Z-Score of 3.79.
- Coromandel International Ltd, was found to be in Safe zone for all the select 5 years' time period with highest Z-Score of 6.71 in FY-21.
- Tata Chemicals Ltd, also been classified as safe zone with secure financial health for select 5 years with highest Z-Score of 9.98 in FY-22.
- Chambal Fertilisers and Chemicals Ltd, being in distress zone in FY-19 consistently has increasing trend in its Z-Score values attaining the status of safe zone in FY-20 and maintaining the same.
- Gujarat Narmada Valley Fertilizers and Chemicals Ltd, has been in distress zone in FY-19 and FY-20 and entering into safe zone thereby. Its highest Z-Score (5.35) is recorded in the FY-22.
- On average, Tata Chemicals Ltd have highest Z-Score of 7.44 followed by Coromandel International Ltd (5.19). On the basis of average Z-Score values all the select Fertilizers companies except Fertilizers and Chemicals Travancore Ltd (grey zone) are placed in safe zone with minimal risk of bankruptcy.

With respect to Refineries companies: -

- Indian Oil Corporation Ltd, has been placed in grey zone for all the select 5 years with highest Z-Score of 2.73 in FY-19.
- Bharat Petroleum Corporation Ltd, has been classified to be in safe zone in all select years except in FY-20 (grey zone). From thereon, it has again entered into safe zone with highest Z-Score of 3.86 in FY-19.
- Hindustan Petroleum Corporation Ltd, been in grey zone for FY-20, FY-21 and FY-23. It's highest Z-Score (3.69) is recorded in year FY-19.
- Mangalore Refinery and Petrochemicals Ltd, from safe zone in FY-19 has entered into grey zone for next three financial years before entering into safe zone again.
- Chennai Petroleum Corporation Ltd, been in grey zone for 2 years (FY-20 & FY-21) thereby entering into safe zone with highest Z-Score of 7.14 in FY-23.
- Average Altman Z-Score values of select Refineries companies places all companies in safe zone except Indian Oil Corporation Ltd (2.49) and Manglore Refinery and Petrochemicals Ltd (2.74), placing the latter mentioned in a grey zone.
- Chennai Petroleum Corporation Ltd and Bharat Petroleum Corporation Ltd have highest average Z-Score of 3.83 and 3.46 respectively followed by Hindustan Petroleum Corporation Ltd (3.09).

With respect to select Fertilizers and Refineries companies: -

- Select Fertilizers companies (0.162) have a higher and positive working capital to total assets ratio than select refineries companies (-0.127). In addition, refineries companies have a negative ratio in respect of working capital. Higher liquidity position of Fertilizers industry comparatively is indicated.
- Retained Earnings to Total Assets ratio is higher among select Fertilizers companies (0.2059) than Refineries (0.125) indicating higher profitability position of Fertilizers industry comparatively.
- Earnings before Interest and Taxes to total assets ratio is higher among select Fertilizers companies (0.148) than Refineries (0.0524). Thus, better leverage position for Fertilizers industry comparatively.
- Market Value of Equity to Book Value of Total Debt ratio for select Fertilizers companies stands at 4.01 and Refineries industry average at 0.36. Thus, Fertilizers industry has better solvency position comparatively.
- Sales to total assets ratio is higher in select refineries companies whose industry's average is at 2.712 and Fertilizers industry value at 0.96. Therefore, Refineries have better day to day activity levels with higher volume of sales.

- On the overall, the average taken of Z-Scores of select Fertilizers companies for 5 years stands at 4.34 and Refineries industry at 3.12, both being placed in safe zone (refer table 6.11 under Annexure part). But Fertilizers industry has a higher altman z-score value comparatively.
- In FY-19 2 companies are in grey zone and 2 in distress zone. But in FY-20 number of companies in grey zone increased to 7 and 1 in distress. Next, 5 companies, 3 companies, 2 companies being placed in grey zone in FY-21, FY-22, FY-23 respectively. No companies are in distress zone for these 3 years.
- So we can clearly see the impact of COVID 19 on individual companies during FY-20 with increase in grey zone companies. But the effect not so huge to bring an company into bankruptcy zone.

Hypothesis

- Multiple Linear Regression Analysis shows a strong relationship between the dependent variable i.e. altman z-score and it's 5 independent financial ratios. Altman Z-Score is also affected by increase/decrease in its related financial ratios. Thus, alternate hypothesis is proved by this test.
- Kolmogorov-Smirnov test shows that altman z-score values are normally distributed among both select Fertilizers and Refineries companies. Thus, null hypothesis is accepted that Z-Score values doesn't exhibit any significant differences in the chosen study period of latest 5 years i.e. 2018-2023.
- ANOVA single factor analysis among Fertilizers companies shows that there is significant difference in Altman Z-Score values of select Fertilizers companies. It means that altman-score values are fluctuating among Fertilizers companies and in select 5 years study period.
- On the contrast, ANOVA single factor analysis for Refineries shows that there is no significant difference in Altman Z-Score values of select Refineries companies. It means more or less the altman z-score values are uniform in select refineries companies and 5 years study period.
- T-test for select Fertilizers and Refineries companies shows that there is no significant difference between the altman z-score values of both the companies.

Conclusion

This study is conducted to know the financial health of select Companies. The present study analysed the financial distress of select companies in India with respect to Fertilizers and Refineries sector, applied Altman Z- Score Test with 5 financial ratios. Resulted that the companies are then classified in three zones that are Distress zone, Grey zone and Safe zone. In the Fertilizers sector, Fertilizers and Chemicals Travancore Ltd was in Distress belt in (FY-19), Chambal Fertilisers and Chemicals Ltd (FY-19) and GNFC Ltd (FY-20) but has recovered to Safe zone by better planning of resources. Remaining Fertilizers companies are in safe zone. While coming to the Refineries sector, Indian Oil Corporation Ltd has been in the Grey Zone for the last five years. And on average Indian Oil Corporation Ltd, Mangalore Refinery and Petrochemicals ltd. has been placed in grey zone and has potential of going into distress zone. Thus, these companies have to increase their operating efficiency in order to achieve better financial health. Moreover, there is an impact of COVID-19 on individual financial values of select companies but the impact is not too significant to lead a company into distress zone.

Suggestions for Select Companies

Throughout this entire study, it is observed that major of the companies going to grey and distress zone are suffering from decrease in working capital and negative working capital due to more current liabilities than the current assets. And another observation includes companies experiencing comparatively low EBIT. Thus, efforts by the companies should be directed towards increasing working capital and EBIT levels.

Increasing Working Capital

Working Capital of a company can be increased in the following ways

- **Sale of assets**: Selling unutilized and underutilized assets to increase working capital and pay off short term obligations.

- **Inventory Optimization**: Reducing excess stock and associated carrying cost, warehouse expenses.
- **Accounts Receivable Management**: Effective management of outstanding payments from customers by implementing efficient invoicing systems and other to encourage early payments.
- **Operational efficiency**: Increasing operational efficiency by maximizing sales and other activities of business to increase current assets.

Increasing Earnings before Interest and Taxes

EBIT of a company can be optimised in the following ways:

- **Revenue Growth**: Increasing sales through market expansion, increasing customers base
- **Cost control**: Optimizing the costs through cost control and cost reduction techniques.
- **Increasing productivity**: Increasing production capacity, efficiency of workers.
- **Operating efficiency**: Enhancing productivity with reorganized workflows, adopting new technologies.
- **Tax planning**: identifying ways to reduce the tax liability.
- **Debt management**: Reducing finance costs of an enterprise by selecting those alternatives with lower interest payments.

5.4.2 For Future Research

This study examined the financial health of select 10 companies i.e. 5 Fertilizers and 5 Refineries using the Altman Z-Score Model. It aims to find out the financial Distress, if any, among the select companies. In future, researchers can increase the number of companies considered for study. In addition, they can incorporate other financial distress predictive models such as Grover Model, Springate Model, Fulmer Model, Phalon Model etc, company specific factors/variables, qualitative factors and other statistical tools and techniques to study in detail the financial status of select companies and provide a strong base for more accurate interpretation and decision making.

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