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Brijesh C Purohit

MADRAS SCHOOL OF ECONOMICS
Gandhi Mandapam Road
Chennai 600 025
India

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Brijesh C. Purohit
Professor, Madras School of Economics
brijesh@mse.ac.in; brijeshpurohit@gmail.com

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MADRAS SCHOOL OF ECONOMICS
Gandhi Mandapam Road
Chennai 600 025
India

Phone: 2230 0304/2230 0307/2235 2157
Fax : 2235 4847/2235 2155
Email : info@mse.ac.in
Website: www.mse.ac.in

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Abstract

Rajasthan being India's largest state comprising 10.4 percent of India's total area is located on the western side of the country. The state is divided into 33 districts. Over the 1990s and early 2000s, enrolment rates at the primary level were rising and gender gap converging, though female enrolment rate is still to catch up with that of male. There also exist considerable differential across districts in the State. As per survey in 2012, overall literacy varies from 55.58 percent (Jalore) to 77.48 percent (in Kota).

In this paper, considering the district level variations in literacy and other pertinent socio-economic variables we explore whether efficiency in education in district level enrolments is merely a reflection of the other conditions or is it owing to lack of efficient utilization of available educational input variables. Thus we estimate district level efficiency in enrolments at primary and upper-primary levels, in government and private schools, in Rajasthan and look into reasons for their differentials. Using data for the period 2008-2012 and applying stochastic frontier analysis our results indicate that a strong role is being played by economic development parameters like income and urbanization. And simultaneously direct educational interventions seem to play a positive role in enhancing enrolments at different levels. Therefore an education policy should capture district specific gaps to strengthen the outcomes. This may thus necessitate more information at district level both in terms of educational and economic parameters and this information gap needs to be overcome through planning process.

Keywords: *Efficiency; education sector; Rajasthan; stochastic frontier model*
JEL Codes: *C14 ; H52*

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INTRODUCTION

Rajasthan is India's largest state by area (342,239 square kilometers or 132,139 sq miles; or 10.4 percent of India's total area). It is located on the western side of the country. It is surrounded by other Indian states, namely, Gujarat (to the southwest), Madhya Pradesh (to the southeast), Uttar Pradesh and Haryana (to the northeast) and Punjab to the north. Its capital and largest city is Jaipur. The state is divided into 33 districts.

Rajasthan has traditionally been classified as a state ranking low on human development[1]. Upto the early 1980s, the state exhibited slow progress. In the 1980s, the state displayed improvement in its economic and social performance. Besides all-round improvement, literacy rates also improved. Additionally, there has been a regional dimension to this development pattern: some northern and a few eastern districts and most urban areas have exhibited dynamism but the southern districts, particularly, have lagged behind. There also exist differences between the far western districts (e.g. low literacy rates and extremely adverse sex ratios in Jaisalmer and Barmer) and some eastern ones (e.g. low female literacy and high infant mortality in Bharatpur and Dholpur) relative to other districts.

Status of Education: Literacy

The literacy rate among males in Rajasthan in 2001 was 75.70 per cent and among females 43.85 per cent, up from 54.99 per cent and 20.84 per cent respectively, in 1991. These numbers make Rajasthan among the best performers on this count during the decade. Over the 1990s and early 2000s, enrolment rates at the primary level were rising and gender gap converging, though female enrolment rate is still to catch up with that of male. There also exist considerable differential across districts in the State. As per survey in 2012, overall literacy varies from 55.58 percent (Jalore) to 77.48 percent (in Kota). Likewise the female literacy

[1] Government of Rajasthan (2008), *Human Development Report Rajasthan (An Update 2008)*, Institute of Development Studies, Jaipur.

also varies across districts from 38.73- 66.32 percent (in Jalore and Kota). In fact, there are also considerable variations in per capita income within the state. As per the state Human Development Report (2008), the per capita income varied from Rs. 8194 (for Churu) to Rs. 17820 (for Bhilwara).

Hypothesis and Objective

In this paper, considering the district level variations in literacy and other pertinent socio-economic variables we intend to explore whether efficiency in education in district level enrolments is merely a reflection of the other conditions or is it owing to lack of efficient utilization of available educational input variables. Thus we estimate district level efficiency in enrolments at primary and upper-primary levels in Rajasthan, in government and private schools, and look into reasons for their differentials.

We presume that districts within a state differ in their technical efficiency. Some districts may be performing better than others in terms of the enrolment rates at different levels. These differences may arise owing to available facilities in the schools including physical and manpower resources. Despite direct inputs by government resources, these factors may differ from district to district according to their level of development. Thus the estimated efficiency parameters should help the education policy makers to improve overall State level system performance pertaining to the sector.

Review of Earlier Studies

In the education sector, previous research on the performance and efficiency of the public sector and its functions that applied non-parametric methods mostly used either FDH (Freely Disposable Hull analysis) or DEA (Data Envelopment analysis) and found significant inefficiencies in many countries (Purohit, 2014a,b). Some studies focus on aggregate level or country/ state or local governments levels. Among

these studies include notably Gupta and Verhoeven (2001) for education and health in Africa, Clements (2002) for education in Europe, St. Aubyn (2003) for education spending in Portugal, Afonso, Schuknecht, and Tanzi (2005) for public sector performance expenditure in the OECD. Afonso and St. Aubyn (2005a, b) in providing health and education in OECD countries. De Borger at al. (1994), De Borger and Kerstens (1996), and Afonso and Fernandes (2006) find evidence of spending inefficiencies for the local government sector. Some studies apply both FDH and DEA methods at primary/ secondary or higher college level education. For instance, Afonso and St. Aubyn (2005b) undertook a two-step DEA/Tobit analysis, in the context of a cross-country analysis of secondary education efficiency. Sutherland, D. et al. (2007) develops performance indicators for public spending efficiency in primary and secondary education in OECD countries using both DEA and SFA. The paper assesses the potential to raise public spending efficiency in the primary and secondary education sector. In order to draw cross-country comparisons of the efficiency in the provision of education, this paper develops a set of comparable indicators which reflect international differences in the levels of efficiency in the primary and secondary education sectors both within and among countries. The paper identifies significant scope to improve efficiency by moving towards best practice.

Using data for a sample of developing countries and transition economies, the paper by Emanuele, Guin-Siu and De Mello (2003) estimates the relationship between government spending on health care, education and selected social indicators. Unlike previous studies, where social indicators are used as proxies for the unobservable health and education status of the population, this paper estimates a latent variable model. The findings suggest that public spending is an important determinant of social outcomes, particularly in the education sector. Overall, the latent variable approach yields better estimates of a social production function than the traditional approach, with higher elasticities of social indicators with respect to income and spending, therefore

providing stronger evidence that increases in public spending do have a positive impact on social outcomes.

The study by Cunha and Rocha (2012) apply DEA techniques to evaluate the comparative efficiency of public higher education institutions in Portugal. The analysis is performed for three separate groups: public universities, public polytechnics and the several faculties of University of Porto. By using several inputs and outputs at the institutional-level, they identify the most technically efficient institutions that may work as benchmark in the sector. The results suggest that a great portion of institutions may be working inefficiently, contributing to a significant waste of resources.

Wolszczak-Derlacz Joanna and Parteka (2011) examine efficiency and its determinants in a set of higher education institutions (HEIs) from several European countries by means of nonparametric frontier techniques. The analysis is based on a sample of 259 public HEIs from 7 European countries across the time period of 2001–2005. They conduct a two-stage DEA analysis; first evaluating DEA scores and further regressing them on potential covariates with the use of a bootstrapped truncated regression. Results indicate a considerable variability of efficiency scores within and between countries. Unit size (economies of scale), number and composition of faculties, sources of funding and gender staff composition are found to be among the crucial determinants of these units' performance. Specifically, they found evidence that a higher share of funds from external sources and a higher number of women among academic staff improve the efficiency of the institution.

Sav (2012) provides stochastic frontier cost and (in) efficiency estimates for private for-profit colleges with comparisons to public and private non-profit colleges. The focus is on the two-year U.S. higher education sector in which there exists the largest and fastest growing entry of for-profit colleges. Unbalanced panel data is employed for four

academic years, 2005-2009. Trans-log cost frontiers are estimated with an inefficiency component that depends upon environmental factors defined by college specific characteristics. More experienced public and private non-profit colleges are found to be more cost efficient relative to the newer entrants. In addition, the newer for-profits exhibit greater efficiency variability but also show some evidence of efficiency gains over the academic years. There is some cursory evidence that for-profit entry is positively correlated, albeit weakly, with greater public college sector inefficiency.

The study by Ahmed (2012) investigates the public sector's efficiency in the educational expenditure in the two major provinces of Pakistan. The data of Punjab and Sindh at district level have been used and Data Envelopment Analysis (DEA) has been conducted. The efficiency scores and rankings for districts in each of the provinces have been computed and analyzed.

A study of the efficiency of Uganda's public education system has been carried out by Winkler and Sondergaard (2008). This study carried out a rapid unit cost survey of 180 public and private primary schools in six districts across three regions. This study documents the magnitude and extent of the leakage and misuse of educational resources. When possible, it identifies the principal causes of inefficiencies. However, in general, further research is needed in order to pinpoint causes and thus identify cost-effective solutions. For example, the study documents the problem of an inequitable and inefficient assignment of teachers across districts and schools. The internal efficiency of public secondary education is low and unit costs are high. The reasons for low efficiency include low workloads, poor teacher deployment, and high teacher salaries. A significant portion of secondary school teachers are underutilized.

Notably there are very few studies in the developing countries' context and except a few particularly in the Indian context, which have focused on this aspect; the literature is nearly marked by absence for recent period. Our study thus covers this gap for India for the latest period.

METHODOLOGY, STUDY DESIGN AND DATA BASE

Stochastic Frontier Method

In the application of parametric techniques, stochastic methods can be used to correct for measurement and other random errors in the estimation of the production possibility frontier. In any parametric technique a functional form is postulated for the production possibility frontier, and then a set of parameters is selected that best fit the sample data.

Model Specification

In the estimation of education system efficiency, our specification is based on a general stochastic frontier model that is presented as:

$$\ln q_j = f(\ln x) + v_j - u_j \qquad (1)$$

Where: $\ln q_j$ is the enrolment (either primary or upper primary in government or private schools or girls enrolments in primary or upper primary levels) by a district level education system in a state"j"

x is a vector of factor inputs represented by per capita school facilities (including per capita availability of teachers, per capita schools, per capita class rooms, or per capita other facility or grants.)

v_j is the stochastic (white noise) error term.

u_j is a one-sided error term representing the technical inefficiency of the health system "j"

Both v_j and u_j are assumed to be independently and identically distributed (iid) with variance σ_v^2 and $\sigma_u^{2,}$ respectively

From the estimated relationship $\ln \hat{q}_j = f(\ln x) - u_j$

The efficient level of education outcome (with zero technical inefficiency) is defined as:

$\ln q^* = f(\ln x)$
This implies $\ln TE_j = \ln \hat{q}_j - \ln q^* = - u_j$
Hence $TE_j = e^{-u}{}_j$, $0 <= e^{-u}{}_j <= 1$
If $u_j = 0$ it implies $e^{-u}{}_j = 1$
Education system is technically efficient.

This implies that technical efficiency of j^{th} education system is a relative measure of its output as a proportion of the corresponding frontier output.

An education system is technically efficient if its output level is on the frontier which in turn means that q/q^* equals one in value.

Study Design: Sample and Sampling Technique

This study uses secondary data published in official documents of government of India and State governments. The study makes use of a purposive sampling and therefore focuses on district level for a major Indian State, namely Rajasthan. The purpose is to carry out an analysis which reveals broadly the district's scenario at a state level disaggregation. Data used thus are presumed to be authentic and therefore reliable. Validity of the results is thus subject to the reliability of official publications and underlying statistical techniques deployed in the study.

For this approach, we use panel data since it does not require strong assumptions about the error term and unlike the cross section data, the assumption of independence of technical efficiency from factor inputs is not imposed (Pitt and Lee, 1981; Schmidt and Sickles, 1984). The frontier estimation for education is carried out using a set of explanatory variables which include manpower variables like pupil teacher ratio, availability of female teachers, age of the schools in terms of older schools established since 1994, facilities like common toilets, girls toilets, drinking water facilities, student class room ratio, and other policy inputs like utilization of school development grant or teaching learning material grant or enrolment of scheduled castes and scheduled tribe category of students. These variables are used to explain enrolment at primary level and upper primary level in the government schools and private schools separately, and enrolment of girls at primary and upper primary levels. The explanatory variables relevant for either primary or upper primary level are used to explain the corresponding primary or upper primary level enrolments.

Data Base

This study is based on availability of comparable information for the years 2008-09 to 2011-12. This is obtained from the surveys of schools annually published as State Report Cards for Elementary Education in India by National University of Educational Planning and Administration (NUEPA), New Delhi. Thus all the major variables used in the estimation (mentioned above) for education sector efficiency have a uniform and comparable source. Statistical analysis tools used by our study include frontier regression technique applying STATA software.

Results and Analysis

Results of our frontier estimation are presented in the Annexure (Tables A1 to A15)[2]. The results are presented to show the specifications

[2] Hausman statistics for all the sets indicated fixed effect model being consistent and thus it is used by us.

indicating variables that could be logically important and for which information is also adequately available. For primary enrolments in govt. schools, the major variables are thus teachers in govt. schools and total no. of primary level govt. schools in the respective districts. Among this only manpower, namely, teachers are found to be statistically significant (Table A1).

Actual and estimated values indicating a comparison between actual and potential are presented in Table 1. Based on this the district ranks (for top achiever rank =1) are presented in column 3 which indicate that how much of the potential has been achieved by a particular district in these enrolments (Table 1). Thus the highest performer in primary enrolments in govt. schools is Jalore and the lowest happens to be Barmer.

The results for primary school enrolments in private schools presented in Table A2 also indicate manpower variable, namely, teachers in private primary schools as the main determinant of these enrolments. The district rankings based on this result (Table 2) indicate Karauli as the top achiever and Hanumangarh as the lowest performer.

The results of upper primary enrolments in government schools presented in Table A3, however, depict statistical significance of both the manpower and primary enrolments in the government schools as important factors. Based on this result, the estimated values indicate Sirohi and Ganganagar respectively as top achiever and the lowest performer relative to all other districts (Table 3).

Table 1: Primary Enrolments in Government Schools: Actual and Estimated values and Ranks

District Name	Actual as % of Estimated Values	Rank
Ajmer	73.21	17
Alwar	86.24	9
Banswara	95.75	2
Baran	67.73	20
Barmer	25.69	33
Bharatpur	90.29	6
Bhilwara	87.88	8
Bikaner	94.26	3
Bundi	65.71	23
Chittaurgarh	62.07	24
Churu	66.56	22
Dausa	67.47	21
Dhaulpur	88.34	7
Dungarpur	82.92	11
Ganganagar	60.71	25
Hanumangarh	51.58	29
Jaipur	74.26	15
Jaisalmer	77.04	13
Jalore	99.89	1
Jhalawar	72.65	18
Jhunjhunun	39.25	32
Jodhpur	91.63	4
Karauli	58.63	26
Kota	50.40	30
Nagaur	69.89	19
Pali	74.70	14
Pratapgarh (Raj.)	77.74	12
Rajsamand	73.45	16
Sawai Madhopur	56.79	27
Sikar	49.03	31
Sirohi	85.63	10
Tonk	56.28	28
Udaipur	90.76	5

Source: Estimated.

Table 2: Primary Enrolments in Private Schools: Actual and Estimated Values and Ranks

District Name	Actual as Percent Estimated Values	Rank
Ajmer	81.58	15
Alwar	86.76	11
Banswara	73.53	20
Baran	51.63	30
Barmer	89.34	9
Bharatpur	100.14	3
Bhilwara	91.55	8
Bikaner	93.94	7
Bundi	61.20	26
Chittaurgarh	71.47	22
Churu	86.07	13
Dausa	95.37	6
Dhaulpur	52.57	29
Dungarpur	55.43	28
Ganganagar	98.28	4
Hanumangarh	40.23	33
Jaipur	77.73	18
Jaisalmer	83.60	14
Jalor	96.76	5
Jhalawar	48.40	32
Jhunjhunun	63.11	24
Jodhpur	100.20	2
Karauli	100.30	1
Kota	57.28	27
Nagaur	87.18	10
Pali	86.30	12
Pratapgarh (Raj.)	61.68	25
Rajsamand	64.45	23
Sawai Madhopur	72.64	21
Sikar	80.49	16
Sirohi	75.19	19
Tonk	50.61	31
Udaipur	79.08	17

Source: Estimated.

Table 3: Upper Primary Enrolments in Government Schools: Actual and Estimated Values and Ranks

District Name	Actual as Percent Estimated values	Rank
Ajmer	50.79	22
Alwar	56.00	15
Banswara	58.38	13
Baran	48.69	24
Barmer	44.66	31
Bharatpur	62.91	9
Bhilwara	52.76	20
Bikaner	48.24	25
Bundi	70.56	5
Chittaurgarh	62.20	10
Churu	64.58	8
Dausa	59.01	12
Dhaulpur	86.05	2
Dungarpur	46.55	28
Ganganagar	38.01	33
Hanumangarh	42.15	32
Jaipur	54.93	19
Jaisalmer	50.01	23
Jalor	55.30	18
Jhalawar	46.51	29
Jhunjhunun	70.06	6
Jodhpur	55.72	17
Karauli	46.90	27
Kota	75.57	4
Nagaur	68.67	7
Pali	58.07	14
Pratapgarh (Raj.)	46.20	30
Rajsamand	47.44	26
Sawai Madhopur	55.76	16
Sikar	59.41	11
Sirohi	86.47	1
Tonk	81.62	3
Udaipur	51.38	21

Source: Estimated.

The results of upper primary enrolments in private schools also indicate the statistical significance of manpower variable (namely, teachers in private upper primary schools) and upper primary enrolments in government schools (Table A4). The positive sign of the latter variable is suggesting a complementarity between govt. and private schools enrolments and not a competition between two. District rankings based on actual accomplishing the potential for upper primary enrolments indicates Junjhunu and Jaisalmer as top and lowest performer respectively (Table 4).

Results for girl's enrolments at primary level indicate three variables, namely, primary overall enrolments in government schools, no. of schools with pupil-teacher ratio exceeding 100 and total number of class rooms as statistically significant with a positive sign (Table A5). The result indicates that government emphasis on increasing literacy and thus enrolments, popularity/ convenient location of a school (pupil-teacher ratio) as well as infrastructure variable (total no. of class rooms); all these seem to matter in enhancing girls' primary schools enrolments. The district level rankings based on their achieved potentials indicate that state capital city, Jaipur, and the western desert district Jaisalmer are the top and lowest achievers respectively (Table 5).

Results for girl's enrolments at upper primary level denote statistical significance of four variables (Table A6). These include overall upper primary enrolments in government schools, number of female teachers, number of older schools (established in year 1995) and school development grants. The results are thus suggestive that two pronged government efforts, namely, emphasis on increasing enrolments and expenditure policy variable, school development grant; have a desirable positive impact. In terms of achievements relative to their potentials, Churu and Udaipur hold top and bottom positions respectively (Table 6).

Table 4: Upper Primary Enrolments in Private Schools (6th GRADE) Actual and Estimated Values and Ranks

District Name	Actual as Percent Estimated values	Rank
Ajmer	62.4546	4
Alwar	61.4455	5
Banswara	26.8880	29
Baran	38.8470	22
Barmer	31.4243	26
Bharatpur	52.5366	10
Bhilwara	37.4898	23
Bikaner	41.6570	16
Bundi	39.9844	20
Chittaurgarh	39.6924	21
Churu	61.3368	6
Dausa	54.4362	9
Dhaulpur	44.7938	15
Dungarpur	29.0271	28
Ganganagar	56.7894	7
Jaipur	88.2111	3
Jaisalmer	19.8343	31
Jalor	40.6464	18
Jhalawar	40.6586	17
Jhunjhunu	95.6237	1
Jodhpur	46.7868	13
Karauli	46.7423	14
Nagaur	56.3865	8
Pali	50.3984	12
Pratapgarh (Raj.)	20.7602	30
Rajsamand	33.5608	25
Sawai Madhopur	50.8012	11
Sikar	91.1002	2
Sirohi	29.0573	27
Tonk	40.0789	19
Udaipur	34.7876	24

Source: Estimated.

Note: For the districts of Hanumangarh and Kota data were insufficient and thus these districts are dropped in this Table.

Table 5: Girls Enrolments at Primary Level: Actual and Estimated Values and Ranks

Girls Enrolment Primary Results		
District Name	**Actual as % Estimated Values**	**Rank**
Ajmer	85.7272	13
Alwar	80.23744	25
Banswara	86.26122	10
Baran	85.88165	12
Barmer	75.19466	31
Bharatpur	88.08482	4
Bhilwara	78.79663	29
Bikaner	86.58704	9
Bundi	86.25001	11
Chittaurgarh	83.84251	17
Churu	86.62168	8
Dausa	87.58241	5
Dhaulpur	82.86727	20
Dungarpur	85.00161	14
Ganganagar	80.49139	24
Hanumangarh	76.58883	30
Jaipur	96.29151	1
Jaisalmer	72.56605	33
Jalor	84.47792	16
Jhalawar	84.51087	15
Jhunjhunun	79.42794	28
Jodhpur	83.41851	19
Karauli	87.50537	6
Kota	93.46623	2
Nagaur	79.79016	27
Pali	72.91397	32
Pratapgarh(Rajasthan)	80.59932	23
Rajsamand	82.8275	21
Sawai Madhopur	87.2511	7
Sikar	82.79107	22
Sirohi	80.0507	26
Tonk	91.20869	3
Udaipur	83.61812	18

Source: Estimated.

Table 6: Girls Enrolments at Upper Primary Level: Actual and Estimated Values and Ranks

Girls Enrolment Upper Primary results		
District Name	**Actual as % Estimated values**	**Ranks**
Ajmer	39.8539	16
Alwar	42.3303	10
Banswara	42.9916	9
Baran	34.7548	22
Barmer	44.9851	6
Bharatpur	39.7287	17
Bhilwara	33.8867	23
Bikaner	39.9951	14
Bundi	55.1547	2
Chittaurgarh	40.0447	13
Churu	62.1515	1
Dausa	40.0511	12
Dhaulpur	46.7469	5
Ganganagar	32.3135	26
Hanumangarh	38.6377	18
Jaipur	44.8375	7
Jalor	33.6627	24
Jhalawar	30.4847	27
Jodhpur	43.8902	8
Karauli	36.8436	20
Nagaur	53.4332	3
Pali	37.4528	19
Pratapgarh(Rajasthan)	40.3023	11
Sawai Madhopur	33.3739	25
Sikar	34.8804	21
Sirohi	48.6642	4
Tonk	39.9690	15
Udaipur	29.3657	28
For some districts including Dungapur, Jaisalmer, Kota and Rajsamand estimates not provided due to inadequate data		

Source: Estimated.

Table 7: Highest and Lowest Achievers Relative to Others in Different Categories of Enrolments

Category	Highest Achiever	Lowest Achiever
Primary enrolments in govt. schools	Jalore	Barmer
Primary school enrolments in private schools	Karauli	Hanumangarh
Upper primary enrolments in government schools	Sirohi	Ganganagar
Upper primary enrolments in private schools	Junjhunu	Jaisalmer
Girls enrolments at primary level	Jaipur	Jaisalmer
Girls enrolments at upper primary level	Churu	Udaipur

Source: Tables 1-6 above.

A synoptic view of these results in terms of different category of enrolments and top vs. lowest achievers is presented in Table 7. We observe that lowest achievers seem to be low in general in terms of income or urbanization or availability of schools. For instance, a low achiever Barmer is also very low in ranking in per capita income (Table 8). By contrast, in terms of total number of schools and urbanization, Jaiasalmer and Hanumangarh, are ranking very low. Another reason is a saturation level probably in reaching relative literacy levels. For instance, in case of Hanumangargh and Ganganagar, their relative ranking in terms of literacy being on the higher side probably leading to a decline in rate of enrolments.

To confirm whether the residual part of efficiency or inefficiency of districts in enrolment is related with any of these above variables or other literacy variables, we compute Spearman rank correlations of the residuals (of efficiency). We observe, for instance, that the correlations of residuals and per capita income are generally significant at 10 percent or lower levels (Tables 9-10). In case of residual of upper primary enrolments, urbanization correlation is also significant both for

government and private schools enrolment (Tables 11-12). In case where such correlations are statistically not significant, there may be a likelihood of rather inefficient utilization of existing inputs. This is the case for Udaipur where none of these correlations seem to hold statistical significance and thus indicating rather an inefficient utilization of educational inputs relative to other districts.

By contrast, among the top achievers, Jaipur being state capital has highest no. of schools as well as female literacy. Among other top achievers, the impact of higher female literacy in achieving a better position in enrolments is mainly visible for Jhunjhunu. This is also reinforced by the fact that generally total literacy and female literacy have significant rank correlations with all the enrolment residuals (Tables 9-14). For others like Jalore and Sirohi, unlike saturation, an overall very low ranking in literacy and government emphasis on literacy seem to have resulted in better relative performance.

Having observed the significant spearman correlations above, we further carried out second stage regressions by considering the efficiency residuals as dependent variables. Though for upper primary enrolments in government schools and upper primary enrolments of girls, none of these other variables were found with spearman correlation as statistically significant, yet in the second stage residual regressions, for primary enrolments in govt schools, the significant variables were female literacy and total number of schools (Annexure Table A8). For primary enrolments in private schools, in second stage regressions, only total number of schools representing overall schools availability in the district was significant (Annexure Table A9). For upper primary enrolments in private schools and primary enrolments of girls, in the second stage, urbanisation was statistically significant (Annexure Tables A10-11).

Table 8: Number of Schools, Urban Population, Literacy and Income for Districts of Rajasthan State

District Name	Total Number of Schools	Ranks	Urban Population (percent)	Ranks	Overall Literacy	Ranks	Female Literacy	Ranks	Per Capita Income (INR)	Ranks
Ajmer	3240	14	40.09	3	70.46	7	56.42	8	15066	8
Alwar	5502	4	17.82	23	71.68	5	56.78	7	15527	7
Banswara	3519	10	7.11	31	57.2	30	43.47	28	9842	28
Baran	2226	27	20.79	13	67.38	13	52.48	14	13789	13
Barmer	5789	2	7	32	57.49	29	41.03	30	9662	29
Bharatpur	3663	9	19.41	20	71.16	6	54.63	10	10791	24
Bhilwara	4341	8	21.29	12	62.71	22	47.93	21	17820	1
Bikaner	3315	12	33.95	5	65.92	17	53.77	12	16093	5
Bundi	2070	29	19.94	16	62.31	25	47	24	14499	9
Chittaurgarh	2688	19	18.47	22	62.51	23	46.98	25	13119	17
Churu	2813	18	28.24	6	67.46	12	54.25	11	8194	32
Dausa	2650	20	12.38	28	69.17	10	52.33	15	10198	25
Dhaulpur	1909	30	20.51	14	70.14	9	55.45	9	8428	31
Dungarpur	2874	17	6.39	33	60.78	27	46.98	25	9460	30
Ganganagar	3241	13	27.2	7	70.25	8	60.07	4	17572	3
Hanumangarh	2385	23	19.71	19	68.37	11	56.91	6	14489	10
Jaipur	8016	1	52.51	2	76.44	2	64.63	2	17727	2
Jaisalmer	1687	31	13.28	27	58.04	28	40.23	31	14304	11
Jalor	2928	16	8.3	29	55.58	33	38.73	33	10837	23
Jhalawar	2368	24	16.26	24	62.13	26	47.06	23	12075	19
Jhunjhunun	3452	11	22.91	9	74.72	3	61.15	3	10915	21
Jodhpur	5660	3	34.3	4	67.09	15	52.57	13	13349	14
Karauli	2444	22	14.99	26	67.34	14	49.18	16	9996	27
Kota	2328	25	60.3	1	77.48	1	66.32	1	17327	4
Nagaur	5267	5	19.17	21	64.08	18	48.63	18	10171	26
Pali	3148	15	22.56	10	63.23	20	48.35	20	13074	18
Pratapgarh*	1654	32	8.26	30	56.3	31	42.4	29	n.a	n.a
Rajsamand	2291	26	15.93	25	63.93	19	48.44	19	13305	15
Sawai Madhopur	2145	28	19.9	17	66.19	16	47.8	22	11499	20
Sikar	4409	7	23.65	8	72.98	4	58.76	5	10840	22
Sirohi	1403	33	20.13	15	56.02	32	40.12	32	16039	6
Tonk	2583	21	22.36	11	62.46	24	46.01	27	13195	16
Udaipur	5181	6	19.85	18	62.74	21	49.1	17	13985	12

Source: Government of Rajasthan (2008), Human *Development Report Rajasthan (An Update 2008)*, Institute of Development Studies, Jaipur and NUEPA(2014a)

Table 9: Spearman Correlations of Primary Enrolments in Government Schools (Residuals)

Primary enrolment in govt. schools	1				
Total schools	0.1414	1			
Urban population	-0.1541	0.1788	1		
Total literacy	-0.3199*	0.2871	0.6140*	1	
Female literacy	-0.2512	0.3259*	0.6607*	0.9630*	1
Per capita income	0.0705	-0.0009	0.5138*	0.1773	0.2505

Source: Estimated; * denotes significance at 10 percent or less.

Table 10: Spearman Correlations of Primary Enrolments in Private Schools (Residuals)

Primary enrolment in private schools	1					
Total schools	0.5274*	1				
Urban population	0.0191	0.1788	1			
Total literacy	0.0936	0.2871	0.6140*	1		
Female literacy	0.0565	0.3259*	0.6607*	0.9630*	1	
Per capita income	-0.028	-0.0009	0.5138*	0.1773	0.2505	1

Source: Estimated; * denotes significance at 10 percent or less.

Table 11: Spearman Correlations of Upper Primary Enrolments in Govt. Schools (Residuals)

Upper primary enrolment in govt. schools	1					
Total schools	-0.0712	1				
Urban population	0.3105*	0.1788	1			
Total literacy	0.1781	0.2871	0.6140*	1		
Female literacy	0.0725	0.3259*	0.6607*	0.9630*	1	
Per capita income	-0.1427	-0.0009	0.5138*	0.1773	0.2505	1

Source: Estimated; * denotes significance at 10 percent or less.

Table 12: Spearman Correlations of Upper Primary Enrolments in Private Schools (Residuals)

upper primary enrolment in private schools	1					
total schools	0.4329*	1				
urban population	0.5989*	0.1788	1			
total literacy	0.8565*	0.2871	0.6140*	1		
female literacy	0.8227*	0.3259*	0.6607*	0.9630*	1	
per capita income	0.0166	-0.0009	0.5138*	0.1773	0.2505	1

Source: Estimated;* denotes significance at 10 percent or less.

Table 13: Spearman Correlations of Girls Primary Enrolments (Residuals)

girls enrolments in primary schools	1					
total schools	-0.0682	1				
urban population	0.1915	0.1788	1			
total literacy	0.254	0.2871	0.6140*	1		
female literacy	0.1847	0.3259*	0.6607*	0.9630*	1	
per capita income	-0.0821	-0.0009	0.5138*	0.1773	0.2505	1

Source: Estimated;* denotes significance at 10 percent or less.

Table 14: Spearman Correlations of Girls Upper Primary Enrolments (Residuals)

girls enrolments in upper primary schools	1					
total schools	-0.1356	1				
urban population	-0.0442	0.1788	1			
total literacy	0.0084	0.2871	0.6140*	1		
female literacy	-0.0122	0.3259*	0.6607*	0.9630*	1	
per capita income	-0.1425	-0.0009	0.5138*	0.1773	0.2505	1

Source: Estimated;* denotes significance at 10 percent or less.

These results indeed point out three important features: i) there are variations in technical efficiency of enrolments at district levels. These are partly explained by either of three sets of variables which include facilities, manpower and policy variables; ii) there are other socio-economic factors like income, urbanisation which also have a strong bearing on ranking of efficiency performance of districts and iii) inefficiency is explained by second stage residual regressions and these again reinforce the role of socio-economic factors. Thus technical efficiency in education as measured by enrolment rates is influenced not only by efficient utilisation of existing governmental inputs in terms of school facilities, manpower resources and policy grants but our evidence indicates that a powerful influence is also exhibited by existing level of urbanisation and socio-economic parameters like income and female literacy in general. This in turn means that the same type of education planning in all the districts to increase enrolments at primary or upper primary levels in Rajasthan may not be appropriate strategy. There needs to be a fine tuning of policy or different strategy for the districts which lack in development relative to others. Most optimum it would be to create a better development environment in less developed districts either by special governmental interventions like specific grants or explore possibility of public-private partnerships which may avoid some of the undesirable outcomes like cost escalation associated with only private sector taking a prime role in increasing educational and developmental role in a particular district. For instance, the districts like Churu, Dholpur, Dungarpur, Barmer and Banswara, which are on the lowest rung of per capita income, may be benefitted by development grants suited to develop income generating opportunities in these districts and this in turn may have an impact on literacy and enrolment rates. Unlike this, for districts of Bhilwara, Jaipur, Ganganagar and Kota with higher levels of per capita income, encouraging public-private partnership in education may yield better results to enhance literacy as these may be more conducive to encourage private involvement. In this aspect, a study, for instance in learning achievements in primary education in Rajasthan also

indicates that private unaided schools were nearly twice as more cost effective than government schools implying that public schools teachers earn considerable rents (Goyal, 2007). Thus it will be more cost effective in some of the better off districts, as discussed above, to encourage private schools. Further, evidence on a public primary education policy in Rajasthan also indicates that the state government should focus on creating appropriate incentives to private schools (Bajpai and Dholkia, 2006). In line with this thinking, an interesting step recently initiated by the state government of Rajasthan is to absorb about 10, 000 teachers and non-academic staff of aided educational institutions into state run schools and colleges. This policy move will provide an option for joining a newly created rural education service cadre (Kapoor and Mehta, 2010). This will remove the existing category of private aided educational institutions in the state. As a result government funds will be saved in new recruitments and existing vacancies in different schools and other educational institutions may be filled without the extra cost.

CONCLUSIONS

These results thus pertinently indicate a strong role being played by economic development parameters like income and urbanization. And simultaneously direct educational interventions seem to play a positive role in enhancing enrolments at different levels. Therefore an education policy should capture district specific gaps to strengthen the outcomes. This may thus necessitate more information at district level both in terms of educational and economic parameters and this information gap needs to be overcome through planning process.

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ANNEXURE

Table A1: Enrolments at Primary Level in Government Schools

Results for primary enrolment
Time-invariant inefficiency model
Number of obs. = 132; Number of groups = 33;
Obs. per group: min = 4
Avg. = 4; max = 4
Wald chi2(2) = 102.97
Log likelihood = -49.659 ; Prob > chi2 = 0.0000

enr_govt1	Coeff.	Std. Err.	z	P>|z|
tch_govt1	0.754	0.094	7.980	0.000
schgovt1	-0.026	0.089	-0.300	0.765
Constant	5.740	59.965	0.100	0.924
Mu	0.271	59.962	0.000	0.996
lnsigma2	-2.085	0.123	-16.930	0.000
ilgtgamma	-3.988	4.357	-0.920	0.360
sigma2	0.124	0.015		
Gamma	0.018	0.078		
sigma_u2	0.002	0.010		
sigma_v2	0.122	0.018		

Source: Estimated.

Table A2: Primary Enrolments in Private Schools

Primary Enrolment private schools Time-invariant inefficiency model Number of obs. = 132 Number of groups = 33; Obs. per group: min = 4 Avg. = 4 max = 4 Wald chi2(3) = 93.63 Log likelihood = -67.865 ; Prob > chi2 = 0.0000			
enr_pvt1	Coeff.	z	P>|z|
tch_pvt1	0.6862	8.4100	0.0000
schpvt1	-0.1227	-1.3500	0.1780
sdg1	-0.0029	-0.0300	0.9740
Constant	5.8025	0.3400	0.7370
Mu	0.1837	0.0100	0.9920
lnsigma2	-1.8095	-14.7000	0.0000
ilgtgamma	-4.7922	-0.5300	0.5930
sigma2	0.1637		
Gamma	0.0082		
sigma_u2	0.0013		
sigma_v2	0.1624		

Source: Estimated.

Table A3: UPPER PRIMARY Enrolments in Government Schools

UPPER PRIMARY GOVT Enrolments Time-invariant inefficiency model Number of obs. = 123; Number of groups =33 Obs. per group: min =1; avg. = 3.7; max = 4 Wald chi2(2)= 391.70 Log likelihood = -19.450 Prob > chi2 = 0.0000				
upperprime~4	Coeff.	Std. Err.	z	P>|z|
tch_govt4	0.2342	0.0576	4.0700	0.0000
enr_r_govt4	0.6300	0.0453	13.9100	0.0000
Cons	2.2803	0.7376	3.0900	0.0020
Mu	0.5556	0.7053	0.7900	0.4310
lnsigma2	-2.4036	0.1530	-15.7100	0.0000
ilgtgamma	-0.7475	0.5291	-1.4100	0.1580
sigma2	0.0904	0.0138		
Gamma	0.3214	0.1154		
sigma_u2	0.0290	0.0134		
sigma_v2	0.0613	0.0095		

Source: Estimated.

Table A4: Upper Primary Enrolments in Private Schools (6th GRADE)

Time-invariant inefficiency model Number of obs = 114;
Number of groups =31
Obs per group: min =1 avg = 3
max = 4 Wald chi2(2) = 125.12
Log likelihood = -18.510;Prob > chi2=0.0000

enr_cy_c6	Coeff.	z	P>|z|
enr_r_govt1	0.6455	10.9100	0.0000
tch_f_p4	0.1108	3.4300	0.0010
constant	3.9112	5.5600	0.0000
Mu	0.7981	3.1500	0.0020
Lnsigma2	-1.8649	-7.8500	0.0000
ilgtgamma	0.9303	2.4800	0.0130
sigma2	0.1549		
Gamma	0.7171		
sigma_u2	0.1111		
sigma_v2	0.0438		

Source: Estimated.

Table A5: Girls Enrolments at Primary level

Girls Enrolment Primary results
Time-invariant inefficiency model;
Number of obs.=66; Number of group =33
Obs. per group: min =2;avg.=2;
max = 2; Wald chi2(3) =1407.96
Log likelihood = 92.449 ; Prob > chi2 = 0.0000

pcgirls1	Coeff.	z	P>|z|
Enrr govt1	0.7983	23.6800	0.0000
sch100ptr	0.0256	1.8500	0.0640
Totcls	0.1700	5.3400	0.0000
constant	0.2025	0.6400	0.5230
Mu	0.1723	2.6500	0.0080
Lnsigma2	-5.1320	-20.5500	0.0000
ilgtgamma	1.3225	3.1000	0.0020
sigma2	0.0059		
Gamma	0.7896		
sigma_u2	0.0047		
sigma_v2	0.0012		

Source: Estimated.

Table A6: Girls Enrolments at Primary level

Girls Enrolment Primary results
Time-invariant inefficiency model Number of obs.=66; Number of group =33
Obs. per group: min =2;avg. =2;
max = 2; Wald chi2(3) =1407.96
Log likelihood = 92.449; Prob > chi2=0.0000

pcgirls1	Coef.	z	P>|z|
Enrr govt1	0.7983	23.6800	0.0000
sch100ptr	0.0256	1.8500	0.0640
Totcls	0.1700	5.3400	0.0000
constant	0.2025	0.6400	0.5230
Mu	0.1723	2.6500	0.0080
Lnsigma2	-5.1320	-20.5500	0.0000
ilgtgamma	1.3225	3.1000	0.0020
sigma2	0.0059		
Gamma	0.7896		
sigma_u2	0.0047		
sigma_v2	0.0012		

Source: Estimated.

Table A7: Girls Enrolments at Upper Primary level

Girls enrolment UPPER PRIMARY
Time-invariant inefficiency model
Number of obs.= 53; Number of groups= 28
Obs. per group: min = 1 ; avg. = 1; max = 2
Wald chi2(4) = 301.21
Log likelihood = 9.137; Prob > chi2 =0.0000

Pc girls4	Coeff.	Std. Err.	z	P>|z|
Enrr govt4	0.4674	0.0537	8.7100	0.0000
Tch female	0.3520	0.0769	4.5700	0.0000
ch1995estd4	0.2011	0.0778	2.5900	0.0100
sdg4	-0.0754	0.0428	-1.7600	0.0780
constant	2.9643	10.9073	0.2700	0.7860
Mu	0.9118	10.9039	0.0800	0.9330
Lnsigma2	-2.9294	0.2455	-11.9300	0.0000
ilgtgamma	0.5952	0.6298	0.9400	0.3450
sigma2	0.0534	0.0131		
Gamma	0.6446	0.1443		
sigma_u2	0.0344	0.0145		
sigma_v2	0.0190	0.0061		

Source: Estimated.

Table A8: Second Stage Regression: Primary Enrolments in Government Schools

Residual primary enrolments in govt schools	Coeff.	t value	P>|t|
female literacy	1.1232	4.2600	0.0000
total number of schools	-0.2307	-2.5900	0.0150
Constant	-2.2346	-2.1500	0.0390
Number of obs = 33; F(2, 30) = 9.80; Prob > F= 0.0005 R-squared = 0.3951; Adj R-squared= 0.3548; Root MSE = .19307			

Source: Estimated.

Table A9: Second Stage Regression: Primary Enrolments in Private Schools

Residual primary enrolments in private schools	Coeff.	t	P>|t|
total number of schools	-0.2940	-2.6500	0.0130
Constant	2.6379	2.9600	0.0060
Number of obs = 33; F(1, 31) =7.02; Prob > F = 0.0125 R-squared = 0.1847; Adj R-squared = 0.1584;Root MSE=.25597			

Source: Estimated.

Table A10: Second Stage Regression: Upper Primary Enrolments in Private Schools

Residual enrolment in upper primary in private schools	Coeff.	t	P>|t|
percentage of urban population	-0.5119	-4.4600	0.0000
Constant	2.3020	6.7900	0.0000
Number of obs = 30; F(1, 28) =19.88; Prob > F =0.0001 R-squared = 0.4152;Adj R-squared = 0.3943;Root MSE = .31663			

Source: Estimated

Table A11: Second Stage Regression: Primary Enrolments of Girls

Residual primary enrolments girls	**Coeff.**	**t**	**P>|t|**
Percentage urban population	**-**0.0408	-2.0300	0.0510
Constant	0.3007	5.0000	0.0000
Number of obs = 33; F(1, 31)=4.12; Prob > F = 0.0510 R-squared = 0.1173; Adj R-squared = 0.0889; Root MSE = .06045			

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