MEASURING AND BENCHMARKING THE COMPARATIVE PERFORMANCE OF SCHOOL DISTRICTS

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ABSTRACT

This study measures the comparative efficiency of school districts in Colorado Springs using data envelopment analysis (DEA). Based on efficiency analyses, managerial implications for improving the performance of the school districts have been suggested. Overall, the study concludes that DEA is a useful and practical method for measuring and benchmarking school districts.

INTRODUCTION

In this paper, the efficiency of public school districts located in Colorado Springs, Colorado, and surrounding areas is measured using Data Envelopment Analysis (DEA). To determine efficiency, inputs that are controlled by school districts: Student-teacher Ratio and Per Pupil Funding, are analyzed for how they influence selected outputs: ACT scores and graduation rates.

The purpose of the study is to analyze a cross-section of the school districts in El Paso County, Colorado and to measure efficiency of the four socio-economically diverse school districts Data was compiled from publicly available financial reports of the selected school districts and from the Colorado Department of Education website (School Performance) [1] [2] [3] [5] [6] [7] [8] [9]. This study seeks to measure the effects of socioeconomic conditions as they relate to public education.

There are many studies to support the theory that schools in more affluent neighborhoods outperform schools in less economically advantaged areas [11]. This study seeks to test the accepted theory and apply the DEA method to the Colorado Springs region. To simplify results, the data was limited to four school districts in the Colorado Springs area. School district selection was based upon perceived differences in educational efficiency and in geographical location.

RELATED STUDIES

Many studies focus on the measures of school performance, rather than the identification of the areas that need improvement. In a comparable study [14], the DEA model was applied to a sample of public schools in the United Kingdom to show that performance of schools could be improved by estimating target results based on average performance rather than *best* performance. Mean verbal reasoning score per pupil on entry, percentage of students not receiving free school meals, average GCSE (General Certificate of Secondary Education) score per pupil, and percentage of pupils not employed after GCSEs, were the variables selected. The study chose to ignore per pupil funding amounts, concluding the costs covered by per pupil funding in the UK were "unlikely to advantage one school over another."

A similar study measured the efficiency of public schools in the state of New Jersey to explore significant performance variances among school districts in the state [11]. The study also examined the effect of certain socio-economic factors on efficiency. Educational performance in the districts of Camden, Newark and Jersey City, typically seen as the poorer cities in New Jersey, much lower than the state average. This poor performance raised questions about the factors contributing to the large variability. Results disclosed the average efficiency for all schools in the state of New Jersey is 81%. The wealthier districts have an efficiency score of 88%, while the neediest districts had an efficiency of 63%. When adjusted for socio-economic factors (household income, ethnicity, community involvement, among others), the difference between the two districts became smaller.

Cherchye et al. [4] used a DEA model to assess educational efficiency at the pupil level. The DEA model was used to measure educational efficiency on the basis of test scores in mathematics and language proficiency. While the inputs are controlled, other environmental variables – socio-economic status of parents and lagged test score results – that may affect pupil performance were also taken into consideration. Briefly, the literature opines there is not a strong significant favorable relationship for private versus public education, when the data is limited to comparison by a student's individual performance.

Ruggiero [13] evaluated the efficiency of 556 school districts in New York State for school year 1990-1991 using the average score on standardized tests given to all third and sixth grade students. Ruggiero selected labor inputs such as per pupil expenditures on teacher salaries, and pupil personnel instruction costs. It was necessary to create a teacher salary index to capture and control for differences in teacher experience, education, and certification; and pupil personnel instructional expenditures consisted of books, computers and all other spending related to instruction. Ruggiero found that approximately 80 percent of school districts reviewed were inefficient, and on average, could have provided the same level of services by using 80 percent of observed inputs. Further, half of the inefficient districts were only 71 percent efficient. Approximately 25 percent of school districts, on average, faced harsher environments requiring 11 percent more of all inputs to provide the same level of services.

In a related study, the efficiency of Oklahoma school districts [12] was measured using two different specifications of DEA. An inefficiency model included environmental factors that school districts cannot control, such as students requiring special education services and poverty rates; and inputs school districts can control, such as teacher's salaries. The data set included factors that (directly or indirectly) provided socioeconomic indicators of its students in the form of quantity of students eligible for subsidized lunch programs, parent education level, and family income. Rassouli- Currier concluded the environmental variables which school districts have no control over have strong effect. Subsidized lunch eligibility, which may indicate lower socioeconomic status, has a strong negative effect; while the percentage of students with an adult in the household education beyond high school has a strong positive effect on school district efficiencies. Further, Rassouli- Currier concluded controlled variables, such as teacher salary, experience, and education, are insignificant when explaining efficiency variations.

METHODS AND DATA COLLECTION

Data Envelopment Analysis (DEA) has propagated into a frequently used productivity measurement tool that is applied in a broad range of contemporary manufacturing and service-oriented decision-making environments. The basic function of DEA measures the difference between the observed productivity and the potential productivity given a specific set of Decision-Making Units (DMUs). Comparing two or more DMUs that are homogeneous in nature to one another, DEA identifies the most efficient DMUs and provides related measurements of productivity performance for those DMUs operating less productively. DEA offers measurements to improve productivity in DMUs that are less productive than the most efficient DMUs [13]. To handle a bounded variable: Graduation Rate that takes a value between 0 and 1 inclusively, we employ two DEA bounded models, BND-O-V and the BND-O-C for analyzing selected DMUs.

This study includes two input variables (Per Pupil Funding and Student Teacher Ratios) and two output variables (Graduation Rates and ACT scores). Four school districts were selected for comparison in this study: Academy School District # 20 (D20), Colorado Springs District #11 (D11), Harrison School District # 2 (D2), and Widefield School District # 3 (D3), for school years ending 2009, 2008, 2007, 2006, and 2005, for a total of 20 DMUs. The descriptive statistics of the variables are provided in Table 1.

TABLE 1
DESCRIPTIVE STATISTICS OF VARIABLES

	Student Teacher Ratio	Per Pupil_Funding	ACT Score	Graduation Rate
Maximum	20.4	7031.8	22.0	94.7
Minimum	13.1	5689.8	16.1	61.8
Mean	16.7	6230.3	18.9	76.7
Standard Deviation	2.2	368.2	1.8	11.0

The primary input variable, Per Pupil Funding, represents the revenue received by each public school district in the State of Colorado for each student enrolled on or after October 1 of each school year. Per Pupil Funding is first financed by local sources, such as commercial and residential property taxes. If these local sources are insufficient to meet the required amount set by the state legislature, the State of Colorado provides the additional funding necessary to meet the funding requirement. The State of Colorado’s Per Pupil Funding equalization payments ensure that all students receive the same financial resources in their education independent of the socio-economic environment in which they attend public schools. However, local sources and Per Pupil Funding are not the only source of revenue that School Districts receive. Additional sources include federal, state, and local grants; voter approved mill levy overrides; and bonded indebtedness. These sources add to the overall funding level that each school district receives and could have a measurable impact on the assessment results of the students.

The secondary input variable is Student-teacher ratio as calculated by the Colorado Department of Education. Although school districts may be limited in their ability to increase personnel funding, managerial decisions also impact the Student-teacher ratios of each school district. The Student-teacher ratio provides an insight into the DMUs with regard to student achievement and the quality of instruction that is provided in each district.

The primary output variable, Graduation Rates, provides the analysis with a simple measure of the percentage of students who have completed the required curriculum in order to complete grade 12. Optimal graduation rates of 100% are expected, but are affected by such things as socioeconomic factors, parental involvement and peer pressure. The State of Colorado graduation rate for the Class of 2009 was 74.6 percent [6]. Two selected districts (D20 and D3) consistently achieve Graduation Rates well above the State average, while D2 and D11 are below the state average.

The secondary output variable, ACT exam results, assessed the student achievement of each district. This output variable is used as a measure of how well the public school districts compare to other public school systems across the nation. Further, ACT exam results provide a measure of how well graduating students are prepared to pursue secondary education.

RESULTS AND DISCUSSION

We used two bounded data envelopment analysis models and computed technical efficiency and pure technical efficiency scores. Based on these two efficiency scores, scale efficiency is computed. Scale efficiency represents the operating conditions of the school districts. Table 2 shows the efficiency scores.

TABLE 2
EFFICIENCY SCORES OF SCHOOL DISTRICTS

	Technical Efficiency (TE)	Pure Technical Efficiency (PTE)	Scale Efficiency (SE)
Academy 2009	1.0000	1.0000	1.0000
Academy 2008	1.0000	1.0000	1.0000
Academy 2007	0.9802	1.0000	0.9802
Academy 2006	0.9836	0.9891	0.9944
Academy 2005	1.0000	1.0000	1.0000
Harrison 2009	0.7406	0.7909	0.9364
Harrison 2008	0.7225	0.7723	0.9355
Harrison 2007	0.7431	0.7733	0.9609
Harrison 2006	0.7181	0.7521	0.9548
Harrison 2005	0.7131	0.7344	0.971
District 11 2009	0.7889	0.8727	0.904
District 11 2008	0.7716	0.8429	0.9154
District 11 2007	0.7998	0.8432	0.9485
District 11 2006	0.8087	0.8264	0.9786
District 11 2005	0.8481	0.8547	0.9923
Widefield 2009	0.7704	0.8364	0.9211
Widefield 2008	0.8050	0.8414	0.9567
Widefield 2007	0.8363	0.8493	0.9847
Widefield 2006	0.8215	0.8241	0.9968
Widefield 2005	0.8829	0.9999	0.8830

TABLE 3
MEAN EFFICIENCY SCORES

District	TE	PTE	SE
Academy	0.9928	0.9978	0.9949
Harrison	0.7275	0.7646	0.9517
District 11	0.8034	0.8480	0.9478
Widefield	0.8232	0.8702	0.9485

The four school districts analyzed had student-teacher ratios that were within the normal distribution of scores. Therefore, the data seems to suggest lower student-teacher ratios do not strongly impact school efficiency. Current common public perception is to lower the student-teacher ratio to improve student performance. Logically, lower ratios would increase and improve one-on-one contact time.

The results suggest school efficiencies are not resolved simply by increasing funding levels. School systems are by no means richly compensated; additionally, "throwing money at the problem," so to speak, will not necessarily result in greater efficiencies. Additional monetary compensation alone cannot solve the perceived gaps in the school districts surveyed. The results suggest different approaches such as, reallocation of available funding, higher academic standards, and increased teacher quality, to improve student performance. Administrations could consider increased resource allocation to community outreach programs and the recruiting of more stable, qualified teaching professionals.

The nearest secondary education institution, University of Colorado at Colorado Springs (UCCS), does not accept ACT scores lower than 18. ACT scores from D11 and D2 average 17 or lower, historically. Therefore, these districts are not adequately preparing students for matriculation to higher education. Geographic locations of the cited school districts are primarily located in older sections of Colorado Springs, which are predominantly more challenged socioeconomic environments. Thus, the school districts most in need of qualified, experienced teachers are also located in environments with little parental involvement and higher instances of crime. These school districts tend to have increased employee turnover rates and may be forced to hire less experienced teachers, who may not be prepared for the environmental adversities encountered teacher may not be equipped to endure within these challenging environments where students are deemed "at risk" or who place a low priority on education.

Graduation rates in D11, while improving, still leave room for enhancement. The results show increased funding and lower student-teacher ratios will not strongly impact (increase) expected graduation rates. Therefore, it may be assumed that factors beyond the control of the school districts could improve the graduation rate. For example, external variables such as parental involvement and economics may be stronger factors to predict future performance. While each school district sets its own graduation standards, the fact remains that D11 and D2 are failing to prepare its students to complete their established program requirements and to graduate. D11's five-year average graduation rate is 68 percent, and D2's five-year average graduation rate is 65 percent.

CONCLUSION

Using a DEA methodology with bounded variables results in concluding District 20 (D20) is the most efficient school district in relation to the other three school districts included in this study. D20's controlled inputs, such as student-teacher ratio, benefit its overall efficiency; but D20 also gains from community investment and a strong socioeconomic environment. District 3 is determined second efficient, District 11 as third most efficient, and District 2 (D2) as the least efficient. D2 is the least efficient district, having the lowest average graduation rate and the lowest average ACT scores of all districts analyzed. D2 should focus on allocation of resources to community outreach programs to strengthen community relationships, and on professional development to equip teachers with the skills necessary to manage at-risk students. Overall, the study finds DEA is a useful and practical method for measuring and benchmarking school districts. The major contribution of this study is a practical application of DEA for evaluating the school districts in Colorado Springs, Colorado.

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