Efficiency and Companies: An Empirical Study of Performance Measurement

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ABSTRACT

Ranking of companies with the help of traditional accounting based methods has its own pros and cons. In this paper a new method has been used to measure the performance of companies which is based on the efficiency defined by optimum use of limited resources for the maximum possible level of output. A tool of operation research sciences (Data Envelopment Analysis) which uses linear programming, has been put in use to rank the companies on the basis of efficiency.

Keywords: DEA, Performance Efficiency, Distance Function, Linear Programming

INTRODUCTION

Owner of a company, firm, factory, laboratory, school, hospital or any organization and want to improve its performance should try to get replies to the following questions. Do the clients feel satisfied with the performance of the company? Has the company started a system of obtaining feedback from its clients at regular intervals and whether prompt action is taken on such feedbacks? Is there a proper Complaint Resolution Procedure in the Company? Many larger companies have been wiped off the surface of this earth just due to the avoidance of asking these basic questions. On the face of it, it looks something very ordinary, but in essence, it's a very powerful tool in getting first hand information and has got a lot of wisdom in it. Besides taking such actions to improve its performance companies should also start measuring its performance form some not routinely used methods. Because by following the regular ways to measure its performance there had been instances that company was unable to identify what and when things went wrong and company starts losing its market share and sometime even lost its existence too. A company has many methods to measure its performance. Some of them are financial (Accounting based or value based like EVA (Economic Value Added)) and some of them are non financial in nature like Balance Score Card. Companies can be ranked on the basis of any method of performance measurement. The popular methodologies to evaluate company performance are focused on a combination of fundamental factors and share price performance, using both absolute and relative measures. One additional added factor can be to capture company size as it is a driver of compensation as well. Relative measures such as comparison with sectoral indices are used to adjust for sector-specific factors. Revenues (or sales) and profit after tax (PAT) growth over previous year, both measured on an absolute and relative (by comparison with peers in the same industry) are used to measure the performance. Similarly, price performance can be measured on sector basis. Lastly, absolute market capitalization can be included to reflect company size, as otherwise, based on only growth and share price performance, smaller companies could have had an advantage over larger ones. That is also why size (in terms of market capitalization) is given high weightage.

But a different perspective can be used which is obviously less treaded path than the conventional ways, to evaluate the performance of the companies. Eventually this measure can further be used to rank the companies. Efficiency is a new perspective to measure the performance of companies. Efficiency has wide meaning and it can be interpreted in different ways too. In this paper we have defined efficiency in terms of how efficiently an organization uses its resources

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or factors of production to produce its products and services. This approach of using efficiency has its own utility. Because, now-a-days companies are taking every possible measure to remain competitive, not only on the national level but on the International front too. This approach of measuring the performance of companies can give companies a different perspective to work upon. In this paper we have used efficiency in the above sense to rank the companies.

India has many registered (under Companies Act 1956) companies. It is practically not possible to take all the companies and rank them. Therefore we have taken companies of five industries only to rank them industry wise. The following five basic industries have been taken for this purpose because these industries are the main drivers of any economy mainly for Indian Economy. These industries are Cement Industry, Aluminum Industry, Petroleum Industry, Steel Industry and Sugar Industry

METHODOLOGY

In microeconomic production theory a firm's input and output combinations are depicted using a production function. Using such a function one can show the maximum output which can be achieved with any possible combination of inputs, that is, one can construct a production technology frontier (Seiford & Thrall 1990). Some 30 years ago Data Envelopment Analysis (DEA) (and frontier techniques in general) set out to answer the question of how to use this principle in empirical applications while overcoming the problem that for actual firms one can never observe all the possible input-output combinations. Building on the ideas of Farrell (1957), the seminal work "Measuring the efficiency of decision making units" by Charnes, Cooper & Rhodes (1978) applies linear programming to estimate an empirical production technology frontier for the first time. Since then, there have been a large number of books and journal articles written on DEA or applying DEA on various sets of problems. Other than comparing efficiency across units within an organization, DEA has also been used to compare efficiency across firms. The main developments of DEA in the 1970s and 1980s are documented by Seiford & Thrall (1990).DEA has been used for both production and cost data. Utilizing the selected variables, such as unit cost and output, DEA searches for the points with the lowest unit cost for any given output, connecting those points to form the efficiency frontier. Any company not on the frontier is considered inefficient. A numerical coefficient is given to each firm, defining its relative efficiency. Different variables that could be used to establish the efficiency frontier are: number of employees, service quality, environmental safety, and fuel consumption. An early survey of studies of electricity distribution companies identified more than thirty DEA analyses—indicating widespread application of this technique to that network industry. (Jamasb, T. J., Pollitt, M. G. (2001). A drawback of this technique is that model specification and inclusion/exclusion of variables can affect the results (Berg 2010). DEA is commonly applied in the electric utilities sector. For instance a government authority can choose DEA is as their measuring tool to design an individualized regulatory rate for each firm based on their comparative efficiency. The input components would include man-hours, losses, capital (lines and transformers only), and goods and services. The output variables would include number of customers, energy delivered, length of lines, and degree of coastal exposure. (Berg 2010). In the DEA methodology, formally developed by Charnes, Cooper and Rhodes (1978), efficiency is defined as a weighted sum of outputs to a weighted sum of inputs, where the weights structure is calculated by means of mathematical programming and constant returns to scale (CRS) are assumed. In 1984, Banker, Charnes and Cooper developed a model with variable returns to scale (VRS).

The methodology covers that how to define efficiency which has been used to measure the performance of companies. The difference between maximum potential output and observed output while maintaining a given level of input use, or actual and minimum potential input for given output, or some combination of the two is attributed to technology or X-inefficiency (Leibenstein, 1966). We interpret these inefficiencies to be the result of contracting costs, managerial slack or oversight. They differ from allocative inefficiencies which are due to the choice of a non-optimal mix of inputs and outputs. Distance functions are alternative representation of production technology which readily models multiple input and multiple output technological relationships. Following Fare and Grosskopf (1994) we assume that firms employ N inputs denoted by $✡x=(x_1.....x_N) \in R^N_+$ to produce M outputs denoted by $✡_1y=(y_1.....y_N) \in R^N_+$. Technology may be characterized by a technology set T, which is the set of all feasible input and output combination. The Shephard output and input distance functions (see Shephard, 1970) are defined, respectively, as:

$$D_0 (x, y)=min \{ \theta (x, y / \theta) \in T\} \quad (1)$$

$$D_1 (y, x)=min \{\lambda : (x / \lambda, y) \in T\} \quad (2)$$

They scale in either the output direction by seeking the minimum value of θ to achieve the maximum radical expansion of y so that y/ θ remain feasible; or separately,

in the input direction by seeking the maximum feasible contraction λ of the input vector. One thing which is to be noted is that we only require a weak form of optimality for measuring X-efficiency. Revenue maximization and cost minimization are stronger forms of optimization. Profit maximization entails an even stronger optimization requirement. It implies cost minimization given the profit maximization choice of output(s); it also implies revenue maximization given the optimal choice of inputs (but not the converse). In this regard, the proposed methodology is general enough to encompass a variety of behavioral assumptions and market structures.

The input or output functions may be estimated using linear programming methods. In particular, Data Envelopment Analysis (DEA) which is a non-parametric mathematical programming technique. It can be used to construct the empirical technological or best practice frontier and obtain the efficiency measures as distance from this frontier. This can be implemented as follows:

Suppose we have k observations of inputs and outputs for k firms. From these we can construct a reference technology under constant returns to scale (CRS) as:

$$T=\{(x, y): \sum_{k=1}^{K} Z_k \, y \geq y_m, m=1 \ldots M : \sum_{k=1}^{K} = {}_k x_{km} \leq x_n, n=1 \ldots N; =_k \geq 0, k=1 \ldots N \quad (3)$$

The input distance function can be as:

$$D_i(y, x) := \min_{\lambda, z} \lambda \quad (4)$$

So that $\sum_{k=1} Z_{km} y \geq y_m, m=1 \ldots, M : \sum_{k=1}^{K} z_k x_{km} \quad \lambda x_n, n=1 \ldots N: z_k \geq 0, k = 1 \ldots K$

Alternatively, an output distance function D0 can be computed by max (θ) subject to a similar set of constraints.

In this paper we have taken one output (EBIT; Earnings before Interest and Taxes) and two inputs (first input is 'expense compensation to employee' and second input is 'capital') to measure the efficiency of the companies using above discussed distance function with the help of DEA method.

DATA

The data has been taken from PROWESS database of CMIE (Center of Monitoring Indian Economy) of the FY2008-09. There were 160 cement companies, 49 Aluminum companies, 15 petroleum companies, 196 steel companies and 53 sugar companies for which data has been taken for the FY 2008-09.

RESULTS

In the model used by us, the efficiency of a company can take any value equal to or less than 1. In this study having estimated all the companies (Industry wise) we have sorted them in descending order. For the sake of convenience we are putting only top 20 companies in terms of efficiency of every Industry in the following tables.

Cement Industy	Ranking (Using DEA)
Singhal Cement & Allied Inds. Ltd.	1
Prism Cement Ltd.	0.3944328
Ambuja Cements Ltd.	0.3404643
My Home Inds. Ltd.	0.3329643
Meghalaya Cement Ltd.	0.3262959
Birla Corporation Ltd.	0.2886047
Mangalam Cement Ltd.	0.2778763
Kalyanpur Cements Ltd.	0.2635159
A C C Ltd.	0.2486013
K C P Ltd.	0.2421813
Ultratech Cement Ltd.	0.2172009
Anjani Portland Cement Ltd.	0.2169766
Grasim Industries Ltd.	0.2044394
Penna Cement Inds. Ltd.	0.1928771
Chettinad Cement Corpn. Ltd.	0.1826515
J K Cement Ltd.	0.1783229
J K Lakshmi Cement Ltd.	0.1747554
Madras Cements Ltd.	0.1713356
Deccan Cements Ltd.	0.1679218
Andhra Cements Ltd.	0.1659581

Table: 1; Raking of the Cement Industry

Singhal Cement and Allied Industries Limited has been ranked number one among all the cement companies operating in India using efficiency as a performance measure. Andhra Cement Limited has been ranked 20th using the same performance measurement criteria. The coefficient of variation of efficiency performance measurement criteria of companies of Cement Industry in India is 63.64 percent (Table -1).

Aluminum Industy	Ranking (Using DEA)
Sudal Industries Ltd.	1
Eastern Sugar & Inds. Ltd.	1
National Aluminium Co. Ltd.	0.999999
Ess Dee Aluminium Ltd.	0.999999
Hind Aluminium Inds. Ltd.	0.950595
Parekh Aluminex Ltd.	0.927045
Gujarat Foils Ltd.	0.922504
Hindalco Industries Ltd.	0.815555
Century Extrusions Ltd.	0.799601

Cont.

Aluminum Industy	Ranking (Using DEA)
S B E C Sugar Ltd.	0.682581
P G Foils Ltd.	0.680809
K M Sugar Mills Ltd.	0.552597
Shree Renuka Sugars Ltd.	0.488179
Sakthi Sugars Ltd.	0.486086
Man Aluminium Ltd.	0.456367
Venus Sugar Ltd.	0.450765
Ugar Sugar Works Ltd.	0.427491
Sir Shadi Lal Enterprises Ltd.	0.393606
Sacheta Metals Ltd.	0.370363
Triveni Engineering & Inds. Ltd.	0.348036

Table: 2 Raking of the Aluminum Industry

Sudal Industries Limited has been ranked number one among all the cement companies operating in India using efficiency as a performance measure. Triveni Engineering and Industries Limited has been ranked 20th using the same performance measurement criteria. The coefficient of variation of efficiency performance measurement criteria of companies of Aluminum Industry in India is 35.31 percent (Table -2).

Chennai Petroleum Corporation Limited has been ranked number one among all the cement companies operating in India using efficiency as a performance measure. Reliance Petroleum Limited has been ranked 20th using the same performance measurement criteria. The coefficient of variation of efficiency performance measurement criteria of companies of Petroleum Industry in India is 85.47 percent (Table -3).

Petroleum Industry	Ranking (Using DEA)
Chennai Petroleum Corpn. Ltd.	1
Mangalore Refinery & Petrochemicals Ltd.	1
Bongaigaon Refinery & Petrochemicals Ltd.	1
Reliance Industries Ltd.	0.734196
Numaligarh Refinery Ltd.	0.56071
Indian Oil Corpn. Ltd.	0.476268
Bharat Petroleum Corpn. Ltd.	0.386683
Hindustan Petroleum Corpn. Ltd.	0.285308
H P C L-Mittal Energy Ltd.	0.015167
Essar Oil Ltd.	0.009426
Nagarjuna Oil Corpn. Ltd.	0
Reliance Petroleum Ltd.	0

Table: 3 Raking of the Petroleum Industry

Jalgaon Re-Rolling Industries Limited has been ranked number one among all the cement companies operating in India using efficiency as a performance measure. Impex Ferro Technology Limited has been ranked 20th using the same performance measurement criteria. The coefficient of variation of efficiency performance measurement criteria of companies of Steel Industry in India is 45.04 percent (Table -4).

Eastern Sugar & Industries Limited has been ranked number one among all the cement companies operating in India using efficiency as a performance measure. Riga Sugar Co. Limited has been ranked 20th using the same performance measurement criteria. The coefficient of variation of efficiency performance measurement criteria of companies of Sugar Industry in India is 38.69 percent (Table-5).

Steel Industry	Ranking (Using DEA)
Jalgaon Re-Rolling Inds. Ltd.	1
Jindal Seamless Tubes Ltd.	1
Remi Metals Gujarat Ltd.	0.839046
Anjaney Ferro Alloys Ltd.	0.654058
Swapna Sakar Steel Ltd.	0.558541
Steel Strips Ltd.	0.491342
Hira Ferro Alloys Ltd.	0.45801
Sujana Towers Ltd.	0.456422
Maithan Alloys Ltd.	0.434191
Alok Ferro Alloys Ltd.	0.426328
Kamper Concast Ltd.	0.417465
Ankit Metal & Power Ltd.	0.378297
Inducto Steel Ltd.	0.362671
Godawari Power & Ispat Ltd.	0.334223
Nava Bharat Ventures Ltd.	0.322718
Andhra Ferro Alloys Ltd.	0.320893
Gallantt Metal Ltd.	0.313583
Facor Alloys Ltd.	0.31317
Sova Ispat Alloys Ltd.	0.287783
Impex Ferro Tech Ltd.	0.279272

Table: 4 Raking of the Steel Industry

CONCLUSION

Using DEA the companies of all the five industries have been ranked. Singhal Cement & Allied Industries Limited, Sudal Industries Limited, Chennai Petroleum Corporation Limited, Jalgaon Re-Rolling Industries Limited and Eastern Sugar & Industries Limited of cement, aluminum, petroleum, steel and sugar industries respectively have been ranked number one. It was a stark surprise that no relatively known company of respective industry could mange to come up at the number one position. This unique

situation can be attributed to using this new perspective of measuring performance of companies by efficiency using distance function with the help of DEA (Data Envelopment Analysis).

Sugar Industy	Ranking (Using DEA)
Eastern Sugar & Inds. Ltd.	1
Ugar Sugar Works Ltd.	0.992203
Sir Shadi Lal Enterprises Ltd.	0.894543
Venus Sugar Ltd.	0.841093
Triveni Engineering & Inds. Ltd.	0.79959
Shree Renuka Sugars Ltd.	0.757575
Ravalgaon Sugar Farm Ltd.	0.733252
Sakthi Sugars Ltd.	0.708551
Jeypore Sugar Co. Ltd.	0.632834
Kothari Sugars & Chemicals Ltd.	0.531618
K C P Sugar & Inds. Corpn. Ltd.	0.492337
Bannari Amman Sugars Ltd.	0.467907
Indian Sucrose Ltd.	0.459533
G M R Industries Ltd.	0.403675
Empee Sugars & Chemicals Ltd.	0.379708
Simbhaoli Sugars Ltd.	0.379207
Piccadily Agro Inds. Ltd.	0.367699
Kesar Enterprises Ltd.	0.329953
Bajaj Hindusthan Ltd.	0.320182
Riga Sugar Co. Ltd.	0.294066

Table: 5 Raking of the Sugar Industry

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