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A Case Study of Minority Institutions by Using BCC Model-DEA Approach

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Abstract: *To understand the performance of the Technical Institutes for enriching a better teaching and research process. The score of the performance appraisal of the Institutes would serve an individual in choosing a particular Institution, to hire the right manpower, and provide financial support for the betterment of students and underperforming Institutions. In order to play a major role and be in the journey of the global economy a vast country like India needs the Institutions performance to go up so as to promote the Technical Education. In this paper, the Technical Efficiency and Efficiency differences among 19 Minority Technical Institutions under JNTUH of Telangana in India are measured by a linear programme based technique, Data Envelopment Analysis using BCC Model. DEA Efficiency evaluation method identifies the functions that improves the quality of education and brings improvement in the system*
Keywords: *BCC Model, Data Envelopment Analysis, DMUS, Efficiency Measurement, Technical Efficiency.*

I. Introduction

India being the world's largest democracy has shown a tremendous growth in its techno-economic prowess, over the last 62 years of post-Independence era, sustaining an economic growth of 7 to 8% during the last 10 years. It attains self-reliance in strategic sectors and in key areas including food security which makes the Indian economy the third largest economies of the world. Above all, it makes India proud by meeting the requirement of S&T manpower of the advanced Nation's of the world for their outsourced qualified and skilled brain power to manage the businesses, knowledge, Industries and Research centers. All this could be possible primarily because of a formidable support offered by India's ever growing Technical Education sector. The Technical Education has become the primary source in the Education sector which has become a business for private societies and trusts. The priority is been laid on the intake of the revenue which is taken from the students in the form of fees and the focus on quality education has taken a set back. Ideally, there needs to be a private participation that should enhance the Philanthropic contributions which should come from the corporate, industry and society to Technical Education but this has not happened. Further, the major corporate houses, large industries, PSUs and multi-national industries have not come forward to join the private initiative for supporting the growth of quality Technical Education in India. This is a major area of concern and requires strategic interventions on behalf of the government policy.

II. Data Envelopment Analysis

Data envelopment analysis (DEA) is a linear programming methodology to measure the efficiency of multiple decision-making units (DMUs) when the production process presents a structure of multiple inputs and outputs."DEA has been used for both production and cost data. Utilizing the selected variables, such as unit cost and output, DEA software searches for the points with the lowest unit cost for any given output, connecting those points to form the efficiency frontier. Any organization not on the frontier is considered inefficient. A numerical co-efficient 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 on the studies of electricity distribution in organizations identified more than thirty DEA analyses—indicating widespread application of this technique to that network industry. (Jamasb, T. J., Pollitt, M. G. 2001). A number of studies using this technique have been published for water utilities. The main advantage to this method is its ability to accommodate a multiplicity of inputs and outputs. It is also useful because it takes into consideration returns to scale in calculating efficiency, allowing for the concept of increasing or decreasing efficiency based on size and output levels.
Some of the advantages of DEA are:

- No need to explicitly specify a mathematical form for the production function.
- Proven to be useful in uncovering relationships that remain hidden for other methodologies.
- Capable of handling multiple inputs and outputs.
- Capable of being used with any input-output measurement.
- The sources of inefficiency can be analyzed and quantified for every evaluated unit.

Some of the disadvantages of DEA are:

- Results are sensitive to the selection of inputs and outputs. (Berg 2010).
- One cannot test for the best specification. (Berg 2010).
- The number of efficient firms on the frontier tends to increase with the number of inputs and output variables. (Berg 2010).

A desire to Improve upon DEA, by reducing its disadvantages or strengthening its advantages has been a major cause for many discoveries in the recent literature. One such approach is the Stochastic DEA, which makes a synthesizes of DEA and SFA, improving upon their drawbacks .

III. BCC Model

Introduced by Banker, Chames and Cooper (1984), this model measures Technical Efficiency as the convexity constraint and ensures that the composite unit is of similar scale size as the unit being measured. The resulting efficiency is always at least equal to the one given by the CCR model, and those DMUs with the lowest input or highest output levels are rated efficient. Unlike the CCR model, the BCC model allows for variable returns to scale. While Farrell (1957) introduced the model for efficiency analysis, the model was restrictive with the assumption of constant returns to scale. Farrell and Field house (1962) extended this model to allow non-decreasing returns to scale. Afriat (1972) provides the variable returns to scale model that was popularized in the operations research literature by Banker et al. (1984). Banker et al. (1984) (BCC) show that the addition of a convexity constraint to the CCR model results in a DEA model that allows increasing, constant, and decreasing returns to scale. In addition, BCC provides a decomposition of CCR Farrell efficiency into scale and technical parts.

BCC FORMULATION- VARIABLE RETURNS TO SCALE

$$Z(BCC) = \text{Min}\,\lambda$$

Subject to

$$\sum_{j=1}^{n} \lambda_j X_{ij} \leq \lambda X_{io} \qquad i = 1,2 \ldots\ldots m$$

$$\sum_{j=1}^{n} \lambda_j \mu_{rj} \geq \mu r_o \qquad r = 1,2 \ldots\ldots s$$

$$\sum_{j=1}^{n} \lambda_j = 1 \qquad \lambda_j \geq 0$$

There are 'n' decision making units each employs 'm' similar inputs and produces's' similar outputs. Z (BCC) is an efficiency measure corrected for scale differences. The BCC formulation is called as an envelopment problem. Since the production possibility set envelops all the observation tightly and hence the name Data Envelopment Analysis (DEA).

IV. Empirical Investigation

To measure the Technical Efficiency using BCC Model through DEA approach a sample of 19 Minority Technical Institutes were taken. The Analysis uses 3 inputs and 2 outputs in the various Technical Institutions. Out of 19 Minority Technical Institutions 13 are Efficient Institutions and the remaining can emerge to be efficient if they improve the overall Technical efficiency.

Statistic by BCC Model

Result Analysis	BCC Score of Minority Institutions
No. of Efficient Institutions	13
No. of Inefficient Institutions	06
Average Efficiency Result	0.9161
Standard Deviation	0.061085
Maximum Efficiency Result	1.000
Minimum Efficiency Result	0.834
Coefficient of Variation	6.3498

V. Conclusion

In recent decades, Higher Education has experienced an exponential growth. Along with the increases there has come the need to establish accreditation systems that ensure the quality of Higher Education. Basing on the comparison of N.B.A & Non- N.B.A Accredited Institutions, N.B.A Accredited Institutions are more efficient. More over, most of the Institutions that show inefficiencies are near to the aim value. There exists the possibility that this high number of efficient units responds to an elevate grade of heterogeneity among the Institutions. The mean size of these Institutions is slightly smaller than the mentioned standards of the University. As the co-efficient of the Institutions that have been evaluated inefficient are near to 1, it will not be difficult to approach the efficiency

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