

Comparing & Analysing the Efficiencies of the top 5 Cement Companies in India using Data Envelopment Analysis

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Abstract

Data Envelopment Analysis (DEA) is a non-parametric approach applied to analyse & compare the performance of various organisations in the context of multiple input and output. This paper aims at evaluating and analyzing the production efficiencies of the top market players in the Indian cement manufacturing sector. The period of study spans from 2014 to 2019, where the data has been collected from moneycontrol.com website as well as from the annual reports of these companies. The paper analyses the efficiency of these companies during the period based on certain input and output factors. The factors considered as the input are the raw material expense, power & fuel expenses and compensation to employees. Whereas the output factors are profit before tax & net sales. The factors have been decided based on secondary research. These factors have been analyzed using BCC-O/P & CRS-O/P DEA models. The technical as well as scale efficiency has been determined to analyze and compare the companies. The study establishes that the 3 out of the 5 cement companies are efficient, whereas 2 companies are inefficient. Slacks of these companies have also been studied.

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I. INTRODUCTION

The Indian Cement industry is competitive in the global scenario in terms of its production capacity. Factors such as increased construction activities, technological developments and cost control has led to the development of the industry, thus establishing an upward trend. With approximately 480 million tons of installed annual production capacity (MTPA) in FY 2019, India is the 2nd largest cement producer after China. Yet, per capita intake remains to be lowest at a 210 kg vs world average of 575 kg. In terms of market share and competitiveness in the industry, the top 5 companies accounted for approximately 48 per cent of the installed capacity market and approximately 47 per cent of production in FY19. Installed total capability grew by 46 per cent over seven years (FY12-FY19). More than 25 MTPA of new capacity had been installed in FY19. A modest CAGR of 5.6 percent was added to capability

throughout 2012-19. Cement production in FY19 increased by 13.3% to 337.3 million tonnes (MMT) compared to 6.3% in FY18. This has been the largest increase in cement production recorded in the last decade in a single year. Bioenergy and other alternative fuels are being used increasingly by the major cement manufacturers in the country to fire their kilns. It helps to slash cement producers' production costs. It also aids in reducing discharges. The Cement industry's raw materials include the calcareous, slag, gypsum, fly ash, clinker. Data Envelopment Analysis (DEA) was used in this research paper to measure the output of the selected cement companies in India.

Because of the growing construction & infrastructural activities in recent times, the cement industry in India has experienced various innovations.

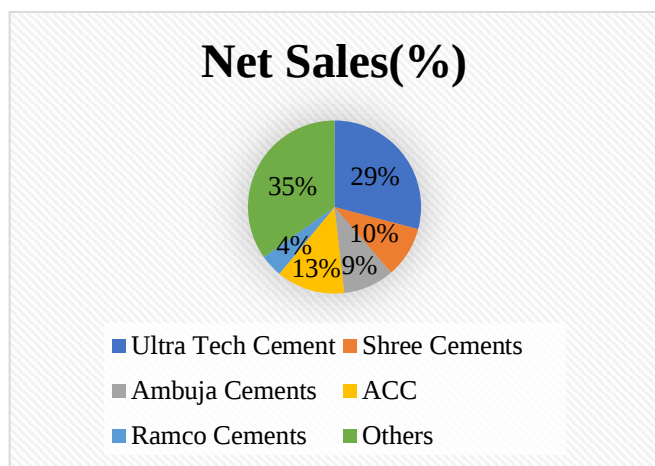


Fig 1: Percentage share of major cement manufacturers in India

The Indian government has also taken measures to boost the construction and real estate sector. All these factors are anticipated to slingshot the housing segment's stipulated demand for construction materials, including cement. With the government's policies of rapid resolution of legal procedures, lower taxation and a marked increase in infrastructure spending, the cement industry is bound to grow and drive the economy upwards. Moreover, the Indian cement industry is projected to produce 550-600 million tons of cement per annum by 2025. This rapid growth in the upcoming years can be attributed to the soaring demands from allied sectors. Construction activities, be it commercial, industrial or housing is expected to fuel the growth of the cement industry.

II. LITERATURE SURVEY

Data Envelopment Analysis (DEA) is a non-parametric approach applied to analyse & compare the performance of various organisations in the context of multiple input and output. In their paper, Banker, Charnes, and Cooper (1984) designed mathematical programming to calculate the decision-making units' operational effectiveness. Its linear method of equation formulation was useful in determining the performance efficiency scores of cement manufacturers in India. The authors of the paper in the discussion developed the model of VSR i.e. variable scale return. It also helped to gather more information about the Data Envelopment Analysis (DEA) & their methodology as well as its application. DEA is a fairly novel method that is useful in estimating a DMU's

(Decision-making units) efficiency. Many inputs are translated to different outputs.

In their paper, Andersen and Peterson (1993) offered instructions for the ranking of the productive units and helped to compare the ranks obtained by parametric methods. Anderson and Peterson published an Analysis of Super Performance.

In his academic paper, Karimzadeh (2012) attempted analyzing the performance of Indian commercial banks following the DEA approach. The study had concluded that the performance efficiency of PSB's (Public-sector banks) was more superior in comparison to that of the private-sector banks.

In their paper, Nandkumar and Singh (2014) have attempted to calculate the commercial banks' technological performance in the Indian scenario. The analysis found that, during the period of the study, performance of the private sector banks was superior to that of the public sector banks.

Tandon and Malhotra (2014) in their paper had made an effort to quantify Indian commercial banks' economic, basic, and scale performance. The paper analysed that the efficiency scores of three kinds of banks, i.e. private, public & foreign had different efficiency scores. Tehrani, Megharagan and Golkani (2012) in their paper evaluated selected firms' corporate performance by analyzing data envelopment in the study taking into account the productivity ratio as a contribution.

By applying DEA on the data of the Peruvian banks, Zegarra, Kumar, Charles, and Avolio (2011) in their research paper made an attempt to quantify the bank's performance. Overall, global banks were found to be better performers than Peru's regional banks. This study provides a context for the application of DEA in evaluating and comparing efficiency performance at an industry level, according to Canan Saricam and Nazan Erdumlu (TUI Istanbul, Turkey) (November 2012). They are researching DEA to calculate productivity levels compared to each other. They used the DEA model to prove the use of DEA in efficiency calculations. d DEA model was analyzed under the assumption of a variable return to scale.

Dr V.Sarangarajan, Dr A.Ananth and Dr S.A.Lourthuraj noted that the cement industry's production in Tamil Nadu

was strong in 1997, 1998, 2004 and that the remainder of the years the industry would improve its financial performance as a result of its research into the financial performance of selected cement companies in Tamil Nadu (January-April 2013). This work also allows us to make the work done on quality production in the cement sector a reality. For this study, the cement company that is based for Tamil Nadu used them only as a random sample. Here they concluded that, in addition to maintaining a good supply chain management strategy, the Tamil Nadu cement companies had to combine to become strong, vibrant, and also conclude they had to concentrate on the export market.

We thus represent the average overall technical performance score of large, medium-sized and small businesses, using the DEA model. At the end of research, they found that the small-scale manufacturing industries are the finest performing enterprises in terms of relative efficiency. According to them, the findings of this study provide a valuable guide in terms of evaluating their output level for top manufacturing companies in Kenya.

III. RESEARCH METHODOLOGY

In this paper, Data Envelopment analysis(DEA) is used to measure the scale and technical efficiencies of the top 5 Indian cement manufacturing industries according to market capitalization.

Analysis of Data Envelopment: Efficiency is a significant factor in DEA research to find a relationship in a manufacturing process between input and output. DEA is a non-parametric method used for estimating production limits in research and economics of operations. This is used in a practical way to measure the total efficacy of units of decision making. The tool was designed with multi-input and multi-output production functions which are used to calculate efficiency results in many industries.

Analysis carried out in this paper has been done by taking into account two outputs and three inputs. Two outputs in this analysis are the Net Sales & Profit Before Tax(PBT).The three inputs considered for analysis are raw material expenses, power & fuel charges, and employee benefit expenses. Top five cement companies according to the market capitalization have been chosen for the study. According to money control website these top 5 companies in India are Shree Cement, Ultra tech, Ambuja cement, ACC & Ramco Cements, not necessarily in the same order. The data has been collected from moneycontrol.com website and the annual reports of these companies. The analysis was carried out using Excel solver.

The mean values of the data collected of the various DMU's from 2014-2019 are shown in Table 1.

The input-output variables were selected after studying the available literature on the topic. Charnes, Cooper and Rhodes (1978), introduced the CCR-Model. The CCR model is based on assuming constant scale returns; an efficiency margin is built to estimate DMU operating efficiency. Cooper, Charnes & Banker then created the BCC model in 1984, which incorporates efficiency concepts and implementations under the CCR model.

The original model CCR applied only to globally defined technologies with steady scale returns. Banker, Charnes, and Cooper (BCC) , in what turned out to be a significant advancement, expanded the CCR model to fit technologies that show variable returns to scale. In the years that followed, empirical contributions from a significant number of researchers accumulated into a considerable amount of literature around the CCR–BCC models, and DEA's generalized methodology emerged as a valid alternative to efficiency-calculation regression analysis. The DEA method is designed to assess the relative performance of peers within a category, i.e. comparable DMUs. Appropriate consideration should, therefore, be taken when choosing the units of analysis. In India over 200 companies operate in the cement industry in the organized market. Companies were listed in current research based on their market capitalisation.

Table-I: The Mean values of input and output parameters from 2014-2019

DMU	Net Sales	PBT	RM Exp	P & F Cost	Compensation to Employees
Shree Cement	8139.43	1149.28	657.333	1766.34	518.767
Ultratech	27481.1	3329.33	4783.56	5542	1541.24
Ambuja Cement	19388	2419.45	2303.32	4089.99	1192.8
ACC	13045	1273.85	2079.36	2642.14	807.997
Ramco Cements	4079.22	586.512	696.132	727.695	272.783

IV. RESULTS & DISCUSSION

In this research paper, we have used the financials of the cement manufacturing industries, operating in India, to perform Data envelopment analysis. These are the top 5 cement manufacturing companies according to market capitalization in India. The data has been taken for 6 years from FY 14 to FY 19. The various factors considered for this study are profit before tax (PBT), net sales of the company, compensation to employees, power and fuel charges and raw material expenses. The data includes three input and two output. The data accumulated is then written in the form of linear programming formulas, which then are solved using Data envelopment analysis (DEA) technique. The CCR-O/P & BCC-O/P models were used for DEA to compare the CRS as well as the VRS of different companies in the sector. Technical efficiency and scale efficiency comparing both the models is shown in table II.

Constant return to scale (CRS) shows that for a certain change in input, the output is changed in the same proportion. If the change in output is not proportionate to the change in input, it is classified as either increasing returns to scale or decreasing returns to scale, depending on the increase or decrease in the output. A decision-making unit(DMU) having an efficiency score of 1 indicates that it lies on the efficiency frontier. A score of less than 1 indicates that a DMU is relatively inefficient.

The efficiency score of 1 specifies that the company is producing the maximum possible output by utilizing the input resources ideally.

An inefficient company is the one having a score of less than 1. Companies operating under the increasing return of scale can increase productivity by increasing production volume. The companies that operate under diminishing return to scale are over-using capital, so they are inefficient. The point lies below the efficiency frontier.

Table-II: Output table with various parameters of the companies under study

	COMPANY	Variable returns to scale TE	Constant returns to scale TE	Scale Efficiency	Returns to Scale
1	SHREE CEMENT	1	1	1	Constant returns to scale
2	ULTRATECH	1	1	1	Constant returns to scale
3	AMBUJA CEMENTS	1	0.9942	0.9942	Decreasing Returns to Scale
4	ACC	0.9894	0.9774	0.9878	Decreasing Returns to Scale
5	RAMCO CEMENTS	1	1	1	Constant returns to scale
	Average	0.9979	0.9943	0.9964	

Table-III: Weighted output data of the selected companies

No.	DMU	CRS TE	RM Exp	P & F Cost	Compensation Emp	Net Sales	PBT
1	Shree Cement	1	1	0	0	1	0
2	Ultratech	1	0	0	1	0.1756	0.8244
3	Ambuja	0.9942	0.106786376	0.541054947	0.35795	1	0
4	ACC	0.9774	0.1432782S05	0.519473769	0.36037	1	0
5	Ramco	1	0	0.109917273	0.89008	0	1

This work is an attempt to evaluate the relative performance of Indian cement companies by evaluating their performance in terms of both technical and quality of scale.

Overall, both in terms of technical efficiency and scale performance, the industry seems to be doing well as the industry's average scores were 0.9979 for variable return to scale, 0.9943 for constant return to scale and 0.9964 for scale output. All 5 companies are efficient companies out of the chosen group of size, but 1 company is not technically efficient and all other companies are technically efficient. Slacks of the two inefficient companies are shown in the Table IV.

Table-IV- Output table indicating Slack and CRS TE

S.no	Company	CRS TE	Slack: PBT
1	Ambuja Cement	0.9942	183.621
2	ACC	0.9774	448.295

A slack value in the PBT indicates that the firm is losing out on specified amount of money due to inefficiency. The slack values for Ambuja cement & ACC is as shown in the table above. Table III displays the weighted data of the DMUs. It illustrates that Ambuja cement should consider putting in 54.10% effort in reducing in power & fuel expenses, approximately 36% on compensation to employees & only around 10% in reducing raw material expenses. This would help in improving the total efficiency score of the company. Similarly, ACC needs to focus on power & fuel cost more than other input costs.

V. CONCLUSION

Cement demand is tightly linked to the overall economic growth of the country. There is a cross linkage of demand between the housing and infrastructure development in the country. The real estate sector accounts for a large chunk of India's overall domestic demand for cement. This paper analyzes the output of the cement producers. We found two companies i.e., ACC & Ambuja Cements were inefficient according to CRS-O/P efficiency scores. The other three companies, Ultratech, Shree Cements & Ramco Cements were found to be efficient. In the study slacks were found to be in both inputs and outputs, but the input slacks were more than the output slacks. Hence, inputs have to be reduced in order to increase the firm's productivity and efficiency.

REFERENCES

- [1] Shekhar, Chandra. (2017). A STUDY ON THE PERFORMANCE EFFICIENCY OF CEMENT SECTOR IN INDIA. International Educational Scientific Research Journal. 3. 36.
- [2] Tali, Arif & Padi, Tirupathi Rao & Dar, Qaiser. (2018). DEA Window Analysis with slack-based measure of Efficiency in Indian Cement Industry. Statistics, Optimization & Information Computing. 6. 10.19139/soic.v6i2.360.
- [3] BANERJEE, Dr. (2018). Measuring the Efficiency of Indian cement companies utilizing Data Envelopment Analysis during the Pre and Post recession period. Serbian Journal of Management. 13. 10.5937/sjm13-14685.
- [4] Chandrasekaran, Satish & Chitnis, Asmita. (2019). Performance of Indian Cement Companies: A Super Efficiency DEA Study. 10.4108/eai.18-12-2018.2283810.
- [5] Gholami, Kobra & ghelej beigi, Zahra. (2013). Allocating the Fixed Resources and Setting Targets in Integer Data Envelopment Analysis. Journal of Data Envelopment Analysis and Decision Science. 2013. 10.5899/2013/dea-00030.