DEA BASED ANALYSIS FOR EFFICIENCY OF SCHOOLS UNDER KVS: A CASE STUDY ON KVS SCHOOLS OF ODISHA

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Abstract -Higher Secondary & Secondary Schools play an active, important and vital role in the development of a country. They are sources for generating ideas and knowledge which relates to the development of a country's educational filed as well as the quality life of its citizens.This paper assesses the efficiency differences among 5- KendriyaVidyalaya's result of last 15 years of 3-district in Odisha state in India by Data Envelopment Analysis (DEA).The input and output variables used in this study are those contributing to teaching and learning performance. The input variables considered are number of teaching staff, number of non-teaching staff , number of students and yearly money paid by students while the output variables are total number of passed students for the year, total number of students medial qualified forthat year, total number of students engineering qualified forthat year and total number of students AG qualified forthat year. To investigate the performance of Students with different input-output combinations are defined. Sensitivity analysis performedsuggests that different combinations of input-output yield different efficiency scores. Furthermore, when all outputs areincluded, the KendriyaVidyalaya Schools are better then the other Schools.

Keywords -Data Envelopment Analysis, Efficiency, Schools.

1. Introduction

Today, Higher Secondary Schools and Secondary Schools are centers of generating and transferring knowledge which leads to the development of a country. This can be done through two main activities of schools namely teaching andlearning. But the questions like what is goodschool and how can improve the performance of a school are always of interest forparents, teachers, educationists and policy makers. The definition of good schooldiffers for individual to individual. For instance in opinion of a budget official agood school has the lowest expenditure per pupil as his attention is only onfinancing of schooling.At the same time, in parent's view a good school is thatwhose students perform the best in examination as they often pay attention tooutput or achievement.

In actual fact educational institutions differ most often interms of facilities (inputs) that they provide as well as in achievements (outputs)that they produce. So it is the challenge to evaluate the performance of schools inthis kind of multidimensional setting.

The main aim of this paper is to analysis the result of different KVS schools' efficiency to some extent in the presence of multiple inputs andoutputs by using Data Envelopment Analysis (DEA) technique (Charnes et al,1978). This is a linear programming based technique which is applied to assess theefficiency of organizations such as universities, schools, bank branches, hospitals,power plants, police stations, tax offices, prisons, manufacturing units and a set offirms or even practicing individuals such as medical practitioners which often usemultiple resources (inputs) to achieve multiple goals (outputs). The methodologymeasures the relative efficiency without prior assumption of input-output weights.We have used it to calculate the relative efficiency scores of last 15th years results of 6-KVS schools in 3-distritOdisha State in India.

2. Literature Survey

Tyagi et al. (2009) evaluated technical, pure and scale efficiencies of 19 departments of a university in India via DEA. Sensitivity analysis was conducted to test robustness of the efficiency results. Martin (2003) conducted a DEA analysis on assessing the performance of departments that belong to a university in Spain. The study revealed the existence of differences between departments of different areas. Köksal and Nalçaci (2006) employed DEA to measure efficiency of academic departments of an engineering college in Turkey. Multiple criteria decision making was integrated to improve the discrimination power. Agha et al. (2011) evaluated technical efficiency at the Islamic University in Gaza. Super-efficiency was applied on efficient departments to determine the most efficient department. Moreno and Tadepali (2002) used DEA to examine efficiency ofNur Azlina Abd Aziz et al. / Procedia - Social and Behavioral Sciences 90 (2013) 540 – 548academic departments at a public university and suggested using DEA as a planning tool. Kao and Hung (2008) applied DEA to assess the relative efficiency of academic departments at National Cheng Kung University in Taiwan. They applied cluster analysis to categorize the academic departments into groups that have similar features. They also restricted the flexibility in selecting the weights by constructing assurance region for the weight based on the priori information given by the top administrators.

3. Data Envelopment Analysis

Data envelopment analysis (DEA) is a linear programming based technique for measuring the relative performance of organisational units where the presence of multiple inputs and outputs makes comparisons difficult.Farell (1957) developed the Data Envelopment Analysis (DEA). Farell was based on the work of Debrew and Coopmans (1951) in order to define a simple measure of corporate performance by using numerous entrances [8]. More specifically, Farell expressed the efficiency of units production by using the total productivity factor, which is defined as the fraction of the overall output towards the overall input.

Farell handled the disadvantages of the previous three methods, the method of labor's medium (average) productivity, the method of measuring the factor of performance (performance indicators) as well as the cost compare method through the definition of technical profitability. Farell's theory is mainly oriented towards the decrease of input.

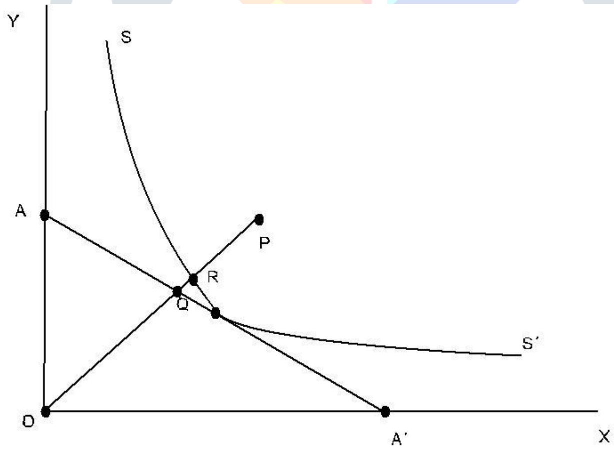
Farell defined Technical Efficiency as the combination of productive factors oriented by the function of production, which are used for the production of the maximum quantity of output without wasting them. Allocative Efficiency refers to the combination of factors of production that minimizes the cost of production [13]. In figure 1, the graph explains the Technical and Allocative Efficiency in conditions of steady climax return and effective function of production. The curve H is the curve of production (isoproductive curve). The input of the decision making unit is expressed per unit of output and is shown on axes Y and X. The element P represents the combination of both input factors per output unit.

The same height SS' represents various fluctuations of both factors which a perfect effective trade name uses in order to produce an exit unit. Then, efficiencies are defined as:

Technical Efficiency: TE=OR/OP Allocative
Efficiency AE=OQ/OR Overall Efficiency
OE=OQ/OP=TE*AE

Figure 1

Diagram of efficiency interpretation



Then Farell developed the inability to find the production function in real conditions and made the technical efficiency (the efficient operation of production) by the comparative method of business inputs and outputs with unknown production function.

Input and output concern the overall quantities that units insert or produce, provided that a unit might outweigh in specific inflows or outflows but lose in other inflows or outflows

The main equation of efficiency for the application of DEA method is given by Charnes' equation [7],

$$\text{Efficiency}=\frac{\sum_{r=1}^{s} UrYrj}{\sum_{i=1}^{m} NiXij}$$

i is the footnote of entries (i = 1,2,…..m)

j is the annotation of DMUs (j = 1,2,…..n)

r is the annotation of exits (r = 1,2,….s) $Xij$is

the i entry of j DMU

Yrj is the r exit of j DMU

s is the number of exits

m is the number of entries

n is the number of units

3.1 CCR Model

CCR Model was initially developed by Charnes and it exclusively calculates DMUs efficiency [7]. The model uses the acknowledgement that Production Probability Set (PPS) is the minimum total that satisfies the conditions required for the construction of PPS itself [30]. The particular model is focused on the estimation of non-efficiency of units.

During the estimation of efficiency in a unit, the solving of the equation reaches solutions that neither involves cuts to exits (outputs) nor rises to entries (inputs). In CCR model, restrictions don't allow solutions that involve changes in both entries and exits, because the study is conducted in relevance with technical efficiency. Units are evaluated by the combination of efficient units. The best solution of efficiency never outperforms the unit.

3.2 BCC Model

BCC Model was developed by Banker, Charnes and Cooper [2]. This model, which is linear, measures the productive efficiency and other sizes of the productive process through inflows (inputs) and outflows (outputs) relations. Whereas, CCR model deals with constant return to scale, BCC model deals with variable return to scale. The assumption of convexity of Banker, Charnes and Cooper, in relation with the principle of the minimum approach indicate that BCC model measures the productivity of the studied productive plan with a linear means.

4. Experimental Design

Thedata of Kendriya Vidyalaya Baripada, Kendriya Vidyalaya Balasore, Kendriya Vidyalaya Bhadark, Kendriya Vidyalaya Murgabadi, Kendriya Vidyalaya Rairangpur of Higher Secondary and Secondary School results of Mayurbhanj are collected and analysed.

4. Data, Variables and Models

4.1. Data -The present study investigates the KVS result efficiency differences of higher secondary schools and secondary schools of Odisha in India. Data are collected from different schools of class X & XII students, the examination havebeen conducted by CBSE in each year. We have the data of last 15-years in 5 schools of 3 districts in Odisha. The data are cross-sectional and aggregated to the school level.

YEAR	NO.OF STUDENTS	Teaching Staff for School	Teaching Staff for class XII	Non_Teaching Staff	Passed	1st Division	Agriculture	Medical	Engineering
2005	60	35	9	6	60	60	0	11	13
2006	61	37	11	5	61	55	3	8	11
2007	56	34	8	4	56	49	5	13	16
2008	58	33	10	6	58	58	0	15	16
2009	54	30	8	5	51	45	4	12	18
2010	63	36	7	4	57	51	6	11	17
2011	52	38	10	4	52	52	0	9	13
2012	60	41	8	4	58	55	0	5	15
2013	55	31	10	8	55	50	9	14	12
2014	61	39	7	5	56	50	3	8	11
2015	51	32	8	4	48	45	5	13	16
2016	56	30	9	6	54	50	2	10	25
2017	58	38	6	7	52	45	8	13	18
2018	57	36	8	8	57	57	5	11	15
2019	59	33	10	8	59	59	9	15	18

Table 1

4.2. Variables-As little is known about the nature of the educational productionfunction (Hanushek, 1986) and no clear criterion is available about selection ofinputs and outputs, choice of the variables for educational analysis is a criticalissue. In literature it is seen school related variables (teaching staff, non-teaching staff and students etc) on input side and academic (passed & 1st division) andnon academic (medical, engineering and AG qualified) achievements on output side. Following Bessent et al.(1980,1982); Sengupta (1987); Diamond et al, (1990); Beasely (1995), this studyhas considered 3 inputs and 5 outputs variables.

4.3 Models -To assess the intuitive picture of performance and to measure thedependency of efficiency on different variables we consider four models withdifferent input-output setting. The guiding principle in construction of models is toproceed from simple one (with less number of input-output variables) to morecomplicated ones (with greater number of variables). This strategy of running fourmodel enable us to test the robustness of results also as our methodology DEA isnot a statistical method with which the theoretically based hypothesis can be testedwith classical tests. The input and output variables included in our four models areshown in the Table 2.

5. Analysis

Sl	Year	M1	M2	M3	M4
1	2005	0.58	0.498333	0.516667	0.395
2	2006	0.538	0.470492	0.459016	0.355738
3	2007	0.575	0.523214	0.5125	0.405357
4	2008	0.607	0.532759	0.558621	0.431034
5	2009	0.557	0.507407	0.5	0.413725
6	2010	0.522	0.468254	0.457143	0.396491
7	2011	0.585	0.501923	0.519231	0.394231
8	2012	0.535	0.456667	0.455	0.35
9	2013	0.584	0.527273	0.518182	0.421818
10	2014	0.497	0.437705	0.42623	0.360714
11	2015	0.576	0.519608	0.523529	0.439583
12	2016	0.589	0.525	0.525	0.409259
13	2017	0.533	0.489655	0.474138	0.423077
14	2018	0.6	0.519298	0.529825	0.412281
15	2019	0.627	0.552542	0.562712	0.447458

Table 2

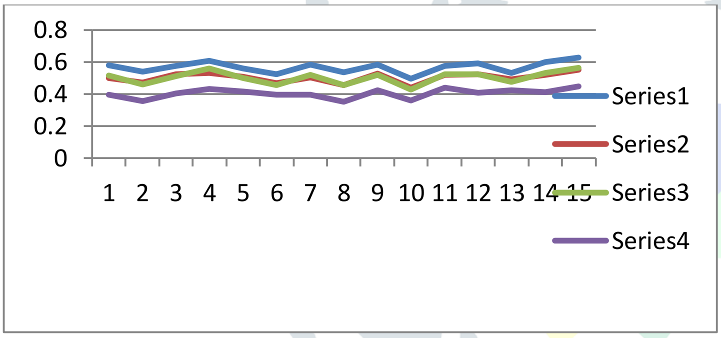


Figure 2. The efficiency distributions of model 1-4

6. Conclusion and Future Scope

This paper attempts to measure the efficiency scores of results in higher secondary schools and secondary schools of KVS in Odisha. DEA proves to be an appropriate method to analyze efficiency of educational institutions. It is commonly accepted that the performance of a school can be attributed to both internal and external factors. Based on most of the empirical literature in schooling, the model of education has been modeled as a function where inputs (teaching-staffs, non-teaching staffs, students, fees) are combined in order to produce output (school performance, like- pass, 1st division, 2nd division, 3rd division, medical qualified, engineering qualified, AG qualified). Information from the observed performance of schools will help those deemed relatively inefficient to improve their performance. This deep insight can be useful in developing strategies in order to improve the quality of education on a national scale.

7. Refernces

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