EXPENDITURES' LEVEL AND EFFICIENCY IN PUBLIC EDUCATION: A STUDY OF SÃO PAULO MUNICIPALITIES USING DATA ENVELOPMENT ANALYSIS

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ABSTRACT

The quality of education offered by the public sector is important for impact in the formation of the citizen and the generation of human capital. In this context, studying the level of public spending and management efficiency allows us to identify best practices, and strengthen the assessment of the public sector as a mechanism of social control and effectiveness of the state. This article aims to assess the level of municipal spending on education in relation to efficiency in the promotion of basic education quality. 47 counties, with the use of Data Envelopment Analysis (DEA) in a model using three inputs and six outputs for the years 2007, 2009 and 2011 were analyzed. The results indicate an increase in total spending on education, however, the greater allocation of resources did not provide better results, since the application was inefficient.

Keywords: Education, Public Efficiency, Data envelopment analysis.

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1 INTRODUCTION

The evaluation of the public sector is an important issue, as it shows where and how the public money obtained through the collected taxes are applied. According to Ramos and Schabbach (2012), when we evaluate the public sector we aim to improve the efficiency of public spending and, through social control, we seek to improve the effectiveness of State action and the improvement of management quality.

In the education sector, the theme is of great importance because of the influence of the public sector in the formation of the citizen and human capital. The investment of resources and time in school education seeks to ensure that individuals reap their benefits through better jobs, job satisfaction or because they acquire a greater knowledge of the world around them (BONAMINO et al., 2010). In this perspective, several researchers have dedicated time in assessing and understanding the relationship between the level of spending on education and school performance (MARLOW, 2000; UNNEVER; KERCKHOFF; ROBINSON, 2000; KIM, 2001; WOESSMANN, 2003). In addition to the level of expenditures, it is important to evaluate the efficiency in the application of these resources.

Considering the importance of education quality, as well as the public expenditure and the evaluation of the public management efficiency, we aim to assess the level of municipal spending on education in relation to efficiency in the promotion of Basic Education Quality using Data Envelopment Analysis (DEA), as done by Sampaio and Guimarães (2009). Rosano-Penã et al. (2012) and Wilbert and D'Abreu (2013).

The article contains four main topics. The first part presents a review of the literature to understand important variables in school performance and studies on public efficiency in the promotion of quality education, as well as studies that sought to measure the efficiency of public management in generating satisfactory educational outcomes. The second presents the method, data collection and analysis. The third discusses the results and, finally, we present the conclusions.

2 LITERATURE REVIEW

This literature review discuss into two major topics. On the first part, we discuss school performance, emphasizing the importance of public expenditure on education and its impact on education quality. On the second part, we discuss public efficiency in education and presents previous studies that sought to measure the efficiency of public management in generating educational outcomes.

3 FACTORS THAT INFLUENCE ACADEMIC PERFORMANCE

Several researchers has studied the conversion of financial investment (economic capital) into human capital through education. In 1966, the Coleman Report, a study published in the United States, broke the dogma that there would be a significant relationship between student performance and investment in education, as well as provoked a "break with the optimistic view of building an equal society through education for all "(BONAMINO et al., 2010, p 487). Since the publication of the Coleman Report, researchers in several countries have dedicated time and effort to the subject, in the search to confirm or refute the information.

According to Kim (2001), studies following the Coleman Report ignore two facts: a) the method used (in most studies, regression analysis) to measure the effectiveness of school resources

is inadequate and b) greater resources in education can make parents reduce the time and/or investments in the education of their children. The author also argues that when there is an increase in educational resources, mothers with more schooling does not change their time with the children, but mothers with less schooling decrease their time of care. In the words of the researcher, "educational resources not only have a direct effect on student performance but also an indirect effect on student performance through their capability to alter family dynamics" (KIM, 2001, p. 80).

Unnever, Kerckhoff, and Robinson (2000) developed a study analyzing school district data through Weighted Least Squares regression to analyze the relation of the socioeconomic status of the population and its influence on student performance. Based on the results the authors proposed a model that considers three factors that influence school performance: socioeconomic characteristics, prior conceptual skills and economic resources for education.

Woessmann (2003) analyzed a set of data on more than 250,000 students in 39 countries. The results shows that the quality of education is influenced by a number of factors such as presence of centralized examinations; distribution of decision-making power between schools and government agencies; influence of teachers and unions in educational policy; distribution of decision-making power over the education system between levels of government and the degree of competition between public and private schools. The author also argues that the crucial issue is not to provide more resources but to improve the institutional setting in which schools function, and emphasizes that "an education system in which all people have an incentive to improve student performance is the only alternative which promises positive effects "(WOESSMANN, 2003, p.74).

In Brazil, Barros et al. (2001) conducted a study with young people from the Northeast and Southeast regions to investigate the impact of four factors on educational performance: the quality and availability of services, the opportunity cost of time, the availability of family resources and the availability of resources community. According to the authors, the communities with better financial conditions positively affect the school performance of the students who live there, because they live with adults with higher schooling and assists them in school tasks. Among the results, we highlight that parents' schooling is an important factor in the performance of the students who were part of Barros et al. (2001) study, because "the impact on the educational performance of one year of schooling of the parents exceeds the impact of three years of schooling teachers "(ibid., p.35). Regarding the teachers, the study reveals that teachers' schooling exerts influence, being more noticeable in elementary school than in high school. Thus, in order to improve the educational quality is necessary to upgrade the quality of basic educational services.

Albernaz, Ferreira and Franco (2002), through the application of linear hierarchical models to a database of the Basic Education Evaluation System (SAEB), analyzed the factors that affect students' performance. The authors analyzed the data in two groups: the role of individual and family characteristics and the role of school variables and teachers. Regarding the first group, the socioeconomic level is determinant in the students' performance, but not only the family level, but the socioeconomic level of the clientele of the school, that the higher, the higher the average performance of the students. Regarding school variables, both the quality of the teacher (level of schooling) and the quality of the physical structure contribute to a better performance of the students.

4 PUBLIC EFFICIENCY IN EDUCATION

The educational system contributes not only to formation of human capital, but also social capital, thus it is important to evaluate from time to time the existing educational systems in order to adapt it to the new needs of society. In addition to the periodic evaluation, the educational system is currently required to produce more and more, and the quality of this production is always improved (DELORS et al., 1998).

To measure the production of the educational system, it is possible to apply an efficiency measure that relates how much is produced with how much could be produced at a level of maximum productivity, thus using the inputs as best as possible (RIBEIRO FILHO, et al., 2010) . Analyzing educational production is notoriously difficult for two reasons: education involves the production of various outputs and it is difficult to measure these outputs properly. "Further complicating analysis is the fact that our knowledge about which factors affect educational outputs is inadequate" and measuring the outputs we know is hard (BIFULCO; BRETSCHNEIDER, 2001, p. 419).

Waldo (2007) argues that the technical efficiency estimates the maximum productivity and this way the efficiency is the distance between the production of a producing unit and the unit with the best performance indexes. Conroy and Arguea (2008) corroborate with the thinking of Waldo (2007) and complement by arguing the main difference between the technical efficiency and the economic efficiency is the fact that the first one disregards the prices of the inputs and products.

Zoghbi et al. (2009) analyzed the States' performance regarding public spending on education using the concept of "relative efficiency", applying SAEB indicators, such as age-series distortion, rate of completion, and attendance rate to measure the efficiency of each state and compare the scores obtained. The authors concluded that States with better academic performance are not always the most cost-efficient, but this suggests that there is a possibility of improving efficiency if better management techniques are adopted. The results are in line with the results of Silva, Souza and Araújo (2013) who analyzed 26 Brazilian capitals to verify if the most efficient ones performed better in elementary school and concluded that there is no relationship between these variables.

In this context of efficiency measurement, the use of Data Envelopment Analysis (DEA) has grown. Farrell (1957) initially developed the technique, however, it has gained notoriety after the study of Charnes, Cooper and Rhodes (1978). The DEA is a non-parametric technique that defines an efficiency frontier from multiple inputs and outputs for each of its Decision Making Units (DMU). According to Saurin et al. (2013), this methodology was initially applied in public institutions due to the difficulty of allocating prices to inputs and products, making it impossible to measure efficiency. Several studies use the DEA as a model in broad areas of society, from commercial sectors to comparisons between municipalities (DIDONET; VILLAVICENCIO, 2008, VILLAVICENCIO, DIDONET 2008).

In the DEA model known as CCR we assume that the returns of the scale are constant, that is, the variation in the inputs causes a variation of the same proportion in the outputs (CHARNES; COOPER; RHODES, 1978). Banker, Charnes and Cooper (1984) proposed a model known as BCC, applicable to cases where the returns to scale are variable and does not consider the proportionality between inputs and outputs. The efficiency obtained by the DEA is relative and based on real observations of the set of DMUs. DMUs considered efficient form the border of efficiency and inefficiencies have their inefficiency calculated based on their distance from the border. According to Faria, Jannuzzi and Silva (2008, page 158), "the DEA allows the efficiency of each DMU to be calculated by comparing the units of the analyzed group in order to highlight the best ones within it."

Specifically in Education, Sampaio and Guimarães (2009) used the DEA to compare the efficiency of public and private schools in the metropolitan region of Recife - Pernambuco. The authors adopted a sample of 23,040 students who took the entrance exam to the Federal University of Pernambuco (UFPE), 76.58% of which were students of private schools and 23.42% of public schools. From the decomposition of the efficiency index, the authors concluded that there is a great distinction between public and private schools of education, since private schools obtained maximum efficiency and public schools were at a distance of 10% from the efficiency frontier, need for improvements in public education. The authors also emphasize that the federal institutes obtained better income than the state colleges (SAMPAIO; GUIMARÃES, 2009).

Rosano-Peña, Albuquerque and Marcio (2012) studied the efficiency of education expenditures by comparing the results obtained through the DEA methodology and the inverted border method. The authors analyzed the years between 2005 and 2009 and using a sample of 246 municipal schools of Goiás. The results indicate a global inefficiency of 67.44% and that if schools had adopted better management practices they would achieve the same results, however, saving R$ 178 million. The authors conclude that greater resource allocation does not provide better results if applied inefficiently.

Wilbert and D'Abreu (2013) applied the DEA methodology to measure the efficiency of public spending in the education of 57 municipalities in Alagoas. The authors conclude that municipalities with low Gross Domestic Product (GDP) per capita and low value per student were the most efficient in the study, reinforcing the idea that the amount of investment does not influence the quality of education.

Blackburn, Brennan and Ruggiero (2014) conducted a study to estimate the efficiency of primary and secondary schools in Australia. The authors constructed the model, using DEA, with a conditional factor in which schools located in environments with better socioeconomic indicators were not used as benchmarking for schools in worse environments. The authors suggest that this factor seeks to reduce the bias of efficiency comparison as a function of non-controllable variables. The results indicated that Australian schools are moderately inefficient and that efficiency increases for the quintile of schools with the most favorable environment. Moreover, the authors observed that efficiency gains occur as the number of registrations increases. On average, primary schools spend about 20% above the minimum cost. Under these conditions, the authors identified a potential savings of $ 1,903 per student in the schools studied (BLACKBURN; BRYAN; ROGGER, 2014).

Harrison and Rouse (2014) in turn performed an analysis of the efficiency of schools in New Zealand using as inputs the school resources and as outputs the performance of students, in addition the model of comparison was stratified according to the socioeconomic characteristics of the students. The study concludes that average school performance tends to be higher when schools are located in areas of high competition by qualified students both in public schools and in private schools. For the authors, these results contrasted with other international studies in finding evidence that competition leads to better performance. However, these results appear to have varied according to the size of the school, suggesting that competition may increase the gap between schools with better and worse performances. In the long run this may result in an increase in the inefficiency of fixed public resources, since the survival of public schools is indirectly related to performance (HARRISON; ROUSE, 2014).

5 METHODOLOGY: DATA ENVOLTORY ANALYSIS

In this study we aim to assess the level of municipal spending on education in relation to efficiency in the promotion of Basic Education Quality using Data Envelopment Analysis (DEA) in the years 2007, 2009 and 2011. The period evaluated in the study was defined according to the three editions of the Basic Education Development Index (IDEB). The IDEB is an indicator of quality of education that combines information regarding the approval in each period with the results obtained in a standardized test (Prova Brasil) applied to the final series of each cycle. The application of the test occurs biannually, with evaluation for students in the 4th and 8th grade of schools that have a minimum of 20 students enrolled (INEP, 2014).

We chose Data Envelopment Analysis (DEA) as the method to relate multiple inputs and outputs to the efficiency analysis of a Decision-Making Unit (DMU). It is necessary to define the Decision-Making Units (DMU), the inputs and outputs employed, as well as the type and orientation of the model for the understanding of this study.

5.1 Decision Making Units (DMU)

Due to the decentralization policies that took place after the 1988 Constitution, municipal public management became the main responsible for social policies focused on education, health and social assistance (RIBEIRO, 2009). According to data released by the Brazilian Institute of Geography and Statistics (IBGE) in 2014, the state of São Paulo currently has 645 municipalities, in this way it we considered a priori the total population of municipalities as DMU. Not all municipalities, however, provide complete data for the proposed three years, thus leaving a sample of 48 municipalities. Due to incongruence in the data (the values were different between the information disclosed by the municipality and the data sent), the municipality of São Paulo was disregarded, leaving 47 DMUs for analysis.

5.2 Inputs and Outputs of the study

We defined the inputs, Table 1, based on the work of Rosano-Peña, Albuquerque and Marcio (2012), which provided a similar analysis of the quality of education for municipalities in the State of Goiás. Using these inputs, we seek to the expenses related to maintenance and operation of schools, employees and teachers payments, and the expenditure of resources to acquire new durable goods.

INPUT	Personnel Expenses Other Current Expenses Capital Investments
OUTPUT	Approval rate in the early years Approval rate in the final years Standardized average of the Brazil Test in the initial years Standardized average of the Brazil Test in the final years Number of enrollments made in the initial years Number of enrollments made in the final years

Table 1 - Inputs e Outputsof the study.

Fonte: Adapted from Rosano-Peña, Albuquerque e Marcio (2012).

Regarding the outputs, we used the ones that relates to the amount of output produced (measured by number of enrollments and passing rate) as well as the quality of education (as measured by the standardized test result). For each of the indicators we consider the results in the initial and final years. The outputs are the same as those used in the work of Rosano-Peña, Albuquerque and Marcio (2012).

5.3 Type and orientation of the model

To measure the efficiency of the DMUs we applied the variable return model of scale (BBC or VRS), which makes it possible to measure the technical inefficiency associated to the managerial ability. (AMBROZINI; NAGANO; MERLO, 2003) and the constant return scale model (CCR), aiming to evaluate the inefficiencies in scale regarding the size of the institutions. To evaluate the scale inefficiency we also applied the Wilcoxon test of median difference for independent samples.

Regarding orientation, we estimated models for both input and output models. The input orientation makes it possible to identify the DMUs that maintains a better result level with a lower consumption of resources (WILBERT; D'ABREU, 2013). The orientation to output estimates the best possible results with the current level of expenditure.

6 DATA COLLECTION AND ANALYSIS

We collected the data used in the study as described below:

- We collected the data from municipalities, such as name and population at IBGE website (2014);
- The data collected for municipal expenditures (inputs) we did through the website of the Public Budgeting Information System in Education - SIOPE (FNDE, 2014). As the data were not available, the information was requested from the National Fund for Education Development by the website using as a prerogative the public data transparency law 12.527/11 (BRAZIL, 2011).
- The standardized means of the Brazil Test and the Approval Rate (IDEB) we obtained through information published by the National Institute of Educational Studies and Research Anísio Teixeira (INEP, 2014).
- The number of enrollments made in the 4th and 8th grades of Elementary School in each municipality we collected on the SEADE Foundation (SEADE, 2014).

In relation to the data analysis, we organized the information grouped into a single database and analyzed through graphs and tables. In the descriptive statistics phase, the software program "Software Action" version 2.4.163.322 was used, which operates on R platform (PORTAL ACTION, 2012). For the resolution of the DEA models, we used the R platform directly using the "Benchmarking" package developed by Bogetoft and Otto (2011).

7 ANALYSIS AND DISCUSSION

The inputs we use refers to personnel, investment and other current expenses. On average, 60% of the amounts are allocated to personnel expenses, in addition, we observed that for each real (R$ 1.00) in investment, seven (R$ 7.00) are spent on personnel expenses. However, we emphasize that the Fiscal Responsibility Law usually defines the minimum percentage spending bands. Besides spending between the three accounts analyzed, it is observed in Figure 1, the increase in the total amount spent on education between 2007 and 2011. For the analyzed group, in 2007 the total expenditure was 1.25 billion and in 2011 reached 1,69 billion, an increase of 31% (actual values, updated to June/2014).
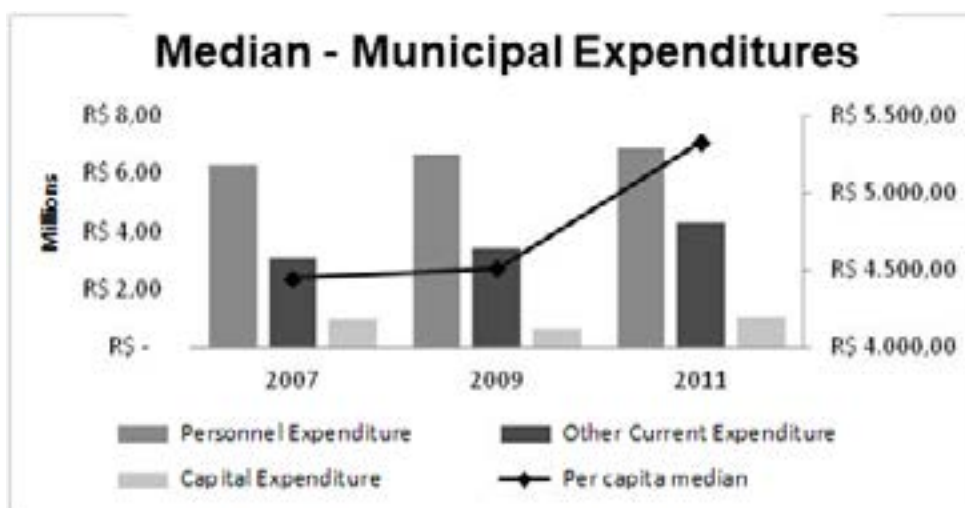
Figure 1 - Municipal Expenditures (2007-2011)
Source: The authors based on data from FNDE (2014)

Regarding the per capita expenditure, Figure 2 shows the median and average progress between 2007 and 2011. The median per capita, calculated from the number of students enrolled, increased from R$ 4,447.39 in 2007 to R$ 5,326, 22 in 2011. Thus, the increase in spending observed in Figure 1 did not occur proportionally to the increase in the number of students enrolled in the same period.
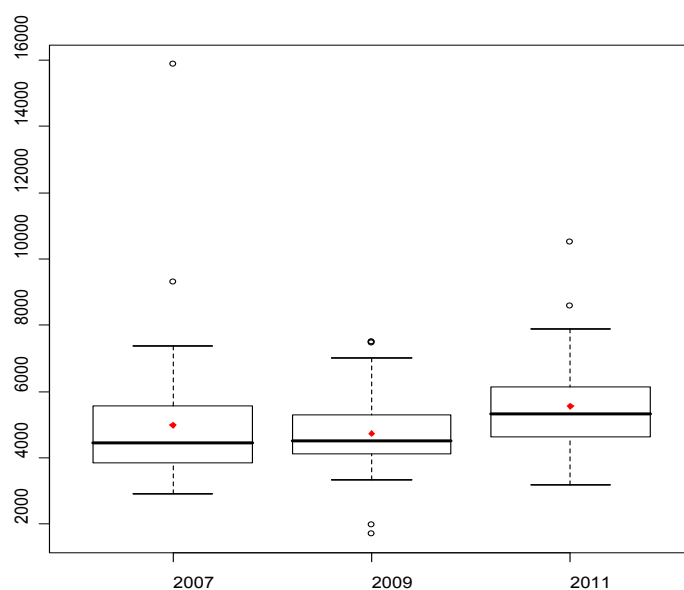
Figure 2 – Per capta expenditure in education (2007-2011)
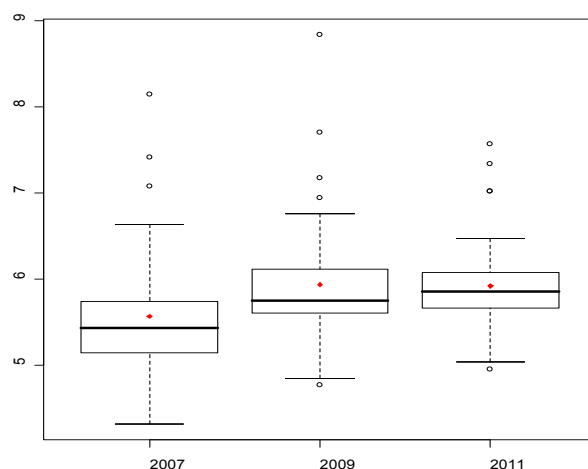**Source:** The authors based on data from FNDE (2014)

It is possible to observe that the median remained below the mean in all three periods. Regarding the interquartile range, in 2007 it was R $ 1,725 and in 2011 R $ 1,501. Thus, although the median increased, the dispersion of data remained close between the three periods. Regarding the outputs, Table 2 shows the median of the indicators used in the study, and it shows that all indicators presented median improvements over the three periods.

Output	2007	2009	2011
Approval rate in the early years	93,9	94,6	95,6
Approval rate in the final years	90,5	90,8	91,3
Standardized average of the Brazil Test in the initial years	5,43	5,75	5,86
Standardized average of the Brazil Test in the final years	4,90	5,08	5,26
Number of enrollments made in the initial years	1567	1869	1718
Number of enrollments made in the final years	669	695	745

Table 2 - Outputs median
Source: The authors based on data from FNDE (2014)

It is possible to observe in Figure 3 the result of the grades obtained in the initial years. The figure illustrates the progress between 2007 and 2009, with the median in 2009 in line with the third quartile of 2007. However, between 2009 and 2011 there was only a reduction in the dispersion of the notes, with average and median levels close to those of the previous period. Although Figure 2 points out an increase in per capita spending, between 2009 and 2011 it we observed that there was no direct conversion in improvements in the initial years' bills.

Figure 3 - Grades obtained in the initial years
Source: The authors based on data from FNDE (2014)

7.1 Municipal Efficiency

Table 3 presents a statistical summary of the DEA models used. According to the CCR-OUT model, if all municipalities had adopted the best allocation and resource management practices, it would be possible to achieve 23%, 29.9% and 26.7% better results, respectively, for each year analyzed. On the global average, the results could be 26.5% better.

Variables		2007	2009	2011
BCC - INPUT	Geometric Mean	0,919	0,92	0,905
	Arithmetic Mean	0,932	0,928	0,918
	Standard deviation	0,133	0,118	0,139
	Minimum	0,408	0,579	0,533
	Maximum	1	1	1
BCC-OUTPUT	Geometric Mean	1,012	1,01	1,01
	Arithmetic Mean	1,012	1,01	1,01
	Standard deviation	0,024	0,019	0,017
	Minimum	1	1	1
	Maximum	1,109	1,081	1,068
CCR-INPUT	Geometric Mean	0,813	0,77	0,789
	Arithmetic Mean	0,832	0,794	0,812
	Standard deviation	0,169	0,193	0,178
	Minimum	0,408	0,446	0,331
	Maximum	1	1	1
CCR-OUTPUT	Geometric Mean	1,23	1,299	1,267
	Arithmetic Mean	1,264	1,343	1,314
	Standard deviation	0,327	0,357	0,408
	Minimum	1	1	1
	Maximum	2,452	2,241	3,017

Table 3 - Statistical summary - DEA Results
Source: The authors based on data from FNDE (2014)

The output-oriented model searches for the best results from the current resource level, and the input-oriented model changes the analysis optics: given the level of results obtained, it is verified which DMUs were more efficient in the application of resources (expenses incurred). In the BCC-INPUT model, only 21 of the 47 DMUs studied are benchmarking because they achieved efficiency equal to 1 in the three periods evaluated (Table 3). In other words, less than half of the municipalities analyzed used the best level of inputs possible to produce the results obtained.

DMU	2007		2009		2011	
	Expenditure	BCC-INPUT	Expenditure	BCC-INPUT	Expenditure	BCC-INPUT
Cajamar	High	1	Low	1	High	1
Dois Córregos	High	1	Low	1	High	1
Fernando Prestes	High	1	High	1	High	1
Fernandópolis	High	1	High	1	High	1
Praia Grande	High	1	High	1	High	1
Ribeirão Corrente	High	1	High	1	Low	1
Santana de Parnaíba	High	1	Low	1	High	1
São José dos Campos	High	1	High	1	High	1
Tanabi	High	1	High	1	High	1
Adolfo	Low	1	High	1	Low	1
Cajuru	Low	1	Low	1	Low	1
Capão Bonito	Low	1	Low	1	Low	1
Conchal	Low	1	High	1	High	1
Cosmópolis	Low	1	Low	1	Low	1
Elisário	Low	1	High	1	Low	1
Iperó	Low	1	Low	1	Low	1
Lindóia	Low	1	Low	1	Low	1
Mairinque	Low	1	Low	1	Low	1
Novais	Low	1	Low	1	Low	1
Pedra Bela	Low	1	High	1	Low	1
Taboão Da Serra	Low	1	Low	1	High	1
Novo Horizonte	High	0,7	Low	1	Low	1
Guarujá	High	1	High	0,99	High	1
Catanduva	Low	1	High	0,96	Low	1
Igarapava	Low	1	Low	0,95	Low	1
Urupês	Low	1	Low	0,92	Low	1
Mauá	High	0,41	Low	0,91	Low	1
Buritizal	High	1	High	0,9	Low	1
Guará	Low	0,91	Low	0,83	Low	1
Jaú	Low	1	Low	0,75	Low	1
Águas De Lindóia	High	0,54	High	0,67	High	1
Uchoa	Low	0,96	High	1	Low	0,93
Martinópolis	Low	0,86	Low	1	High	0,91
Guaratinguetá	High	0,68	High	0,85	High	0,9
Pradópolis	High	0,91	Low	0,76	Low	0,9
Charqueada	Low	1	Low	0,75	Low	0,86
Monte High	High	1	Low	0,58	Low	0,84
Caraguatatuba	High	0,76	High	0,86	High	0,83
Ubarana	Low	0,87	Low	1	Low	0,81
Jeriquara	High	1	High	1	High	0,78
Botucatu	High	0,85	High	0,78	High	0,76
Viradouro	Low	0,87	High	1	High	0,71
São Carlos	High	0,97	High	0,86	High	0,69
Itirapina	Low	1	Low	0,6	High	0,59
José Bonifácio	Low	0,79	Low	1	High	0,56
Cubatão	High	1	High	1	High	0,55
Araraquara	High	0,72	High	0,7	High	0,53

Table 4 - Municipal expenditure and efficiency
Source: The authors.

he DMUs "Adolfo", "Elisário", "Novaes" and "Pedra Bela" stand out in this model. In the three periods analyzed, these municipalities reached an efficiency index equal to 1. Given the level of expenditure of the studied group, these municipalities may be considered benchmarking in obtaining educational results.

According to the geometric mean of the BCC-INPUT model shown in Table 3, DMUs in all cases presented efficiency of approximately 92% for 2007 and 2009 and 91% for 2011. In a hypothetical situation in which all municipalities were on the efficient frontier, it would be possible to obtain the same output with less 8% of municipal spending in 2007 and 2009 and 9% in 2011. We emphasize that the values resulting from technical inefficiency could be converted into the expansion/improvement of the education network more efficiently. Blackburn, Brennan and Ruggiero (2014) when evaluating schools in Australia also found an extra level of spending (20%), however, higher than the levels verified in this study.

Table 4 presents in absolute values the possible savings of resources referring to the three analyzed periods (updated data for June 2014).

Year	Personnel Expenses	Other Expenses	Investments
2007	R$59.196.225,65	R$31.635.200,38	R$12.846.008,55
2009	R$64.753.665,85	R$35.613.302,81	R$6.886.365,24
2011	R$87.909.443,27	R$52.745.469,19	R$12.292.427,25
Total	**R$211.859.334,78**	**R$119.993.972,38**	**R$32.024.801,05**

Table 5 – Possible resource economy according to BCC-INPUT model
Source: The authors.

Part of this inefficiency may relate to inadequate size, generating a scale inefficiency. Usually measured by the difference between BCC-INPUT and CCR-INPUT, the results found for scale inefficiency is 10.6%, 15.00% and 11.6%, respectively, in relation to the total inefficiency observed.

In order to deal with the problem of educational structure (scale), Rosano-Peña, Albuquerque and Marcio (2012) suggests the decentralization process for oversized municipal networks by creating school units in municipalities that operate on a large scale. On the other hand, the undersized ones could use systems of consortia or inter municipal systems of education, favoring the gain in scale. It is noteworthy that between the 47 municipalities analyzed only four of them, "Adolfo", "Elisário", "Novaes" e "Pedra Bela", maintained the scale efficiency during the three periods.

7.2 Levels of Expenditure and Efficiency

In order to evaluate the level of government spending and the efficiency of municipalities, we divided the DMUs into two groups using the median of per capita spending for each year. We classified the Municipalities with spending above the median as "High" and municipalities with spending below the median as "Low".

Table 4 shows the results for each year. The shaded lines mark the 21 municipalities that remained in the efficiency frontier in the three years studied, among them there are municipalities classified with high and low expenses. The remaining municipalities were on the efficiency frontier in at least one of the periods, except "Araraquara", which was inefficient in the three years analyzed.

Figure 4 shows the average efficiency of the groups, low-cost municipalities have higher average efficiency in two of the three periods studied. In 2009, both groups approach the average overall efficiency. However, it was not possible to verify statistically significant differences of means among the groups with expenditure, high or low. The results corroborate with the work of Marlow (2000) who found that there is no relation between educational resources and students' performance. The efficiency frontier found in the study was composed of municipalities with both expenses above and below the median per capita. In this way, there are municipalities with low expenditure, but with high efficiency in the application of these resources. Thus, although Sobreira and Campos (2008) found a positive relationship between spending and school performance using a data panel, when the efficiency level was evaluated, it was not possible to corroborate this result.
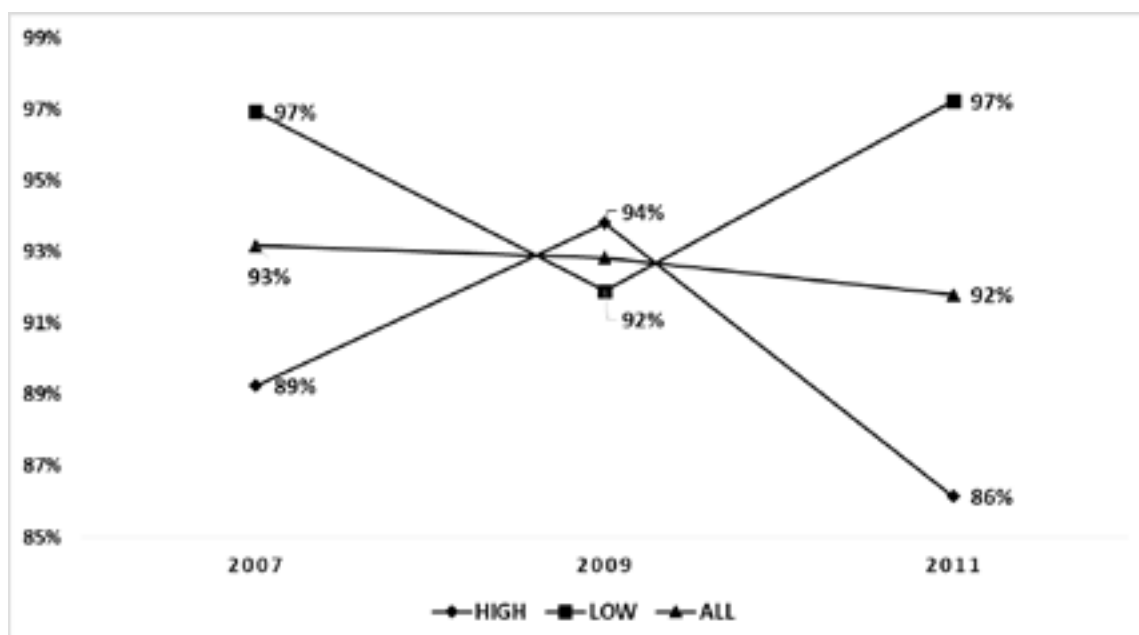
Figure 4 - Average Efficiency (BCC-INPUT) as a function of per capita expenditure
Source: The authors.

We also analyzed the inefficiency of the groups. Table 6 shows how much of the total inefficiency can originate from an scale inefficiency, the results obtained when considering per capita expenditure tends to be more consistent than the general average (10.6%, 15.00% and 11.6 %) previously found. Groups with high expenditure presented greater scale inefficiency in all the periods. Additionally, the application of the Wilcoxon test (with 95% confidence interval) returned that municipalities with spent below the median have lower inefficiency in scale than municipalities with spent above the median.

Relation	2007	2009	2011
High	18%	20%	19%
Low	3%	7%	5%

Table 6 - Average scale inefficiency in relation to per capita expenditure
Source: The authors

These results may indicate that increased spending on education, when not properly

planned, generates oversized units, influencing the overall efficiency of the decision-making unit. In this way, the unit presents efficient management to the possible level of results achieved, but has excessive productive capacity due to higher per capita expenditure, presenting worse results in technical efficiency of scale.

8 FINAL REMARKS

The purpose of this study was to analyze the efficiency of a sample of municipalities in São Paulo regarding the application of resources in basic education in the years 2007, 2009 and 2011. For that purpose, we applied Data Envelopment Analysis (DEA) using financial resources invested in elementary education as inputs and the outputs related to the performance of the students in the respective level of education.

The results indicated an increase in the total expenditure (inputs) in education between the analyzed periods, and from 2007 to 2011 there was a real increase of 31% in all municipalities of the group. As for the outputs, there was also an improvement in the indicators used in the three periods. However, although there is an increase in per capita spending between 2009 and 2011, it is observed that there was no direct conversion to improvements in students' grades. According to an output-oriented model, if all municipalities studied had adopted the best allocation and resource management practices, it would be possible to achieve an average of 26.5% better results.

Regarding the level of municipal spending, there was no significant difference between the groups of municipalities with high and low expenditures. Thus, it is not possible to say if municipalities that spend above or below the median have greater technical efficiency in the generation of educational results. On the other hand, high-spending groups presented greater scale inefficiency in all periods. These results corroborate with the studies by Rosano-Peña, Albuquerque and Marcio (2012) that conclude that greater allocation of resources does not give better results if applied inefficiently. In this way, the unit presented efficient management to the possible level of results achieved, but has excessive productive capacity due to the higher per capita expenditure. Thus, these oversized units have ultimately affected the overall efficiency of the decision-making unit (DMU).

The municipalities of Adolfo, Elisário, Novaes and Pedra Bela, are small, with low expenditure, except in 2009, and presented efficiency in all models analyzed. We suggest as future research the deeper understanding of the best practices adopted by these DMUs, as a means of benchmarking for educational networks. The only municipality that presented itself as inefficient in the three periods analyzed was Araraquara. We also suggest that future studies evaluate the impact of municipal size and its specificities to improve the efficiency of this municipality in achieving favorable educational results.

With regard to academic contributions and management, it is possible to highlight, above all, the importance of a coordinated action between training and practice of school managers. These contributions are based on two relevant results that the research undertaken added to the debate: (i) finding a positive relationship between spending and school performance is not enough to confirm a high level of efficiency; (ii) the evaluation of elementary education through scale efficiency metrics pointed to effective cost reduction strategies that consider the ideal size of the units.

In this sense, it is crucial to promote a training oriented to the efficient management of resources, encouraging the qualification and the continuous training of managers, as well as the promotion of debates on programs and pedagogical and managerial proposals. In addition,

the need to include in the curricular curriculum of undergraduate courses in public management disciplines, which address concepts of revenues, costs, expenses, inventories, among other important aspects for an efficient management of the basic education school. It is also recommended to implement the management through indicators that support decision making and allow a better allocation of resources.

In addition, this study had limitations regarding the number of DMUs analyzed, since for the three years only data were available of 47 municipalities of the 645 of the State of São Paulo. In addition, as a limitation, the method and the sample do not allow generalizations for the study population. It is suggested, therefore, as future research the application of parametric methods as stochastic frontier, for example. In addition, future studies may also assess the impact on the efficiency of external variables not controllable by DMUs as socioeconomic characteristics and prior conceptual skills.

REFERENCES

ALBERNAZ, Ângela; FERREIRA, Francisco de Hollanda Guimarães; FRANCO, Creso. Qualidade e Equidade no Ensino Fundamental Brasileiro. **Pesquisa e Planejamento Econômico**, v. 32, n. 03, p. 453-476, 2002.

AMBROZINI, Marcelo Augusto; NAGANO, Marcelo Seido; MERLO, Edgard Monforte. O Desempenho do Setor de Varejo no Brasil e suas Mudanças no Período Recente. **Anais** do VI SEMEAD, v. 6, p. 1–12, 2003.

BANKER, Rajiv D.; CHARNES, Abraham; COOPER, William W. Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. **Management Science**, v. 30, p. 1078 – 1092, 1984.

BARROS, Ricardo Paes; MENDONÇA, Rosane; SANTOS, Daniel Domingues; QUINTAES, Giovani. Determinantes do Desempenho Educacional no Brasil. **Pesquisa e Planejamento Econômico**, v. 31, n.01, p. 1-42, 2001.

BIFULCO, Robert; BRETSCHNEIDER, Stuart. Estimating school efficiency: a comparison of methods using simulated data. **Economics of Education Review**, v. 20, p. 417–429, 2001.

BLACKBURN, Vincent; BRENNAN, Shae; RUGGIERO, John. Measuring efficiency in Australian Schools: A preliminary analysis. **Socio-Economic Planning Sciences**, v. 48, n. 1, p. 4–9, mar. 2014.

BOGETOFT, Peter. OTTO, Lars. Benchmarking with DEA, SFA, and R, v. 157, 2011**.**

BONAMINO, Alicia Maria Catalano; ALVES, Fátima; CAZELLI, Sibele; FRANCO, Creso. Os efeitos das diferentes formas de capital no desempenho escolar: um estudo à luz de Bourdieu e de Coleman. **Revista Brasileira de Educação**, v. 15, p. 487-499, 2010.

BRASIL. **Lei nº 12.527, de 18 de Novembro de 2011**. 2011. Disponível em: < http://www.planalto. gov.br/ccivil_03/_ato2011-2014/2011/lei/l12527.htm > Acesso em: 18 jun. 2014.

CHARNES, Abraham; COOPER, William W.; RHODES, Edwardo L. Measuring the efficiency of decision making units. **European journal of operational**, v. 2, p. 429 – 444, 1978.

CONROY, Stephen J.; ARGUEA, Nestor M. An estimation of technical efficiency for Florida public

elementary schools. **Economics of Education Review**, v. 27, n. 6, p. 655–663, 2008.

DELORS, Jacques.; AL-MUFTI, In'am.; AMAGI, Isao.; et al. **Educação: um tesouro a descobrir. Relatório para a UNESCO da Comissão Internacional sobre Educação para o Séc. XXI**. São Paulo: Cortez Editora, 1998.

DIDONET, Simone Regina; VILLAVICENCIO, Guillermo Javier Díaz. Orientácion al mercado y eficiencia em los supermercados: evidencias empíricas. **Revista de Administração da UFSM**, v. 1, n. 1, p. 134-152, 2008.

FARRELL, Michael James.The measurement of productive efficiency. **Journal of the Royal Statistical Society. Series A**, v. CXX, n. part 3, p. 253 – 290, 1957.

FARIA, Flávia Peixoto; JANNUZZI, Paulode Martino e SILVA, Silvano José. Da. Eficiência dos gastos municipais em saúde e educação : uma investigação através da análise envoltória no estado do Rio de Janeiro. **Revista de Administração Pública**, v. 42, n. 1, p. 155–177, 2008.

FNDE, FUNDO NACIONAL DE DESENVOLVIMENTO DA EDUCAÇÃO. **Relatórios Municipais**. Sistema de Informações sobre Orçamentos Públicos em Educação. 2014. Disponível em: < https://www. fnde.gov.br/siope/relatoriosMunicipais.jsp> Acesso em: 18 jan. 2014

HARRISON, Julie; ROUSE, Paul. Competition and public high school performance. **Socio-Economic Planning Sciences**, v. 48, n. 1, p. 10–19, mar. 2014.

IBGE. INSTITUTO BRASILEIRO DE GEOGRÁFIA E ESTATÍSTICA. **Cidades**. 2014. Disponível em: <http://www.cidades.ibge.gov.br/xtras/uf.php?lang=&coduf=35&search=sao-paulo> Acesso em: 18 de jan. de 2014

INEP. Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. Nota Técnica (2014). 2014. Disponível em: <http://download.inep.gov.br/educacao_basica/portal_ideb/o_que_e_o_ideb/Nota_Tecnica_n1_concepcaoIDEB.pdf>. Acesso em 11 de jan. de 2014.

KIM, Hong-Kyum. Is there a crowding-out effect between school expenditure and mother´s child care time? **Economics of Education Review,** v. 20, n. 1, p. 71-80, Feb. 2001.

MARLOW, Michael. Spending, school structure, and public education quality: evidence from California. **Economics of Education Review**, v. 19, n. 1, p. 89-106, Feb. 2000.

PORTAL ACTION. Teste binomial exata. Disponível em: <http://www.portalaction.com.br/content/36-teste-binomial-exata>. Acesso em: 29/01/2013.

RAMOS, M.; SCHABBACH, L. O estado da arte da avaliação de políticas públicas: conceituação e exemplos de avaliação no Brasil. **Revista de Administração Pública**, v. 46, n. 5, p. 1271–1294, 2012.

RIBEIRO, Patrícia Tavares. A descentralização da ação governamental no Brasil dos anos noventa: desafios do ambiente político-institucional. **Ciência & Saúde Coletiva**, v. 14, n. 3, p. 819–828, 2009.

RIBEIRO FILHO, José Francisco; LOPES, Jorge Expedito de Gusmão; PEDERNEIRAS, Marcleide Maria Macedo; SILVA, Alan José Moura; MULATINHO, Caio Eduardo Silva. Recomendações em auditoria operacional: uma prospecção de fragilidades, com base na inteligência competitiva.

Revista de Administração da UFSM, v. 3, n. 2, p. 191-204, 2010.

ROSANO-PEÑA, Carlos; ALBUQUERQUE, Pedro Henrique Melo; MARCIO, Carvalho Jose. A eficiência dos gastos públicos em educação: evidências georreferenciadas nos municípios goianos**. Economia Aplicada**, v. 16, n. 3, p. 421–443, 2012.

SAMPAIO, Breno; GUIMARÃES, Juliana. Diferenças de eficiência entre ensino público e privado no Brasil. **Economia Aplicada**, v. 13, n. 1, p. 45–68, 2009.

SAURIN, Valter; LOPES, Ana Lúcia Miranda; COSTA JUNIOR, Newton Carneiro Affonso; GONÇALVES, Carlos Alberto. Medidas de eficiência e retorno de investimento: um estudo nas distribuidoras de energia elétrica brasileiras com base em Data Envelopment Analysis, Índice de Malmquist e ROI. **Revista de Administração da UFSM**, v. 6, n. 1, p. 25-38, 2013.

SEADE, FUNDAÇÃO SISTEMA ESTADUAIS DE ANÁLISE DE DADOS. **Banco de dados educação municipal**. 2014. Disponível em: <http://www.seade.gov.br/banco-de-dados/> Acesso: 10 maio 2014

SILVA, Maurício Corrêa; SOUZA, Fábia Jaiany Viana de; ARAÚJO, Aneide Oliveira. Análise da eficiência dos gastos públicos com educação nas capitais brasileiras. **Contexto**, v. 13, n. 24, p. 7–21, 2013.

SOBREIRA, Rogério; CAMPOS, Bruno Cesar. Investimento público em educação fundamental e a qualidade do ensino: uma avaliação regional dos resultados do Fundef. **Revista de Administração Pública**, v. 42, n. 2, p. 327-346, 2008.

UNNEVER, James D.; KERCKHOFF, Allan C.; ROBINSON, Timothy J. District variations in the educational resources and student outcomes. **Economics of Education Review**, v. 19, n. 3, p. 245-259, Jun. 2000.

VILLAVICENCIO, Guillermo Javier Díaz; DIDONET, Simone Regina. Eco-eficiencia em la gestión de residuos municipales em Catalunya. **Revista de Administração da UFSM**, v. 1, n. 2, p. 193-208, 2008.

WALDO, Staffan. On the use of student data in efficiency analysis-Technical efficiency in Swedish upper secondary school. **Economics of Education Review**, v. 26, p. 173–185, 2007.

WILBERT, Marcelo Driemeyer; D'ABREU, Erich Cesar Cysne Frota. Eficiência dos Gastos Públicos na Educação: Análise dos Municípios do Estado de Alagoas. **Advances in Specific and Applied Accounting**, v. 6, n. 3, p. 348–372, 2013.

WOESSMANN, Ludger. Why students in some countries do better? International evidence on the importance of education policy. **Education Matters**, v.1, n.2, p. 67-74, 2003.

ZOGHBI, Ana Carolina Pereira; MATOS, Enlinson Henrique Carvalho de; ROCHA, Fabiana Fontes; ARVATE, Paulo Roberto. Mensurando o Desempenho e a Eficiência dos Gastos Estaduais em Educação Fundamental e Média. **Estudos Econômicos**, v. 39, n. 4, p. 785–809, 2009.