Inter District Variation of Efficiency of Elementary Education in West Bengal: Evidence Based on Non Parametric Data Envelopment Approach

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Abstract

The paper measures technical efficiency (TE) scores for primary and upper-primary level of education separately for different districts in West-Bengal over the period 2005-06 to 2010-11, assuming variable-returns-to-scale and using non parametric Data Envelopment Analysis. While estimating TE score it takes into account both quantities as well as quality aspects of outputs and inputs. After obtaining efficiency score a second stage panel regression is resorted to find out the determinants of TE score both for primary and upper-primary level. The factors consist of school specific infrastructure, social indicators, policy variables and also some district-specific variables representing its general environment. Empirical estimates suggest that not all the districts of West- Bengal are perfectly efficient, both for primary and upper primary level. Inter district variation in efficiency score is evident. Either high level of literacy rate or the Educational Development Index (EDI) not necessarily implies that the districts are more technically efficient. A comparison of the literacy rate, TE score and EDI reveals that there are some districts which have above average literacy rate and EDI but below average TE level. Further, infrastructural variables, policy variables, social indicator variables and also the district level macro aggregates are important in explaining TE scores. The paper supports the existence of regional variability with respect to upper primary level of TE score. Some policy suggestions are also made to promote TE score of the districts.

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1. Introduction

Among the different levels of education crucial is the development of elementary level of education. Different programme was launched by the government of India to improve the overall performance of elementary education system in India. Performance as represented by literacy-rate during the Five Year Plans is quite satisfactory across different states of India. Literacy Rates in India has risen dramatically from 18.3% in 1951 to 74% to 2011 according to census data. At the same time there is a steady increase in enrolment both at primary and upper primary level. At the all India level enrolment has increased (i) from 110394128 in 2003-04 to 137099984 in 2011-12 corresponding to primary level and (ii) from 3314152 in 2003-04 to 61955154 in 2011-12 corresponding to upper primary level. (Source: District Information System for Education (DISE), National University of Educational Planning and Administration). However, disparities are present amongst different States of India. A related question is whether the schools are functioning efficiently. Is the school is maximizing output given the quantity of inputs usage? *Here output may be defined as net enrolment ratio and also the student's educational achievement, measured by results obtained on standardized test applied. Basic question is whether educational output can be improved with existing resources. In other words is there any room for greater efficiency?* This is a major policy issue.

For attainment of equalization of education facilities across different States of India, an analysis of efficiency at the State level is needed. The present paper addresses this issue considering West Bengal economy as a case study. Performance of West Bengal as represented by literacy-rate during the Five Year Plans is also quite satisfactory. Literacy rate in West Bengal has increased steadily from 24.61 in 1951 to 68.64 in 2011 and also the enrolment both at primary and upper primary level. For West Bengal enrolment has increased from (i) 9575246 in 2003-04 to 10086047 in 2011-12

corresponding to primary level and from (ii) 3259679 in 2003-04 to 474190 in 2011-12 corresponding to upper primary level. (Source: District Information System for Education (DISE) National University of Educational Planning and Administration) *The basic question is whether in West-Bengal the schools in different district districts are technically efficient in the sense that they are generating maximum output given the existing resources and whether the district with high literacy rate are also the districts with high technical efficiency. A related question is what are the factors responsible for the variation of technical efficiency across different districts of West Bengal?* Such type of analysis will help us to identify the districts that are lagging behind the West Bengal average efficiency-score and to formulate policies for enhancing educational efficiency of less efficient districts .

In the literature, estimation of efficiency of a school is basically rests on assumed production relationship between input and outputs. Bowles(1970) defined educational production function as : A = f (X1...Xm, Zn…Zp,) ,Where A = some measure of school output—for example, enrolment ratio and or marks obtained in standardised examination system. X1,….Xm= variables measuring the school environment. The variables here would typically include the amount and quality of teaching services, the physical infrastructure or facilities of the school. Zn,….Zp = variables representing environmental influences on learning outside the school—These variables take care of the general environment of learning that the students faces. *In efficiency analysis it is not assumed that the production unit always behaves optimally and hence they can operate inefficiently. Efficiency measurement is a two stage problem- In order to judge the performance of the production units* ***, a benchmark production function has to be constructed*** *which is called as frontier, and is supposed to be perfectly efficient. The method of comparing the observed performance of production unit with the postulated standard of perfect efficiency is the basic problem of measuring efficiency.*

Research on Efficiency Measurement has, since the seminal work of Farrell (1958) bifurcated, with economists typically following the route of Statistical analysis (Aigner et all, 1977) and management scientists characteristically opting for non-parametric route grounded in linear programming (Charnes et all, 1978). The former

approach has come to be known as Stochastic Frontier analysis, the later as Data Envelopment Analysis (DEA) which is basically a linear programming method. Charnes, Cooper and Rhodes [CCR (1978), (1981)] introduced the method of DEA to address the problem of efficiency measurement for decision making units (DMU) with multiple inputs and multiple outputs. Among the DMU they include non-market agencies like schools, hospitals, courts which produce identifiable and measurable output from measurable inputs but generally lack market prices of outputs (and often some inputs as well) and ***constructed a benchmark production function*** *which is called as frontier, and is supposed to be perfectly efficient, using programming approach under the assumption of* constant returns to scale globally. Later Banker, Charnes and Cooper (BCC) (1984) extended the CCR model to variable returns to scale. ***The advantage of DEA analysis is that it is not dependent on the prior specification of functional form or the criterion function.***

Several studies have applied DEA in measuring the efficiency and productivity in education sector around the globe. In particular, the technical efficiency of schools was estimated by),Bessent and Bessent (1980), Jesson et al (1987), Fare et al (1989), Ray(1991) and Bonesrqnning and Rattsq (1994) among others. In the Indian context Tyagi (2009) assessed the technical efficiency and efficiency differences among 348 elementary schools of Uttar Pradesh state in India. Sengupta and Pal (2010), (2012) explained the efficiency of only primary education sector in India and Burdwan District of West Bengal respectively, corresponding to a single year 2006. *Such type of study on West Bengal is practically non-existent for the upper primary level. For primary level it is available for only one district Burdwan , so that inter district comparison of efficiency scores cannot be made .The present paper contributes to the literature in this direction.*

The present study first of all, measures efficiency scores for primary and upper-primary level of education separately for different districts in West-Bengal for 2005-06 to 2010-11 assuming variable-returns-to-scale and thus measuring inter-districts variation in efficiency score. ***While estimating technical efficiency score it takes into account both quantities as well as quality aspects of outputs and inputs***. Relevantly it may be mentioned that earlier studies on West Bengal did not take into account quality aspects and also assumed constant returns to scale. **Secondly,** after obtaining efficiency score a second stage panel regression is resorted to find out the

determinants both for primary and upper-primary level. The factors consist of school specific infrastructure, social indicators, policy variables and also some district-specific variables representing its general environment.

The present paper unfolds as follows. Section 2 discusses the methodology and the data sources. The estimated results are presented in section 3.The section 6 presents summary and conclusions and recommend some policy suggestions to improve efficiency score of elementary eduction in West Bengal.

2. Methodology and Data

There are two component of efficiency: technical efficiency (TE) and allocative efficiency (AE). TE shows the ability of a Decision Making Unit (DMU) to obtain maximum output from a given set of inputs and technology. On the other hand allocative efficiency reflects the ability of a DMU to use the inputs in optimal proportions, given their respective prices. ***The present paper is concerned only with the measurement of technical efficiency (TE).***

TE of a DMU can be measured either by (i) output-oriented or by (ii) input-oriented approach. ***Input oriented*** TE measure represents the maximum amount of input quantities, which can be proportionately reduced without changing quantities produced as output. ***Output oriented*** technical efficiency measure on the other hand represents the maximum output quantities that can be proportionately increased without altering input quantities. In case of output oriented measure, the TE of a DMU can be computed by comparing its actual output with the maximum producible quantity from its observed inputs i.e.by how much can output quantities be proportionally expanded without altering the inputs quantities used. In input oriented measure, the TE of a DMU can be measured by comparing its actual input in use with the minimum input that would produce the targeted output level i.e. by how much can input quantities be proportionally reduced without changing the actual output bundle. **Figure 1** represents these measures in case of single input and output.

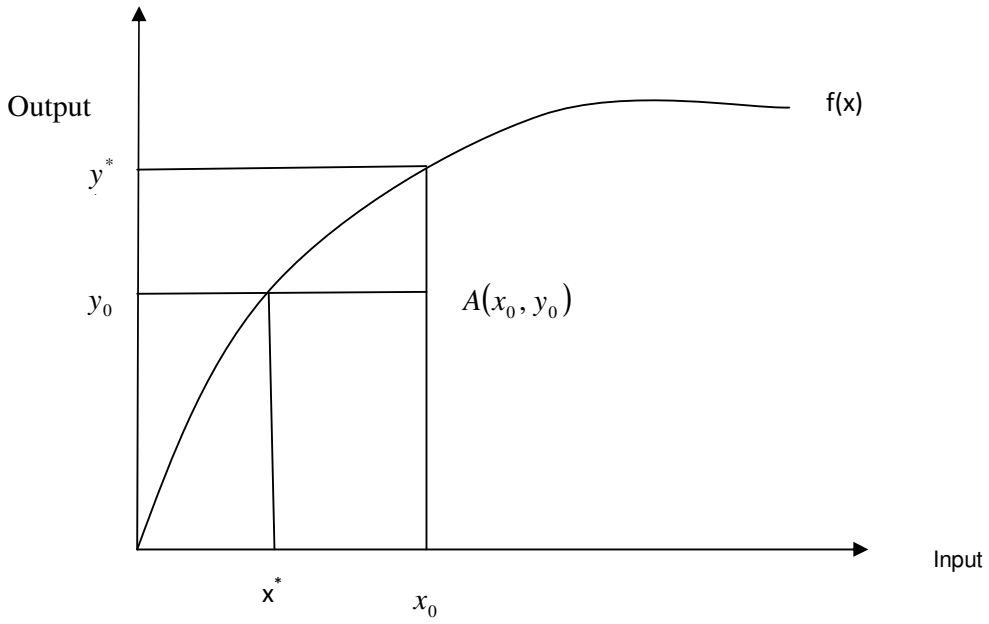

Figure 1

In **Figure 1 input** x is measured along the horizontal axis and output y is measured along the vertical axis. Point A (x_0, y_0) represents the actual input-output bundle of a DMU at a

point A. $y^* = f(x_0)$, where y * is the maximum output producible from input x_0 .The ***output-***

oriented measure of technical efficiency of DMU at point A = $\frac{y_0}{y^*}$ which is the comparison of actual output with the maximum producible quantity from the observed input.

Now for the same output bundle y_0, the input quantity can be reduced proportionately till the frontier is reached. So, y_0 can be produced from input x *. Thus the ***input-oriented*** technical efficiency measure for DMU at a point A=$\frac{x^*}{x_0}$. The TE score of a DMU takes a value between 0 & 1. A value of one indicates the production unit is fully technically efficient.

In this context let us note that the TE of the DMU depends also on the assumption of returns to scale. Two different assumptions can be made, i.e. constant return to scale (CRS) and variable returns to scale (VRS). The CRS describes the fact that output will change by the same proportion as inputs are changed (e.g. a doubling of all inputs will double output). On the other hand, VRS reflects the fact that production technology may exhibit increasing, constant and decreasing returns to scale. If there are economies of scale, then doubling all inputs should lead to more than a doubling of output.

Figure 2 illustrates the basic ideas behind DEA and return to scale. Four data points (A,C, B' , and D) are used here to describe the efficient frontier under VRS . In a simple one output case only B is inefficient, lies below the frontier, i.e. shows capacity underutilization. So unit B can produce more output at point B' on the frontier (which is equal to theoretical maximum) utilizing same level of input at X_1. Under CRS the frontier is defined by point C for all points along the frontier, with all other points falling below the frontier (hence indicating capacity underutilization). So capacity output corresponding to VRS is smaller than the capacity output corresponding to CRS.

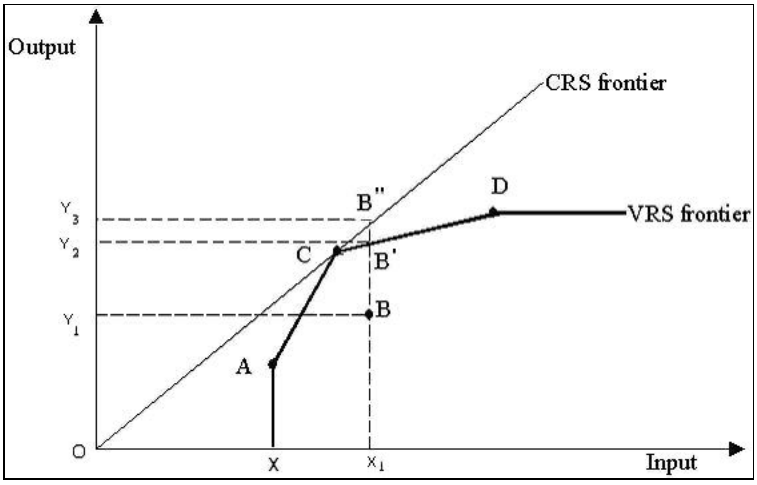

Figure 2: The Production Frontier and Returns to scale

The assumption of CRS is restrictive; it did not allow us to conceptualise economies of scale. A more generalized case will be the assumption of VRS. ***Given the actual input output bundle the paper estimates TE score by constructing the frontier*** under variable returns to scale (VRS) ***using non-parametric Data-Envelopment-Analysis*** **as formulated by** Banker, Charnes and Cooper (BCC) (1984). Using a sample of actually observed input-output data

and a number of fairly general assumptions about the nature of the underlying production technology, namely, (i) all actually observed input-output combinations are feasible, (ii) the production possibility set is convex, (iii) inputs are freely disposable, (iv) outputs are freely disposable, BCC(1984) ***derives a benchmark output quantity without any prior specification of the production frontier*** applying a linear programming(LP) problem ,with which the actual output of a DMU can be compared for efficiency measurement.

2.1 Methodology for finding Output Oriented TE Score

It is supposed that there are *N* DMUs. Each of them is producing 'g' outputs using 'h' inputs. The DMU t uses input bundle $x^t = \left(x_{1t,} x_{2t,.....} x_{ht}\right)$ and produces the output bundle $y^t = \left(y_{1t,} y_{2t,.....} y_{gt}\right)$. This paper assumes VRS.

The specific production possibility set under VRS is given by

$$T^{VRS} = \left\{(x,y): x \geq \sum_{j=1}^{N} \lambda_j x^j; y \leq \sum_{j=1}^{N} \lambda_j y^j; \sum_{j=1}^{N} \lambda_j = 1; \lambda_j \geq 0; (j = 1,2....N)\right\} \quad \ldots 2$$

The output oriented measure of TE of any DMU t under *VRS technology* requires the solution of the

following LP problem

$$\max \phi$$

Subject to $\sum_{j=1}^{N} \lambda_j y_{rj} \geq \phi y_{rt}$; $(r = 1,2,....g)$;

$\sum_{j=1}^{N} \lambda_j x_{ij} \leq x_{it}$; $(i = 1,2,.....h)$;

ϕ free $\lambda_j \geq 0;$, $(j = 1,2.....N)$

$$\sum_{j=1}^{N} \lambda_j = 1$$

….3

Output oriented TE of DMU t can be determined by using equation (4).

$$TE_o^{ct} = TE_o^{ct}(x^t, y^t) = \frac{1}{\phi^*} \qquad \text{….4}$$

Where ϕ^* is the solution of equation (3) showing the maximum value of ϕ . The maximum output bundle producible from input bundle x^t is y* and is defined as $y^* = \phi^* y^t$

The paper considers two ***outputs*** viz. (i) net enrolment ratio and (ii) percentage of students passed with 60% in the examination**. This variable measures achievement of quality output.**

The ***inputs*** used are: (i) number of schools per lakh population, (ii) teacher-pupil ratio in school, (iii) classroom-student ratio in school, (iv) percentage of teachers with qualification graduate and above in schools. **This variable measures quality of the teacher input** and (v) some infrastructural inputs like (a) percentage of schools with drinking water facility, (b) percentage of schools with common toilet, (c) percentage of schools with girls' toilet.

After obtaining technical efficiency score (TE) a second stage panel regression is resorted to find out the determinants of technical efficiency score.

2.2 The Determinants of TE score

The factors used to explain the variation of TE score are the following:

Poor Infrastructure: The basic question which will be asked is: Does poor infrastructure negatively affects efficiency score? Here the effects of the following variables are considered: (i) proportions of schools without building(X1), (ii) proportions of schools having no pucca building(X2), (iii) proportion of classrooms in "bad" condition in schools(X3), (iv) proportion of single teacher in school(X4), (v) proportion of para teachers in school(X5). The variable para teachers are included as due to lack of sufficient number of full time teachers many schools employ a significant number of para teachers and the basic question is whether the para teachers play any significant role in promoting TE? , (vi) proportion of schools

with no drinking water facility(X6), (vii) proportion of schools having no common toilet(X7), (viii) proportion of schools having no girls toilet(X8).

Social Indicators: The basic question which will be asked is: Does more inclusion of the backward classes into the system increase efficiency? Here the impacts of the following variables will be investigated: (i) proportion of SC teacher to total teacher in schools(X9), (ii) proportion of ST teacher to total teacher in schools(X10), (iii) proportion of SC enrolment in schools(X11), (iv) proportion of ST enrolment in schools(X12), (v) proportion of female teachers to male teachers in schools(X13), (vi) proportion of girls enrolment to boys in schools(X14), (vii) proportion of schools having girls toilet to common toilet in schools(X15).

Policy Indicators: The basic question that will be asked is: Does provision of more public facilities increase efficiency score? Here the effects of the following variables will be considered: (i) proportion of students getting free text books in schools(X16), (ii) proportion of girls getting free text books to boys in schools(X17), (iii) proportion of girls getting free stationary to boys in schools(X18), (v) proportionion of schools received School Development Grant(X19), (vi) proportionn of schools received Teaching Leaning Material Grant(X20).

Macro Indicators: The basic question which will be asked is: Does general economic environment of the district has something to with its efficiency score? In this context the impacts of inequality in distribution of income i.e. Gini coefficient (GINI) and density of population (POPDEN) and the per capita net district development product of the districts (PCNDDP) are investigated.

In the second stage panel regression estimated TE score will be taken as a dependent variable and the above indicators as explanatory variables. Separate regression is carried out for primary and upper primary level. Since the basic interest is to find out the impact of the individual explanatory variables, the panel regression with composite index representing the above four broad indicators has not been tried out. It is possible that some of the individual variables may be significant while the others are not and the use of a composite index cannot differentiate between these possibilities.

2.3 The Data

The sample consists of 20 districts in West-Bengal namely Dakshin Dinajpur, Darjeeling, Howrah, Cooch Bihar, Kolkata, Malda, Murshidabad, 24 Parganas(North), Midnapore East, Midnapore West, Purulia, Siliguri, Uttar Dinajpur, Bankura, Burdwan, Birbhum, Hooghly, Jalpaiguri, Nadia, 24 Parganas(S0uth), over the six years 2005-06 to 2010-11.

The secondary data are taken from different sources like District Information System for Education (DISE), National University of Educational Planning and Administration, Office of the Registrar General and Census Commissioner, India, NSSO, Bureau of Applied Economics and Statistics, Government of West Bengal.

3. Empirical Findings

3.1. Results of Estimation of Technical Efficiency Score

The estimated average value of TE score under the assumption of variable returns to scale for different districts of West Bengal over the sample year 2005-06 to 2010-11 along with the respective ranks of the districts for primary and upper primary level of education separately are presented in **Table 1.**

(Insert **Tables 1** here)

The results suggest that not all the districts are perfectly efficient. Inter district variation in TE score is evident. This observation is true for both primary and upper primary level of education. ***The perfectly efficient districts over the sample years 2005-06 to 2010-11*** **ar**e (i) Darjeeling, Kolkata, Maldah, Murshidabad, 24 Parganas (North). Midnapore (East), Midnapore(West), Purulia, Siliguri, Uttar Dinajpur, for ***Primary level*** and (ii) Kolkata, 24 Parganas (North), and Siliguri for ***upper primary*** level. The mean TE over all the years and all the districts are 0.9840 and 0.92 for primary and upper primary level respectively, showing that mean level of TE score is less in upper primary level as compared to primary level. A comparison of the figures on TE score at primary and upper primary level reveals that *the performance of the districts Kolkata, 24 Parganas (North) and Siliguri are very good with respect to elementary education in the sense that they are perfectly efficient both in case of primary and upper primary level of education.*

The ***districts with below average level of technical efficiency are*** Bankura, Burdwan, Birbhum,Hooghly, Jalpaiguri, Nadia, 24 Parganas(South) **for primary level**, and Bankura, Birbhum, Darjiling, Hooghly, Jalpaiguri, Coach Behar , Maldah , Nadia , 24 Parganas (South) and Uttar Dinajpur for **upper primary level.** A comparison of TE score at primary and upper primary level suggests that *the districts Bankura, Birbhum,Hooghly, Jalpaiguri, 24 pargana (South) and Nadia are in general bad performer with respect to technical efficiency in elementary education as these districts correspond to below average TE score both with respect to primary and upper primary level of education.*

The ***districts with above average level of technical efficiency are*** Dakshin Dinajpur, Darjiling, Howrah, Cooch Behar, Kolkata, Maldah, Murshidabad, 24 Parganas(North), Midnapur (East) , Midnapur (West) , Purulia, Siliguri, and Uttar Dinajpur **for primary level**, and Burdwan, Dakshin Dinajpur, Howrah, Kolkata , Murshidabad, 24 Parganas(North), Midnapur (West), Midnapur (East), Purulia and Siliguri, for **upper primary level.**

Thus the districts Dakshin Dinajpur, Howrah, Kolkata, Murshidabad,24 pargana(North) Midnapur (East) , Midnapur (West) , Purulia and Siliguri, are in general good performer with respect to technical efficiency in elementary education as these districts correspond to above average TE score both with respect to primary and upper primary level of education.

3.2. **A Comparison** of **Technical Efficiency Score, Literacy Rate and Education Development Index**

A comparison is carried out between the average level of TE and the literacy rate of the districts. Literacy rate for different districts of West Bengal can be found from **Table 2**.

(Insert **Table 2** here)

Considering the literacy rate it can be found that ***Districts which are above the average literacy rate*** in West Bengal (68.64) are : Burdwan , Darjeeling, Howrah,

Hooghly , Kolkata, 24 Pargana(North), Midnapore West, Midnapore East, Siliguri and 24 Parganas(South).

A comparison of the literacy rate and TE score thus reveals that there are some districts which have above average literacy rate but below average TE level. These districts are : (i) Burdwan, Hooghly and 24 Pargana(South) for ***primary level*** and (ii) Darjeeling, Hooghly and 24 Pargana(South) for the upper primary level, *suggesting that on average there exists scope of further expansion of educational output given the existing resources from these districts. Hence for Burdwan , Hooghly, 24 Pargana(South)there is possibility of expansion of educational output both at upper primary and primary level.*

Following UNDP methodology and assigning 2/3 weights to total literacy index and 1/3 weights to gross enrolment index, West Bengal Development Report (2010) , Planning Commission Government of India, has derived an **Education Development Index** for different Districts of West Bengal. Education index for different districts of West Bengal can also be found from **Table 2**.

The mean education index turned out to be 0.510. The districts having above average level of **Education Development Index** are Kolkata, 24 parganas(North) , Howrah Midnapore(East) Hooghly, Darjeeling, Burdwan and 24pargana(South) and Siliguri.

The comparison of TE score corresponding to upper primary level and Education Development index (EDI) reveals that although EDI for Hooghly , Darjeeling and 24 Pargana(s) is higher than average level of EDI, TE score for these districts are below the average TE corresponding to the upper primary level, *implying that there can be the possibility of expansion of educational output given the existing resources* for these districts. Similarly, comparison of TE score corresponding to primary level and Education index reveals that although EDI for Burdwan, Hooghly and 24 pargana (South) is higher than average level of EDI, TE score for these districts are below the average TE corresponding to primary level, *suggesting that there can possibility of expansion of educational output given the existing resources* for these districts. Hence for Hooghly and 24 pargana(south) there is scope of expansion of educational output both for primary and upper primary level.

The combined results on EDI and the literacy rate and TE score reveals that the districts which are above average EDI and Literacy rate are (i) Burdwan , Hooghly , 24 Pargana(South) for primary level and Darjeeling, Hooghly, 24 pargana(South) at upper primary level. Hence for the districts Hooghly and 24 pargana (South) although lies above average level both with respect to EDI and literacy rate but they corresponds to below average TE both for primary and upper primary level, *implying that there can be the possibility of expansion of educational output given the existing resources.*

3.3. **Factors influencing Technical Efficiency Score**

While carrying out the determinant analysis using panel regression, to test for appropriateness of the assumption of fixed affect *Vis. a vis*. the random effect panel model , Haussmann's specification test is performed for each of the regressions, which strongly rejects the assumption of fixed effect model in favour of random effect model. Separate regression is carried out for primary and upper primary level. Different specifications are tried out and the best fitted results are reported in **Tables 3** and **4** for upper primary and primary level of education in West Bengal respectively.

(Insert **Tables 3** and **4**here)

3.3.1. **Factors influencing Technical Efficiency Score at upper primary level**

The results of panel regression suggest that infrastructural variables, policy variables, social indicator variables and also the district level macro aggregates are important in explaining TE scores. This observation is true for both the primary and upper primary level.

For ***upper primary level***, the major significant explanatory variables suggest that: **(i)** the proportion of classroom in bad condition in schools (X3) exert a negative influence of TE, proportion of schools having no girls toilet (X8) has a negative influence of TE and the proportion of schools having no common toilet(X7) exert a

negative influence on TE, ***showing the negative impact of poor infrastructure***. Relevently it may be pointed out that due to lack of sufficient number of full time teachers many schools employ a significant number of Para teachers. So the basic question is whether these of Para teachers play any significant role in promoting TE? The estimated results show TE score of the upper primary level is positively influenced by proportion of para teachers to total teachers suggesting the importance of the para teachers in promoting TE. This observation also ***highlights the effect of poor infrastructure*** and establishes the need for supplying adequate number of full time teachers to the schools. **(ii)** Proportion of schools received Teaching Leaning Material grant(X20), positively influence TE score. Further there is also some positive effect of variable : the proportion of students getting free text books (X16). It may be possible that availability of free text book encourages SC and or ST enrolment ratio and the joint effect of these variables on TE is positive. For the present sample TE score is positively influenced by the joint interaction between proportion of students getting free text books and the enrollment ratio of the ST students(STENFTB). TE score is also positively influenced by proportion of girls getting free stationary to boys, implying provision of free stationary to girls(X18) increases TE score. All these observations suggest ***that policy variables are in fact effective in promoting TE.*** **(iv)** Density of population (POPDEN) of the districts positively influences TE score for upper primary level. It implies that more the density of population, more the concentration of child population and hence the economies of scale in terms of provision of inputs results. This in turn, makes the districts with high density of population more efficient. TE score is significantly and negatively influenced by Gini coefficient suggesting that if inequality of distribution of income increases then the probability that the access to education of relatively more expensive upper primary level (as compared to the primary) is limited to fewer number of child population, increases. This in turn generates diseconomies of scale in terms of provision of inputs and hence adversely affects TE score**.** The other variable from the macro aggregates which positively influence TE score is per capita net district domestic product suggesting that the income of the district has a significant positive impact in explaining TE. ***Thus general economic environment of the district in fact matters in explaining TE.***

To account for regional variability, whole West Bengal is divided into four regions: **(I) North Bengal** : Coochbehar, Darjeeling, Siliguri, Jalpaiguri, and two Dinajpur, **(II) Ganga Belt** : Malda, Nadia, Murshidabad, Bardhaman, and Midnapore (East), **(III) Western Rarh** : Purulia, Bankura, Birbhum and Midnapore (West), **(IV) Adjoining Kolkata:** Kolkata, two 24 parganas, Hooghly and Howrah.

The average values of TE level for these groups are 0.98, 0.99, 0.97, 0.98 respectively for primary level and 0.8903, 0.8974, 0.94, 0.95 respectively corresponding to upper primary level. To test for the existent of regional variability at the upper primary level, North Bengal region is taken as the base(having lowest value of mean TE) and the three dummies RD1, RD2 and RD3 are introduced for the three regions **Ganga Belt**, **Western Rarh** and **Adjoining Kolkata** respectively. The result of regression suggests that the coefficients of RD2 and RD3 are positive and statistically significant, while that of the RD1 is not statistically significant. Therefore one can claim that the upper primary level of TE score is higher for **Western Rarh and Adjoining Kolkata as compared to North Bengal.**

3.3.2 **Factors influencing Technical Efficiency Score at primary level**

In case of primary level (i) school specific poor infrastructure namely the proportion of classroom in bad condition in schools (X3) **,** proportion of schools having no girls toilet(X8) has a negative influence of TE ***, showing the negative impact of poor infrastructure***, **(ii)** Proportion of schools received school development grant(X19), positively influence TE score ***suggesting the role of policy variable in explain TE score***, (iii) TE score is positively influenced by proportion of ST teacher to total teacher (X10), ST enrolment to total enrolment (X11)and , proportion of female teacher to total teacher(X13) ***, suggesting that inclusion of the disadvantage groups into the system improves TE score*** (iv) density of population of the districts positively influence TE score for primary level. The justification of this variable is same as provided in case of upper primary. TE score is positively influenced by per capita net district domestic product suggesting that the income of the district has a significant positive impact in explaining TE.

Like the case of upper primary, three regional dummies are used taking Western Rarh as a base (having minimum value of average TE score) . However in this case the coefficients of the dummies are not statistically significant.

4. Summary and policy suggestions

On the whole the analysis of the present paper reveals that:

- Not all the districts of West- Bengal are perfectly efficient, both for primary and upper primary level. Inter district variation in efficiency score is evident.

- *The perfectly efficient districts over the sample years 2005-06 to 2010-11* are (i) Darjeeling, Kolkata, Maldah, Murshidabad, 24 Parganas (North). Midnapore (East), Midnapore(West), Purulia, Siliguri, Uttar Dinajpur, for *Primary level* and (ii) Kolkata, 24 Parganas (North), and Siliguri for *upper primary* level.

- The districts Dakshin Dinajpur, Howrah, Kolkata, Murshidabad,24 pargana(North) Midnapur (East) , Midnapur (West) , Purulia and Siliguri, are in general *good performer* with respect to technical efficiency in elementary education as these districts correspond to above average TE score both with respect to primary and upper primary level of education. On the other hand the *bad performer* districts in this respect having below average TE score both with respect to primary and upper primary level are Bankura, Birbhum,Hooghly, Jalpaiguri, 24 pargana (South) and Nadia.

- Either high level of literacy rate or the Educational Index not necessarily implies that the districts are more technically efficient. A comparison of the literacy rate, TE score and EDI reveals that there are some districts which have above average literacy rate and EDI but below average TE level. These districts are : (i) Burdwan, Hooghly and 24 Pargana(South) for *primary level* and (ii) Darjeeling, Hooghly and 24 Pargana(South) for the *upper primary level*. Thus although these districts correspond to above average EDI and literacy rate that on average there exists scope of further expansion of educational output given the existing resources.

- Further, infrastructural variables, policy variables and social indicator variables and also the district level macro aggregates are important in explaining TE scores. The major significant explanatory variables suggests that : (i) proportion of schools having no girls toilet and the proportion of classroom in bad condition in schools have a negative influence of TE in case of both primary and upper primary level ,and the proportion of schools having no common toilet exert a negative influence of TE in case upper primary level **,** ***showing the negative impact of poor infrastructure*** on TE. TE score of the upper primary level is positively influenced by proportion of para teachers to total teachers suggesting the importance of the para teachers in promoting TE and the need for recruiting appropriate number of teachers for promotion of TE. (ii) Proportion of ST teacher to total teacher, proportion of SC enrolment have positive influence on TE of the primary level , ***implying that more inclusion of the backward classes into the education system increases efficiency score***. iii) Proportion of students getting free text books, proportion of schools received Teaching Leaning Material grant and the proportion of girls getting free stationary to boys positively influence TE score of the upper primary level. At the primary level TE score is positively influenced by proportion of schools received school development grant. All these imply ***that policy variables are in fact effective in promoting TE.*** (iv) Density of population of the districts positively influence TE score for both primary and upper primary level. It implies that more the density of population, more the concentration of child population and hence the economies of scale in terms of provision of inputs results. This in turn, makes the districts with high density of population more efficient. Gini coefficient negatively influence TE score of upper primary level suggesting that if inequality of distribution of income increases then the probability that the access to education of relatively more expensive upper primary level as compared to the primary is limited to fewer number of child population increases. This in turn generates diseconomies of scale in terms of provision of inputs and hence adversely affects TE score**.** Further TE score is positively related to per capita net district domestic product both for primary as well as upper primary level. ***Thus general economic environment of the district in fact matters in explaining TE.***

- The present study also supports the existence of regional variability of TE score in case of upper primary. A dummy variable analysis suggests that division of whole West Bengal into four different regions North Bengal, Ganga Belt , Western Rarh and Adjoining Kolkata produces higher level of TE for Western Rarh and Adjoining Kolkata as compared to North Bengal.

  The present study thus highlight role of some policy variables in fostering TE score of elementary education. There is need for improving the condition of the class rooms, providing girls toilets to every school for enhancement of TE score both for primary and upper primary level. The supply of teaching learning material grant, provision of more free-stationary to the girls, supply of free text book and the recruitment of adequate number of teachers will enhance TE score of the upper primary level. Provision of school development grant will promote TE score of the primary level. Further, the encouragement to the backward classes like ST should continue so that enrolment of ST and their participation in the teaching process increases. This will help to foster TE score of primary level. The TE score at the upper primary level is negatively related to inequality of distribution of income and thus attempts to curb the inequality in the distribution of income will be helpful in promoting TE score of the upper primary. Per capita net district domestic product positively affects TE score both for primary and upper primary level. Thus in order to increase TE of both primary and upper primary any measure for generating more income of different districts will definitely be called for.

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Table 1: District-wise Output Technical Efficiency Primary

Sl No	Districts	Average TE for Primary Level over the period 2005-06 to 2010-11	Rank of different Districts based on Average TE for Primary Level over the period 2005-06 to 2010-11	Average TE for upper Primary over the period 2005-06 to 2010-11	Rank of different Districts based on Average TE for upper Primary Level over the period 2005-06 to 2010-11
1	**Bankura**	0.9678	8	0.8908	13
2	**Burdwan**	0.9270	11	0.9607	6
3	**Birbhum**	0.9822	5	0.8520	15
4	**Dakshin Dinajpur**	0.9943	3	0.9800	2
5	**Darjiling**	1.0000	1	0.7393	18
6	**Howrah**	0.9977	2	0.9633	4
7	**Hooghly**	0.9333	10	0.9087	10
8	**Jalpaiguri**	0.9408	9	0.9087	11
9	**Coch Behar**	0.9882	4	0.8502	16
10	**Kolkata**	1.0000	1	1.0000	1
11	**Maldah**	1.0000	1	0.8377	17
12	**Murshidabad**	1.0000	1	0.9258	8
13	**Nadia**	0.9747	7	0.9103	9
14	**24 Pargana(North)**	1.0000	1	1.0000	1
15	**Midnapur (West)**	1.0000	1	0.9748	3
16	**Midnapur (East)**	1.0000	1	0.9612	5
17	**Purulia**	1.0000	1	0.9460	7
18	**Siliguri**	1.0000	1.0000	1.0000	1
19	**24 Pargana(South)**	0.9747	6	0.9053	12
20	**Uttar Dinajpur**	1.0000	1	0.8638	14
	All Districts	**0.9840**		**0.9189**	

Table2 : District- wise EDI & Literacy Rate & Rank

Districts	EDI Based on West Bengal Development Report (2010)	Rank	Literacy Rates (%; As per 2011 Cencus)	Rank
Bankura	0.472	10	63.44	14
Burdwan	0.665	7	70.18	9
Birbhum	0.361	14	61.48	16
Dakshin Dinajpur	0.338	15	63.59	13
Darjiling	0.696	6	71.79	7
Howrah	0.814	3	77.01	5
Hooghly	0.786	5	75.11	6
Jalpaiguri	0.461	12	62.85	15
Coch Behar	0.452	13	66.3	11
Kolkata	1	1	80.86	2
Maldah	0.042	18	50.28	19
Murshidabad	0.148	17	54.35	18
Nadia	0.472	11	66.14	12
24 Pargana(North)	0.824	2	78.07	4
Midnapur (West)	0.797	4	70.41	8
Midnapur (East)	0.797	4	80.16	3
Purulia	0.247	16	55.57	17
Siliguri	0.523	9	85.46	1
24 Pargana (South)	0.561	8	69.45	10
Uttar Dinajpur	0.015	19	47.89	20
Average value for West Bengal	**0.510**		**68.64**	

Table 3: Significant Variables influencing TE of upper Primary

Variables	Coefficients	z-value	p-value
proportion of classroom in bad condition in schools **(X3)**	-0.0006941	-2.74	0.006
proportion of upper primary schools having no girls toilet **(X8)**	-0.0004336	-2.02	0.044
proportion of upper primary schools having no common toilet **(X7)**	-0.0034893	-1.97	0.049
proportion of para teachers to total teachers**(X5)** in schools	0.0026407	2.35	0.019
Proportion of upper primary schools received Teaching Leaning Material grant **(X20)**	0.009466	2.22	0.026
joint interaction between proportion of students getting free text books and ST enrollment ratio(**STENFTB)** in schools	0.0003629	3.58	0.000
Proportion of girls getting free stationary to boys (X18) in schools	0.0000781	2.15	0.032
per capita net district domestic product**(PCNDDP)**	0.1307671	2.10	0.036
Density of population(**POPDEN**)	2.77* E-07	1.99	0.046
Gini coefficient **(GINI)**	-0.7037292	-2.40	0.016
RD1	0.044455	1.93	0.054
RD2	0.0312553	2.29	0.022

Constant	1.279425	9.25	0.000
Goodness of fit	Wald $Chi^2 = 105.65$, $P > Chi^2 = 0.0000$		

Table 4: Significant Variables influencing TE of Primary level

Variables	**Coefficients**	**z-value**	**p-value**
proportion of classroom in bad condition in schools (X3)	-0.0005705	-2.22	0.026
proportion of primary schools having no girls toilet (X8)	-0.0000619	-2.14	0.032
Proportion of primary schools received school development grant(X19)	0.0002252	2.96	0.003
proportion of ST teacher to total teacher(X10) in schools	0.0010033	1.98	0.047
ST enrolment to total enrolment(X11) in schools	0-.0000226	1.95	0.052
Proportion of female teacher to total teacher(X13)) in schools	0.0001939	2.35	0.019
density of population of the districts(POPDEN)	2.06 *E-07	2.60	0.009
per capita net district domestic product(PCNDDP)	0.1362677	3.32	0.001
Constant	1.160049	22.82	0.0000
Goodness of fit	Wald $Chi^2 = 70.19$, $P > Chi^2 = 0.0000$		