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Ranking of Efficient States of India on the Basis of Performances in Secondary Education: An Application of Super Efficiency Models

Dr. Rangalal Mohapatra*

*Assistant Professor,
Department of Economics,
Sikkim University,
Sikkim, India.

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Abstract

This paper is an empirical study of examining the efficiency of the states of India on performing in the class 10 levels by using two educational outputs and five educational inputs. From the results the fully efficient states were ranked using the radial and non-radial super efficiency DEA model and it was found that out of 23 states considered, only 10 states were efficient and rest 13 states were inefficient. In ranking the efficient states it was observed that Goa was found to be the rank one super efficient state which can at least increase its inputs by at least 167% in case of radial model and non radial model under CRS environment. In case of non-radial model under VRS Manipur and Mizoram also became super efficient. The result suggests that the all the super efficient states can expand their input use and still remain efficient. The study will enable the states to manage their inputs use more efficiently which will improve the educational standard of the country.

Keywords: Radial Super Efficiency, SBM Super Efficiency, Input Slack, Input Oriented Radial Super Efficiency Under CRS and VRS, Input Oriented Non Radial Super Efficiency under VRS.

1. Introduction

Human resource development is the key to development in the sense that education has to play a significant and interventionist role in correcting and reducing the imbalances in the socio economic fabric of the society. Education for all aims at quality basic education all over the country and seeks to ensure access, retention and quality improvement; the focus on girls education to equalize educational opportunities and eliminate gender disparities. As far as the secondary education is concerned, Rastriya Madhyamik Siksha Abhiyan (RMSA) was launched in March 2009 with the objective to enhance access to secondary education and to improve its quality. It envisaged at achieving an enrolment rate of 75% from 52.26% in 2005-06 at secondary stage within five years by providing a secondary school within a reasonable distance of any habitation. The number of high schools (as per the reports of Ministry of Human Resource Development, GOI) increased from 7416 in 1951 to 126047 in 2000-01 and the number of boards increased from 7 to 39. The other objectives include improving quality of education impaired at secondary level through making all secondary schools confirm to the prescribed norms removing gender socio economic and desirability barriers providing universal access to secondary level education by 2017. Improvement in the quality will be through: appointment of additional teachers to reduce pupil teacher ratio to 30:1; to focus on Science Math and English education; in service training of teachers; ICT enabled education; curriculum reform and teaching learning reform. Equity aspect will be addressed through special focus on micro planning preference to areas concentrated with SC/ST/Minorities and more female teacher etc. As per the constitution of India, school education was originally a state subject. Besides CBSE and ICSE schools, each school has its own department of education that runs its own school system within its own text books and evaluation system. The curriculum, pedagogy and evaluation methods are largely decided by the SCERT in the state, following the National guidelines followed by NCERT. As per the data of Department of Higher education, MHRD, GOI 2006-07, the government managed secondary schools increased from 26.54% in 1973-74 to 31.16% in 2006-07 where as the private aided schools have decreased from 57.02% to 28.12% in 2006-07 but comparatively, the private unaided schools have increased from 5.59% in 1973 to 34.56% in 2006-07. The more revealing fact is that the total private schools (aided and unaided) consisted of more than 63%. Thus, among all the types of schools, the private unaided schools have increased by 30% during the same period.

Secondary education is a crucial stage in the educational hierarchy as it prepares the young person's for higher education and also the world for the work. The Government of India's intervention in secondary education is at two levels: through apex national bodies and through centrally sponsored scheme such as boarding and hostel facilities for girls student of secondary and higher secondary school, information and communication technology schools and quality improvement in the school. Improving the efficiency of the schools is a growing concern of educational planners and managers in recent years. The shift of the attention towards strategies which focus on school functioning rather than the overall education system is inspired by several considerations. Firstly, reforms have very often targeted the provision of the inputs in the system rather than the process of teaching and decision making in particular in schools which are crucial in explaining differences in quality. Secondly, many reforms in the past tried to focus on isolated components of the system for instance, teachers or text book. However, improving the efficiency of the individual component does not automatically lead to improving an organization. Processes are contextual and their improvement depends on the capacity of each school to become an effective organization. Thirdly, reforms were not adopted to the very varied means of the individual schools characterized as they were by general, system wise strategy. Educational sector is substantially varied. It is therefore necessary to use extreme care in constructing "performance indicators" for efficiency analysis. Two issues are of primary importance: first, institutions operate under different conditions and environments, which are often not simply explained. Second, the educational production sector contains many inputs and output. Despite a huge rise in the number of high schools at All India level (from 7416 in 1950-51 to a 126047 in 2000-01) and increment in the enrolment of students, increase in student teacher ratio, recruitment of more male and female teachers, all the states in India do not perform in an uniform manner.

Hence, keeping in view that secondary school education (Class 10) is indeed important in building the career; the present paper has made an attempt to measure the level of efficiency of the states as far as the performance in the 10th class result is concerned* using the CCR DEA input oriented model and to classify the fully efficient and inefficient state. Then an attempt has been made to rank the fully efficient states using the super efficiency DEA model of Anderson and Peterson (1993) and the Slack Based Measure (SBM) super efficiency model as advocated by Tone (1997, 2001). State level data on educational input and outs for the year 2010-11 have been used to analyze the objectives.

2. Literature Review

Data Envelopment Analysis (DEA) is a non parametric approach of frontier estimation, first developed by Charnes, Cooper and Rhodes (CCR) (1978). Based on the original CCR model, Banker Charnes and Cooper (BCC) (1984), developed a Variable Returns to Scale (VRS) variation. The most important adaptation is to rank decision making units (DMUs). DMUs are divided into efficient and inefficient groups and their ranks are examined by using DEA. The first application of DEA was to public schools in the evaluation of Program Fellow through CCR model. Since then DEA has been greatly extended and advanced in its method of specialization. DEA has been applied to a variety of other non-profit entities (Emrouznejad and Thanassoulis, 1996). According to DMUs efficiency scores, DMUs are classified into efficient and inefficient groups. Unlike the inefficient ones, efficient DMUs cannot be ranked based on their efficiencies because of having same score of unity. According to Alder et. al .(2002) , super efficiency is one of the ranking techniques which ranked the efficient units of the frontier and concluded that each technique has its own importance in a particular area and hence, no single method can be prescribed.

According to Banker and Gifford (1988) and Banker et.al. (1989) Super Efficiency (SE) is the possible capacity of a DMU in increasing its inputs and or reducing its output without becoming inefficient. The measurement of SE is significant because of identifying outlier (Banker and Gifford, 1988; and Banker et.al., 1989; Banker and Chang, 2006; Johnson and McGinnis, 2009; Wilson, 1995) , ranking the efficient DMUs (Anderson and Peterson, 1993), measuring technology and productivity change (Fare et.al., 1994) and solving two persons ratio efficiency games (Rousseau and Semple, 1995) identifying extreme efficient DMUs (Thrall, 1996), analyzing sensitivity of efficient classification (Charnes et.al., 1992; Charnes et.al., 1996; Seiford and Zhu, 1998; Zhu, 1996, 2001, 2003), calculating efficiency stability region (Seiford and Zhu, 1998) and overcoming truncation problem in second stage regression intended to explain variation in

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* Out of 29 states only 23 states are considered because of the unavailability of required secondary data accessed from the Statistics of School Education (2010-11), Government of India, MHRD, Bureau of Planning and Monitoring and Statistics, New Delhi, 2012.

efficiency. Anderson and Peterson 1993, introduced the super efficiency as a ranking methodology to differentiate the performance of extreme efficient DMUs. They proposed both constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) by making modification in CCR model of Charnes et al., (1978) and BCC model Banker et.al. (1984). However, the infeasibility of SE model occurs when an efficient DMU under evaluation cannot reach the frontier formed by the rest of the DMUs via input increment or output reduction.

The studies on SE measurement are classified into Radial and Non-radial. Under radial model, the basic CRS- based SE model is the CRS based AP model (1993). In addition to the issue of infeasibility CRS-AP model may be unstable as it is extremely sensitive to small variation in the data when some DMUs have rather small values for some inputs.

Liu and Tsai (2004) analyzed the profitability performance of 29 public semi conductor Taiwanese companies using super efficiency model to overcome some deficiencies. Nordin et.al., (2012) used super efficiency model to analyse the ranking of efficient units of Malaysian Business Units. There are a number of important DEA studies looking at the efficiency of higher education, including Ahn (1987), Ahn et. al., (1989) and Avkiran (2001). Recent country specific paper include studies looking at the efficiency of higher education in UK (Johnes, 2006) Australia (Abott and Doucouliagos, 2003) and China (Ng and Li, 2010), Rhodes and Southwick (1986) compiled data from 1979-80 for 96 public and 54 private institutions to perform their analysis. For inputs they used the number of full Professors, no of Assistant Professors no of associate professors, dollars spent on maintenance and dollar spent on libraries. For output they used undergraduate enrolment. Their results indicate that public institutions of higher learning are less efficient than private ones. In studying the technical efficiency of IITs and IISc. using Stochastic Frontier Analysis and DEA models Kulashrestha and Nayak (2015) found that TE varies across the institutions and highlights the need for strengthening the know-how. Other applications of DEA to measure efficiency in higher education include Buston and Phimister (1995), who have applied DEA to evaluate the efficiency of a set of "core Journals". Haksever and Muragishi (1998) have used output oriented CCR for the top 20 MBA programs in USA to analyze early 1990s data from business week and found no efficiency differences between the above two groups of MBA programs.

The international literature contains several studies in many countries which mostly apply Data Envelopment analysis. Ahn et. al. (1998) compared higher US higher education institution aimed at research using three inputs and three output factors. Public universities achieved greater levels of efficiency than private facilities. In a separate study, Rhodes and Southwick (1986), contrast the efficiency of 96 public and 54 private universities in United States (US), applying DEA models with five inputs and six output factors. Results indicated that efficiency in private institutions at that time was higher than public facilities. Breu and Raab (1994) used DEA to access efficiency in 25 of the best universities. Their findings confirm DEA as an appropriate method for measuring efficiency in higher education. Sarrico et. al.,(1997) evaluated 90 higher education facilities in the Unites Kingdom in three categories: (i) government; (ii)institutions: department staffs and students and (iii) potential students. The authors used DEA methodology to determine efficiency levels and compared these with a local ranking and found that DEA indicated better efficiency. Forsund and Kalhagen (1999). investigated efficiency in Norweigian regional facilities in 1994 to 1996. Some institutions were found to be efficient with regard to education services, while inefficient facilities showed significant variation between inefficiency level. Additionally productivity improved during the year studied. Thurlow and Field (2003) analyzed the technical efficiency of 45 British Universities from 1980-81 to 1992-93. The study recorded a significant increase in technical efficiency during this time. Research by Afonso and Santos (2005) estimated efficiency of public universities in Portugal in 2003. Findings indicate a mean efficiency index of approximately 55.3 and 67.8 respectively among facilities investigated. Abbot and Doucouliagos (2003) studied technical efficiency scale of Australian University system. Results point to performance homogeneity for the whole university system. Joumady and Ris (2004) applied DEA methodology to measure efficiency differences in a group of 210 higher education institutions from 8 European countries using a sample of students graduated for more than three years and efficiency varied in accordance with the models used. Souza and Ramos (1997) analyzed the performance of federal higher education facilities in Brazil using DEA and found that 39.1 of the institutions evaluated achieved maximum efficiency while 6.5 were among the least efficient. In his doctorate thesis Belloni (2001) evaluated the productive efficiency performance of 33 Brazilian Federal Universities using DEA methodologies. In contrast to Souza and Ramos (1997) only 6 of 33 federal universities investigated were considered technically efficient. Oliveira and Turrioni (2005) assessed the relative efficiency of federal institutions of higher education (IFES). Five out of 19 institutions were found to be technically inefficient. However, none of the studies used super efficiency DEA model for ranking the fully efficient states in performing secondary education.

3. Theoretical Models

Among several approaches, DEA is perhaps the most commonly used methodology for measuring performance and efficiency estimation (Seiford and Zhu, 1999). Its ability to handle production process involving multiple inputs and outputs makes it an appealing choice and outweighs its statistical shortcomings. The model of SE is proposed by Anderson and Peterson (1993). The efficiency scores from this model are obtained by eliminating data on DMU_0 to be evaluated from the solution set. For input model this results in values which are regarded as according DMU_0, the status of being „super efficient". These values are then used to rank the DMUs and eliminate some ties that occur for efficient DMUs. The usefulness of this method is to know the number of observations that experience a change in their measure of technical efficiency and the magnitude of these changes (Wilson, 1993). Roughly speaking there are two types of measure in DEA: radial and Non radial. Radial measures are represented by CCR and BCC model.

The Radial super efficiency model proposed by Anderson and Peterson (1993) takes the form of CCR model and gives a feasible solution to the problem as opposed to the BCC model associated with the convexity constraint. In this model x_0 and y_0 are omitted from the RHS of the constraints. It means the inputs and outputs of the DMUs to be evaluated are omitted from the production possibility set. The input- oriented super -radial model is shown in equation (1).

[Super Radial-I-C] $\theta^* = \min_{(\theta,\ \lambda,\ s^- s^+)}\ \theta - \varepsilon e s^+$ ------------------------------(1)

Subject to $\theta x_0 = \sum_{j=1,\neq 0}^{n} \lambda_j\ x_j + s^-$

$$y_0 = \sum_{j=1,\neq 0}^{n} \lambda_j \; y_j - s^+$$

Where all components of the λ, θ, s^+, s^- are constrained to be non negative, ε> 0 is the usual Archimedean element and e is a row vector with unity for all the elements. The solution exists so long as X and Y > 0. If the omission of the input and output from the production possibility set does not create any change in the performance, then it implies that the evaluation of an inefficient point is not affected by the omission because the efficient points do not get disturbed due to omission of that point. This happens only in case of the extreme point in the frontier.

However, the Anderson and Peterson model is deficient in treatment of nonzero slacks. It is also have demerit in treating the slacks that is not unit variant. Hence slack based measure is an alternative that eliminate these deficiencies Cooper et.al., (2000). Non Radial SE model based on the slack based measure as advocated by Tone (1999), the SE of (x_0, y_0) as the optimal objective function value δ^* from the following program:

[Super- SBM-C] $\delta^* = \min_{\bar{x},\bar{y},\lambda} \frac{\frac{1}{m}\sum_{i=1}^{m}\frac{\bar{x}_i}{x_{i0}}}{\frac{1}{s}\sum_{r=1}^{s}\frac{\bar{y}_r}{y_{r0}}}$ ---------------------(2)

Subject to $\bar{x} \geq \sum_{j=1,\neq 0}^{n} \lambda_j \; x_j$

$\bar{y} \leq \sum_{j=1,\neq 0}^{n} \lambda_j \; y_j$

$\bar{x} \geq= x_0$ and $\bar{y} \leq y_0$

$\bar{y} \geq 0$ and $\lambda \geq 0$

The non Radial super efficiency under variable returns to scale is evaluated under the following program:

[Super- SBM-V] $\delta^* = \min_{\bar{x},\bar{y},\lambda} \frac{\frac{1}{m}\sum_{i=1}^{m}\frac{\bar{x}_i}{x_{i0}}}{\frac{1}{s}\sum_{r=1}^{s}\frac{\bar{y}_r}{y_{r0}}}$ ------------------ (3)

Subject to $\bar{x} \geq \sum_{j=1,\neq 0}^{n} \lambda_j \; x_j$

$\bar{y} \leq \sum_{j=1,\neq 0}^{n} \lambda_j \; y_j$

$\bar{x} \geq= x_0$ and $\bar{y} \leq y_0$

$$\sum_{j=1,\neq 0}^{n} \lambda_j = 1$$

$\bar{y} \geq 0$ and $\lambda \geq 0$

As per Tone (2000) the non radial super efficiency model under the variable returns to scale environment is always feasible and has a finite optimum.

4. Results and Discussion

The Input oriented CCR model under CRS assumption has been used to compute the efficiency score using two outputs (percentage of students scoring marks 60% and above (PSSM60A) and percentage of students scoring marks between 50% and 60% (PSSMB50-60) and five inputs such as No of students appeared class 10 examination (NSAE), no. of private unaided schools (NPUAS), number of ST enrolment (NSTE), pupil teacher ratio (PTR) and no. of girls per 100 boys (NGP100B). The usual practice of choosing the no of observations is based on the criteria of 3(m + s). The data on these 7 variables have been collected for 23 states of India for the year 2010-11 as the data for other states for all variables under the study are not available. The basic information on all the inputs and outputs used are presented in Table-1.

Table-1: Basic Statistics of the inputs-outs used for Efficiency Analysis

	NSAE	NPUAS	NSTE	PTR	NGP 100B	NSSM A60	NSSMB 50-60
Max	2385701	14097	130646	68	102	62.9	42.4
MIn	9940	43	1478	11	62	7.4	11.2
Mean	457254.5	2965.82	43156.2	27.2	27.36	27.36	27.64
S.D	529336.3	3705.63	37607.4	12	14.91	14.91	7.92

The result of the input oriented CCR model is presented in Table-2. The average efficiency scores for all the DMUs is 0.86203 with a standard deviation of (sd) 0.1726. The minimum score is 0.34973 is achieved by Assam. There are 10 states (as shown in the Table 1 from sl. No 1 to Sl. No 10) which are fully efficient under the constant returns to scale assumption. It means these DMUs are on the frontier who uses minimum input mix to produce maximum outputs as specified above.

Table 2: Efficiency Scores of the States under CCR-I

Sl. No	States	Efficiency Score s	Sl.No	States	Efficiency Scores
1	Uttarakhand	1	13	Mizoram	0.8928
2	Tripura	1	14	Manipur	0.8788
3	Tamil Nadu	1	15	Gujarat	0.8653
4	Bihar	1	16	UP	0.8406
5	Nagaland	1	17	Chhattisgarh	0.7849
6	Goa	1	18	Maharashtra	0.7785
7	Meghalaya	1	19	Odisha	0.7456
8	Haryana	1	20	Karnataka	0.6961
9	Himachal P	1	21	Rajasthan	0.6528
10	MP	1	22	Kerala	0.5065
11	Jharkhand	0.9324	23	Assam	0.3493
12	Andhra P	0.9026	-	-	-
Avg score-	.86203	sd-0.1726	Min-0.34937	Max-1	

The rest states starting from Jharkhand till Assam are considered to be inefficient as their scores are below one. For example Assam is the most inefficient state among all the inefficient states and it can reduce its inputs by 65%. The virtual state formed by the linear combination of 3.1%(Bihar), 15% (Haryana), 1.3% of Tamil Nadu and 23.3% (Uttarakhand) can use 35% of the Assam's input mix and can produce the output of Assam. Therefore relative to the virtual DMU Assam is 35% efficient. The maximum projected input reduction will be in case of NPUAS (74%) followed by NSAE (66%). The result indicates that the state has more number of private unaided schools with more students being admitted for business purpose. This results in high pupil teacher ratio and the deterioration of the quality of education at the secondary schools. Secondly, the number of ST enrolment is more which most often argued as a factor for dismal performance in the examination. However, this cannot be generalized. As per the State report Card, 2010-11, MHRD, GOI, out of total class 10 student enrolment around 11% are repeaters in Assam and 7% of the total secondary schools are equipped with science laboratories. Of all the teachers 11.43% are male trained and 8.72% are female trained in Assam. The more pathetic situation is that only 31% of all the class rooms are in good condition. The second lowest inefficient state is Kerala (of course it is known for its highest literacy percent among all the states in India) with a score of .5065. The state can produce the same level of output even if it goes on reducing the input mix at least by 49% excluding the input slacks. For example, the NPUAS can be reduced by 86% and there will be no change in the present performance of the state. As per the data of State Report Card (2010-11), MHRD, GOI most of the schools (85.76%) of the total enrolment is in the rural schools. The average student-class room ratio is 47 (2012-13) and people teacher ratio is 66 which is much larger than the all India average of 28 in the same period. This has a serious implication on the performance in terms of delivery of quality education. Added to this is that in Kerala only 27% male teachers of all the teachers are trained and this figure is 43% for female teachers. Around 46% of the inefficient states (scores lee than 1) have scored between 80% and 99%.; 38% of the inefficient states have scores between 60% and 79% and 7% of the inefficient states have scores between 40% and 60% and also between 20% and 39%.

Among the frontier states Uttarakhand is treated as the peer state for 11 inefficient states followed by Tamil Nadu (9 times) and Haryana 6 times. Unlike Assam and Kerala, 60% of the total teachers are male trained and 66% of the class rooms are in good condition. In Tripura 60% of the class rooms are in good condition.

Table-3: Ranking of Efficiency Scores with Weights of the Reference DMUs under Radial Super Efficiency-CCR Model

Rank	States	Super eff. score	Weights of Reference DMU
1	Goa	5.3523	Himachal P(0.6954)+Nagaland(0.2351)
2	Nagaland	1.802	Mizoram(1.124)+ Tripura(0.350)
3	Tripura	1.573	Goa (0.0064)+Nagaland(.2198)
4	Uttarakhand	1.561	Goa(.6247)+Meghalaya(.4077)
5	TamilNadu	1.452	Himachal P (1.269) +MP(.00268)
6	Meghalaya	1.431	Manipur(1.278)+Nagaland (.19764)
7	MP	1.248	Himachal P(.487) + Tamil Nadu(.742)
8	Haryana	1.157	MP(.0091)+Uttarakhand(1.023)
9	Bihar	1.070	Goa(.70058)+Nagaland(.00684) +Uttrakhand(.3205)
10	Himachal P	1.021	Goa(.991) + MP(.0034) + Tamil Nadu (.0098) + Uttarakhand (.00271)

However, this method is incapable of ranking all those fully efficient DMUs. Therefore, the basic super efficiency model as advocated by Anderson and Peterson (1993) shown in the equation-1 have been used to compute the ranks of all the 10 fully efficient states. As per Table-3. Now Goa has been ranked as the super efficient state (5.352) followed by Nagaland (1.802) and Tripura (1.573). Among all the super efficient states Himachal P has been ranked in the last with super efficiency score of 1.021. The result indicates that if Goa will be not included in the production possibility frontier then the virtual state formed by the linear combination of Himachal P, Nagaland with the weight of 69.54% and 23.15% respectively can produce the same output by using 435% of the actual input mix used by Goa. That means Goa can increase its input mix by 435% and still remain efficient as far as the performance is concerned. Goa's projection of inputs as per the equation-1 will be:

NSAE = (5.352389 x 14068)-0=75297

NPUAS = (5.352389 x 297) - 1114.956=474.40

NSTE = (5.352389 x 1478) - 0 = 7910.83

PTR = (5.352389 x 19) -79.67822 = 22.017

NGP100B = (5.352389 x 90) – 387.85318 = 93.86

Now as per the reference set with weight the virtual state uses 75297 of NSAE, 474.40 of NPUAS, 7910.83 of NSTE, 22.017 of PTR and 93. 86 of NGP100B to produce the exact level of output produced by Goa. For example, in case of the NSAE 75297 = .695436(104702) + 0.231596 (10725). Therefore, Goa can increase the inputs by such amount and still remains efficient. Since the possibility of increasing the input mix is very large for Goa, it is ranked as the most super efficient state among all the efficient states. Now among all these super efficient states as shown in Table-3, Goa and Nagaland act as peer for 3 other super efficient states. Himachal P is the last ranked super efficient state which has the possibility of increasing the inputs by 2 % and can still remain efficient.

This radial super efficiency input oriented model under CRS assumption suffers from the drawback of ignoring the non-zero slack and the treatment of the slack does not yield a measure that is unit invariant. Hence, Slack Based Measure (SBM) is used to eliminate these deficiencies. Table-4 & 5 presents the results of SBM super efficiency both under CRS and VRS conditions The result is obtained from the equation-2 & 3 (super-SBM-CRS and Super SBM-VRS model).

As per the CRS assumption Goa still remains the most super efficient state with rank of 1 with a score of (2.676) followed by Nagaland (1.2429) and Uttarakhand (1.194). Himachal P is ranked as the last super efficient state with the score of 1.2429.

Table-4: Ranks and Super SBM Efficiency score under CRS

States	SE Scores	Weights of the reference DMUs
Goa	2.676	Himachal P(0.339)+Nagaland(0.4118)
Nagaland	1.242	Goa(.2288)+ Mizoram(0.771)
Uttarakhand	1.194	Goa (0.530)+Meghalaya(.221)+ Nagaland(.049)
TamilNadu	1.146	Goa(.127)+Himachal P(1.203)
Meghalaya	1.123	Manipur (.619) +Nagaland(.5615)
Tripura	1.114	Goa(.066)+Nagaland (.19764)
MP	1.067	Himachal P(.487) + Tamil Nadu(.2198)
Haryana	1.031	MP(.091)+Uttarakhand(1.023)
Bihar	1.015	Goa(.966)+Nagaland(.1815) +Uttrakhand(.188)
Himachal P	1.004	Goa(.997) + MP(.003) + Tamil Nadu (.096) + Uttarakhand (.0237)

If Goa remains out of the production possibility set then the output of Goa can be produced by a virtual state by using 165% more of the Goa's observed input mix. The weights of the virtual state for Goa are (Table-4) 0.3396 of Himachal P, 0.411887 of Nagaland. The NSAE input projection for Goa is 0.3396(104702) +0.411887(10725) =38883.2. Goa used 14068 of NSAE and hence can increase this input by an amount of 25915.32 (184.21%) from the actual and can still remain efficient. The efficiency score for Goa computed as per the objective equation of equation 4 is

$$\delta = \frac{\left[\frac{39983.32}{14068} + \frac{297}{297} + \frac{8011.789}{1478} + \frac{19}{19} + \frac{90}{90}\right]/5}{\left[\frac{24.11388}{35.3} + \frac{28.3}{28.3}\right]/2} = 2.67667$$

Similar way Nagaland can increase its input by 24.29% and still remains efficient. This shows that how the efficient states ranked under CCR model can still improve their input use and can reduce the output and still remain efficient. The SBMsuper efficiency model under VRS is also compute by using the restriction of $\sum_{j=1,\neq 0}^{n} \lambda_j = 1$. The results of the SBM- SE –VRS model (equation 5) is shown in Table-5. As per the result it is observed that Goa is ranked as the 1st super efficient state followed by Tripura and Nagaland. However, under VRS two new states comes into the SE ranking (Manipur and Mizoram). The reason is that under CRS the states may not be efficient under global conditions but under local conditions they remain efficient. Secondly the SE score under VRS are greater than the CRS SE score. This shows the variation of scale efficiency under different environment. As per the weights of the reference states The Virtual state of Goa consists of 61.1% of Himachal P, 38.8% of Nagaland and it uses 204% of the actual input used by Goa. This result confirms the study by Ramos (1997) and Ahn et.al (1998).

Table-5: Ranks and SBM Super Efficiency scores with the weights of the Reference DMU under VRS

States	SE score	Weights of the Reference DMU
Goa	3.040	Himachal P (.611)+Nagaland(.388)
Tripura	1.84	Nagaland (1)
Nagaland	1.244	Goa(.236)+Mizoram(.7639)
Uttarakhand	1.222	Goa(.673)+Meghalaya(.0995)+Nagaland(.226)
Manipur	1.172	Goa(.478)+Meghalaya(.508)+Uttarakhand(.0417)
Tamil Nadu	1.158	Himachal P (.9873)+MP(.0126)
Meghalaya	1.123	Manipur(.1958)+Nagaland(.7624)+Uttarakhand(.0417)
Himachal P	1.116	Goa(.555)+MP(.00380)+Nagaland(.3178)+ TamilNadu(.122)
MP	1.108	Himachal P(.407)+tamilNadu(.5924)
Haryana	1.04	MP(.069)+Nagaland(.4007)+Uttarakhand(.529)
Mizoram	1.030	Nagaland (1)
Bihar	1.0165	Goa(.532)+Himachal P(.026)+Nagaland(.368) +TamilNadu(.0455)+Uttarakhand(.0276)

The input projection for NSAE is (0.611 x104702) + 0.388(10725) = 68234.222. This is the maxim input of NSAE that Goa can allow to consume and still remains efficient. Therefore, the SE states have lot of potential to utilize more inputs and still perform as efficient. This will enable the states to go for more efficient management for the student admission, no of private unaided school, the pupil teacher ratio, no of ST students enrolled etc. Further while acting towards, the input management the state can follow the peer state and on the basis of the weights the particular state under the evaluation can utilize the inputs. This not only will improve the competitiveness among the states but also will improve the quality of education at the secondary level. The inefficient mix of input use will be avoided and the educational authority can focus on all the infrastructure development that is required while expanding those inputs. For instance, more number of student admissions requires class rooms, more teachers, more buildings and more financial resources. This requires also appropriate state assistance for infrastructural development and more budgetary allocation for the development of education.

5. Conclusion

The paper has employed the AP model and SBM model of super efficiency to rank the efficient states determined by the basic CCR model. As per the result of the basic CCR model, 10 states out of 23 states in India are fully efficient (score=1) and 13 states are found to be inefficient with Assam having the lowest efficiency score of 0.349. The average score of all the states is found to be 0.86203. The result of the radial input oriented super efficiency model reveals that Goa is ranked as the first super efficient state which can improve its input mix by almost 435% and still remains efficient. Goa maintains its rank in all the three models. However, the score in SBM Super efficiency-VRS model the score is more than the corresponding CRS model. In case of non radial SE model under VRS, Bihar has been found to be the last super efficient state. Further, two more states Manipur and Mizoram entered into the super efficiency ranking in SBM VRS model. This implies that these two states when operating under local condition they seem to be fully efficient but in case of global operation they seem to be inefficient. The study concludes that SE ranking will provide an managerial inight for each state as far as the expansion of inputs are concerned. The study will help the states to take appropriate decision in managing the input use such as the maximum no of students to be admitted, the no of private schools to be opened and the finding the optimum student teacher ratio. The states can give weight to different inputs on the basis of the peers that is determined in the process. This will directly help the state to focus on specific factors that will promote educational performance and improve healthy competition among the states to achieve better and promising performance.

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