A Study on Technical, Pure Technical and Scale Efficiency of Indian Oil and Gas Companies

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Abstract: Agricultural sector, Textile industry, Chemical industry, Food Processing sector, Mining, Steel industry, Oil and Gas sector and all other Tertiary sectors including Service sector has to work efficiently for the growth of the economy. The researcher has mainly focussed on Oil and Gas sector as how efficiently it works will determine the growth of the nation. In this paper six major companies namely Oil and Natural Gas Company, Oil India Limited, Gas Authority of India Limited, Indian Oil Corporation Limited, Hindustan Petroleum Company Limited and Bharat Petroleum Company Limited considered and collected data for the financial year 2018-19. Oil and Natural Gas Company, Oil India Limited and Gas Authority of India Limited are efficient under CCR Model and Oil and Natural Gas Company, Oil India Limited and Gas Authority of India Limited, Indian Oil Corporation Limited, Hindustan Petroleum Corporation Limited are efficient under BCC model. 3 companies are Scale Efficient. Input and Output Targets are also calculated.

Key Words: Data Envelopment Analysis, Technical Efficiency, Pure Technical Efficiency, Scale Efficiency, BCC, CCR.

Introduction: Indian oil company sector is managed by Government sector and private sector. Recently there are more fluctuations in the Oil prices. In India, oil companies play very important role to develop the economy. The Economic status of the World heavily depends on petroleum-based products. The Oil and Gas industry among the eight core industries plays a protagonist role in India to influence decision making for all other major sections of the economy. The growth of Indian economy is pedantically related to energy demand; therefore, the need for oil and gas is projected to grow more, thereby making the sector quite beneficial for investment. India's progression today is witnessed majorly by natural gas and petroleum sector (which is inclusive of refining, transportation, and marketing of these products), as it contributes about 15% to India's GDP. India's consumption of petroleum products in India is increased about 2.66 per cent in Financial Year 2019 as compared to the previous year 2018.India is the third largest energy utilizing country. India's energy demand is increasing year by year and is expected to double to 1,516 Mtoe by 2035 from 753.7 Mtoe in 2017. The present paper evaluates the relative efficiency of oil companies by using **Data Envelopment Analysis**. In Data Envelopment Analysis Over all Technical Efficiency, Pure Technical Efficiency and Scale Efficiency scores will be measured for all Oil and Gas companies.

Review of literature:

Charnes, Cooper and Rhodes (1978) developed a method called Data Envelopment Analysis to find efficiency of same set of observations. Data Envelopment Analysis is a non- parametric technique which can be used to find relative efficiency of Decision-making units (DMUs) which are having multiple inputs and outputs. CCR method works under constant return to scale. Later it was extended by Banker, Charnes and Cooper (BCC) in 1984 for variable return to scale. Only few researchers have done research on efficiency of oil and gas companies of India, but globally there are some research papers to find efficiency of Oil and Gas companies.

Vikas and Rohit Bansal (2018) studied efficiency of 22 oil companies in India. They revealed that 13 companies out of a total of 22 companies' i.e. 59 per cent companies are efficient under CCR model. Under BCC model they have observed that 16 companies are pure technical efficient and 14 companies are scale efficient. They found the performance of all 22 companies for the year 2013 to 2017 i.e. for 5 years and they observed that Chennai Petroleum Corporation Ltd, Oil India Ltd, Petronet LNG Ltd, Gujarat State Petronet Ltd, Mahanagar Gas, IGL Ltd, and BPCL Ltd as consistently efficient companies. They also set the benchmarks for inefficient companies. Input variables Material consumed, Employee benefit expenses, Capital Investment and Output variables are Operating Revenues and Profit after Tax.

Mohd Afial and Mohd Izhar Ahmad (2018) analysed the performance of Indian Oil Companies from 1991 to 2017 and applied Window DEA model to find efficiency scores for six companies namely Reliance Industries Ltd, Oil India Ltd, Oil and Natural Gas Corporation of India, Indian Oil Corporation Ltd, Hindustan Petroleum Corporation Ltd and Bharat Petroleum Corporation Ltd. They revealed that there is no company is performing efficiently and they have suggested some policies to improve the efficiency of companies under size and management level.

Chiranjeevi Gudala and E.S.V Narayana Rao (2014) Studied on 13 major private sector banks. Interest expenditure on deposits as percentage of deposits, Deposits, Total Expenses, Compensation to Employees, Financial Charges, Non-Cash Charges and Total Interest Expenses are inputs and Total Assets, Net Assets, Total Income, Net worth, Interest Income, Profit before Depreciation, Interest, Taxes & amortization and Interest Income on advances as percentage of loans and advances are outputs and concluded that five out of thirteen banks operating at constant returns to scale. They assigned the ranks for all 13 banks using super efficiency model.

Dr. Sabah M. AI- Najjar and Mustafa A. AI- Jaybhjy (2012) had demonstrated that DEA is an effective tool to monitor and control the performance of Oil Refineries. They have calculated relative efficiency of some Oil Refineries of Iraq. 50% in 2009 and 58% in 2010, Oil Refineries are efficient. They suggested some recommendations to inefficient companies to improve their performance.

Methodology: Data Envelopment Analysis is a linear programming technique developed by Charnes, Cooper and Rhodes (CCR) in 1978 to measure relative efficiency of same set (homogeneous) of observations called as Decision Making Units(DMUs) for constant returns to scale. Under constant returns to scale if inputs are

increased outputs are also increased in the same proportion. Therefore, under CCR model efficiency scores remain same whether it is input oriented method or output oriented method. CCR model evaluates Overall Technical Efficiency scores of Decision Making Units. Later it was extended by Banker, Charnes and Cooper (BCC) in 1984 for variable return to scale i.e. Pure Technical Efficiency for DMUs. Overall Technical Efficiency is a product of Pure Technical Efficiency and Scale Efficiency. If efficiency score is 1, then DMUs are efficient, otherwise it is said to be inefficient. Efficient DMUs can set the targets for inefficient DMUs. So that inefficient DMUs can follow the efficient DMUs and can reach to efficient frontier.

Data: Data was collected from Annual Reports of all Individual companies namely Oil and Natural Gas Company, Oil India Limited, Gas Authority of India Limited, Indian Oil Corporation Limited, Hindustan Petroleum Company Limited, Bharat Petroleum Company Limited of the financial year 2018-19.

Input and Output Variables: There is no consensus to take the inputs and outputs in Data Envelopment Analysis. Researcher considers Operating Expenses and Other Expenses are Inputs and Revenue from Operations, Other Income and Profit after Tax are outputs.

Data Analysis:

CCR Scores:

CCR model is applied to measure Overall Technical Efficiency scores of oil companies.

S.No.	Name of the Company	Overall Technical Efficiency Scores
1	Oil and Natural Gas Company	1.0000
2	Oil India Limited	1.0000
3	Gas Authority of India Limited	1.0000
4	Indian Oil Corporation Limited	0.7467
5	Hindustan Petroleum Corporation Limited	0.8843
6	Bharat Petroleum Corporation Limited	0.7886

Under CCR model it is observed that ONGC, OIL and GAIL companies are utilizing their resources seamlessly and proportionately they are producing outputs. So, they are working efficiently. Least score attained by the company is IOCL. Still they can reduce 25% inputs to produce same outputs.

BCC Input-Oriented Scores:

S.No.	Name of the Company	Pure Technical Efficiency Scores
1	Oil and Natural Gas Company	1.000
2	Oil India Limited	1.000
3	Gas Authority of India Limited	1.000
4	Indian Oil Corporation Limited	1.000
5	Hindustan Petroleum Corporation Limited	1.000
6	Bharat Petroleum Corporation Limited	0.9689

Under BCC input-oriented model, pure technical efficiency scores were calculated and are mentioned in the above table. Out of six companies 5 companies are working efficiently except Bharat Petroleum Corporation Limited. BPCL can reduce approximately 4% of their inputs to produce same outputs.

Scale Efficiency Scores:

Scale Efficiency scores are calculated and is mentioned in the below table.

S.No.	Name of the Company	Scale Efficiency Scores
1	Oil and Natural Gas Company	1.0000
2	Oil India Limited	1.0000
3	Gas Authority of India Limited	1.0000
4	Indian Oil Corporation Limited	0.7467
5	Hindustan Petroleum Corporation Limited	0.8843
6	Bharat Petroleum Corporation Limited	0.8139

Oil and Natural Gas Company, Oil India Limited and Gas Authority of India Limited are scale efficient. Indian Oil Corporation Limited, Hindustan Petroleum Corporation Limited and Bharat Petroleum Corporation Limited are not scale efficient. These three inefficient companies can reduce their branch sizes to get same output. Indian Oil Corporation Limited, Hindustan Petroleum Corporation Limited and Bharat Petroleum Corporation Limited can reduce their sizes by approximately 25%, 12% and 19% respectively.

Input and output Targets:

Input and output targets are calculated by using BCC input additive non-oriented model.

Sr. No	Name of the Company	Operating Expenses	Other Expenses	Revenue from Operations	Other Income	Profit after Tax
1	Oil and Natural Gas Company	86313.24	45907.96	112312.3	26478.49	118362.6
2	Oil India Limited	413.19	17964.8	14050.99	1739.89	2734.15
3	Gas Authority of India Limited	71671.4	67849.87	105012.4	2037.78	8122.83
4	Indian Oil Corporation Limited	611416.9	189786.3	869487.2	4265.16	18760.15
5	Hindustan Petroleum Corporation Limited	252655.6	203010.8	606977.4	2309.32	6717.38
6	Bharat Petroleum Corporation Limited	254253.98	183445.2	502928.7	3802.08	15972.05

Conclusion:

1. It is revealed that under Charnes, Cooper and Rhodes (CCR) model 3 companies namely Oil and Natural Gas Company, Oil India Limited and Gas Authority of India Limited are efficient and other 3 are inefficient.

2. In Banker, Charnes and Cooper (BCC) model Oil and Natural Gas Company, Oil India Limited and Gas Authority of India Limited, Indian Oil Corporation Limited, Hindustan Petroleum Corporation Limited are efficient. Only Bharat Petroleum Corporation Limited is found as inefficient.

3. Natural Gas Company, Oil India Limited and Gas Authority of India Limited are scale efficient.

4. Input and output targets were found for all the companies.

Oil companies in India plays very important role to develop the economy of the country. Results also depicts that they are working efficiently and thereby helping the country to develop the economy.

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