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A Study on the Financial Health of Oil and Gas Indices in India#

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Abstract

India is one of the major drivers of global oil consumption, about 25%; it is crucial to assess the financial health of its oil and gas companies to understand their capacity to meet growing demand and sustainable long-term growth. This study investigates the financial stability and the likelihood of bankruptcy in oil and gas sector companies in India. The research adopts a quantitative approach by analyzing secondary data from financial statements to identify the potential financial health and distress of selected companies. Financial tools such as profitability and operational ratios, Piotroski's F-Score, and the Altman Z-Score have been taken for the analysis. The findings of the study corroborate the previous research findings, which affirm the predictive accuracy of Altman Z score and Piotroski's F score in assessing the financial health of corporates and also highlighting the resource allocation and capacity utilization of the corporates. The study helps in 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, determining whether the financial structure is in a sound manner, and knowing whether there is a chance of bankruptcy in the near future.

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

1. Introduction

The oil and gas industry is a critical component of the global economy, particularly in the energy sector in developing nations like India. As this is one of the eight core industries, it impacts the decision-making of all other sectors essential for the economy's growth. According to the December Short-Term Energy Outlook (STEO), India has become the primary driver of global oil consumption growth in 2024 and 2025 by surpassing China this year (EIA, 2024). As it plays a pivotal role in global energy production, 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 creates uncertainty for firm profitability, valuations, and investment decisions. Alaali (2020) study examines the effects of industry uncertainty and market instability on total investment expenditures in UK firms. 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 with the intent to earn profit. Profitability indicates the financial soundness and the overall profit performance of an industry. Through the analysis of a company's financial statement, 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 crucial for stakeholders as they will become interested in knowing the organization's short-term and long-term financial viability (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 stakeholder concern, 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 assessing a company's financial distress (Altman *et al.*, 2016). 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.

The objective of this study is to evaluate the financial stability and to check the companies' financial structure within the oil and gas sector. The study employs a quantitative approach by employing established financial tools like Piotroski's F- Score and Altman Z Score (Piotroski, 2000; Altman, 1968). Through this analysis, the study seeks to determine financial soundness, the ability to manage increasing demand, and the risk of bankruptcy in the near future. This study builds upon prevailing studies that highlighted the predictive accuracy of financial metrics in evaluating corporate health, resulting in valuable insights for investors, corporate managers, and policymakers, as this sheds light on the stability and sustainability of oil and gas firms. The study contributes to a broader understanding of financial risk and performance within one of the world's fastest-growing markets.

2. 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.

2.1 Financial Health and Profitability of Oil and Gas Companies

As India is the third largest oil consumer in the world (EIA, 2024), it experiences high demand and plays a critical driver in the country. However, the interplay of demand and supply causes price fluctuation, creating market volatility. The study by Saif-Alyousfi *et al.* (2018b) found that the oil and gas price directly impacts banks' deposits at the aggregate level in Qatar. The empirical study shows that oil price volatility significantly depresses the firm's profitability. The study also highlights that high oil price volatility exposes Shariah-compliant firms to higher bankruptcy risk than non-Shariah-compliant firms and that positive and negative oil price shocks have asymmetric effects on firm performance (Bugshan *et al.*, 2021). The asymmetric impact of oil and price volatility on corporate environmental responsibility has been studied by Yaghoubi and Yaghoubi (2024), where the author found out one standard deviation increase in oil volatility resulting from positive changes in oil prices correspondents to a 12.7% decrease in environmental score, while the same increase in volatility from negative changes in oil price leads to a 5.5% decrease in environmental score. The study on how oil price certainty affects earnings management shows an association between oil price volatility and accrual earnings management. (Bugshan *et al.*, 2022) Geopolitical events also impact the dynamics of oil and gas prices. The author observed a positive and statistically significant stock price reaction at and

around the military conflicts, and these results are consistent with the asset pricing perspective where the companies were forced to divest in Russia. These reactions are reinforced or mitigated by company-specific characteristics such as size, profitability, and institutional ownership.

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 crucial for making decisions about their solvency and corporate sustainability. Operating ratios like the asset turnover ratio assess the efficiency with which companies utilise their resources to generate revenue, which is crucial for firms operating in a capital-intensive industry. The study of Meghanathi and Chakrawal (2023) 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 Earnings Per Share (EPS) and how this sector efficiently finances debt. In the study of 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. (Terzoudis *et al.*, 2024). Zarb (2018) investigated the impact of liquidity, solvency, and financial health on the profit volatility of U.S. airlines. This shows that liquidity, solvency, and financial health 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).

2.2 Financial Distress and Bankruptcy Prediction of Oil and Gas Companies

Financial distress is a situation where liability exceeds assets in a company, and it generally happens due to under-capitalization, insufficient cash, insufficient resources being utilized properly, inefficient management in all activities, sales decline, and adverse market situations. Foster (1986) has defined financial distress as a serious liquidation problem that is unable to be resolved without a large-scale restructuring of the operation or structure of economic entities (Sun *et al.*, 2014), whereas (Wruck, 1990) states financial distress as a scenario were the current cash flow is insufficient to pay for immediate obligations, which may include non-payment of debts to contractors and workers with missed principal or interest payments. The incapacity of a corporation to make its payments when they become due is said to be financial distress. In a broad sense, it can refer to the inability to pay obligations (such as debt) when they are due (Beaver, 2010). The definition made by (Pindado *et al.*, 2008) also provides a company's ability to pay for its obligations and falling market value between consecutive periods.

Predicting companies that operate in financial difficulties has become a subject of interest in research academics, business, government, *etc*. Much research has been done on the analysis of the financial health of companies. Financial distress prediction models are accounting-based and market-based models. Accounting-based models include (Altman, 1968; Beaver, 1966; Dietrich, 1984; Ohlson, 1980), and market-based models include (Bharath & Shumway, 2004; Black & Scholes, 1973; Hillegeist *et al.*, 2004; Merton, 1974). The widely used prediction model is the Z score model developed using linear discriminant analysis. Later, alternative approaches emerged, such as O Score (Ohlson, 1980; Zmijewski, 1984), which used the probit model in his analysis (Pindado *et al.*, 2008). Hillegeist *et al.* (2004) in his study compared the Z score (Altman, 1968) with the O score (Ohlson, 1980), with BSM- Prob (Black & Scholes, 1973) and highlighted the BSM- Prob model provides more information than accounting-based models. Still, most of the researchers used an accounting-based model rather than a market-based model for their studies.

Piotroski (2000) in his paper demonstrated a simple accounting-based fundamental analysis strategy when applied to a broad portfolio of high book-to-market firms, which can shift the distribution of returns earned by the investor. This F score is mainly focused on

judging the financially sound mix and the investment opportunities. Ho *et al.* (2022) have used this score to study the usefulness of separating winners and losers in Vietnam. Safdar (2016) found that the F score has a greater ability to identify potential mispriced securities in industries with lower competition. The result of the study is robust in using a variety of competition measures and implies that industry competition is an important consideration in the application of fundamental analysis. F score has been used on the stocks with high book-to-market ratios to eliminate the firms with poor future prospects from the entire portfolio of value stock in the study (Singh & Kaur, 2015).

2.3 Integration of Altman Z Score and Piotroski's F Score Models in the study

Recent research has emphasized the need for a more comprehensive approach to assessing financial distress in the oil and gas sector. Most studies focus on global firms or specific aspects such as profitability or distress. However, a holistic analysis of financial health encompassing both profitability and distress for Indian oil and gas indices is rare. Useche *et al.* (2024) used the Z score and F Score as indicators to investigate the relationship between financial performance and ESG indicators and disclosures for a sample of Latin American firms. A direct relationship between them was found. Better practices and transparency in ESG are related to lower profitability of bankruptcy, greater financial strength, greater EVA, and superior risk-adjusted return, as found in the study.

Most studies focus on global firms or specific aspects such as profitability or distress. Still, a holistic analysis of financial health encompassing both profitability and distress for Indian oil and gas indices is rare. Only one article has been found which studies the financial health and performance of oil and natural gas companies in India. In that study, only five random oil and gas companies were interviewed. They have taken ROE and Z scores to assess the profitability and determine financial health. The findings highlight the financial health and performance distinctions between public and private sector companies rooted in resource allocation and capacity utilization variations (Das *et al.*, 2023). ROE is needed not only to assess profitability but also to determine a company's performance. So, the author has taken the F score, which consists of ROA and its variations, operating cash flow, gross margin, asset turnover ratio, debt-equity ratio, current ratio, and additional shares issued, for the calculation, which gives more understanding of the company's performance. It also helps the investor to decide whether to invest it or not. While previous research offers valuable insights, the unique contribution of this study lies in its focus on indices rather than individual firms, providing a broader understanding of sectorial performance.

In conclusion, this study is justified as it bridges the identified research gaps and provides timely and relevant insights into the financial health of a critical sector in the Indian economy. By synthesizing existing knowledge and introducing novel analytical dimensions, this research contributes meaningfully to the academic and practical understanding of financial stability in the oil and gas sector.

3. 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, data from 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 and NSE's official database. This section provides essential information for calculating the financial ratios and scores, which are used for the analysis. It highlights the ability of the selected companies to manage short-term and long-term debts effectively and generate profits over the financial years.

The primary tool of this study is ratio analysis, which evaluates a company's performance. Various models were taken to determine ratios and compare

them with the competitors to analyze the company's performance.

3.1 Altman Z Score

Altman developed the following discriminant function in 1968:

$$\mathbf{Z = 0.012\ Z_1 + 0.014\ Z_2 + 0.033\ Z_3 + 0.006\ Z_4 + 0.999\ Z_5}$$

where,

$\mathbf{Z_1}$ = net current asset / total assets
$\mathbf{Z_2}$ = reserve/ total assets
$\mathbf{Z_3}$ = (profit before tax + interest)/ total assets
$\mathbf{Z_4}$ = market capitalization/total liabilities
$\mathbf{Z_5}$ = revenues/total assets Later, Altman derived a new model which is more popular now:

$$\mathbf{Z = 1.2\ Z_1 + 1.4\ Z_2 + 3.3\ Z_3 + 0.6\ Z_4 + 1.0\ Z_5}$$

If,

Z score < 1.81 Chance of bankruptcy likelihood is high
1.81 < Z score < 2.99 Grey Zone
2.99 < Z score Stable (Chance of bankruptcy is low)

3.2 Altman Z-Score (Emerging Markets)

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

$$\mathbf{Z = 3.25 + 6.56\ Z_1 + 3.26\ Z_2 + 6.72\ Z_3 + 1.05\ Z_4}$$

If,

Z score < 1.1 Chance of bankruptcy likelihood is high
1.1 < Z score < 2.6 Grey Zone
2.6 < Z score Stable (Chance of bankruptcy is low)

3.3 F Score

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.

$$\mathbf{F\ Score = F_ROA + F_\Delta ROA + F_OCF + F_accural + F_\Delta margin + F_\Delta turn + F_\Delta lever + F_\Delta liquid} + F_\Delta EQ$$

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_accural	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 during 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).

4. Analysis of the Results

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

4.1 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 and can cover their short-term liabilities as they have a strong current ratio.

GAIL and ONGC are generally stable as they have fluctuated around the critical threshold of 1, and they may face liquidity risk in the future. HPCL, BPCL, and IOC 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.

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
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: Calculation on data from Bloomberg and annual report

Table 2 shows the Operating ratio of the companies. This includes the debt-equity, interest coverage, and asset turnover ratios. 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, 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 companies like PLNG, GPT, CAST, 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.

Table 2. Operating ratio of oil and gas indices (2013-2023)

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

Source(s): Calculation on data from Bloomberg

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 (NPM) 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 a ROA of 0.266 in March 2023, reflecting efficient use of assets.

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 provides returns to shareholders, while HPCL demonstrates weak per-share profitability.

4.2 Altman Z Score (Revised Formula)

The chance of going bankrupt is calculated using the Altman Z Score (revised formula), and using the Z score (emerging markets) (Table 4). As already stated, a Z score below 1.81 indicates the company is in the stage of the likelihood of bankruptcy, and if the Z- Score is between 1.81 and 2.99, it indicates the company is in a grey zone, and above 2.99 indicates the company is financially stable.

Here the calculation in Table 4 shows CAST having more stable with a high Z score of 8.167 followed by 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.

4.3 Altman Z Score (Emerging Market)

Z score which is 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). The calculated values are 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.

4.4 F Score

The Piotroski F-score is designed to evaluate a company's financial strength from an investment perspective. Value scores between 7 and 9 judged a sound potential investment, and scores below 3 indicate weak financial health, as shown in Table 6. OILI, showing an F Score of 9, which is the highest from the previous year, reflects a good investment opportunity despite its weaker Altman Z Score. GSPT maintains a medium F score. HPCL scored very low in March 2023, reflecting a weak financial condition, making it less attractive for investment, but it showed a good score in the previous years. CAST falls in a low range in the previous year, suggesting it may also accompany risk in the future.

5. Results and Discussion

The analysis of selected companies' financial health, liquidity, profitability, and solvency shows significant

Table 3. Profitability ratio of oil and gas indices (2013-2023)

Company	Ratio	Mar 13	Mar 14	Mar 15	Mar 16	Mar 17	Mar 18	Mar 19	Mar 20	Mar 21	Mar 22	Mar 23
RELI	ROA	0.058	0.053	0.048	0.050	0.042	0.044	0.040	0.034	0.041	0.044	0.046
	RONW	0.115	0.113	0.113	0.129	0.113	0.123	0.103	0.088	0.077	0.085	0.103
	NPM	0.053	0.052	0.063	0.109	0.098	0.092	0.070	0.067	0.115	0.095	0.084
	EPS	34.990	37.920	39.660	42.150	50.090	58.400	66.140	70.010	74.330	83.800	98.410
HPCL	ROA	0.005	0.011	0.023	0.067	0.103	0.080	0.062	0.023	0.079	0.047	-0.043
	RONW	0.037	0.077	0.106	0.281	0.391	0.283	0.220	0.085	0.280	0.176	-0.216
	NPM	0.002	0.005	0.007	0.026	0.044	0.033	0.024	0.010	0.046	0.021	-0.016
	EPS	0.190	7.880	3.610	20.380	35.060	31.690	28.900	14.980	46.720	34.460	-31.240
PLNG	ROA	0.104	0.060	0.081	0.074	0.124	0.134	0.146	0.123	0.154	0.161	0.146
	RONW	0.258	0.143	0.153	0.139	0.211	0.215	0.218	0.209	0.249	0.252	0.218
	NPM	0.037	0.019	0.023	0.034	0.070	0.069	0.058	0.066	0.113	0.080	0.056
	EPS	7.660	4.750	6.030	6.220	11.320	12.980	14.280	15.610	19.390	22.570	21.930
BPCL	ROA	0.024	0.046	0.064	0.090	0.079	0.071	0.055	0.015	0.110	0.054	0.000
	RONW	0.110	0.200	0.208	0.266	0.278	0.232	0.196	0.062	0.329	0.192	-0.001
	NPM	0.008	0.015	0.021	0.041	0.043	0.036	0.025	0.008	0.077	0.029	0.000
	EPS	4.340	9.920	11.080	19.180	22.090	22.730	18.880	12.610	27.380	26.150	11.940
GAIL	ROA	0.072	0.071	0.050	0.031	0.058	0.078	0.096	0.127	0.076	0.127	0.052
	RONW	0.150	0.146	0.082	0.051	0.086	0.115	0.142	0.193	0.116	0.192	0.081
	NPM	0.084	0.076	0.051	0.036	0.070	0.088	0.086	0.131	0.107	0.133	0.038
	EPS	6.480	6.630	4.580	2.980	4.740	7.030	9.540	13.460	9.080	18.390	8.480
GSPT	ROA	0.099	0.075	0.075	0.080	0.061	0.080	0.096	0.171	0.155	0.146	0.135
	RONW	0.177	0.124	0.114	0.117	0.159	0.395	0.361	0.467	0.343	0.282	0.248
	NPM	0.458	0.399	0.387	0.469	0.122	0.132	0.127	0.186	0.190	0.124	0.129
	EPS	9.560	7.390	8.640	8.260	9.840	13.330	18.030	30.660	28.610	29.300	29.110

Table 3. (continued)

Company	Ratio	Mar 13	Mar 14	Mar 15	Mar 16	Mar 17	Mar 18	Mar 19	Mar 20	Mar 21	Mar 22	Mar 23
CAST	ROA	0.302	0.315	0.318	0.370	0.358	0.350	0.336	0.371	0.244	0.280	0.266
	RONW	0.689	0.677	0.955	1.069	1.133	0.678	0.608	0.605	0.412	0.461	0.432
	NPM	0.143	0.160	0.140	0.187	0.200	0.193	0.181	0.213	0.195	0.181	0.171
	EPS	4.910	4.800	6.230	6.690	6.840	7.170	8.360	6.080	7.690	8.270	8.760
IOC	ROA	0.015	0.026	0.021	0.054	0.075	0.077	0.052	-0.006	0.061	0.063	0.026
	RONW	0.058	0.103	0.055	0.137	0.198	0.196	0.151	-0.019	0.191	0.189	0.082
	NPM	0.008	0.014	0.011	0.036	0.057	0.054	0.033	-0.004	0.060	0.044	0.014
	EPS	3.050	3.980	1.600	7.460	14.110	15.250	12.260	7.260	16.440	18.040	7.900
ONGC	ROA	0.095	0.082	0.054	0.038	0.065	0.057	0.068	0.022	0.039	0.084	0.055
	RONW	0.157	0.155	0.094	0.066	0.149	0.129	0.157	0.056	0.096	0.189	0.120
	NPM	0.148	0.153	0.110	0.097	0.103	0.081	0.080	0.029	0.070	0.100	0.054
	EPS	19.200	21.110	14.750	10.860	15.790	16.420	26.520	18.370	12.710	38.840	36.700
MGAS	ROA	0.167	0.151	0.139	0.131	0.150	0.159	0.159	0.178	0.135	0.114	0.131
	RONW	0.252	0.229	0.188	0.180	0.214	0.228	0.228	0.250	0.192	0.166	0.191
	NPM	0.197	0.158	0.144	0.150	0.193	0.214	0.196	0.248	0.288	0.168	0.125
	EPS	30.220	30.090	33.690	30.620	38.630	47.550	54.260	71.620	60.400	58.870	76.030
IGAS	ROA	0.135	0.126	0.140	0.133	0.145	0.142	0.136	0.147	0.130	0.135	0.130
	RONW	0.237	0.204	0.196	0.178	0.201	0.198	0.195	0.207	0.185	0.198	0.207
	NPM	0.105	0.092	0.118	0.124	0.159	0.159	0.146	0.171	0.237	0.195	0.116
	EPS	5.060	5.150	6.400	6.540	8.660	10.160	11.810	15.850	16.660	21.380	23.420
OILI	ROA	0.144	0.083	0.064	0.052	0.031	0.056	0.056	0.088	0.075	0.110	0.133
	RONW	0.187	0.141	0.103	0.083	0.054	0.094	0.138	0.216	0.175	0.220	0.256
	NPM	0.360	0.302	0.249	0.212	0.167	0.256	0.235	0.269	0.235	0.259	0.273
	EPS	21.420	19.140	16.190	15.210	16.750	17.070	26.540	34.870	25.830	39.450	57.750

Source(s): Calculation on data from Bloomberg

Table 4. Z-score (revised formula) of oil and gas indices (2013-2023)

Company Name	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
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

variability. The companies - PLNG, CAST, MGAS, and OILI- have a strong liquidity ratio, indicating strong financial health and the ability to effectively cover short-term liabilities. This aligns with the study of Narenhra (2013), who emphasized that effective liquidity management mitigates the risk of short-term insolvency. The companies - GAIL and ONGC are somehow around stability, while HPCL, BPCL, and IOC struggle to meet their short-term obligations with a current ratio below 1, signalling challenges in the meeting immediately, which could impact the operational flexibility of the company. These findings underscore the critical need for efficient liquidity planning within the companies.

The operating ratio, which includes the debt-equity ratio, interest coverage ratio, and asset turnover ratio, further shows these companies' financial health and efficiency. In the case of debt management, HPCL, IOC, and BPCL are concerned with high financial risk with a high debt-equity ratio, which indicates high reliance on debt financing, which may lead to low earnings period in the future, while MGAS, CAST, show prudent debt management with ratio less than 0.5, which demonstrate prudent financial management by relying less on external debt. The interest coverage ratio reflects solvency issues for several companies like PLNG, MGAS, and IGAS, despite RELI, ONGC, and IOC, which maintain a strong ability to cover interest obligations, consistent with Beaver (1966), which finds that the net liquid asset flow is crucial for the financial health of the companies. Additionally, the decline in the asset turnover ratio in CAST indicates inefficiencies in the utilization of assets, which requires optimization to sustain revenue generation. CAST and OILI generate consistent earnings, while HPCL and BPCL have negative returns, indicating low operational efficiency.

Profitability metrics, which include ROA, RONW, EPS, and Net profit margin, highlight significant inequality. CAST and OILI, with high ROA and profit margins, show robust profitability, which reflects the efficient utilization of assets. Conversely, HPCL and BPCL consistently reported negative profitability measures, which points to operational inefficiencies and mismanagement of the company's assets. These should be a tradeoff between liquidity and profitability to reinforce the importance of companies' balanced financial strategies (Sandhar *et al.*, 2013). The Altman Z Score and Piotroski's F-Score provide insights into the companies' financial stability and investment potential. CAST exhibits exceptional stability with a high Z score, highlighting strong financial health. OILI, despite being weaker in Z-scores, remains a favourable 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.

Table 5. Z-score (emerging market) of oil and gas indices (2013-2023)

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

Table 6. F-score of oil and gas indices (2013-2023)

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

6. Conclusion

The study highlights the empirical evidence regarding the financial stability and investment potential of oil and gas companies in India. It aligns with the financial distress theory, which emphasizes the role of liquidity, profitability, and solvency as critical determinants of a company's financial health and potential distress. Some companies exhibited strong financial health, whereas others faced vulnerabilities that could undermine the long-term sustainability of their existence. The observed trends show weak liquidity, declining profitability, and high debt reliance are consistent with the challenges faced by companies in volatile sectors like oil and gas. The results corroborate previous research findings, which affirm the predictive accuracy and validating the theory of financial distress of Altman Z-scores and Piotroski's F-score in assessing corporate financial health (Altman, 2000; Piotroski, 2000). Consequently, investors are encouraged to carefully consider these

companies' financial profiles, particularly in volatile sectors like oil and gas. The study shows 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.

However, the study subject to certain limitations. Firstly, the data used for this analysis were sourced from Bloomberg and annual reports for 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 excludes 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 extend this analysis to other sectors, such as renewable energy, manufacturing, or technology, to determine whether the Altman Z-score and F-score models equally effectively assess financial health across industries. Incorporating non-financial metrics like Environmental, Social, and Governance (ESG) scores would 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 more profound 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.

7. List of Abbreviations

Acronym	Variables
RELI	Reliance Industries Ltd.
HPCL	Hindustan Petroleum Corporation Ltd.
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.
ONGC	Oil and Natural Gas Corporation Ltd.
MGAS	Mahanagar Gas Ltd.
IGAS	Indraprastha Gas Ltd.
OILI	Oil India Ltd.

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