

# **Inter District Variation of Efficiency of Elementary Education in West Bengal**

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# The Back Ground of the study

- The development of human capital is basically dependent on development of education sector.
- **Among the different levels of education crucial is the development of elementary level of education.**
- Elementary Education has been of priority in terms of sub-sectoral allocations in Indian five year Plans.  
**A number of Schemes like**
- District Primary Education Programme
- National Programme of Nutritional Support to Primary Education (Mid-Day Meal Scheme)  
**was introduced to meet needs of the educationally disadvantaged groups .**
- .

# The Back Ground of the study (contd.)

- **Sarva Shiksha Abhijaan (SSA) was launched by the Central Government in November 2000, in partnership with the states to improve the performance of the school system through a community-based approach and to impart quality elementary education to all children of 6-14 years.**
- **Performance of the education sector is satisfactory**  
:Literacy Rates has increased from 18.3% in 1951 to 74% in 2011.
- ***Although , vast disparities is present between the States.***
- States in the North-East are performing better than the Other. Kerala has the highest literacy rate at 93.91%, followed by Lakshadweep at 92.28 %,Bihar is at the bottom with 63.82%

# The Back Ground of the study

- *Given this vast development of the education, a related question : whether the Education Sector is functioning efficiently?*
- *whether the output gets maximized given the quantity of input usage.*
- *whether educational output can be improved with existing resources.*
- *Is there any room for greater efficiency?*

# The Back Ground of the study

- *For attainment of equalization of education facilities across different Indian States, an analysis of efficiency at the **State level** is needed. This will help us to identify the States that are lagging behind with respect to the Indian average in terms of efficiency and also to formulate appropriate policies for enhancing educational efficiency of those States, so that equalization of educational efficiency across different States can be ensured.*
- ***The present paper basically addresses these issues and is concerned with the analysis of efficiency of elementary education in West Bengal(WB).***

# The Back Ground of the study

- Literacy rate in WB has increased from 24.61 in 1951 to 68.64 in 2011 and also the enrolment both at primary and upper primary level, showing satisfactory performance
- **QUESTION : What happens to extent of efficiency in WB? What are its Determinants?**
- **The objectives :**
- **First, measurement of the extent of efficiency, of elementary education in WB and highlight the inter district variation of such efficiency.**
- **Second, to find out the determinants of efficiency.**

# The Back Ground of the study

- *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 :

$$A = f (X_1 \dots X_m, Z_n \dots Z_p) ,$$

- **A = some measure of school output**—for example, enrolment ratio and or marks obtained in standardised examination system
- **X<sub>1</sub>,.....X<sub>m</sub>= variables measuring the school environment** :like the amount and quality of teaching services, the physical infrastructure or facilities available in the school.
- **Z<sub>n</sub>,.....Z<sub>p</sub> = variables representing environmental influences on learning outside the school**—The general environment of learning
- **Question : whether the output gets maximized given the quantity of input usage**

# Measurement of Efficiency

- In efficiency analysis **it is not assumed that the producers always behave optimally** and hence they can ***operate inefficiently***.
- *Efficiency measurement- a two stage problem-*  
***First, a benchmark production function has to be constructed which is called as frontier, and is supposed to be perfectly efficient.***
- ***Second, one need to compare the observed performance*** of production unit with the ***postulated standard of perfect efficiency*** to measure the extent of efficiency.

# Measurement of Efficiency

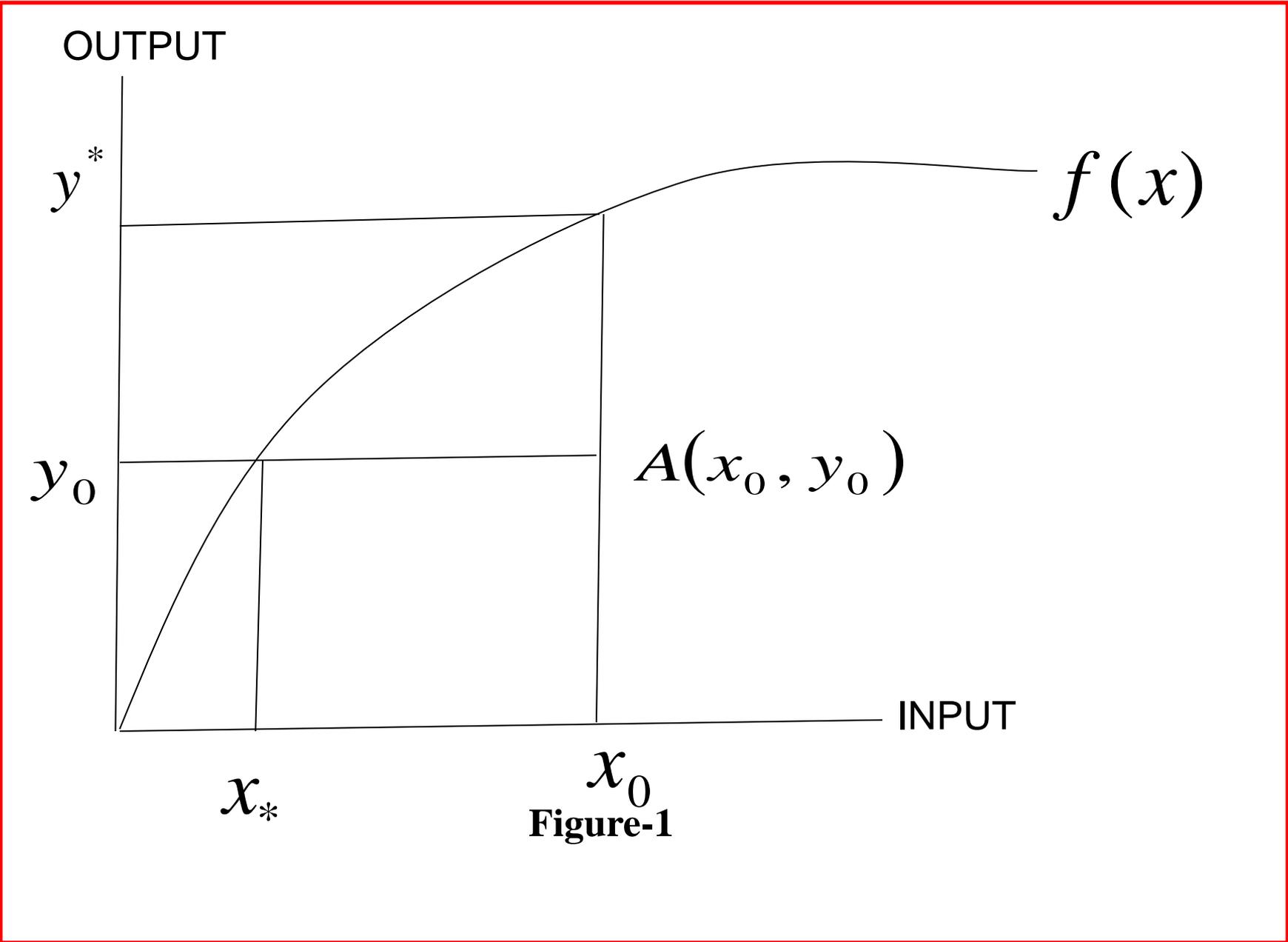
- Debreu (1951) and Koopmans (1951) tried to design some idea on the measurement of efficiency of a producing unit.
- The effective measurement of efficiency started with the Farrell's seminal work "The Measurement of Productive Efficiency" published in the Journal of Royal Statistical Society in 1957.

# Measurement of Efficiency

- There are the two concept of efficiency **Allocative Efficiency (AE)** and **Technical Efficiency (TE)**
- **Allocative Efficiency(AE)** : Situation in which it is impossible to generate a larger welfare total from the available resources. ----- the situation where some people cannot be made better off by **reallocating** the resources or goods, without making others worse-off.
- **Technical Efficiency(TE)**: Situation where it is impossible for a **Decision making unit (DMU)** to produce, with the given know how,
  - Either, a larger output from the same inputs
  - or, the same output with less of one or more inputs without increasing the amount of other inputs.
- **This paper deals only with TE.**

## Two concept of measurement of TE

- **(i) output-oriented measure : Here** TE of a DMU is computed by comparing its actual output with the maximum producible quantity from its observed inputs usage i.e. **by how much can output quantities be proportionally expanded without altering the inputs quantities used.**
- **input oriented measure :** Here 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 .**
- **This paper concentrate on output oriented measures.**



$x_0$   
Figure-1

## Two concept of measurement of TE

**output-oriented measure of technical efficiency of firm**

=  $Y_0/Y^*$  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  $X^*$  .

The input-oriented technical efficiency measure for firm =  $X^*/X_0$ .

The TE score of a firm takes a value between 0 & 1 .

A value of one indicates the firm is fully technically efficient.

# Analysis of TE

The analysis consists of **two stages**:

**Stage 1** : *Estimation of efficiency score. It needs computation of a benchmark production function which is called as frontier, and is supposed to be perfectly efficient.*

*Efficiency score of a DMU : can be obtained by comparing benchmark output quantity with the actual output of that DMU.*

The bench mark production function has been created by using **Data Envelopment Analysis (DEA)**

**Stage 2** : A second stage panel regression is used to get the determinants.

# Estimation Method of TE

## ***The advantage Non parametric DEA Approach :***

- DEA method introduced by Charnes *et al.* (1978) and further generalized by Banker *et al.*(1984)  
***requires no parametric specification of the production frontier.***
- ***Computation of Benchmark output quantity:***
- Using a sample of ***actually observed input-output data a benchmark output quantity is obtained using a linear programming problem*** and with a number of fairly weak assumptions namely:
  - i) Actually observed input-output combinations are feasible.
  - ii) The production possibility set is convex.
  - iii) Inputs and outputs are freely disposable.

# THE LITERATURE

- Several studies have applied DEA in measuring the efficiency and productivity in education sector around the globe. In ,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 study by Taygi(2009). Sengupta and Pal(2010).**

# THE LITERATURE(contd)

- In India, Tyagi (2009) assessed the TE of 348 elementary schools of Uttar Pradesh by using DEA.
- Sengupta and Pal (2010) explained the *TE of primary education for different states* in India for the single year 2006, using CRS. They identified five basic aspects of education: deprivation aspects, social aspects, policy aspects.
- Using the formula of Human Poverty Index (HPI) suggested by Anand and Sen (1997) they derived Grand Poverty Index comprising of various poverty indicators of Indian education system and related these with the efficiency score in DEA. Results show
- Poverty indicators have negative impacts and *Social and policy indicators are not significant.*

# THE LIMITATIONS OF THE LITERATURE

- ***Such type of Study is practically non-existent for the primary and upper primary level for different districts of West Bengal.***
- Sengupta and Pal (2012) explained the efficiency of only primary education of Burdwan District of West Bengal, corresponding to a single year 2006 using DEA under the restrictive assumption of CRS. So, ***the inter district comparison of efficiency score can not be made.***
- Further, TE score will also be expected to be affected by ***general environment of the districts, i.e., by*** district level macro aggregates like per-capita net district domestic product, income inequality, Density of population etc.
- Earlier studies on TE did not consider these.

# Contribution of the paper

- **First** , the paper estimates the extent of efficiency, i.e., the technical efficiency scores(TE) for primary and upper-primary level of education **separately** for different districts in West-Bengal for 2005-06 to 2010-11, using **DEA** by assuming **variable returns to scale** and **thus measuring inter-districts variation in TE**. While estimating TE it considers both quantities and quality aspects of outputs and inputs. **The earlier study on TE for WB assumed CRS and** did not considered quality .

# Contribution of the paper (contd)

- **Second**, while finding out the determinants of TE score the paper *takes some district level macro aggregates like (i)Gini coefficient, (ii)density of population and (iii)the per capita net district development product*
- *to see what extent the general environment of the districts matters in explaining TE* , along with (i) factors from poor infrastructure , (ii) social indicators and (iii) policy variables.  
*The earlier studies on TE on WB did not considered these district level figure.*

# Contribution of the paper(contd)

- **Third, *rather than using a composite index the present paper attempts to find out the individual effect of the different explanatory variables.***
- **The results of earlier studies that social and policy indicators are not significantly related to the efficiency performance may be due to the use of composite index.**
- **It is possible that some of the individual variables comprising of the composite index are significant, while the others are not.**

# Empirical Analysis

Empirical Model considers **two outputs** :

- (I) Net enrolment ratio , (ii) percentage of students passed with 60% and above in the examination. This variable **measures output quality**.
- The **inputs** used are :
- (I) Number of schools per lakh population, (ii) Teacher-pupil ratio, (iii) classroom-student ratio, (iv) percentages of teachers with qualification graduate & above, **measuring quality of the teacher input**, (v) **school specific 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.

# Empirical Analysis (contd)

- **The study estimates TE using variable returns to scale.**
  - **Considered districts :** 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(South)
- Period of Analysis :** 2005-06 to 2010-11

# The variables included to explain efficiency

- **Poor infrastructure variables** : to see **whether poor infrastructure inhibit the achievement of TE**. The variables are :
  - proportions of schools without building,
  - proportions of schools having no pucca building,
  - proportion of classrooms in “bad” condition in schools,
  - proportion of single teacher in school,
  - **proportion of para teachers in school**. This variable is included as due to lack of sufficient number of full time teachers many schools employ a significant number of para teachers and the question is whether such recruitment improves TE? ,
  - **proportion of schools with no drinking water facility,**
  - **proportion of schools having no common toilet,**
  - **proportion of schools having no girls toilet.**

# The variables included to explain efficiency

- ***social indicator variables*** : to see ***whether inclusion of the backward classes into the education system increases TE.***
- ***The considered variables are :***
  - proportion of SC teacher to total teacher in schools
  - proportion of ST teacher to total teacher in schools
  - proportion of SC enrolment in schools
  - proportion of ST enrolment in schools
  - proportion of female teachers to male in schools
  - proportion of girls enrolment to boys in schools
  - proportion of schools having girls toilet to common toilet

# The variables included to explain efficiency

- **Policy variables** : to *see whether provision of more public facilities increases TE.*
- The considered variables are :
- proportion of students getting free text books in schools,
- proportion of girls getting free text books to boys in schools,
- proportion of girls getting free stationary to boys in schools,
- proportion of schools received School Development Grant,
- no of schools received Teaching Learning Material Grant.

# The variables included to explain efficiency

- **Macro Indicators:** to see whether general economic environment of the district has something to with its TE. .The considered variables are:
  - Gini coefficient
  - density of population
  - the per capita net district development product of the districts

# Data Sources

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.

# Findings on TE Score

- Mean TE over all the years and all the districts are 0.9840 and 0.92 for primary and upper primary level respectively
- Mean level of TE score is less in upper primary level as compared to primary level

# Findings on TE Score

- Not all the districts of WB 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**.
- **For the Districts for which TE score equal to one for every year there is a possibility of expansion of outputs.**

# Findings on TE Score(Contd)

- **Good performer districts** : Dakshin Dinajpur, Howrah, Kolkata, Murshidabad,24 pargana(North) Midnapur (East) , Midnapur (West) , Purulia and Siliguri, are in general 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.
- **Bad performer districts** : having below average TE score both with respect to primary and upper primary level are Bankura, Birbhum, Hooghly, Jalpaiguri, 24 pargana (South) and Nadia.

# Findings on TE Score(Contd)

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 , has derived an **Education Development Index(EDI)** for different Districts of WB.

***A comparison is carried out between***

- the average level of TE and the literacy rate of the districts and
- the average level of TE and EDI. It shows

***Either high level of literacy rate or the EDI does not implies that the districts are more technically efficient***

# Findings on TE Score(contd)

- ***There are some districts which have above average literacy rate and EDI but below average TE .***

These districts are :

- Burdwan, Hooghly and 24 Pargana(South) for *primary level* and
- Darjeeling, Hooghly and 24 Pargana(South) for the *upper primary level*.
- Thus although these districts have above average EDI and literacy rate , ***there exists scope of further expansion of educational output given the existing resources, since TE score is below average.***

# Factors influencing TE Score

- *Separate regression is used for primary & upper primary to find out the determinants.*
- Hausman's specification test strongly rejects the assumption of fixed effect model in favour of random effect model.
- *The results suggest that infrastructural variables, policy variables, social indicator variables and also the district level macro aggregates are important in explaining TE scores, both for primary & upper primary .*

# Factors influencing TE Score at upper primary level

- ***The effect of poor infrastructure*** : the proportion of classroom in bad condition in schools and
- proportion of schools having no girls toilet and no common toilet
- ***exert a negative influence on TE.***
- ***Due to lack of sufficient number of full time teachers many schools employ Para teachers.***
- **Question:** whether Para teachers promote TE? The results show TE score of the upper primary level is positively influenced by proportion of para teachers to total teachers, ***highlighting the effect of poor infrastructure*** and establishes the need for supplying adequate number of full time teachers to the schools.

# Factors influencing TE Score at upper primary level

- ***The role of policy variables :***
- Proportion of schools received Teaching Learning Material grant and availability of free text book positively influence TE score. 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.
- TE score is also positively influenced by proportion of girls getting free stationary to boys, implying provision of free stationary to girls increases TE score. ***Thus policy variables are in fact effective in promoting TE .***

# Factors influencing TE Score at upper primary level

- ***Role of economic environment of the district :***
- **TE score is positively influenced by**
  - (i) ***per capita net district domestic product*** : suggesting that the income of the district has a positive and significant positive impact
  - (ii) **Density of population** : more the density of population, more the concentration of child population and hence the economies of scale in terms of provision of inputs results.
- ***TE score is significantly and negatively influenced by***
- **Gini coefficient** : 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 generates diseconomies of scale in terms of provision of inputs and adversely affects TE . Thus ***General economic environment of the district in fact matters.***

# Factors influencing TE Score at primary level

***The effect of poor infrastructure*** ***The effect of poor infrastructure*** (i) school specific poor infrastructure namely the proportion of classroom in bad condition in schools , proportion of schools having no girls toilet has a negative influence of TE , ***showing the negative impact of poor infrastructure,***

***The role of policy variables :***

(ii) Proportion of schools received school development grant, positively influence TE score ***suggesting the role of policy variable in explain TE score,***

# Factors influencing TE Score at primary level

**The role of social Indicators :** TE depends positively on

- proportion of ST teacher to total teacher
- ST enrolment to total enrolment and
- proportion of female teacher to total teacher ,

***suggesting that inclusion of the disadvantaged groups into the system improves TE***

***Role of economic environment of the district :*** TE score is positively influenced by

- **per capita net district domestic product suggesting the positive role of the income of the district**
- **the density of population of the districts.**

# The sum up

- Not all the districts of West- Bengal are perfectly efficient.
- 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***
- (ii) Kolkata, 24 Parganas (North), and Siliguri for ***upper primary level.***

# The sum up

- ***Good performer districts*** : Dakshin Dinajpur, Howrah, Kolkata, Murshidabad, 24 pargana (North) Midnapur (East) , Midnapur (West) , Purulia and Siliguri, are in general 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.
- ***Bad performer districts*** : Bankura, Birbhum, Hooghly, Jalpaiguri, 24 pargana (South) and Nadia, having below average TE score both with respect to primary and upper primary level.

# The sum up

- ***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 have above average EDI and literacy rate, *on average there exists scope of further expansion of educational output given the existing resources.***

# The sum up

- infrastructural, policy and social indicator variables and also the district level macro aggregates are important in explaining TE scores.
- ***Role of Poor infrastructure*** : 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***

# The sum up

- TE 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 also supports the existence of poor infrastructure***
- and the need for recruiting appropriate number of full time teachers for fostering TE.

# The sum up

- **Role Social Indicator variables:** 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.***
- **Role of policy variables:** Proportion of students getting free text books, proportion of schools received Teaching Learning 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 suggesting the role of ***policy variables in promoting TE.***

# The sum up

- ***Role of general economic environment of the district***  
Density of population of the districts positively influence TE score for both primary and upper primary level.
- Gini coefficient negatively influence TE score of upper primary
- TE score is positively related to per capita net district domestic product both for primary and upper primary level  
***Thus general economic environment of the district in fact matters in explaining TE.***

# Policy Suggestions

- The present study highlight role of some policy variables:
- 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.***

***To enhance TE score of the upper primary*** it is required

- to supply of teaching learning material grant
- Provision of more free-stationary to the girls
- Supply of free text book
- the recruitment of adequate number of teachers

***To enhance TE score of the primary level***

- Provision of school development grant is needed,

# Policy Suggestions

- ***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
- 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 any measure for generating more income of different districts will definitely be helpful.

- Thank you .
- Waiting for your valuable  
comments!!!