Comparative Efficiency Analysis of Public and Private Colleges of Multan District: Data Envelope Approach Analysis

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ARTICLE DETAILS	ABSTRACT
History *Revised format: May 2016* *Available online: Jun 2016* **Keywords** *DEA,* *Efficiency,* *technical efficiency,* *scale efficiency,* *public colleges,* *private colleges* **JEL Classification** A23, A20, D60, D61	The purpose of this paper is to evaluate the efficiency of public and private sector colleges in Multan district. We use output oriented data envelopment analysis to measure technical and scale efficiency of a sample of 40 colleges, using data for the year 2014. DEA, which is the most popular technique used to measure the relative efficiency of non-profit organizations due to the absence of prices or relative values of educational outputs, is employed to compare efficiency of both types of colleges. Moreover, it can handle multiple inputs and outputs with great ease. As public and private colleges are working under similar environmental conditions, we have used a single frontier, incorporating four educational inputs and four outputs. The results of the data demonstrate that private colleges lag behind public colleges in terms of CRS and VRS technical efficiency scores and scale efficiency scores. Our study of colleges is in contrast with the dominant paradigm that private colleges outperform the state-run colleges.

1. Introduction

Education is a production process which creates productive and informed populace. Education is the most important factor which plays vital role in human resource development as it produces opportunities for the socially and economically deprived sections of society. According to Haunshek (1986) "education is a service that transforms fixed quantities of inputs (that is individual) into individuals with different qualities".

Educational institutions are of great importance because the production process takes place in such institutions. In these institutions students are treated as input as well as output. In recent years, a range of policy actions have created a space for the promotion of private educational system throughout the world. Privatization has become a dominant paradigm in economic based educational research.

According to this paradigm private educational institutions are superior to public educational institutions. The World Bank (WB) has strong conviction that privately organized educational institutes are far better than the government owned institutes. The arguments given by the proponents of privatization include better management, accountability to parents, greater scope for innovation by teachers and school management.

The notion of privatization of educational institutes is in line with the basic economic concepts of demand and supply. The privatization spurs competition, which eventually improve quality. Friedman (1955) was the first economist who clearly advocated the privatization of education for superior quality educational institutes. Chubb and Moe (1990) argued the promotion of private colleges to improve school choice. Coleman (1997) concluded that school choice would improve educational markets.

Like all over the world, educational system in Pakistan consists of two types of institutions namely public sector educational institutes and private sector educational institutes as public sector alone cannot fulfill the growing demand of education. Both types of educational institutions exited even when Pakistan came into being in 1947.

Keeping in view the fundamental role of education in economic development of a nation, the researchers have been probing the efficiency and performance of schools, colleges and universities since 1970s worldwide. Data Envelopment Analysis (DEA) technique and regression analysis have been utilized for this purpose.

This paper attempts to compare efficiency of public and private sector colleges of Multan district through Data Envelopment Analysis (DEA) indexes. The efficiency of public and private sector colleges will be compared on the basis of DEA efficiency scores. Technical efficiency of boys and girls colleges of both sectors will be computed separately for comparison.

Primary data have been used for the analysis in this study. Data have been collected through a survey from randomly selected public and private colleges of three tehsils of Multan district.

2. Literature Review

Extensive literature is available about the efficiency and effectiveness of public and private sector educational institutes. The literature shows mixed results.

Cavalcanti, *et al.* (2010) found a very interesting result that once student got admission into the university, students belonging to public schools performed better than students from private schools in Brazil. Research conducted by Asadullah (2009) regarding two countries of South Asia gave opposite results relative to each other. Labour market earnings were used as measure of effectiveness between private and public school graduates in Bangladesh and Pakistan. Regarding Bangladesh, results were in favor of public schools. Whereas, in case of Pakistan private schools appeared to be more effective than public schools in boosting students' achievements.

Komatsu (2009) pointed out a number of obstacles that hampered the effective and efficient delivery of education through a qualitative field study at North West Frontier Province of Pakistan. With the help of longitudinal data for 150 schools, Lassibille and Tan (2001) compared the efficiency of private & public school in Tanzania. The results were in contrast to the results given by earlier studies as two types of public schools were more efficient than both types of private schools.

Chudgar and Quin (2012) pointed dissatisfaction of parents with the performance of public schools. The regression analysis resulted in a positive relationship between attending private schools and better performance of students. By using four-year panel data (2006-2009), Cuenca (2011) estimated the efficiency of 78 Philippine State universities and colleges and observed that majority of under observed institutions were inefficient.

Using entrance test exam of the major public university located in Brazil Northeast area, Cavalcanti, *et al.* (2010) assessed the difference in performance of public and private school students. The authors found that private school students got 4.2-17% (on average) high score than their public counterparts.

Coulson (2009) reviewed the research conducted all over the world in the past several decades about public, private and market schools and concluded that the private sector outperformed the public sector. Dronkers and Robert (2008) measured the differences in scholastic achievement of private and public schools in 22 comparable countries using PISA data. Their analysis showed that the higher gross educational outcomes are for private government dependent institutions.

Using the TIMSS (Trends in International Mathematics and Science Study) 2003 data Rutkowski and Rutkowski (2009) concluded that private schools showed significantly higher achievements. Using NAEP data, Lubienski & Lubienski (2006) found no statistically significant differences between private and public education in USA. Braun, *et al.* (2006) also came to the same conclusion, when they used NAEP 8th grade mathematics achievement. They had controlled the data for selected student and school variables.

Dronkers (2001) concluded that privately administered schools performed better in these countries. Bedi and Grag (2000) used labor market earnings and concluded that private secondary school graduates performed better in labor market as compared to public secondary school graduates.

3. Data and Methodology
3.1. Data Source
A field survey, with stratified random sampling technique, is conducted for data collection.
3.2. Sampling Size:
BISE Multan provides institution-wise results of only affiliated institutions while the students of non-affiliated institutions, appearing in the examinations, are treated as private students. As it is impossible to find authentic result of non-affiliated colleges, only affiliated colleges of BISE from Multan district were included in our research plan. Finally, sample from colleges was selected as follows:

Table 1: Total Number of Colleges in Multan district

Colleges	Govt.	Pvt.	Total
Male	10	26	36
Female	12	19	31
Total	22	19	67

40 colleges were selected out of total 67 colleges.

Table 2: Sample Sizes of Colleges in Multan district

Colleges	Govt.	Pvt.	Total
Male	06	16	22
Female	07	11	18
Total	13	27	40

3.3. Data Collection Procedure:
For data collection, randomly selected colleges of Multan district were surveyed. These institutions were selected from all three tehsils and keeping in view the rural-urban divide. For this self-administered survey, a questionnaire was prepared. Intermediate examination results of the selected institutions were

collected from the BISE. The record of CM Punjab extra-curricular activities and some other information were collected from directorate of colleges.

3.4.   *Variables of the Study:*

We have taken following four input and four output variables.

Table 3: Input Variables

Abbreviation	Variable
NT	Number of Teachers
NC	Number of Class-Rooms
ATET	Average Teaching Experience of Teachers
TE	Total Expenditures

Table 4: Output Variables

Abbreviation	Variable
NS	Number of Students
PR	Percentage Result
WAPPM	Weighted Average of Passing Students' Percentage Marks
SECA	Score of Extra-Curricular Activities

In a number of previous studies, six, out of above-mentioned eight variables have been used. Two new output variables, Weighted Average of Passing Students' Percentage Marks (WAPPM) and Score of Extra-Curricular Activities (SECA), have been included in our model. WAPPM is constructed on the basis of the grades of the passing students of the institutes to capture the percentage marks of all students in an institute. WAPPM is constructed by taking the weighted average of the all grades, obtained by the students of the institute, with grades' minimum limits of marks, taken as the weights. They are multiplied with the number of students of the institution, falling in that grade. SECA is the variable for extra-curricular activities and it is constructed on the basis of 3 extra-curricular activities including oral (speech), written (essay-writing etc.) and sports, each category having maximum 1 score and minimum zero. 0.5 score is awarded to the institution for participation in any level of CM Punjab's speech, essay-writing and sports competition, and 1 score is awarded to the institution for wining a competition, and zero score for nonparticipation in any competition. The references of the remaining variables are given in Table 5.

Table 5: Input & Output Variables:

Variable Name	Reference
NT	Johnes (2006) Abbot & Doucouliagos (2003), Martin (2003), Avkiran (2001)
NC	Johnes & Yu (2008), Bedi & Garg (2000), Dronkers & Robert (2008)
ATET	Johnes & Yu (2008), Lassibille & Tan (2001), Oliver, Belluzzo & Pazello (2013)
TE	Castano & Cabanda (2007), Cuenca (2011), Johnes (2006), Martin (2003)
NS	Avkiran (2001), Dills & Mulholland (2010), Lassibille & Tan (2001), Johnes & Yu (2008), Bedi & Garg (2000), Johnes (2006)
PR	Chudgar & Quin (2012), Perelman & Santin (2011), Dronker & Robert (2008), Horowitz & Spector (2005),

	Rutkowski & Rutkowski (2009), Cavalcanti, Guimaraes & Sampaio (2010).

3.5.   Area Profile:

According to 1998 census, Multan district's population was 3,116,851, with 42 percent urban population. Now the population is estimated around 7 million. Multan is a city district and has three tehsils including Multan, Shujabad and Jalapur Pirwala. Multan district has an area of 3,721 square kilometres. According to Bureau of Statistics 2013, literacy rate in Multan district is estimated at 66 percent.

3.6.   Analytical Tool:

Data Envelopment Analysis is the analytical tool for the study. The linear programming method of DEA is based on frontier approach and it is the most suitable frontier method for relative performance. Dyson, et al. (1998) suggested that sample size of DMUs should be greater than the product of number of inputs and outputs while Stern, et al. (1994) recommended that number of DMUs should be greater than thrice the sum of inputs and outputs.

Max $[2(m \times n), 3(m+n)]$

3.7.   Descriptive Analysis

Table 6: Summary Statistics of Colleges' Data

Descriptive Statistics of Colleges					
	N	Minimum	Maximum	Mean	Std. Deviation
NT	40	7	143	26.075	21.95262
NC	40	5	91	18.225	15.1005
ATET	40	6	20	13.075	3.73746
TE	40	4100000	248192000	34440468	40833805.38
NS	40	98	7053	962.475	1155.03757
WAPPM	40	31.4	98.96	67.77	17.65826
PR	40	46.8	70.24	57.3575	6.00464
SECA	40	0	3	1.35	0.89299

3.8.   Correlation Matrix Colleges' Data:

Table 7: Correlation Matrix of Colleges' Data

Correlation Matrix of Colleges Data								
	NT	NC	ATET	TE	NS	PR	WAPPM	SECA
NT	1	0.914142	0.435578	0.980997	0.954189	-0.27816	-0.1179	0.473424
NC	0.914142	1	0.34589	0.886833	0.895012	-0.07632	0.11331	0.365753
ATET	0.435578	0.34589	1	0.441066	0.419927	-0.05644	0.037895	0.376066
TE	0.980997	0.886833	0.441066	1	0.953348	-0.32312	-0.15625	0.469644
NS	0.954189	0.895012	0.419927	0.953348	1	-0.29788	-0.15952	0.54228
PR	-0.27816	-0.07632	-0.05644	-0.32312	-0.29788	1	0.781203	-0.29937
WAPPM	-0.1179	0.11331	0.037895	-0.15625	-0.15952	0.781203	1	-0.28491
SECA	0.473424	0.365753	0.376066	0.469644	0.54228	-0.29937	-0.28491	1

### 4.   Empirical Analysis of Public and Private Colleges' Efficiency

According to Sherman (1998), the ability to produce the output with the minimum inputs required is called efficiency. An institution can be technically efficient even with too much or too little output because "technical efficiency investigates how well the production process converts inputs into outputs" (Abbot 2003). Scale efficiency provides the information about the scale of production. "Scale efficiency shows the extent by which an institution can take the advantage of return to scale by altering its size towards the optimal size" (Abbot 2003). VRS technical efficiency shows pure technical efficiency and CRS technical efficiency represents overall efficiency while scale efficiency is measured as a ratio of CRS to VRS technical efficiency scores. For the segregation of pure technical efficiency from scale efficiency, technical efficiency is measured on both CRS and VRS models. Solver software has been used to compute results. Efficiency results are given in table 8 for public and private sector colleges.

Table 8: DEA Results for Efficiency Comparison
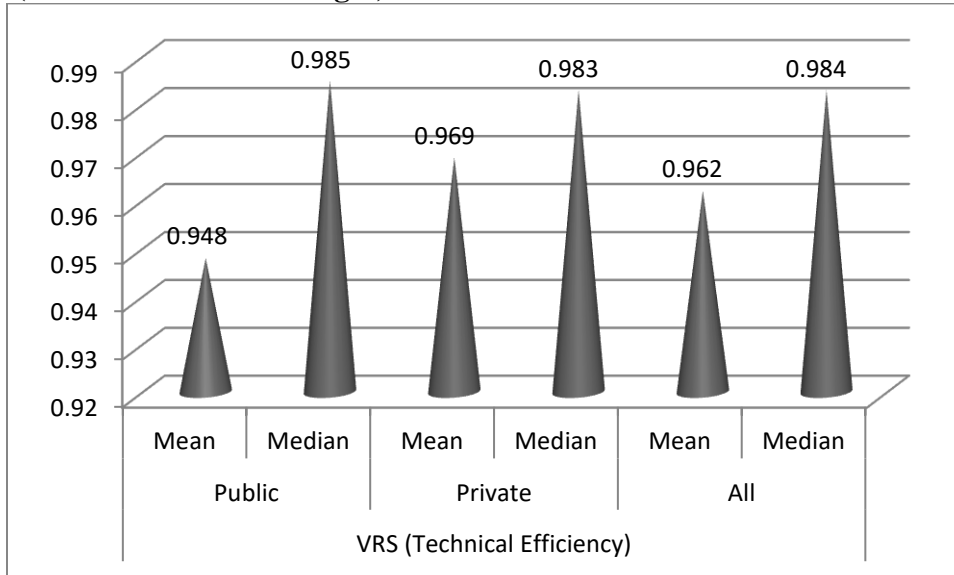**(Public & Private Colleges)**

| Institutions		EFFECIENCY		
		CRS TECHNICAL EFFICIENCY	**VRS TECHNICAL EFFICEINCY**	**SCALE EFFICIENCY**
Public	Mean	0.898	0.948	0.943
	Median	0.928	0.985	0.998
Private	Mean	0.884	0.969	0.911
	Median	0.926	0.983	0.963
All	Mean	0.888	0.962	0.921
	Median	0.927	0.984	0.990
T test P-value		0.35	0.15	0.190

Source: Author's estimations

Figure 1: DEA (CRS) Results for Efficiency Comparison
 (Public & Private Colleges)
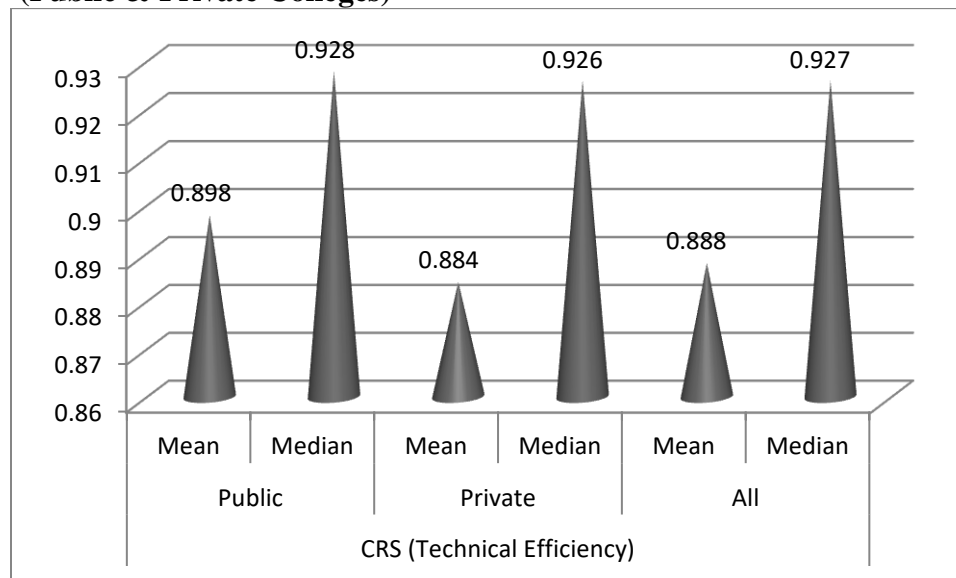
Figure 2: DEA (VRS) Results for Efficiency Comparison (Public & Private Colleges)

Figure 3: DEA (Scale) Results for Efficiency Comparison (Public & Private Colleges)
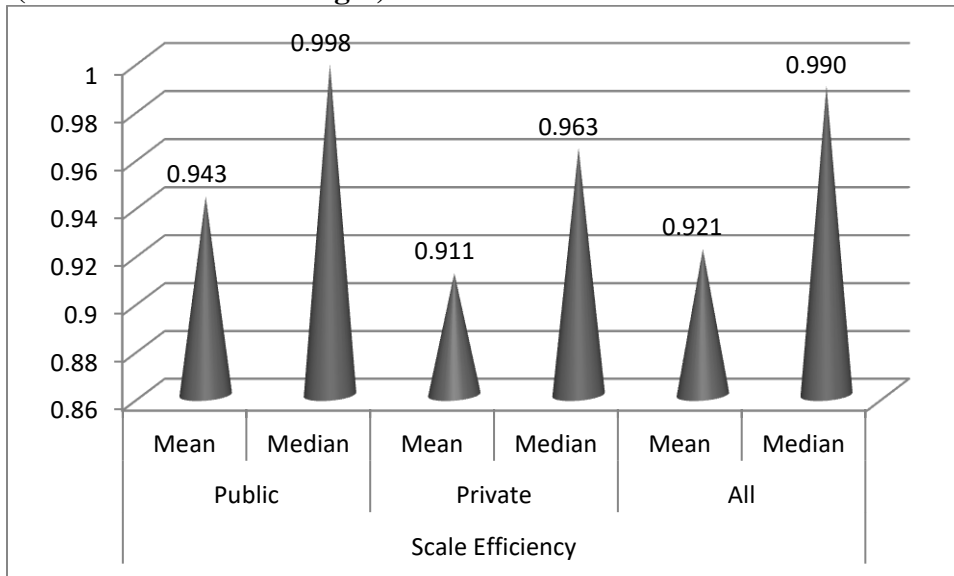
Results of the data demonstrate that CRS score of public colleges is higher than that of private colleges. However, VRS score is higher for private colleges as compared to public colleges. CRS for public colleges is 0.898 and private colleges 0.884. VRS score for public colleges is 0.948 and 0.969 for private colleges. Nevertheless, public sector colleges have higher scale efficiency score i.e. 0.943 as compared to 0.911 of private colleges. P-value shows that the difference between the efficiency of two types of colleges is insignificant.

Table 9: DEA Results for Efficiency Comparison (Public & Private Boys' Colleges)

Institutions		EFFECIENCY

		CRS TECHNICAL EFFICIENCY	VRS TECHNICAL EFFICEINCY	SCALE EFFICIENCY
Public	Mean	0.825	0.912	0.897
	Median	0.858	0.954	0.928
Private	Mean	0.878	0.959	0.914
	Median	0.919	0.961	0.953
All	Mean	0.864	0.946	0.909
	Median	0.909	0.958	0.950
T test P-value		0.232	0.86	0.351

Source: Author's estimations

Results show that CRS score of public boys' colleges is higher than that of private boys' colleges. However, VRS score is higher for private boys' colleges as compared to public boys' colleges. CRS for public boys' colleges is 0.825 and private boys' colleges 0.878. VRS score for public boys' colleges is 0.912 and 0.959 for private boys' colleges. Nevertheless, public sector boys' colleges have low scale efficiency score i.e. 0.897 as compared to 0.914 of private boys' colleges. P-value shows that the difference between the efficiency of two types of colleges is insignificant.

Table 10: DEA Results for Efficiency Comparison
(Public & Private Girls' Colleges)

Institutions		EFFECIENCY		
		CRS TECHNICAL EFFICIENCY	VRS TECHNICAL EFFICEINCY	SCALE EFFICIENCY
Public	Mean	0.961	0.998	0.982
	Median	1	1	1
Private	Mean	0.891	0.982	0.905
	Median	0.993	0.995	0.998
All	Mean	0.918	0.981	0.935
	Median	0.997	0.997	0.999
T test P-value		0.143	0.161	0.05

Source: Author's estimations

CRS, VRS and scale efficiency scores of public girls' colleges are higher than that of private girls' colleges. CRS for public girls' colleges is 0.961 and private girls' colleges 0.891. VRS score for public girls' colleges is 0.998 and 0.982 for private girls' colleges. Public sector girls' colleges also have higher scale efficiency score i.e. 0.982 as compared to 0.905 of private girls' colleges. P-value shows that the difference between the efficiency of two types of colleges is significant.

Table 11: DEA Results for Efficiency Comparison (Boys & Girls Government Colleges)

Institutions		EFFECIENCY		
		CRS TECHNICAL EFFICIENCY	VRS TECHNICAL EFFICEINCY	SCALE EFFICIENCY
Boys	Mean	0.825	0.912	0.897
	Median	0.858	0.954	0.928
Girls	Mean	0.961	0.978	0.982
	Median	1	1	1
All	Mean	0.898	0.948	0.943
	Median	0.928	0.985	0.998
T test P-value		0.049	0.074	0.068

Source: Author's estimations

Results of the data demonstrate that CRS, VRS and scale efficiency scores of public girls' colleges are higher than that of public boys' colleges. CRS for public girls' colleges is 0.961 and public boys' colleges is 0.825. VRS score for public girls' colleges is 0.978 and 0.912 for public boys' colleges while scale efficiency score for public girls' colleges is 0.982 as compared to 0.897 of public boys' colleges. P-value shows that the difference between the efficiency of two types of colleges is significant.

Table 12: DEA Results for Efficiency Comparison (Boys & Girls Private Colleges)

Institutions		EFFECIENCY		
		CRS TECHNICAL EFFICIENCY	VRS TECHNICAL EFFICEINCY	SCALE EFFICIENCY
Boys	Mean	0.868	0.959	0.914
	Median	0.919	0.961	0.953
Girls	Mean	0.891	0.982	0.905
	Median	0.993	0.995	0.998
All	Mean	0.883	0.969	0.910
	Median	0.926	0.983	0.963
T test P-value		0.407	0.073	0.437

Source: Author's estimations

The above table shows that that private girls' colleges outshine private boys' colleges in CRS and VRS. CRS for private girls' colleges is 0.891 and private boys' colleges is 0.868. VRS score for private girls'

colleges is 0.982 and 0.959 for private boys' colleges while scale efficiency score for private girls' colleges is 0.905 as compared to 0.914 of private boys' colleges. P-value shows that the difference between the efficiency of two types of colleges is insignificant.

5. Conclusion and Policy Implications

Using DEA, CRS Input oriented model, we have got mixed results. Our overall result shows that public sector colleges are more efficient in case of CRS and scale efficiency scores while private colleges are more efficient in case of VRS score. Further detailed analysis shows that public sector girls' colleges are more efficient than private girls' colleges while private boys' colleges are performing better as compared to government owned boys' colleges. These results are somewhat contradicting with the dominant paradigm that private colleges outperform the state run institutes. Our findings reveal that due to the inclusion of two variables WAPPM and SECA, public colleges show high efficiency than private colleges. In private colleges students are divided into different sections according to their educational achievements. Classes in private colleges comprise on few extra-ordinary/intelligent students along with a number of week students. No doubt, students belonging to private colleges show higher achievements in annual exams but the number of such achievers is very low was compared to their loser/lower-achieving classmates. Extra-curricular activities are also conducive to greater efficiency of public colleges as public college students also show high achievements in extra-curricular activities as compared to public college that place more emphasis on academic excellence. The study concludes that there is need to alter the popular notion that private institutions are always better than government institutions. Improving quality in government institutions, and regulating and setting standards for the private sector is the need of the hour.

6. Policy Implications

The results have proved that public sector has the potential to outperform the private sector if the government takes some positive steps. As the public sector provides education mostly to the lower and middle classes of the society, therefore, the government should take steps to improve it further. Following policy recommendations are suggested:

   I.   The government should make education its priority and take steps to restore public confidence in state-run institutions.

  II.   Budgetary allocation for education sector should be increased. The government should improve infrastructure and management of public sector institutes.

III.   Strict monitoring system should be adopted to restore public trust on government institutions.

IV.   Skill development programmes should be launched to improve the capabilities of teachers.

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