



“EFFICIENCY ANALYSIS USING DATA ENVELOPMENT ANALYSIS (DEA): A CASE STUDY OF INDIAN OIL AND GAS SECTOR COMPANIES”

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Abstract:

Businesses must efficiently use their resources in the current era of fierce competition. Financial performance indicators play a significant role in determining how effective a business is. Financial ratio analysis has historically been used to gauge financial performance. When a business must take into account several inputs and outputs at once, it faltered. This flaw led the Data Envelopment Analysis to suggest a different strategy to deal with multiple inputs and outputs. It is a mathematical method based on linear programming that uses the benchmarking concept to reveal the companies with the highest levels of efficiency. Data Envelopment Analysis is used in this study to evaluate the financial efficiency of selected oil and gas companies in India. The financial statements of 10 oil and gas companies from 2017-18 to 2021-22 are used for this purpose. Then, scale efficiencies are also determined and calculated, along with CCR and BCC Efficiency scores.

Keywords: *Efficiency, Financial Ratios, Data Envelopment Analysis, Scale Efficiency, CCR Efficiency scores, BCC Efficiency scores*

Introduction:

The evaluation of a company's efficiency has become a crucial issue over the last few decades as public interest in business firms has increased. Efficiency refers to how effectively and efficiently a company uses its current resources. For this purpose, a number of methods have been employed, one of which is financial ratio analysis.

A common historical analytical tool is ratio analysis, which computes efficiency proportionally and provides a foundation for firm comparisons. Although ratios are simple to calculate, they can be difficult to interpret, especially when two or more ratios give contradictory signals. However, the ratio analysis methodology was viewed with suspicion. They can only be an appropriate method, according to the findings, when firms control a single input and output. Due to ratio analysis's flaw, Data Envelopment Analysis (DEA), a new method that can handle the issue of multiple inputs and outputs, was

developed. As a result, the primary goal of this study is to use the Data Envelopment Analysis model to assess financial efficiency. This study makes use of the financial information from 10 companies in the oil and gas sector that are listed on the Bombay Stock Exchange. This information includes the effects of economies of scale, benchmarking firm efficiencies, and quantitative recommendations for future development.

literature review:

Shieh, Hwai-Shuh (2012) in their research "Does Cost Efficiency Lead to Better Financial Performance? A Study on Taiwan International Tourist Hotels," aims to investigate the relationship between cost-effectiveness and financial performance as it relates to the hospitality sector. The data were generated from 68 hotels in Taiwan's international tourist hotels between 1997 and 2006. They used three conventional financial indicators, such as the ratio of net operating profit before taxes, the ratio of earnings before

taxes, and return on assets before to measure financial performance. They used the DEA approach to estimate Cost efficiency. The result suggests that none of the three financial performance variables mentioned above have a significant relationship with cost efficiency.

Taffamel, E.A.&Akrawah,O,D.(2015)

in their research paper “Cost Efficiency of the Oil and Gas Industry in Nigeria: Data Envelopment Analysis” looked into the profitability and cost-efficiency of oil and gas companies in Nigeria from 2012 to 2013. They used a sample of nine quoted oil and gas companies in Nigeria that consistently published their audited financial statements and annual financial reports between the study periods. they adopted a data Envelopment analysis used to evaluate the effectiveness of different businesses under Scale, Constant Return to Scale (CRS), and Variable Return to Scale (VRS) efficiency.

In order to further analyse the inputs and outputs, they conducted a descriptive Statistics and correlation analysis. The findings demonstrate that Caverton Offshore Plc, Eternal Oil and Gas, Japaul Mobile, and Total are reliable benchmarks in Nigeria's oil and gas industry, and all performed well in the scale efficiency test. Oando is scale-efficient as well, whereas it wasn't in the case of CRS. The results of this study showed that only very large oil and gas companies would have sufficient inputs to produce revenue and gross profit.

Aparna Bhatia and Megha Mahendru (2017) in their paper, attempt to evaluate

| | |
|--------------------------------------------|------------------------------------------|
| 1. Indian oil corporation | 6. Oil India Limited |
| 2. Bharat petroleum corporation limited | 7. Reliance Industries Limited |
| 3. Hindustan petroleum corporation limited | 8. Aban Offshore Ltd |
| 4. Oil and natural gas corporation | 9. Hindustan oil exploration company Ltd |
| 5. GAIL India limited | 10. Alphageo |

In order to achieve the objective of studying the efficiency of selected Oil and Gas Companies in India, three inputs and

the Cost Efficiency (CE) ratings of all Indian Scheduled Commercial Banks. The type of the Indian banking sector's Return to Scale (RTS) is also determined by the study. They also identify how many banks are leaders and laggards in terms of Cost Efficiency and their component scores. The study reveals in any of the years from 2002-03 to 2012-13, according to the Data Envelopment Analysis (DEA) results, Indian Scheduled Commercial Banks have never achieved a full Cost Efficiency score of 1. The result shows that foreign sector banks are the most cost-effective banks, followed by Private Sector Banks and last Public Sector Banks.

Objectives of the Study:

This study's main objective is to employ Data Envelopment Analysis (DEA) to examine the efficiency of the oil and gas industry in India. Therefore, the specific objectives are as follows:

1. To investigate the extent of the overall efficiency of the oil and gas industry in India
2. To investigate the extent of the pure technical efficiency of the oil and gas industry in India
3. To investigate the extent of the scale efficiency of the oil and gas industry in India

Research Methodology:

The study is aimed at studying the efficiency of selected Oil and Gas Companies in India. The time period for which the companies are studied is of five years from 2017-18 to 2021-22. In order to study Oil and Gas Companies, ten major companies in the industry were chosen. These were;

one output were chosen for the study. These were;

| Inputs | Output |
|-------------------------------------------------------------------|-------------------------|
| Equity Capital Non-Current Assets Employee Benefit Expenses | Total Operating Revenue |

The requisite data were sourced through the websites of the National Stock Exchange of India (www.nseindia.com), Money Control (www.moneycontrol.com), and the annual reports of the companies given on the company's websites. Two DEA models were used to find efficiency scores, one of which was output-oriented the CCR model was the first model created by Charnes et al. in 1978. The BCC model, created by Banker, was the second model (1984). Contrary to the BCC model, which is based on the assumption that returns to scale are variable (VRS), the CCR model is built on the premise that returns to scale are constant (CRS). The CCR model's relative efficiency evaluation serves as the overall efficiency score, while the BCC model's estimation

serves as the pure technical efficiency score. The range [0, 1] is typically used to define these scores.

Analysis and Interpretation of Results:

Data for this study were obtained from the annual report and financial statements of 10 Oil Gas sector companies. The data was obtained from the annual report from 2017-18 to 2021-22. A commonly held view of previously conducted studies does not provide the most appropriate variable for the DEA program. Therefore, this study specified the Equity Capital (X1), Non-Current Assets (X2), and Employee Benefit Expenses (X3) as three inputs, whereas the output is Total Operating Revenue (Y1).

Table – 1 DEA Efficiency Scores

| DMU Name | Input-Oriented CRS Efficiency | Input-Oriented VRS Efficiency | Scale Efficiency | RTS |
|-----------------------------------------|-------------------------------|-------------------------------|------------------|------------|
| Indian oil corporation | 0.59163 | 1.00000 | 0.59163 | Decreasing |
| Bharat petroleum corporation limited | 0.79303 | 0.87522 | 0.90609 | Decreasing |
| Hindustan petroleum corporation limited | 1.00000 | 1.00000 | 1.00000 | Constant |
| Oil and natural gas corporation | 0.34586 | 0.78705 | 0.43944 | Decreasing |
| GAIL India Limited | 0.48401 | 0.48482 | 0.99832 | Increasing |
| Oil India Limited | 0.11919 | 0.11990 | 0.99404 | Increasing |
| Reliance Industries Limited | 0.48342 | 1.00000 | 0.48342 | Decreasing |
| Aban Offshore Ltd | 0.46939 | 0.88243 | 0.53193 | Increasing |
| Hindustan oil exploration company Ltd | 0.49418 | 1.00000 | 0.49418 | Increasing |
| Alphageo | 0.75692 | 1.00000 | 0.75692 | Increasing |

Table 1 shows the average efficiency scores derived from the Input-Oriented CRS Efficiency and Input-Oriented VRS Efficiency. The scale efficiency indicates that the firms are on the optimum production scale when the score equals one. The return to scale analysis is also shown in Table 1. The table shows that five companies exhibit increasing returns to scale, indicating that managers'

capabilities to use the company's given-resources still need to be enhanced.

Conclusion:

The univariate nature of ratio analysis raised questions about their ability to evaluate the performance of the firm. Because of this, DEA was developed as an alternative method of evaluating the performance of businesses. This work used financial information from 10 Indian oil and gas companies to conduct an

empirical analysis. According to the outcome of the DEA approach, only a small number of businesses managed to maintain an acceptable level of efficiency throughout the testing period. Average CRS efficiency scores range from 0.55 to 1.00, while VRS efficiency scores range from 0.82 to 1.00.

This implies that companies must cut their input costs by up to 45% and 18% while keeping output at the same level. The average CCR, BCC, and scale efficiency score of Hindustan petroleum corporation limited reached 1.00; this indicates that it is at an optimal level of efficiency, whereas the others are still inefficient, although their average CCR, BCC, and scale efficiency are close to 1.00. This implies that most of the large firms and their small counterparts are operating at a suboptimal level of efficiency. Whereas Oil and natural gas corporations, GAIL India Limited, Oil India Limited, Reliance Industries Limited, Aban Offshore Ltd, and Hindustan oil exploration company Ltd are far away from the CCR efficiency, therefore, necessary measures should be taken to improve their operational performance and efficiency.

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