Technical Efficiency of Higher Educational Institutions: A Study of Affiliated Degree Colleges of Barak Valley in Assam, India

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Abstract

Higher educational institutions (HEIs) as producing units involve several tangible and intangible inputs as well as outputs, and these outputs contribute to economic development through development of human capital. In Barak Valley number of colleges is increasing day by day, but the success rates of most of the colleges are below average. Some of the colleges are either over utilising or under utilising their resources, which results in loss of output and inefficiency. The paper investigates the technical efficiency of HEIs in Barak Valley and analyses the factors which influences the output of the HEIs by using stochastic frontier analysis (SFA). It also compares the technical efficiency (TE) scores of National Assessment and Accreditation Council (NAAC) accredited HEIs with other HEIS and then compares the rank of the HEIs with respect to their TE scores and performance. The study reveals that NAAC accredited HEIs are more technically efficient and performing better than non-accredited HEIs.

Keywords: Technical Efficiency, Stochastic Frontier Analysis, Performance, Higher Educational Institutions.

1. Introduction

Efficient management of resources in every sector is a central issue with respect to our scarce resources from the perspective of management. Recently, different organisations and institutions use various methods to measure their efficiency and then search ways to improve them. This does not only apply to profit-making organizations, but also in non-profit making organizations and the public sectors, including educational institutions. Efficiency of Higher Educational Institutions (HEIs) is one of the subjects of growing attention in recent years. The issue of efficiency in higher education in this Barak Valley or elsewhere has remained vague and problematic due to huge heterogeneity within the system itself. As the resources are scarce so the optimal utilisation of resources are required in every sector. Therefore, it is important to analyse whether the educational institutions are working efficiently or not.

One of the ways to find efficiency is the measurement of technical efficiency, which specifies the relationship between inputs and outputs in production processes. Technical efficiency can be defined in two ways; either from input side or from output side. From the input side, technical efficiency refers to the production of a given amount of output with a minimum input combination (input orientated), while from the output side it shows the ability of a firm, sector or institution to produce the maximum output with given inputs (output orientated). The measurement of institution specific technical efficiency is based upon deviations of observed output from the best production or efficient production frontier. A unit is considered efficient if the actual production point lies on the frontier, and technically inefficient if it lies below the frontier.

HEIs produce skill, efficient and trained workers which increase labour productivity and ultimately lead to economic development. But the labour productivity depends on the quality and level of the education; hence efficient management of HEIs is necessary. In Barak

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Valley, numbers of students in colleges are increasing day by day, but there are inadequate infrastructural facilities and low success rate in most of the colleges. Thus the study focuses on measurement of technical efficiency of higher educational institutions in Barak Valley by considering the higher educational institutions as analogous to a firm transforming inputs into outputs through a production process where typical inputs in the education production function are the characteristics of the teaching and learning environment, while output(s) are defined as students' performance.

1.1. Structure of Higher Education in Barak Valley

The Barak Valley is situated in southern part of Assam consisting of three districts viz: Cachar, Karimganj and Hailakandi. In this region both public and private institutions operate simultaneously to provide higher education for the people of the valley and its nearby areas. At present there are 41 degree colleges, one Central University (under it these 41 degree colleges are affiliated), one Medical College, one NIT, one Polytechnic Institute, and few study centres of Distance Education which constitutes the set of Higher Educational Institutions in Barak Valley. Here out of these 41 degree colleges 32 provide general education of either single or combination of Arts, Science and Commerce streams, and the rest nine are professional colleges (seven B.Ed. Colleges and two Law colleges). In Barak Valley, there are 15 NAAC accredited HEIs out of which one is teacher's training college, another one is central university and the rest 13 are three years general degree colleges. The study is concentrated only on affiliated general degree colleges.

2. Review of Literature

There are several literatures in the field of Economics of Education which measures the quality and performance of the educational institutions by measuring the technical and allocative efficiency of the institutions, cost-benefit analysis etc. Many authors across the worlds have used Stochastic Frontier Analysis (SFA) or Data Envelopment Analysis (DEA) or both to estimate efficiency of HEIs.

Daghbashyan (2011) investigates the economic efficiency of 30 higher education institutions in Sweden by using SFA for three groups of variables viz; university specific indicators, staff and student characteristics. The study suggests that young teachers and researchers contribute more to the HEI performance in terms of economic efficiency. Chakraborty (2009) has used Stochastic Frontier Analysis to measure efficiency of public education and its inefficiency effect. The study reveals that students' socio-economic factors plays a crucial role in efficiency of a school than school inputs, higher the expenditure lower is the performance of the school, while class size and teachers' educational level have no impact on it.

Kou and Ho (2007) have used SFA for multiple-product cost function model in order to empirically measure the cost efficiency of the University Operation Fund (UOF) on Taiwan's public universities. The study suggests that the adoption of the UOF has had a significantly negative impact on cost efficiency. John Robst (2001) has measured cost efficiency of Public Higher Education Institutions by using OSL and MLE for a stochastic production frontier. He has examined the factors leading to inefficiency and evaluated the impact on efficiency scores with the change in revenue structure. The study reveals that increase in fees lead to more inefficiency and institutions with less state share are more efficient than institutions with more state share.

Liu et al. (2012) analyze the technical efficiency of 40 Teacher's colleges of Thailand by taking a multiple input-output educational production function. They find that high personnel's quality, more intensity funds and more research and development have positive impact in the technical efficiency scores of teacher's colleges, while the years of establishment of the colleges has no impact on it. Man and Fung (2011) measures efficiency of Hong Kong Public Funded Universities by using output oriented DEA (Data Envelope Analysis). The study reveals that teaching universities are performing better than Research Universities in both teaching and researches. However, they observe that time is not a critical factor on the performances for both groups.

Abbot and Doucougliagos (2002) have estimated technical and scale efficiency of Australian Universities and analyse the sensibility of degree of efficiency with respect to different inputs and outputs. They find that Australian Universities are performing at a fairly high level of technical and scale efficiency.

Abbot and Doucougliagos (2009), McMillan and Chan (2007 and 2004), Kempkes and Pohl (2006) have used both DEA and SFA to measure efficiency of the HEIs. Kempkes and Pohl (2006) have applied both DEA and SFA to find the efficiency of publicly financed universities of Germany and compared the efficiency scores obtained by DEA and SFA. McMillan and Chan (2004) have conducted a study for 45 Canadian universities by using both methodologies for selected specifications and measured correlation coefficient of the efficiency scores obtained from these two methodologies.

3. The Objectives of the Study

The study attempts to analyse the following objectives:

- To estimate a production frontier and identify the responsible factors which influences the output of the HEIs in Barak Valley.
- To measure technical efficiency of both NAAC accredited HEIs and non-accredited HEIs.
- To compare the rank of the HEIs on the basis of their performance in terms of TE score and output produced by the HEIs.

4. Hypotheses of the Study

Based on the above objectives the study, the following hypotheses can be framed:

- Numbers of teaching staffs, appeared students and subject offered by the HEIs are the responsible factors for determining output level of the HEIs.
- There is no variation in the technical efficiency scores between the NAAC accredited and non-NAAC accredited HEIs.
- There is no difference in ranking of the HEIs in terms of TE scores and weighted output produced by the HEIs.

5. Methodology of the Study

This section is divided into two sub-sections. The first sub-section contains the methodology for data sources and selection of variables, whereas second part contains the methodology for data analyses which are in the following:

5.1. Data set and Selection of Variables

The study adopts complete enumeration method for data collection. Here, all the general degree colleges of Barak Valley are taken as sample for the study. To avoid heterogeneity in the dataset professional colleges are omitted. Out of 32 HEIs only three HEIs are excluded from the study due to unavailability of data related to some variables, which are very crucial for the study. Hence the final sample size of the study 29 HEIs. Dataset of the study have been collected from the secondary sources, viz; Annual Report of Assam University, Silchar (AUS) 2011-12 and Result Booklet of AUS-2012.

The measurement of efficiency or inefficiency of educational institution and the determinants of educational efficiency are examined by various authors by considering the educational institution as analogous to a firm transforming inputs into outputs through a production process. Typical inputs in the education production function are the characteristics of the teaching and learning environment, while outputs are generally defined in terms of students' test scores. It follows that a strong assumption held in this type of analysis is that technical relationships are of central importance in the educational process (Worthington 2001). In Higher educational institutions, some specific factors such as size, load, staff and student characteristics as well as government allocations are suggested to be the potential determinants of economic efficiency (Daghbashyan 2011).

5.2. Output of the HEIs

An education production function is an application of the economic concept of a production function to the field of education and involves many tangible and intangible inputs and outputs (Hopkins and Massay 1981). Educational outputs can be defined as a function of services offered by the institutions. One of the primary outputs of every HEI is its quality of successful graduates, which generally measured in terms of the performance of the students in the final examination. Quality of output is however the only aspect of each HEI's contribution to human capital is as the quality of education varies among the HEIs. Degree results are an alternative variable for measuring the quality of education, since it is the most obvious outcome of every HEI (Johnes and Taylor 1990). One can easily distinguish two HEIs with same pass rate, it one has more number of first class and second class than the other. Hence it is more justified to measure output by assigning proper weights with the quality and level of performance (Johnes and Taylor 1990, Kuksal and Naluaci 2006).

In this study final year's result index is taken as proxy for output of the HEIs, which calculated by using following formula:

$$WR_i = \frac{W_1 \times FD + W_2 \times SD + W_3 \times TD}{\sum_{i=1}^{3} W_i}$$

Here WR is the weighted result of the i^{th} HEI, W_1, W_2 and W_3 are the weights assigned to numbers of first division (FD), number of second division (SD), and third division (TD) students respectively. Here weights are assigned into 3:2:1 ratio. Then another index is constructed to measure the performance of the HEIs after estimating result index for both pass and honours graduates, further weights are assigned to honours and pass graduates into 3:2 ratios. Honours graduates are considered as better performer than ordinary pass (Johnes and Taylor1990). This index is denoted by weighted output (WO) and taken output of the study.

5.3. Inputs of the HEIs

This study is based on the available input variables viz; total number of teaching staffs (NTS), number of appeared students (NAS) and number of subjects offered by the HEIs (NSO) are taken as inputs. Here, NTS stands for number of staffs engaged in teaching activity during the session 2011-12. The justification of inclusion of number of teaching staffs (NTS) is that performance of HEI is always positively affected by the teachers (Abbot& Docouliagos 2009, Anastasian et al 2009, Chiu et al 29009, Liu et al 2012). Success rate of the institution is more influenced by its number of candidates finally appeared rather its enrolment number. Because, there may be some drop out candidates in enrolled number and poor quality students may be screened by the authority subject to their performance in the pre-final examination. So, instead of enrolment number, inclusion of number of appeared students (NAS) is more justified for explaining the performance of the institution. Subject offered by the HEIs (NSO) by the HEIs is also a crucial variable because it is observed that enrolment in a particular HEI is largely influenced by it, hence it is assumed that it will have a strong impact in determining output of HEIs (Tochkov et al 2012).

5.4 Methodology for Data Analysis: Stochastic Production Frontier Model

A stochastic frontier captures all the possible combinations and involves fitting stochastic production or cost frontier models to data. The stochastic frontier production function was independently proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977). The original specification involved a production function specified for cross-sectional data which has an error term with two components, one to account for random effects and another to account for technical inefficiency. This model can be expressed in the following form:

$$Y_i = \beta_k X_{ik} + v_i - u_i \quad \text{Or} \quad Y_i = f(X_{ki}; \beta_k)\exp(v_i - u_i)$$

where; i=1,2...,n. Y_i is the production (or the logarithm of the production) of the i-th firm; X_{ik} is a *KX1* vector of input quantities of the i-th firm, β_k is vector of unknown parameters, v_i are random components which follows $N(0,\sigma_v^2)$. u_i are non-negative random variables which accounts for technical inefficiency in production which follows either half-normal or truncated-normal or exponential distribution. Both the error components are independent of each other. For given values of all the variables technical efficiency measures can be calculated as:

Technical Efficiency *(TE)* $= Y_i/Y_i^* = f(X_{ki}; \beta_k)\exp(v_i - u_i)/f(X_{ki}; \beta_k)\exp(v_i) = \exp(-u_i)$

Here Y_i is the observed output, Y_i^* is the desire or frontier level of output and $0 \leq TE \leq 1$.

In this study, for cross-section data both Cobb-Douglas and Translog stochastic frontier model are used for the affiliated degree colleges of Barak Valley. Both these models have taken for checking the suitability of the better fit.

$$LWO_i = \alpha + \beta_1 LNTS_i + \beta_2 LNSO_i + \beta_2 LNAS_i + (v_i - u_i) \qquad (1)$$

$$LWO_i = \alpha + \beta_1 LNTS_i + \beta_2 LNSO_i + \beta_2 LNAS_i + \beta_4 LNTS_i^{\,2} + \beta_5 LNSO_i^{\,2} + \beta_6 LNAS_i^{\,2} + \beta_7 LNTS_i LNSO_i + \beta_8 LNSO_i LNAS_i + \beta_9 LNAS_i LNSO_i + (v_i - u_i) \qquad (2)$$

The variables (both output and inputs) are defined in earlier section. Here, the suffix i stand for a particular institution and the inefficiency term u_i is assumed to be exponentially distributed.

To analyse the performance of the HEIs, performance index is constructed by taking two dimensional indices viz; Technical Efficiency score index (TESI) and Weighted Output (WOI) index with equal weight. The dimension index for both TESI and WOI are constructed by using the following formula:

$$Dimension\ Index = \frac{Actual\ Value\ of\ j^{th}\ variable\ for\ i'th\ HEI - Minimum\ Value of\ j^{th}\ variable}{Maximum\ Value of\ j^{th}\ variable - Minimum\ Value\ of\ j^{th} variable}$$

Where, j=1,2 and i=1,2,3,...........29.

The performance index of i[th] HEI can be written as $PI_i = \frac{1}{2}(TESI_i + WOI_i)$

Where, PI_i is the performance index for i[th] the HEI, and $TESI_i$ *and* WOI_i are the dimensional index for i[th] HEI.

After estimating efficiency scores for each HEI, a rank has been assigned to these HEIs on the basis of its capacity to produce maximum possible amount of output for given level of inputs. Then to rank the HEIs on the basis of its performance, contribution of the HEIs in producing quality graduates are also taken into consideration. Though theoretically more production requires more inputs but when a firm operates under decreasing returns to scale, it uses more inputs relative to its output and hence become inefficient. Since education institutions provide merit goods to the society and production of more output is more desirable to society, so net contribution of an educational institution is also equally important to give ranking to HEIs. Hence to rank the HEIs, Dimension Index has been constructed for both technical efficiency (TE) scores and weighted result of the HEIs which denotes total quality output of the HEIs, and then by assigning equal weights to both one composite index is considered for ranking purpose. A comparison of this ranking with official ranking given by NAAC has been done. Tochkov et al. (2012) have also attempted to correlate the efficiency scores with official rankings of the HEIs and found divergent outcome. Then to compare the rank of the HEIs in terms of TE score, total output produced and performance index Spearman's Rank Correlation coefficient is used in this study.

6. Results and Findings

The results of the ordinary least square estimation (OLS) and maximum likelihood estimation (MLE) of the above mentioned stochastic Cobb- Douglas (C-D) frontier and Trans-log frontier for the session 2011-12 are depicted in a single Table (Table 1). The estimates of the study reveals that higher educational output of this region is positively influenced by number of teaching staffs and number of appeared students.

Table 1: Estimates of stochastic production frontier for the HEIs of Barak Valley

	Variable	Coefficient	Standard Error	*t* values	*p* values
Ordinary Least Square Estimates of Cobb-Douglas Production Frontier	Constant	-5.08071***	0.601587	-8.446	0.00
	LNTS	0.513486	0.37271	1.378	0.16
	LNSO	-0.15414	0.329312	-0.468	0.63
	LNAS	1.131638***	0.133768	8.46	0.00
Maximum Likelihood Estimates of Cobb-Douglas Production Frontier	Constant	-4.38745***	0.590864	-7.425	0.00
	LNTS	0.769509**	0.380317	2.023	0.04
	LNSO	-0.42113	0.298727	-1.41	0.15
	LNAS	1.048067***	7.52E-02	13.931	0.00
	Theta	2.490102***	0.693199	3.592	0.00
	Sigma v	0.189726*	0.11774	1.611	0.10
Maximum Likelihood Estimates of Trans-log Production Frontier	Constant	-5.0972067	3.3052831	-1.542	0.12
	LNTS	0.57601391	4.140313	0.139	0.88
	LNAS	4.51685138	2.9654898	1.523	0.12
	LNSO	-1.4742703	1.3237967	-1.114	0.26
	$LTAS^2$	-8.88E-02	0.22761577	-0.39	0.69
	$LNTS^2$	-0.9104106	1.3704658	-0.664	0.50
	$LNSO^2$	0.46275638	1.0082513	0.459	0.64
	LNSOLNTS	-0.8908503	1.782356	-0.5	0.61
	LNSOLNAS	-1.0244526	0.87898837	-1.165	0.24
	LNASLNTS	1.91055449**	0.95269859	2.005	0.04
	Theta	1.97040***	0.44726356	4.405	0.00
	Sigma v	4.22E-03	5.99E-02	0.07	0.94

Source: Estimated Results of SFA from the AUS Annual reports 2011 -12 & AUS Result Booklet 2012.
Note: **, ** and *** denote variables are significant at 10%, less than 5% and less than 0.01% level of significance respectively.*

Results of C-D frontier reveal that number of appeared students is positively related with output and highly significant at less than one per cent level of significance for both OLS and MLE estimation. The results reveal that number of subjects provided by an institution is inversely related with output but statistically insignificant. Number of teachers is positively related with output and significant at less than five per cent level of significance in case of MLE estimation. Structural factor coefficient is negative and highly significant, indicating that there are other responsible factors in the input vectors which are responsible for loss of output of the HEIs, which are not included in the model. The variance parameters indicate variation in institution specific factors and presence of inefficiency. The calculated value of *gamma* (0.8175) denotes the composite influence of both the error terms which indicates loss of output is more contributed by presence of inefficiency. The coefficient of variances viz; Sigma-squared (v) and Sigma-squared (u) are 0.03600 and 0.16127 respectively. Model test statistic ***F*** value is 69.27 and significant at less than one percent level of significance. The R^2 and *Adjusted* R^2 of the model are 0.89 and 0.88 respectively indicating good fit for the variables in the model.

The results of trans-log production frontier also reveal the presence of inefficiency. Though F test is significant with R^2 and *Adjusted* R^2 of the model are 0.91 and 0.86 respectively indicating goodness of fit of the model, but all parameters are insignificant except one significant parameter that denotes the cross elasticity of number of teachers and appeared students. Therefore, this trans-log production function can not be accepted as the appropriate production frontier due to poor statistical inference. However, Cob-Douglas production is the appropriate production frontier.

Technical Efficiency Score distribution of NAAC Accredited and Non-accredited HEI's

The technical efficiency scores are calculated as the ratio of observed output and the maximum level of output that can be produced in the absence of stochastic inefficiency term. The technical efficiency score lies between 0 and 1; the score closer to 1 indicates greater degree of efficiency and vice-versa. The study reveals that a variation in terms of technical efficiency scores of NAAC accredited HEIs and non-accredited HEIs within and between the groups. Here non-accredited HEIs are showing more variation in terms of TE scores than that of NAAC accredited HEIs. Out of 29 HEIs, most of the HEIs are producing below the production frontier. The technical efficiency scores of 27 HEIs are below 0.9 and only two HEIs are producing near the frontier. Accredited HEIs in comparison to others are producing more with average technical efficiency score 0.762; whereas the average technical efficiency score of non-accredited HEIs is 0.669. Here, 11 HEIs have efficiency score below the ungrouped average 0.699, and out of these 11 inefficient HEIs three are accredited and ten are non-accredited HEIs (Table 2).

Table 2: Technical Efficiency score distribution of the HEIs

Technical Efficiency Scores	Number of HEIs	NAAC accredited HEIs	Non- accredited HEIs
0.00-0.2	1	0	1
0.21-0.4	3	1	2
0.41-0.6	1	0	1
0.61-0.7	6	2	4
0.71-0.8	8	4	4
0.81-0.9	8	6	2
0.91-1.0	2	0	2
Total (N)	29	13	16
Average	0.699236	0.761586	0.669503
Maximum	0.926446	0.886566	0.926446
Minimum	0.137202	0.370353	0.137202
Standard Deviation	0.195427	0.145052	0.22451
Skewness	-1.41579	-1.79411	-1.112974
Kurtosis	1.750781	3.802588	0.821469
Median	0.758434	0.784585	0.720908

Source: Estimated Results from the AUS Annual reports 2011 -12 & AUS Result Booklet 2012.

Non-accredited HEIs ranges their TE score from maximum to minimum values, while there is no single accredited HEIs on highest and lowest class interval of TE score. The coefficient of variation is also high in case of non-accredited HEIs. In this study almost 50 per cent HEIs are technically inefficient in terms of producing successful good quality students. The probable reason may be deficiency in resource management or lack of complementary resources. It is observed that only one non-accredited HEI is operating at the minimum efficiency range 0.0 to 0.2. Among these 29 HEIs only two HEIs are producing near frontier and ten HEIs have high TE score, i.e., more than 0.8, which implies that approximately 34 percent HEIs are efficient and others are inefficient or less efficient. Fifty per cent of the non-accredited HEIs are highly inefficient while approximately twenty-three per cent NAAC accredited HEIs are inefficient and others are technically efficient. Among accredited HEIs, approximately 30 per cent HEIs have below average TE score, while more than 50 per cent of non-accredited HEIs are below average TE score. Hence the study reveals that majority of colleges are technically inefficient and accredited HEIs are performing better than non-accredited HEIs.

Ranking of the HEIs and its comparison with NAAC ranks

After estimating efficiency scores for each HEI a rank has been assigned to these HEIs on the basis of its capacity to produce maximum possible amount of output for given level of inputs. Ranking has been also assigned on the basis of HEIs' contribution to the society in terms of weighted output and final ranking of HEIs was done on basis of a composite index which shows the average value of two dimensional indices, viz; technical efficiency score index (TESI) and weighted output index (WPI).

The result reveals that there is difference among technical efficiency score, weighted output and performance index's ranking, but the correlations among these are very high. The ranking of the HEIs with NAAC ranks are shown in Table 3. Here, efficiency scores are shown along with the NAAC ranks for 13 accredited and 16 non-NAAC accredited HEIs. HEI-1 is producing highest but ranked ninth in terms of technical efficiency. Due to its service in providing highest amount of output to the valley it has ultimately ranked first in terms of composite performance index.

Table 3: Ranking of the HEIs

HEI Code	TE Score Rank	Weighted Output Rank	PI Rank	NAAC Ranks as per Annual Report-2011-12	Latest NAAC Ranks*
1	9	1	1	B++	
2	10	2	2	B+	B
3	3	4	3	B	B
4	6	6	5	B+	A
5	5	7	6	B	B
6	4	9	7	C++	B
7	18	3	8	B+	
8	13	14	14	B	
9	16	11	15	C+	
10	17	13	18	B	
11	20	17	19	C+	
12	24	21	23	C++	

13	27	16	26	C++
14	1	10	4	
15	8	8	9	
16	2	25	10	
17	7	18	11	
18	15	5	12	
19	11	12	13	
20	12	23	16	
21	14	15	17	
22	19	22	20	
23	21	24	21	
24	23	20	22	
25	22	27	24	
26	25	26	25	
27	26	28	27	
28	28	19	28	
29	29	29	29	

Source: Estimated Results from the AUS Annual reports 2011 -12 & AUS Result Booklet 2012.

*Note: * Unpublished latest NAAC Ranks of five HEIs reassessed during 2010- 2011(collected from official website of the Colleges).*

Similarly HEI-2 has ranked second in PI and 10^{th} in TE and finally secures the second position. On the other hand HEI-10 which is a non-NAAC accredited HEI the most efficient HEI is ranked tenth in terms of PI and forth in general. Again HEI-29 has scored least in terms of TE and PI with last rank position in all the three indicators. HEI-4 and HEI-15 have secured equal ranked in both the dimension and ultimately ranked in fifth and ninth position respectively. HEI-7 has ranked third in contributing successful students to the society, but not that much technically efficient and ranked eighth among the HEIs.

From this study it is also observed that there is variation in terms of ranking of the study and NAAC ranks. HEI-3 has ranked third in this study while ranked B by NAAC, while HEI-5 and 7 was ranked B+ by NAAC which have ranked fifth and eight in terms in terms of their performance. HEI-6 and 9 is performing better than HEI-10, but in terms of NAAC rank it is better. Again HEI-12 and 13, which are performing almost at the bottom of the list have ranked better in terms of NAAC score, while HEI-9 laying on the average range of performance has scored lower in NAAC score. The variation in NAAC rank and ranking of the study is due to the reason that the TE scores are here obtained on the basis of current performance subject to the selected explanatory variables. Whereas the NAAC assessment took place more or less five years back. Recently NAAC has assessed only five HEIs. After reassessment of NAAC, it is observed that all these five HEIs have improved their NAAC score which is also reflected in four HEIs technical efficiency scores.

The rank correlation coefficients of the three variables show positive relationship among each other and technical efficiency scores have more influence on ranking of the HEIs than performance indicator than weighted output. Table 4 shows calculated value of Spearman's Rank Correlation coefficients. The result reveals that the rank correlation among technical efficiency scores, weighted output produced and performance indicator of the HEIs are very high.

Table 4: Rank Correlation coefficients of performance indicators

Spearman's Rank Correlation coefficients	Performance Index	Weighted Output Index	Technical Efficiency Score Index
Performance index	1	0.827(**)	0.906(**)
Weighted Output index	0.827(**)	1	0.592(**)
Technical Efficiency Score	0.906(**)	0.592(**)	1

Source: Estimated Results from the AUS Annual reports 2011 -12 & AUS Result Booklet 2012.
*Note: ** denotes correlation is significant at the 0.01 level (1-tailed).*

The correlation coefficient of TE score and weighted output index is positive and significant, which implies that the HEIs which are technically efficient are producing more quality output. Since the performance index is constructed by taking average of TESI and WOI, the correlation coefficients of PI with TESI and WOI is very high, but it is observed that influence of TE score is stronger in determining performance of the HEIs than weighted output.

7. Conclusions

HEIs offers more skills and knowledge which helps in development of a region through development of human resource. Affiliated degree colleges of Barak Valley provide higher education to a large number of students who wants pursue higher education and helps to develop local community, but majority of these HEIs are either over utilising or under utilising their resources. The study reveals that in Barak Valley accredited HEIs are more technically efficient compared to non-NAAC accredited HEIs although both contribute into the sector of higher education. Among the determinants of HEIs' output, number of academic staffs and number of appeared candidates are found highly significant and positively related with the level of HEIs' output, while number of subjects offered by the HEIs is found insignificant and negatively related with the output of the HEIs. Here, it is observed that C-D frontier model is more suitable than Trans-log frontier. In this study only two HEIs are producing near frontier and only ten HEIs have high TE score and others are inefficient or less efficient. Fifty percent of the non-accredited HEIs are highly inefficient while approximately twenty-three percent NAAC accredited HEIs are inefficient and others are technically efficient. Here, majority of colleges are technically inefficient. Probable causes of inefficiency may be the differences in quality of inputs or poor utilisation of the resources. It is also observed that HEIs with same inputs produces different level of outputs. This may be either due to differences in productive capacity of the HEIs or inputs qualities or due to variation in student's background. Hence for assessing efficiency of HEIs, wider range variables are needed to be incorporated in the model and assessment should be made in a continuous and comprehensive manner. As the technical efficiency score depends on set of input variables used in the production frontier, hence inclusion or exclusion of some inputs variables may bring separate picture in technical efficiency scores and performance of the HEIs.

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