International Journal of Finance, Insurance and Risk Management
Volume XIII, Issue 1, 2023

pp. 177-190

DEA and Financial Ratio Analysis: Efficiency of Power Plants in India – Shareholder's View

Submitted 04/02/23, 1st revision 20/02/23, 2nd revision 18/03/23, accepted 30/03/23

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Abstract:

Purpose: *India is among the world's top three producers of electricity and is also its second largest consumer. With the growing demand, the electricity sector continues to grow and currently has an installed capacity of 388.134 GW. Given the growing nature of the sector, the interest in calculating the efficiency of some of the top power plants also grows. This paper explores the business performance of the electricity sector in India and combines the economic and social dimensions.*

Design/Methodology/Approach: *It uses data from financial statements to measure technical efficiency of the chosen DMUs through the DEA approach and the financial ratios measure. Through the study, it was concluded that DEA analysis (Scale Efficiency) is a good measures of efficiency of decision-making units (DMUs), given the management's motives, while the financial ratios provide insight into how to improve efficiency of the inefficient DMUs along with clearer ranking of the efficient ones.*

Findings: *The DMU 9 has been given ranks 1 under DEA, due to its ability to efficiently transform the capital employed into revenues as compared to the other (as shown in Table 6). The same unit was ranked 2nd when it came to ROTA criterion (EBIT/capital) that is 2nd rank in being able to maximize shareholder's profit.*

Practical implications: *Looking at the results, we can say that DEA measures performance more comprehensively as opposed to the financial ratio (ROTA) individually. This is because DEA has more aspects of measurement which helps in a balanced evaluation of the DMUs.*

Originality value: *In fact Scale Efficiency enhances the result as it also takes into consideration the optimum scale of a DMU. Even though the DEA is capable of ranking DMUs according to their efficiency, it faces a drawback when there are two efficient DMUs. In our case though, we can limit this drawback substantially since we can prioritize even among the efficient DMUs depending upon the management's priorities.*

Keywords: *DEA, financial ratios, performance measurement, technical efficiency, energy plants.*

JEL classification: *Q40, Q43.*

Paper type: *Research article.*

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1. Introduction

The power sector in India is one of the most diversified compared to the rest of the world. It is an important component of infrastructure and economic growth. Even though the thermal power has the highest share, the renewable power generation capacity continues to grow. Looking at the current scenario, India's electricity demand is skyrocketing and the trend is expected to continue. To meet this increasing demand, the country must improve the generating capacity and thus the efficiency of the existing power plants.

The increase in efficiency would require higher investment which would happen if the shareholders have an incentive to invest. Thus, to factor in these aspects, the study randomly chose a mix of few public and private power plants and calculated their efficiency using DEA and ROTA model. Total of 10 power plants, termed as decision making units (DMUs) in the study, were taken into consideration. The 10 DMUs included the following plants in the same order:

NTPC Limited (DMU 1) is the largest power generating company in India with a capacity of 62,086 MW. It operates from 70 locations in India, one in Sri Lanka and 2 in Bangladesh.

NLC India Limited (DMU 2) is a government of India company in power generation and has a status of a Navratna. With the growing concerns for the environment, it has recently diversified into renewable energy production. It has an overall power generating capacity of 4431 MW.

SJVN Limited (DMU 3) is a joint venture of the Government of India and the Government of Himachal Pradesh. It currently has the status of a Mini Ratna. As of today, the company has a capacity of 10011 MW, out of which 2016.5 MW is under operation, 3301 MW is under Construction, 426 MW is under Pre-construction and 4267 MW is under Survey and Investigation stage.

JSW Energy Limited (DMU 4), a division of JSW Group in India, has 5681 MW of operational generating capacity. In addition, it has a few upcoming power generation projects, taking the combined installed capacity to 8630 MW.

CESC Limited (DMU 5) is India's first integrated electrical utility company that generates and distributes power in Kolkata. With the rising environmental concerns, they have also ventured in renewable energy production. Currently, they have three operating power plants with 1225 MW of generation capacity.

NHPC Limited (DMU 6) is the largest hydropower generator and developer in India. It has also ventured into the field of Solar & Wind power and currently has an installation base of 7071.2 MW.

Reliance Power Limited (DMU 7) is a part of the Reliance Group and has a large portfolio of power generation capacity. The upcoming Reliance power projects are diverse and are planned strategically according to the availability of the fuel supply. Presently, the company has approximately 6000 MW of operational power generation assets.

Tata Power (DMU 8) has a presence in both the conventional & renewable energy with current electricity generating capacity of 13061 MW.

Torrent Power (DMU 9) is among the top brands in the Indian power sector and one of the largest private sector player. It has coal based, gas based and renewable power plants with an aggregate generation capacity of 3879 MW.

Adani Power Limited (DMU 10) is India's largest private thermal power producer with a generation capacity of 12,450 MW along with a 40 MW solar power project in Gujarat.

The data in this study was collected from the financial reports (2020-21) of each of these power generating companies and then used to calculate their efficiency. The DEA and ROTA models were used to find out the most efficient DMU and the causes for its better performance.

2. Review of Literature

While choosing input and output variables for DEA model, there has to be an appropriate representation of all important factors while keeping the overall number low enough so that a meaningful analysis is possible (Boaz Golany *et al.,* 1994). DEA measures performance in a more comprehensive way compared to financial ratios and complements them meaningfully, providing more confidence in quality of performance evaluation (Adler *et al.,* 2002).

A financial ratio can be used to determine a firm's capital structure, profitability, possibility of bankruptcy and asset turnover. Financial ratios were used to develop an indicator that differentiated between efficient and inefficient firms using univariate analysis (Beaver, 1966).

DEA does not guarantee the cause or remedy and requires internal audits or peer review to define the types of operating changes that can affect efficiency improvements (Wen-Cheng LIN *et al.,* 2005).

Harold O. Fried *et al.* (2008) explained production as a function of the state of technology and economic efficiency. Their paper indicated that by allowing the possibility of a divergence between the economic objective and actual performance, we can gain insightful findings.

The use of ROTA variables as input and output variables in the DEA model, is relevant due to the fact that "Pressure on companies to pay attention to environmental, social, and governance (ESG) issues, continues to mount" (McKinsey, 2020). In the DEA model, by utilizing audited data extracted from financial reports, it is possible to mitigate the problem of measurement of the variables used as inputs and outputs (Curtis, 2020).

3. Research Methodology: Financial Ratios and DEA

3.1 Financial Ratios

Financial or accounting ratios help analyse financial statements and compare the strengths and weaknesses of various enterprises. The ratios are categorised based on the aspect of a business which it quantifies. Debt, profitability, activity, liquidity and market ratios help analyse the return on investment for shareholders and the relationship between investment value and return on a company's share.

However, profitability ratios are generally used to measure business efficiency as it gives a more comprehensive view of the overall performance. Throughout this study we will maintain the assumption of very low fuel and labour operating expenses, that is, the inputs majorly include fixed asset investment and other upfront costs. Considering the assumption, we can compare efficiency based on two financial variables. i.e. Return on Total Assets (ROTA) and Return on Equity (ROE).

ROTA helps determine companies which are efficient with the use of their assets as compared to their revenues. In other words, it shows the percentage of profitability of a company's asset in generating earnings. Likewise, ROE evaluates a company's profit generating efficiency.

However, ROTA is considered a relatively better measure since it focuses on wealth creation for the stakeholders while ROE solely concerns with the amount of money paid to the stakeholders. Thus, the input and output variables were selected on the basis of ROTA calculations.

ROTA = EBIT[2] ÷ Total Assets

OR

ROTA = (EBIT profit margin) * (Total assets turnover)

⇨ ROTA = [EBIT ÷ Revenues] X [Revenues ÷ Total Assets]

Thus, we have 3 variables to consider, that is, Revenues, Total Assets and EBIT. We will be working with these variables in the DEA model.

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[2]*Earnings Before Income and Taxes -> Indicator of profitability: net income before income tax and interest expenses are excluded.*

3.2 Data Envelopment Analysis (DEA)

Data Envelopment Analysis is the parametric mathematical programming approach to assess the inefficiency of a firm relative to a sample of firms. It uses linear programming to obtain the measures of technical efficiency. However the approach did not gain popularity until the paper by Charnes, Cooper and Rhodes (1978) which coined the term Data Envelopment Analysis (DEA) after which a number of papers extended and applied the DEA methodology.

Charnes, Cooper and Road proposed a model which assumed Constant Returns To Scale, that is, the CRS or the CCR mode. Another basic model of DEA was given by Banker, Charnes and Cooper (Banker *et al.*, 1984) called the BCC model or the VRS, that is, Variable Returns to Scale model.

3.3 Efficiency Measurement Using DEA

The piecewise-linear convex hull approach to frontier estimation, proposed by Farrell or the DEA model can be either input or output oriented. The input orientation model relates efficiency scores to the largest possible proportional reduction in inputs while in the output oriented model attempts are made to maximise output without requiring more of any of the input values.

The efficiency score lies between zero and one where in a score of one indicates a point on the frontier and does a technically efficient DMU. The non-zero slack or radial efficiency score indicates a fully efficient DMU, that is, there is no possibility to reduce input or increase the output without changing other inputs or outputs.

Applying DEA to any input-output model should be done taking into consideration precautions like, data collected must be accurate since DEA is not based on hypothesis testing. The variables in the model should be as few as possible and any zero or negative values should be avoided. It is also important to scale down the data before applying the DEA model so that the variables do not have excessively large values. Moreover, for efficient results, the sample size should be adequate. Golany and Roll (1989) stated that the sample size must be at least twice the sum of input and output variables.

In this study we use one input variable, two output variables and 10 DMUs. We will be employing the input – oriented model i.e. how much investment in total assets can be reduced without changing the outputs to make the DMUs more efficient. We will be computing efficiency using both the CRS and VRS DEA models and will also be calculating Scale Efficiency (SE)[3].

[3] *Scale Efficiency = CRS efficiency / VRS efficiency => It measures the divergence between the CRS efficiency and the VRS efficiency rating of a DMU.*

4. Data and Variables

The dataset for this study includes 10 randomly chosen electricity generating power plants in India. The DMUs include both private and public power plants some of them being given the status of navratna. The data was obtained from the annual reports and financial statements of each plant for the year 2020-2021. While selecting the input and output variables, attempts were made to keep the variables comprehensive enough to reflect robust results.

4.1 Input and Outputs

In this paper, we have considered Total Assets as the only input given our assumption that power plants work majorly on fixed investments. Total assets also includes installed capital cost, ongoing operating costs and investments like depreciation, debt financing, insurance, maintenance cost, etc. Moreover, two outputs have been considered in this paper, i.e., Revenues and EBIT, reflecting shareholder's profitability.

The descriptive statistics of these input output variables are given in the Table 1. Looking at the descriptive statistics, we observe that the average amount of capital invested per DMU, is Rs. 61407.817 crore. The average unit generates Rs. 15601.13 crore in revenues and Rs. 3858.494 crore EBIT (or 24.7 % of revenues).

The average capital turnover ratio (Revenues / Capital) is equal to 0.208 (below the usual turnover in other customary sectors). Note that similar input and output variables have been taken in the literature to assess shareholder's profitability for the wind energy farms operating in Greece.

Table 1. *Descriptive Statistics of Input - Output Variables (Self-calculation)*

	Total Assets	**Revenues**	**EBIT**
Maximum	343219.39	103552.71	22737.55
Minimum	14716.31	522.12	141.01
Mean	61407.817	15601.13	3858.494
Standard Deviation	100240.9187	31149.89	6762.11745
No. of regions	10	10	10

Source: *Own study.*

Correlation and regression analysis have been calculated to know the extent of relationship between input and output variables. Table 2 shows that output variables have good correlation with the input.

By performing regression analysis, R^2 comes out to be 0.98 which reveals that 98% of variation in the outputs is due to the variation in the input. F-value is also found statistically significant.

Table 2. *Correlation Matrix of Input-Output Variables (Self-calculation)*

Outputs → Inputs ↓	**Revenues**	**EBIT**
Total Assets	0.99	0.993

Source: *Own study.*

Table 3. *Regression Analysis (Self-calculation)*

	Total Assets – Revenues	**Total Assets – EBIT**
R^2	0.98	0.98
Significance F	2.85165E - 08	6.54832E - 09

Source: *Own study.*

5. Results and Discussions

5.1 DEA – Technical Efficiency (TE)

We applied input oriented DEA approach, which helps us identify the proportional amount of reduction in inputs, while keeping the output proportions constant, to convert an inefficient unit into an efficient one (Ederer, 2015). The TE scores are calculated using the CRS model, which assumes that scale is an irrelevant factor and doesn't affect the efficiency of a DMU.

The data used are related to the ten (10) DMUs (power plants) operating in India, that published their standalone financial statements 2020-21. We chose specific data, that are reflected in Table 4.

Table 4. *Input - Output Data (in Crore Rupees) – Financial Statements*

DMUs	**INPUT**	**OUTPUT 1**	**OUTPUT 2**
	Total Assets	**Revenues**	**EBIT**
DMU 1	343219.39	103552.71	22737.55
DMU 2	37696.02	8966.51	2466.1
DMU 3	16863.57	3213.07	2130.43
DMU 4	14716.31	2959.94	517.84
DMU 5	27657.54	7101.67	892
DMU 6	66302.03	9657.39	4521
DMU 7	17567.92	522.12	479.76
DMU 8	42868.95	7429.55	2397.05
DMU 9	22778.01	12026.8	2302.2
DMU 10	24408.43	581.54	141.01

Source: *Own study.*

Revenues reflect the plant's efficiency to transform assets into energy production while EBIT measures profitability of operations given the revenue earned (EBIT can be calculated as revenue minus expenses excluding tax and interest). In fact, a higher EBIT margin suggests that the company's earnings are stable and thus attracts shareholders. The electricity sector is quite competitive, as far as the effective use of invested capital is considered in transforming it to revenues and ultimately to adequate EBIT.

The more prolific the transformation is, the more it satisfies the needs of the stakeholders, who in return support the continuity of the specific DMU. Applying CRS - DEA, the input oriented method with total assets (as the only input) and revenues and EBIT (as outputs), using the DEAP software Version 2.1 (CEPA), we get the following results:

Table 5. *Technical Efficiency Scores, Reference Set and Peer Weight (Self-calculation)*

DMUs	**Efficiency Score**	**Reference Set**	**Peer Weight**
DMU 1	0.632	9,3	8.096,1.924
DMU 2	0.592	9,3	0.613,0.495
DMU 3	1.000	3	1.000
DMU 4	0.381	9	0.246
DMU 5	0.486	9	0.590
DMU 6	0.563	9,3	0.332,1.763
DMU 7	0.216	3	0.225
DMU 8	0.490	9,3	0.446,0.643
DMU 9	1.000	9	1.000
DMU 10	0.054	9,3	0.043,0.020
Mean	0.541		

Source: *Own study.*

The Peer Weights show us that inefficient DMUs must undergo a reduction in their input to become efficient. The reduction is determined through the peer weights. For example, for DMU1 to become efficient, its total capital must be decreased to Rs. 216857.170 crore , which is equal to 0.632 X 343219.39 (efficiency score X actual total capital used) or given the peer weights and the two efficient DMUs (9 and 3) is equal to 8.096 X DMU9 + 1.924 X DMU3 = 8.096 X 22778.01 + 1.924 X 16863.57 = Rs. 216857.170 crore.

Similarly the reduced input amount for the remaining inefficient DMUs is calculated. Their inputs must be decreased based on the efficient DMUs 9 and 3, located on the efficient frontier.

The DMUs located inside the frontier are considered inefficient and must either reduce their input to achieve the same output or increase its output given the input quantity.

The existence of two outputs implies presence of two efficient DMUs (No. 9 and 3) which are efficient in one output each.

Table 6. *Output/Input Efficiency (Self-calculation)*

DMUs	Revenue/ Total Assets	EBIT/ Total Assets
DMU 1	0.301709965	0.06624786
DMU 2	0.237863573	0.0654207
DMU 3	0.190533203	**0.126333273**
DMU 4	0.2011333	0.035188169
DMU 5	0.256771571	0.032251603
DMU 6	0.145657531	0.068187957
DMU 7	0.029720081	0.027308868
DMU 8	0.17330842	0.055915762
DMU 9	**0.528000471**	0.101071165
DMU 10	0.023825375	0.005777102

Source: *Own study.*

DMU 9 has the highest revenue to capital ratio with an efficiency score of 0.528000471 while on the other hand, DMU 3 has the highest EBIT to capital ratio (0.126333273). Table 6 shows that DMU 9 exhibits a relatively well balanced performance given its input. It has the highest conversion ratio of capital to revenue, and the second highest capital to EBIT conversion percentage. However, even with highest capital to EBIT conversion ratio, DMU 3 exhibits rather low performance in conversion of capital to revenue. Thus, we can consider DMU 9 as a comparatively better choice between the two efficient units.

The two efficient DMUs can further be prioritized on the basis of the overriding priority of the parties involved. If the party chooses energy self-sufficiency as the main concern then a higher capital to revenue conversion ratio would be sought i.e. DMU 9 would be preferred which maximizes energy supply given the price and input quantity.

However, if the priority is to maximize the shareholder's earnings, then DMU 3 would be preferred as it efficiently improves the viability of the unit's operations. Thus, if we get prior knowledge about the party's priority, we can partially eliminate the alleged weakness in DEA's ability to prioritize among efficient units.

5.2 Pure Technical Efficiency (PTE - VRS Model) and Scale Efficiency

The CRS model does not consider the scale size of the units while assessing their technical efficiency. To capture the effect of variable scales of operation of the DMUs in our sample, we also apply the Variable Return to Scale (VRS). The VRS model helps us identify whether the inefficiency is due to poor production operation or unfavourable conditions displayed by the size of the DMUs (Shivi Agarwal *et al.*, 2006). Applying the DEA-VRS model, we get the following results:

Table 7. *Pure Technical Efficiency (PTE) Scores, Reference Set and Peer Weight (Self-calculation)*

DMUs	Efficiency Score	Reference Set	Peer Weight
DMU 1	1.000	1	1.000
DMU 2	0.632	9,1,3	0.516, 0.012, 0.472
DMU 3	1.000	3	1.000
DMU 4	1.000	4	1.000
DMU 5	0.665	9,4	0.457, 0.543
DMU 6	0.825	1,3	0.116, 0.884
DMU 7	0.838	4	1.000
DMU 8	0.519	9,1,3	0.366, 0.010, 0.624
DMU 9	1.000	9	1.000
DMU 10	0.603	4	1.000
Mean	0.808		

Source: *Own study.*

Table 7 provides the detailed results drawn from the DEA-VRS model. Since the VRS efficiency is always greater than or equal to the CRS efficiency, we can see in the Table that 2 additional DMUs (1 and 4) have exhibited an efficiency score of 1. The mean PTE score indicates that an average inefficient DMU can reduce its input by 19.2 percent, without affecting its output, to become efficient.

A PTE score of 1 indicates that the respective DMU is efficient in converting its input to outputs given the scale size. Thus, we can see that DMUs 1 and 4 can efficiently convert their inputs into outputs but they have a disadvantageous scale size. A unit is considered to be operating at an optimal scale when it has the Scale Efficiency (SE) score of 1.

Table 8. *Scale Efficiency Score (Self-calculation)*

DMUs	CRS Efficiency	VRS Efficiency	Scale Efficiency	Returns to Scale
DMU 1	0.632	1.000	0.632	DRS
DMU 2	0.592	0.632	0.936	DRS
DMU 3	1.000	1.000	1.000	CRS
DMU 4	0.381	1.000	0.381	IRS
DMU 5	0.486	0.665	0.731	IRS
DMU 6	0.563	0.825	0.682	DRS
DMU 7	0.216	0.838	0.258	IRS
DMU 8	0.490	0.519	0.944	DRS
DMU 9	1.000	1.000	1.000	CRS
DMU 10	0.054	0.603	0.089	IRS
Mean	0.541	0.808	0.665	

Source: *Own study.*

Comparing the CRS and VRS efficiency scores helps us assess whether or not the scale size has an effect on the technical efficiency. SE score of less than 1 indicates that the region is operating at a scale which is relatively large or small compared to the optimum scale size.

Looking at the CRS efficiency scores, it can be deduced that 70 percent of DMUs operate below the score of 0.600, i.e., only one third of units are operating close to their optimum scale size.

The VRS model improves the efficiency scores considerably. Thus, in this study, scale size affects the efficiency score and the CRS model can't adequately determine efficient DMUs. So, we will be using the SE score while ranking the performances of the DMUs.

5.3 Profitability Ratios

In this study, we decided to focus on shareholder's perspective on a unit's efficiency. Thus, the input and output variables were chosen on the basis of ROTA calculations, which measures stakeholder's wealth creation. The financial variables ROTA and ROE help determine a company's profitability given its assets.

Since ROTA is considered a better measure when it comes to shareholder's interest, we will be considering it along with DEA for ranking the DMUs according to their efficiency calculated from each method. DEA helps asses sustainability while ROTA helps manage priorities while considering stakeholder's interests unlike ROE which focuses majorly on the shareholders.

Table 9. *Return on Total Assets (Self-calculation)*

DMUs	**EBIT**	**Total Assets**	**ROTA**
DMU 1	22737.55	343219.39	0.06624786
DMU 2	2466.1	37696.02	0.0654207
DMU 3	2130.43	16863.57	0.126333273
DMU 4	517.84	14716.31	0.035188169
DMU 5	892	27657.54	0.032251603
DMU 6	4521	66302.03	0.068187957
DMU 7	479.76	17567.92	0.027308868
DMU 8	2397.05	42868.95	0.055915762
DMU 9	2302.2	22778.01	0.101071165
DMU 10	141.01	24408.43	0.005777102

Source: *Own study.*

The efficiency scores measured on the basis of Scale. Efficiency and ROTA gives diverse results and rankings as shown in the following Table:

Table 10. *DEA and ROTA Rankings (Self-calculation)*

DMUs	Scale Efficiency	Ranking	ROTA	Ranking
DMU 1	0.632	6	0.06624786	4
DMU 2	0.936	3	0.0654207	5
DMU 3	1.000	1	0.126333273	1
DMU 4	0.381	7	0.035188169	7
DMU 5	0.731	4	0.032251603	8
DMU 6	0.682	5	0.068187957	3
DMU 7	0.258	8	0.027308868	9
DMU 8	0.944	2	0.055915762	6
DMU 9	1.000	1	0.101071165	2
DMU 10	0.089	9	0.005777102	10

Source: *Own study.*

The DEA - VRS model points towards DMU 1, 3, 4 and 9 as efficient ones while the SE score narrows it down to DMU 3 and 9. Comparing the ranking of these units under ROTA, we observe the following:

The DMU 9 has been given ranks 1 under DEA, due to its ability to efficiently transform the capital employed into revenues as compared to the other (as shown in Table 6). The same unit was ranked 2nd when it came to ROTA criterion (EBIT/capital) that is 2^{nd} rank in being able to maximize shareholder's profit.

The diversity in the scores can be explained by the fact that, the more the criteria pays attention to the narrow view of profitability and return to shareholders, its performance decreases. DMU 3 is ranked 1 under DEA due to its ability in efficient EBIT conversion which is a wider profitability perspective and thus it's also efficient ROTA ratio.

DEA uses the two separate elements of ROI to amplify their individual importance. However ROTA combines them and forms a single profitability branch of the ratio (Curtis *et al.*, 2020). Thus, looking at the results, we can say that DEA measures performance more comprehensively as opposed to the financial ratio (ROTA) individually. This is because DEA has more aspects of measurement which helps in a balanced evaluation of the DMUs.

In fact SE enhances the result as it also takes into consideration the optimum scale of a DMU. Even though the DEA is capable of ranking DMUs according to their efficiency, it faces a drawback when there are two efficient DMUs. In our case though, we can limit this drawback substantially since we can prioritize even among the efficient DMUs depending upon the management's priorities.

Thus, if the management's motive is to maximize shareholder's earnings, DMU 3 would be ranked higher compared to other efficient DMUs. Moreover, it also is ranked the highest when it comes to the financial ratios.

6. Conclusion

The study is about efficiency measurement of power plants and comparing it through the DEA and the financial ratio models. We chose a mix of electricity producing plants, both public and private, to examine how efficiently power plants are using the main resources. For the analysis, we collected data from financial statements as input and outputs. The input and outputs were chosen based on the elements of the ROTA model.

The methods were chosen to measure economic efficiency. We calculated both DEA – CRS which gave us two efficient DMUs (3 and 9) and DEA – VRS which gave us four efficient DMUs (1,3,4 and 9). The comparison shed a light on the fact that scale size affects a DMU's efficiency so Scale Efficiency was chosen as a better measure of efficiency given the DEA model.

However, DEA solely can not provide accurate measure and suggest ways to improve inefficient DMUs. We also used financial ratios (ROTA, Revenue/Total Assets) which gave differentiated rankings and also helped reveal cause so as to form strategies. The results indicate that DEA Scale Efficiency is a good measure of calculating any DMUs efficiency while the financial ratios help in defining the causes.

The Scale Efficiency helped narrow down to two efficient DMUs, as opposed to 4 in DEA-VRS results, and given our motive to maximize shareholder's perspective, the financial ratios help identify DMU 3 as the most efficient while DMU 9 being the next in line. Similar to our analysis, DEA can be extended to incorporate any output and input variables depending on the purpose of analysis.

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