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A Study on the Financial Health and Market Performance of NSE Oil and Gas Indices Using Piotroski's F-Score and Altman Z-Score

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Abstract

This study investigates the financial stability and the likelihood of bankruptcy of companies in the oil and gas sector, specifically those listed on the National Stock Exchange (NSE). It employs financial tools such as profitability and operational ratios, Piotroski's F-Score, and the Altman Z-Score. The research adopts a quantitative approach, analyzing secondary financial data to identify the potential financial distress. The objective is to predict potential financial difficulties within the sector, providing valuable insights for investors, corporate managers, and policymakers. The study sheds light on the stability and sustainability of oil and gas firms, offering a robust methodology for assessing financial risk and performance and determining whether the financial structure is in sound manner and to know whether have bankruptcy likelihood.

Keywords: *Oil and Gas Sector, Profitability Ratio, Operating Ratio, Altman Z Score, Piotroski's F-Score, Bankruptcy Risk, Financial Health, Financial Performance*

Introduction

The oil and gas industry is a critical component of the global economy, particularly in energy-developing nations like India. As this is one of the eight core industries, it impacts the decision-making of all other sectors which are important for the growth of the economy. India is the third largest consumer of oil in the world as of 2021 (Economic Survey 2023-24). It plays a pivotal role in global energy production, though it remains vulnerable to cyclical economic shocks, and volatility of market and regulatory changes (Kisswani & Elian, 2021, BILGIN et al., 2015, Amin & Mollick, 2021). Oil price volatility represents a source of uncertainty for firm profitability, valuations, and investment decisions. Alaali's study examines the effects of industry uncertainty and market instability on total investment expenditures in UK firms (Alaali, 2020). In times of oil price collapse, the financial conditions of energy firms worsen due to the sudden decline in revenues. Also, the high oil price uncertainty leads to vague predictions of future economic growth and the demand for the products and services in the market (Zhao et al., 2016, Henriques & Sadorsky, 2011).

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In this competitive world, every firm thrives intending to earn profit. Profitability indicates the financial soundness and the overall profit performance of an industry. Through the analysis of the financial statement of a company, one can find the analysis of financial statement profitability by enduring through the financial statement a company's trend and shift of financial position can be estimated. This information is useful and very crucial for stakeholders as they will get interested to know both the short-term and long-term financial viability of the organization (Srinvas Gumparthi, 2010).

Financial Distress refers to a situation in which an individual, organization, or entity is experiencing significant financial difficulties or is unable to meet its financial obligations. It includes inability to meet financial obligations, liquidity problems, decline in financial health, impact on creditworthiness (Gurný & Gurný, 2013), excessive debt burden, and eventually leads to the risk of insolvency/bankruptcy. Bankruptcy, a significant concern for stakeholders, can result in substantial economic and social costs. Understanding the factors that contribute to bankruptcy can aid in developing strategies to mitigate these risks. Altman's discriminant analysis model has been widely recognized as an effective tool for the assessment of a company's financial distress (Altman et al., 2016).
This study investigates the Nifty oil and gas indexed companies to check whether the companies' financial structure is sound and to check the bankruptcy likelihood by employing Piotroski's F- Score and Altman Z Score (Piotroski, 2000, Altman, 1968). The study will provide valuable insights for investors, corporate managers, and policymakers as this sheds light on the stability and sustainability of oil and gas firms.

Literature Review

Several previous studies have been conducted theoretically as well as practically on financial health, bankruptcy risk, and profitability in the oil and gas sector. This section of the study explores the prior studies on the financial soundness, and risk of bankruptcy as for the foundation for the study.

Financial health and profitability

Profitability is one of the primary indicators of a company's financial health, with various studies highlighting the importance of profitability ratios in evaluating firm performance. So studying the profitability of health structures is a crucial factor in making decisions about their solvency and corporate sustainability. Operating ratios like the asset turnover ratio assess the efficiency with which companies utilize their resources to generate revenue, which is crucial for firms operating in a capital-intensive industry. The study of Meghanathi & Chakrawal analyses how the earning capacity of this sector is affected by operating costs and fixed financial charges. It also shows the relationship between the Debt equity ratio and Earning per Share (EPS) and how this sector does debt financing efficiently (Meghanathi & Chakrawal, 2023). In the study of Stelios Terzoudis et al., 2024, an investigation on the effect of economic liquidity, debt, and business size on profitability for Greek general hospitals has been made, which resulted there is a positive relationship between the liquidity, size, and profitability and debt has a negative effect on profitability only for GHs. (Stelios Terzoudis et al., 2024). Zarb, 2018, examines the effect of liquidity, solvency, and financial health on U.S. airlines' profit volatility. This shows that liquidity, solvency, and financial health taken together impact U.S. airline companies' profit volatility. In particular, the study shows that the debt-to-equity ratio and the operating profit margin are statistically significant in predicting airline profit volatility. (Zarb, 2018).

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Financial Distress and Bankruptcy Prediction

Financial distress is a situation where liability exceeds assets in a company and it generally happens due to under-capitalization, not maintaining sufficient cash, resources not being utilized properly, inefficient management in all activities, sales decline, and adverse market situations.

The prediction of companies that operate in financial difficulties has become a particular subject of interest in research academics, business, government, etc. A lot of research has been done on the analysis of the financial health of companies. Accounting ratios are widely used in the development of models for the prediction of financial health and financial distress of companies.

During the life cycle, it is quite normal for a company to go through the negative and positive phases, periods of success and failure. When a temporary negative phase shifts to a structural or a continuous form it is often destined to the condition called bankruptcy. One of the most well-known distress prediction models that has a high ability to predict and easy applicability is the Altman Z Score, formulated in 1968. Altman z score forms a benchmark model within this study.

Recent research has emphasized the need for a more comprehensive approach to assessing financial distress in the oil and gas sector, incorporating both traditional profitability ratios and advanced financial models like the Z-Score and F-Score. By combining these models, researchers can better predict potential financial difficulties and provide insights into the long-term financial stability of firms in this sector.

Integration of Models

By using both the Altman Z-Score and Piotroski's F-Score, this study provides a holistic view of the financial health of oil and gas companies. These models, combined with traditional profitability and operational ratios, allow for a comprehensive analysis of both short-term financial soundness and long-term bankruptcy risks.

Data and Analysis Method

This study analyzed the oil and gas index National Stock Exchange (NSE) listed companies. The data for the study has been collected from financial reports and databases of selected companies. To ensure a comprehensive view of financial health and trends within the sector the data span of 11 years (2013-2023) has been taken. Sources for the data that have been taken include the balance sheets, income statements, annual reports, and other relevant documents available from financial platforms such as Bloomberg, Refinitiv Eikon, and NSE's official database. This section provides essential information for the calculation of the financial ratios and scores which are used for the analysis and predicts the performance of selected companies over the financial years, highlighting the financial capacity to overcome the short-term as well as the long-term debts and to generate profits.

The study uses ratio analysis as the primary tool, to evaluate the performance of companies various models were considered to determine ratios and compare with its competitors to analyze the company's performance.

Altman Z Score : Altman generated the following discriminant function in 1968:

$$Z = 0.012Z_1 + 0.014Z_2 + 0.033Z_3 + 0.006Z_4 + 0.999Z_5$$

Where,

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Z1	= Net Current Asset/ Total Assets
Z2	= Reserve/ total assets
Z3	= (profit before tax + interest)/ total assets
Z4	= market capitalization/total liabilities
Z5	= revenues/total assets

Later Altman derived new model which is more popular now:

$Z = 1.2Z_1 + 1.4Z_2 + 3.3Z_3 + 0.6Z_4 + 1.0Z_5$

If,

Z score < 1.81	The chance of bankruptcy likelihood is high
Z score < 2.99	Company Is In Grey Zone
Z score > 2.99	The Company Is Stable

Altman Z-Score (emerging markets)

Altman has also derived a formula for emerging markets for non-manufacturing industries and for its emerging markets.

If,

Z score < 1.1	The chance of bankruptcy likelihood is high
1.1 Z score < 2.6	Company Is In Grey Zone
Z score > 2.6	The Company Is Stable

1. <u>F Score</u>

Piotroski designed a prediction model in 2000 to judge whether the company is in a sound mix of financials and their opportunities in attracting investment. If the F Score ranges from 0 to 9, it indicates a lower score for risky investment, and vice versa. The f-score has been proposed for the assessment of a company's financial strength from an investment perspective.

F_Score = F_ROA + F_ΔROA + F_OCF + F_Accural + F_ΔMargin + F_ΔTurn + F_ΔLever

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+ F_ΔLiquid + F_ΔEQ

Where,

F_ROA	EBIT (earnings before interests and taxes)/total assets	(1 if positive, otherwise 0)
F_ΔROA	ROA Variation	(1 if greater than the previous period, otherwise 0)
F_OCF	Operating Cash Flow	(1 if positive, otherwise 0)
F_ACCRUAL	OCF/Total Assets	(1 if > ROA, otherwise 0)
F_ΔMARGIN	Gross Margin	(1 if greater than the previous period, otherwise 0)
F_ΔTURN	Asset Turnover Ratio	(1 if greater than the previous period, otherwise 0)
F_ΔLEVER	Debt-Equity Ratio	(1 if lower than the previous period, otherwise 0)
F_ΔLIQUID	Current Ratio	(1 if greater than the previous period, otherwise 0) and
F_ΔEQ	Additional shares issued in the previous period	(1 if no, otherwise 0).

The summation of the above measures the F-score. If the F-score is between 7-9, it reflects a sound potential investment, whereas a score between 0-2 or even less than 3, indicates a shaky financial condition and not a good investment opportunity (Piotroski, 2000).

Analysis and Findings

As already mentioned, the study aims to focus on analyzing the profitability and financial distress of selected firms using profitability ratios, operational ratios, Piotroski's F- Score, and Altman Z Score on Oil and Gas Indexed NSE Companies.

Ratio analysis

Table 1 shows the calculation of the Current Ration which measures the ability to meet its short-term liabilities with its short-term assets in selected companies. PLNG, CAST, MGAS, and OILI have stronger financial health in terms of liquidity, capable of covering their short-term liabilities as they have a strong current ratio. GAIL and ONGC are generally stable as have fluctuated around the critical threshold of 1, and they may face liquidity risk in the future. HPCL, BPCL, IOC, and GGAS have weak liquidity, where the current ratio is less than 1, which indicates that they face challenges in meeting their short-term obligations which could affect their operational flexibility.

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Table 1.
Current Ratio of Oil and Gas Indices (2013-2023)

Year / Company	Mar 23	Mar 22	Mar 21	Mar 20	Mar 19	Mar 18	Mar 17	Mar 16	Mar 15	Mar 14	Mar 13
RELI	1.075	1.124	1.344	0.625	0.731	0.586	0.624	0.690	1.024	1.312	1.619
HPCL	0.599	0.696	0.708	0.659	0.760	0.768	0.722	1.033	1.175	1.084	0.874
PLNG	4.037	3.185	3.935	3.242	2.400	2.454	2.267	2.262	2.127	1.262	1.175
BPCL	0.748	0.746	0.902	0.718	0.919	0.886	0.801	1.015	0.971	1.077	0.935
GAIL	0.946	1.080	0.892	0.934	1.036	0.973	1.009	0.945	1.027	1.130	0.872
GSPT	1.039	0.635	0.576	0.597	0.516	0.430	0.931	1.883	1.588	1.446	2.188
CAST	1.996	2.169	2.053	2.184	1.866	1.671	1.207	1.245	1.179	1.528	1.432
IOC	0.769	0.764	0.717	0.686	0.806	0.755	0.726	0.873	0.929	0.999	1.022
GGAS	0.706	0.554	0.579	0.792	0.618	0.467	0.377	0.256	0.558	0.000	0.000
ONGC	0.864	0.832	0.755	0.645	0.646	0.619	0.639	1.134	1.153	0.939	1.144
MGAS	1.285	1.391	1.579	1.590	1.430	1.349	1.262	1.460	1.542	1.063	1.009
IGAS	0.881	1.206	1.316	1.391	1.465	1.515	1.387	1.184	1.033	0.881	0.652
OILI	1.663	1.485	0.977	0.835	1.615	1.944	1.393	5.046	3.863	1.394	3.769

Source: Bloomberg

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Table 2.

Operating Ratio of Oil and Gas Indices (2013-2023)

Company	Year / Operating Ratio	Mar-23	Mar-22	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17	Mar-16	Mar-15	Mar-14	Mar-13
RELI	Debt Equity Ratio	0.467	0.362	0.372	0.761	0.743	0.745	0.746	0.780	0.768	0.698	0.589
	Interest Coverage Ratio	13.278	41.508	7.095	6.970	6.271	11.094	203.494	-46.926	-12.895	-7.049	-6.762
	Asset Turnover Ratio	0.562	0.493	0.375	0.550	0.626	0.513	0.465	0.500	0.811	1.098	2.192
HPCL	Debt Equity Ratio	2.190	1.171	1.148	1.420	0.927	0.860	1.050	1.330	1.496	3.429	3.365
	Interest Coverage Ratio	5.433	-48.458	-19.952	-41.448	-25.427	-30.187	-26.506	-13.100	12.123	4.437	3.238
	Asset Turnover Ratio	2.784	2.423	1.858	2.400	2.796	2.583	2.501	2.629	2.661	2.475	4.685
PLNG	Debt Equity Ratio	0.219	0.252	0.309	0.363	0.072	0.148	0.271	0.392	0.490	0.655	0.682
	Interest Coverage Ratio	-331.251	48.161	31.355	29.464	-55.305	21.317	14.899	7.603	5.167	8.074	29.814
	Asset Turnover Ratio	2.713	2.134	1.371	2.078	2.478	2.063	1.866	2.294	3.432	3.283	5.679
BPCL	Debt Equity Ratio	1.265	1.222	1.016	1.792	1.157	1.028	1.159	0.805	0.804	1.633	1.887
	Interest Coverage Ratio	5.539	13.720	8.037	12.130	26.780	54.132	-26.848	-16.824	-28.956	-140.631	45.788
	Asset Turnover Ratio	2.519	1.990	1.476	1.978	2.318	2.056	2.059	2.268	2.887	3.140	6.089
GAIL	Debt Equity Ratio	0.256	0.144	0.148	0.137	0.048	0.077	0.152	0.183	0.234	0.671	0.572
	Interest Coverage Ratio	298.652	-85.806	-26.119	-325.720	-21.395	-2592.831	24.818	12.023	23.280	19.990	112.319
	Asset Turnover Ratio	1.426	1.045	0.736	1.012	1.174	0.911	0.828	0.865	0.945	0.978	1.713
GSPT	Debt Equity Ratio	0.016	0.090	0.313	0.756	1.390	2.218	0.661	0.268	0.319	0.422	0.530
	Interest Coverage Ratio	-45.340	159.795	19.795	7.965	5.751	8.439	4.268	20.312	11.487	10.316	13.763
	Asset Turnover Ratio	1.111	1.221	0.838	0.949	0.765	0.611	0.669	0.174	0.191	0.190	0.434
CAST	Debt Equity Ratio	0.026	0.004	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Interest Coverage Ratio	-24.468	-28.567	-16.940	-22.336	-20.814	-22.998	-17.979	-19.927	-21.272	-13.526	-14.815
	Asset Turnover Ratio	1.654	1.645	1.297	1.788	1.912	1.855	1.899	2.092	2.184	2.055	4.219
IOC	Debt Equity Ratio	1.042	0.969	1.022	1.334	0.849	0.570	0.615	0.646	0.701	1.398	1.423
	Interest Coverage Ratio	10.655	17.625	5.710	11.140	19.657	66.182	66.953	24.150	10.199	4.328	4.233
	Asset Turnover Ratio	1.975	1.540	1.063	1.455	1.674	1.481	1.407	1.488	1.800	1.924	3.821
GGAS	Debt Equity Ratio	0.022	0.112	0.219	0.620	1.004	1.247	1.418	1.547	2.242	0.000	0.000
	Interest Coverage Ratio	-58.943	201.614	20.173	5.616	6.555	2.978	2.614	3.975	1.844	0.000	0.000
	Asset Turnover Ratio	1.634	1.816	1.199	1.366	1.122	0.947	0.818	0.938	2.593	0.000	0.000
ONGC	Debt Equity Ratio	0.502	0.469	0.602	0.630	0.474	0.501	0.413	0.232	0.232	0.285	0.136
	Interest Coverage Ratio	8.848	6.807	8.597	17.619	10.113	12.781	14.937	-196.799	-14.005	-12.317	-14.867
	Asset Turnover Ratio	1.050	0.870	0.577	0.786	0.881	0.715	0.717	0.405	0.495	0.604	1.281
MGAS	Debt Equity Ratio	0.028	0.029	0.023	0.023	0.000	0.001	0.001	0.003	0.005	0.006	0.008
	Interest Coverage Ratio	-21.964	-19.803	-27.922	-28.143	-25.100	-37.951	-30.022	-38.236	-55.333	-69.078	-91.364
	Asset Turnover Ratio	1.118	0.724	0.493	0.785	0.865	0.793	0.814	0.916	1.012	1.003	1.699
IGAS	Debt Equity Ratio	0.010	0.014	0.018	0.018	0.000	0.000	0.000	0.000	0.066	0.200	0.307
	Interest Coverage Ratio	-14.342	-26.702	-16.624	-26.343	-25.963	-36.412	-37.922	90.411	22.628	14.561	9.002
	Asset Turnover Ratio	1.192	0.765	0.595	0.945	1.022	0.976	0.998	1.125	1.236	1.428	2.560
OILI	Debt Equity Ratio	0.489	0.547	0.833	0.557	0.647	0.425	0.480	0.386	0.362	0.491	0.066
	Interest Coverage Ratio	2.570	0.900	2.434	-2.038	2.209	2.600	-0.950	-0.474	-0.452	-0.352	-0.291
	Asset Turnover Ratio	0.536	0.446	0.315	0.325	0.259	0.214	0.209	0.249	0.269	0.321	0.797

Source : Bloomberg

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The debt-equity ratio shows whether the firm is ensuring sufficient liquidity to meet its obligations, HPCL has the highest value here, with a ratio of 2.190 in 2023, indicating heavy reliance on debt financing. BPCL, IOC also exhibits a higher debt-equity ratio, often above 1.0 indicating greater leverage. These companies have to rely more on their debt to finance operations which may lead to financial risk increases mostly in low-earnings high interest rate periods. GSPT, CAST, MGAS, GGAS, and IGAS show a very long debt-equity ratio, often below 0.5, reflecting wise financial management and low reliance on debt financing. These companies may have prioritized equity or retained earnings over external borrowings.

The interest coverage ratio reflects a margin of safety for going concern. Generally, if the value is less than 1 it indicates the business is not producing sufficient revenue to meet its interest payment. The calculation shows negative interest expenses made by the companies like PLNG, GPT, CAST, GGAS, MGAS, and IGAS. It indicates the company has a lower income generated from investment in debt and they have to pay greater interest than the interest income earned. RELI, ONGC, and IOC have a great EBIT continuously which shows those companies are in good health condition. HPCL shows a drop in EBIT and MGAS, and OILI is in its consistent stage. GAIL experienced a dramatic improvement in 2023, with a ratio of 298.652 from -85.806 in 2022, indicating a recovery in earnings. Conversely, MGAS shows consistently low interest coverage, including a negative ratio in 2023 (-21.964), suggesting potential solvency concerns.

RELI and OILI show values less than 1.0 in their asset turnover ratio indicating the companies need to address the inefficiencies in their operations and inefficiency in utilizing their assets. Companies need to optimize their operations or improve their asset management strategies to enhance revenue generation. Companies OILI and RELI show a value higher than 2.0 which indicates the companies are utilizing their assets efficiently which leads to the generation of revenues and shows effective management of their resources. The asset turnover ratio specifies whether the operating activity is doing well or not. For HPCL, PLNG, and BPCL the values are high, suggesting that the companies are performing better than their competitors. BPCL has maintained relatively high and stable turnover ratios (e.g., 2.713 for BPCL in 2023), indicating efficient asset utilization. On the other hand, companies like CAST exhibit a declining trend, with a turnover ratio falling from 1.654 in 2023 to 1.029 in 2020, suggesting declining operational efficiency.

The findings indicate massive variability throughout corporations in terms of operational performance, economic structure, and solvency. This variability highlights the wonderful monetary techniques and external conditions influencing those groups. Additionally, companies with extreme fluctuations in interest insurance and working ratios might also face lengthy-term sustainability dangers if such trends persist.

Table 3 focuses on the Profitability Ratio, Return on Asset (ROA), Return on Net Worth (RONW), Earnings per Share (EPS), and Net Profit Margin for the listed companies. These metrics help in assessing the profitability and value-creation potential of the firms.

The profitability ratio shows the ability of a company to generate earnings from its operations. ROA is a measure of how efficiently the organization's belongings are used to generate profits. The information shows that IOC has maintained a strong ROA over time, with 0.140 in 2023, whereas HPCL continually reports bad ROAs (e.g., -0.216 in 2023), indicating inefficient asset usage. A terrible ROA should factor into capacity asset mismanagement or negative profitability. CAST, PLNG, and MGAS have shown steady superb ROA over the years. CAST had ROA of 0.266 in March 2023, reflecting efficient use of assets.

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Table 3.

Profitability Ratio of Oil and Gas Indices (2013-2023)

Company	Year / Profitability Ratio	Mar-23	Mar-22	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17	Mar-16	Mar-15	Mar-14	Mar-13
RELI	Return on asset	0.046	0.044	0.041	0.034	0.040	0.044	0.042	0.050	0.048	0.053	0.058
	Return on networth	0.103	0.085	0.077	0.088	0.103	0.123	0.113	0.129	0.113	0.113	0.115
	Net profit margin	0.084	0.095	0.115	0.067	0.070	0.092	0.098	0.109	0.063	0.052	0.053
	Earnings per share	98.410	83.800	74.330	70.010	66.140	58.400	50.090	42.150	39.660	37.920	34.990
HPCL	Return on asset	-0.043	0.047	0.079	0.023	0.062	0.080	0.103	0.067	0.023	0.011	0.005
	Return on networth	-0.216	0.176	0.280	0.085	0.220	0.283	0.391	0.281	0.106	0.077	0.037
	Net profit margin	-0.016	0.021	0.046	0.010	0.024	0.033	0.044	0.026	0.007	0.005	0.002
	Earnings per share	-31.240	34.460	46.720	14.980	28.900	31.690	35.060	20.380	3.610	7.880	0.190
PLNG	Return on asset	0.146	0.161	0.154	0.123	0.146	0.134	0.124	0.074	0.081	0.060	0.104
	Return on networth	0.218	0.252	0.249	0.209	0.218	0.215	0.211	0.139	0.153	0.143	0.258
	Net profit margin	0.056	0.080	0.113	0.066	0.058	0.069	0.070	0.034	0.023	0.019	0.037
	Earnings per share	21.930	22.570	19.390	15.610	14.280	12.980	11.320	6.220	6.030	4.750	7.660
BPCL	Return on asset	0.000	0.054	0.110	0.015	0.055	0.071	0.079	0.090	0.064	0.046	0.024
	Return on networth	-0.001	0.192	0.329	0.062	0.196	0.232	0.278	0.266	0.208	0.200	0.110
	Net profit margin	0.000	0.029	0.077	0.008	0.025	0.036	0.043	0.041	0.021	0.015	0.008
	Earnings per share	11.940	26.150	27.380	12.610	18.880	22.730	22.090	19.180	11.080	9.920	4.340
GAIL	Return on asset	0.052	0.127	0.076	0.127	0.096	0.078	0.058	0.031	0.050	0.071	0.072
	Return on networth	0.081	0.192	0.116	0.193	0.142	0.115	0.086	0.051	0.082	0.146	0.150
	Net profit margin	0.038	0.133	0.107	0.131	0.086	0.088	0.070	0.036	0.051	0.076	0.084
	Earnings per share	8.480	18.390	9.080	13.460	9.540	7.030	4.740	2.980	4.580	6.630	6.480
GSPT	Return on asset	0.135	0.146	0.155	0.171	0.096	0.080	0.061	0.080	0.075	0.075	0.099
	Return on networth	0.248	0.282	0.343	0.467	0.361	0.395	0.159	0.117	0.114	0.124	0.177
	Net profit margin	0.129	0.124	0.190	0.186	0.127	0.132	0.122	0.469	0.387	0.399	0.458
	Earnings per share	29.110	29.300	28.610	30.660	18.030	13.330	9.840	8.260	8.640	7.390	9.560
CAST	Return on asset	0.266	0.280	0.244	0.371	0.336	0.350	0.358	0.370	0.318	0.315	0.302
	Return on networth	0.432	0.461	0.412	0.605	0.608	0.678	1.133	1.069	0.955	0.677	0.689
	Net profit margin	0.171	0.181	0.195	0.213	0.181	0.193	0.200	0.187	0.140	0.160	0.143
	Earnings per share	8.760	8.270	7.690	6.080	8.360	7.170	6.840	6.690	6.230	4.800	4.910
IOC	Return on asset	0.026	0.063	0.061	-0.006	0.052	0.077	0.075	0.054	0.021	0.026	0.015
	Return on networth	0.082	0.189	0.191	-0.019	0.151	0.196	0.198	0.137	0.055	0.103	0.058
	Net profit margin	0.014	0.044	0.060	-0.004	0.033	0.054	0.057	0.036	0.011	0.014	0.008
	Earnings per share	7.900	18.040	16.440	7.260	12.260	15.250	14.110	7.460	1.600	3.980	3.050
GGAS	Return on asset	0.140	0.134	0.149	0.114	0.058	0.044	0.035	0.031	0.064	0.000	0.000
	Return on networth	0.217	0.229	0.284	0.273	0.190	0.157	0.133	0.125	0.306	0.000	0.000
	Net profit margin	0.091	0.078	0.129	0.088	0.054	0.047	0.043	0.031	0.049	0.000	0.000
	Earnings per share	22.190	18.860	18.450	13.160	6.340	4.260	3.200	3.140	6.510	6.560	4.520
ONGC	Return on asset	0.055	0.084	0.039	0.022	0.068	0.057	0.065	0.038	0.054	0.082	0.095
	Return on networth	0.120	0.189	0.096	0.056	0.157	0.129	0.149	0.066	0.094	0.155	0.157
	Net profit margin	0.054	0.100	0.070	0.029	0.080	0.081	0.103	0.097	0.110	0.153	0.148
	Earnings per share	36.700	38.840	12.710	18.370	26.520	16.420	15.790	10.860	14.750	21.110	19.200
MGAS	Return on asset	0.131	0.114	0.135	0.178	0.159	0.159	0.150	0.131	0.139	0.151	0.167
	Return on networth	0.191	0.166	0.192	0.250	0.228	0.228	0.214	0.180	0.188	0.229	0.252
	Net profit margin	0.125	0.168	0.288	0.248	0.196	0.214	0.193	0.150	0.144	0.158	0.197
	Earnings per share	76.030	58.870	60.400	71.620	54.260	47.550	38.630	30.620	33.690	30.090	30.220
IGAS	Return on asset	0.130	0.135	0.130	0.147	0.136	0.142	0.145	0.133	0.140	0.126	0.135
	Return on networth	0.207	0.198	0.185	0.207	0.195	0.198	0.201	0.178	0.196	0.204	0.237
	Net profit margin	0.116	0.195	0.237	0.171	0.146	0.159	0.159	0.124	0.118	0.092	0.105
	Earnings per share	23.420	21.380	16.660	15.850	11.810	10.160	8.660	6.540	6.400	5.150	5.060
OILI	Return on asset	0.133	0.110	0.075	0.088	0.056	0.056	0.031	0.052	0.064	0.083	0.144
	Return on networth	0.256	0.220	0.175	0.216	0.138	0.094	0.054	0.083	0.103	0.141	0.187
	Net profit margin	0.273	0.259	0.235	0.269	0.235	0.256	0.167	0.212	0.249	0.302	0.360
	Earnings per share	57.750	39.450	25.830	34.870	26.540	17.070	16.750	15.210	16.190	19.140	21.420

Source : Bloomberg

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CAST has a higher value for RONW, demonstrating effective equity utilization. BPCL and HPCL record negative values, with HPCL showing a continuous negative value (-0.216) in March 2023, indicating losses for shareholders. OILI, PLNG also shows strong returns to shareholders. Net profit margin indicates the percentage of revenue that is turned into profit after all expenses. OILI and CAST show a higher profit margin with CAST reaching 0.273 in March 2023, reflecting strong profitability, and HPCL, BPCL, and IOC exhibiting a lower or negative profit margin. RELI has higher EPS followed by MGAS, OILI, and GGAS providing returns to shareholders, while HPCL demonstrates weak per-share profitability.

Altman Z Score (Revised Formula)

The chance of getting bankrupt is calculated in Table 4, using the Altman Z Score (revised formula), and in Table 4, using the Z score (emerging markets). As already stated Z score below 1.81 indicates the company is in the stage of the likelihood of bankruptcy and if the Z- Score shows between 1.81 and 2.99 indicates the company in a grey zone and above 2.99 indicates the company is financially stable. Here the calculation in Table 3, shows CAST having more stable with a high Z score of 8.167 followed by GGAS (7.798) and OILI with a continuous decrease in its Z score in the previous years (1.690 in March 2023) indicating the company is in the stage of chance of bankruptcy. RELI's Z score is decreasing whereas ONGC's Z score is increasing year by year.

Table 4.

Z-Score (Revised formula) of Oil and Gas Indices (2013-2023)

Z Score (revised formula)											
Company	Mar-23	Mar-22	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17	Mar-16	Mar-15	Mar-14	Mar-13
RELI	2.408	2.884	2.589	1.54	1.932	1.515	1.417	1.492	1.93	2.524	2.789
HPCL	3.112	2.781	2.445	2.623	3.313	3.365	3.297	3.397	3.934	2.76	2.548
PLNG	6.47	5.267	5.057	4.865	7.52	5.984	5.358	4.422	5.35	4.367	4.235
BPCL	3.133	2.663	2.732	2.482	3.314	3.299	3.177	3.695	4.36	3.816	3.68
GAIL	3.467	5.26	4.764	4.083	7.21	7.254	6.585	4.587	4.832	3.94	3.678
GSPT	3.824	3.842	3.339	2.596	2.182	1.807	1.875	3.42	3.071	1.976	2.113
CAST	8.167	7.16	4.503	8.387	4.224	7.476	8.443	8.682	5.729	4.363	5.531
IOC	2.546	2.58	2.073	2.058	3.118	3.475	3.485	3.158	3.374	2.802	2.915
GGAS	7.798	8.224	7.999	4.428	2.935	2.894	2.573	2.32	2.655	0	0
ONGC	2.251	2.135	1.507	1.543	2.154	2.062	2.028	2.176	2.719	2.719	3.551
MGAS	5.699	5.04	7.225	6.676	8.551	8.658	9.138	2.604	2.751	2.562	2.521
IGAS	6.3	6.727	10.018	10.055	9.543	10.789	9.89	8.209	6.802	5.111	4.661
OILI	1.69	1.491	0.832	0.729	0.926	1.113	0.89	1.346	1.542	1.462	3.002
Source(s): Calculation on data from Bloomberg											

Source : Bloomberg

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Altman Z Score (Emerging Market)

A Z score less than 1.1 indicates the company is in the stage of the likelihood of bankruptcy and if the Z- Score shows in between 1.1 and 2.6 indicates the company is in a grey zone and above 2.6 indicates the company is financially stable (potential bankruptcy). Here the calculation in Table 5, shows all the companies are in in stable positions, with CAST having 24.485 as the highest value in the last year (March 2023) followed by IGAS and MGAS.

Table 5.

Z-Score (Emerging market) of Oil and Gas Indices (2013-2023)

Z Score (emerging market)											
Company	Mar-23	Mar-22	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17	Mar-16	Mar-15	Mar-14	Mar-13
RELI	6.961	8.008	7.885	4.777	5.594	4.658	4.726	4.946	5.655	6.613	7.313
HPCL	3.212	3.793	4.201	3.284	4.291	4.627	4.556	5.043	4.847	4.155	3.423
PLNG	11.907	10.386	11.338	9.79	13.223	11.693	10.581	8.002	7.103	5.778	6.093
BPCL	4.101	4.442	5.739	3.996	5.399	5.734	5.521	6.324	5.792	5.131	4.407
GAIL	7.439	11.482	10.85	9.269	14.593	14.995	13.931	10.228	10.547	9.112	8.542
GSPT	8.451	7.954	7.633	6.126	5.529	4.935	5.793	9.47	8.74	6.837	7.419
CAST	24.485	24.45	15.774	25.691	19.718	26.174	25.995	27.3	22.477	20.475	21.397
IOC	4.165	5.095	4.832	3.801	5.866	6.721	6.87	6.339	6.005	5.178	5.299
GGAS	14.559	14.751	15.325	8.996	6.416	6.459	6.011	4.812	5.055	0	0
ONGC	5.709	5.801	5.041	4.558	5.565	5.624	5.675	6.968	7.777	7.536	9.065
MGAS	12.427	12.002	16.416	15.055	18.016	18.238	18.914	7.455	7.623	6.848	6.916
IGAS	12.787	14.771	20.887	20.508	19.568	21.86	20.116	16.669	13.852	10.316	9.354
OILI	6.334	5.791	4.515	4.253	5.011	5.111	4.569	6.448	6.491	5.526	9.3
Source(s): Calculation on data from Bloomberg											

Source(s): Bloomberg

F Score

The Piotroski F-score is designed to evaluate a company's financial strength from an investment perspective where value scores between 7 and 9 judged a sound potential investment, and scores below 3 indicate a weak financial health which is shown in Table 6.

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Table 6.
F-Score of Oil and Gas Indices (2013-2023)

	F Score										
Company	Mar-23	Mar-22	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17	Mar-16	Mar-15	Mar-14	Mar-13
RELI	6	6	5	4	7	5	5	7	7	8	8
HPCL	2	7	7	4	8	6	6	5	5	4	5
PLNG	5	4	5	4	5	5	4	4	4	3	6
BPCL	3	6	7	4	8	6	7	8	5	5	5
GAIL	5	6	3	6	7	4	4	4	7	7	7
GSPT	6	5	5	7	4	5	7	8	6	6	8
CAST	3	3	1	3	1	1	2	2	1	2	1
IOC	5	6	4	3	7	6	4	5	5	7	4
GGAS	6	4	6	5	3	4	3	4	6	1	0
ONGC	4	6	4	4	8	3	8	7	7	5	8
MGAS	5	5	7	7	5	4	4	6	6	5	6
IGAS	4	6	5	6	6	6	6	4	5	4	6
OILI	8	3	4	7	4	6	3	9	6	5	7
Source(s): Calculation on data from Bloomberg and annual report											

Source(s): Bloomberg

OILI showing F Score of 8 which is the highest from the previous year reflects a good investment opportunity despite its weaker Altman Z Score. RELI, GSPT, and GGAS are maintaining a medium F score. HPCL scored very low in March 2023, reflecting there is a weak financial condition, making it less attractive for investment but it showed a good score in the previous years. BPCL and Cast fall in a range of 3 in the previous year, suggesting it may also accompany risk in the future.

Discussion and Conclusions

The analysis of the financial health, liquidity, profitability, and solvency of selected companies shows significant variability. The companies – PLNG, CAST, MGAS, and OILI reflect a strong liquidity ratio, while GAIL and ONGC are somehow around stability. Companies HPCL, BPCL IOC, and GGAS struggle to meet their short-term obligations. In the case of debt management HPCL, IOC, and BPCL are concerned with high financial risk while MGAS, CAST, and GGAS show prudent debt management. The interest coverage ratio reflects solvency issues for several companies, despite robust EBIT for RELI, ONGC, and IOC. CAST and OILI are generating consistent earnings while HPCL and BPCL have negative returns which indicates their operational efficiency is low. The Altman Z Score and Piotroski F-Score showed OILI, despite being weaker in Z-scores, remains a favorable investment due to a high F-score, while HPCL and BPCL exhibit financial vulnerability, posing investment risks. Overall, the financial performance and risk indicators point to potential challenges for companies with weak liquidity, declining profitability, and high debt reliance, which could affect their long-term sustainability.

This study's results corroborate previous research findings, which affirm the predictive accuracy of Altman Z-scores and Piotroski's F-score in assessing corporate financial health (Altman, 2000; Piotroski, 2000). Consequently, investors are encouraged to consider these companies' financial profiles carefully, particularly in volatile sectors like oil and gas. By the study there shows an empirical evidence of the stability and investment potential of key oil and gas companies in India, aiding investors and policymakers in their decision-making processes.

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Limitations:

This study is subject to certain limitations. Firstly, the data used for this analysis were sourced from Bloomberg and annual reports for a period of 11 years, which, while reliable, may not fully capture real-time financial events or industry shocks, such as geopolitical tensions or regulatory changes. Additionally, the oil and gas sector is uniquely sensitive to external factors like global oil prices and regulatory shifts, which were not specifically addressed in this research (Kisswani & Elian, 2021, BILGIN et al., 2015, Amin & Mollick, 2021). The study focuses on financial metrics alone which leads to the exclusion of non-financial factors, such as corporate governance and environmental impacts, which can also significantly influence a company's long-term financial viability. Additional expansion can be made extend to this analysis to other sectors, such as renewable energy, manufacturing, or technology, to determine whether the Altman Z-score and F-score models are equally effective in assessing financial health across industries. Incorporating non-financial metrics like Environmental, Social, and Governance (ESG) scores would also provide a more holistic view of corporate sustainability. A longer-term analysis that includes macroeconomic variables—such as inflation rates, interest rates, and currency fluctuations—could yield deeper insights into the interplay between broader economic factors and company performance. Comparative studies of companies from emerging and developed markets could also reveal how regional factors affect financial stability and offer guidance to investors and policymakers.

Appendix

List of abbreviations shown in the paper.

Acronym	Variables
RELI	Reliance Industries Ltd.
HPCL	Hindustan Petroleum Corporation Ltd.reli
PLNG	Petronet LNG Ltd.
BPCL	Bharat Petroleum Corporation Ltd.
GAIL	GAIL (India) Ltd.
GSPT	Gujarat State Petronet Ltd.
CAST	Castrol India Ltd.
IOC	Indian Oil Corporation Ltd.
GGAS	Gujarat Gas Ltd.
ONGC	Oil & Natural Gas Corporation Ltd.
MGAS	Mahanagar Gas Ltd.
IGAS	Indraprastha Gas Ltd.
OILI	Oil India Ltd.

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