Do more resources mean better results? The relationship between direct school costs and performance in high school

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This article evaluates the relationships that direct school costs and the organization of school places have with the performance of public schools, measured by the National High School Examination (Enem). It is based on the determinants of school performance from the school effect approach. This is a quantitative research, using multiple and quantum regressions, with fixed-effects panel data model. The sample was composed of Brazilian schools, analyzed between 2012 and 2015. The results indicate that there is a great oscillation in direct school costs between units of the same educational system, suggesting inequality in the distribution of financial resources. The findings also suggest that direct school costs do not explain the school results in the Enem exam, and that more resources do not necessarily translate into better performance. Finally, the findings indicate that the way in which resources are mobilized (in a planned and purposeful manner) can be the differential for learning. In addition, the study proposes a methodology to calculate direct school costs.

Keywords: direct school costs; school performance; efficiency of public spending; National High School Exam.

Mais recursos, melhores resultados? As relações entre custos escolares diretos e desempenho no Ensino Médio

Este artigo avalia as relações que os custos escolares diretos e a organização da oferta escolar têm com o desempenho de escolas públicas, aferido pelo Exame Nacional do Ensino Médio (Enem). O estudo se baseia nos determinantes do desempenho escolar a partir do enfoque teórico do chamado "efeito-escola". Trata-se de pesquisa quantitativa, com uso de regressões múltiplas e quantílicas, com modelo de dados em painel, de efeitos fixos. A amostra foi composta por escolas brasileiras, analisadas entre 2012 e 2015. Os resultados indicam que há grande oscilação nos custos escolares diretos entre unidades de uma mesma rede de ensino, sugerindo desigualdade na distribuição dos recursos financeiros; que os custos escolares diretos, no entanto, têm baixa capacidade de explicação dos resultados das escolas no Enem; que mais recursos não se traduzem necessariamente em melhores resultados em termos de desempenho escolar, sugerindo que a forma como são mobilizados (de maneira planejada e com propósito claro) é que pode constituir um diferencial na aprendizagem. Adicionalmente, o estudo propõe uma metodologia para apurar custos escolares diretos.

Palavras-chave: custos escolares diretos; desempenho escolar; eficiência do gasto público; Exame Nacional do Ensino Médio.

¿Más recursos, mejores resultados? Las relaciones entre costos escolares directos y rendimiento en la educación secundaria

Este artículo evalúa las relaciones que los costos escolares directos y la organización de la oferta escolar tienen con el desempeño de escuelas públicas, determinado por el Examen Nacional de la Enseñanza Media (Enem). Se basa en los determinantes del desempeño escolar a partir del enfoque teórico del denominado "efecto-escuela". Se trata de una investigación cuantitativa, con uso de regresiones múltiples y cuantílicas, con modelo de datos en panel, de efectos fijos. La muestra se compuso por escuelas brasileñas, analizadas entre 2012 y 2015. Los resultados encontrados indican que hay gran oscilación en los costos escolares directos entre unidades de una misma red de enseñanza, sugiriendo desigualdad en la distribución de los recursos financieros; que los costos escolares directos, sin embargo, tienen una baja capacidad de explicación de los resultados de las escuelas en el Enem; que más recursos no producen necesariamente mejores resultados de desempeño, sugiriendo que la forma como se movilizan (de manera planificada y con propósito claro) es lo que puede constituir una diferencia en el aprendizaje. De forma adicional, el estudio propone una metodología para determinar costos escolares directos.

Palabras clave: costos escolares directos; desempeño escolar; eficiencia del gasto público; Examen Nacional de la Enseñanza Media.

1. INTRODUCTION

Economic development studies have already shown a positive relationship between quality education and the competitiveness of nations, labor productivity, wage levels of workers and income distribution (Becker, 1962; Eicher & Garcia-Penalosa, 2001; Garen, 1984; Gylfason, 2001; Hanushek & Kimko, 2000; Hanushek & Woessmann, 2008; Heckman & Raut, 2016; Hendricks, 2002; Reis & Barros, 1991).

However, Campos and Cruz (2009) and Cruz and Jacomini (2017) pointed out that, in spite of these evidences, a greater concern with the guarantee of (at least) minimum funding levels of public education in Brazil is only observed from the Constitution (CF, 1988), in its article 212 and later, with the implementation of the Fund for Maintenance and Development of Primary Education and Valorization of Teaching (Fundef) in 1998 - which from 2006 was renamed Fund for Maintenance and Development of Basic Education and Valorization of the Magisterium (Fundeb).

In 2016, however, such Brazilian assurance of 1988 seemed threatened by the approval of Constitutional Amendment no. 95, which limited the Brazilian Union spending on education for 20 years. This issue was surrounded by debates and protests across the country, especially because of society's concern about the impact of this measure on the quality of education and, consequently, on national developmental delay (Couri & Bijos, 2016).

However, the challenges involving the improvement of the Brazilian education quality seem to be much more complex than the simplistic view of expanding or reducing the amount of financial resources. As an example, it was seen that in spite of the increasing financial investment implemented since 1988, Brazil still appears as 60th place among 76 countries in the World Qualification of Education, performed by the Organization for Economic Cooperation and Development (OECD) (Organisation for Economic Co-Operation and Development [OECD], 2015).

Understanding the factors that may influence such low level of school performance in the Brazilian context, in particular the role that public policies, materialized in financial funding, might play in accelerating improvement seems particularly important. Such understanding is important from the academic point of view as well as for managers from education area - given the positive influence that quality of education has on advances in social and economic indicators of a country (Becker, 1962; Eicher & Garcia-Penalosa, 2001; Garen, 1984; Gylfason, 2001; Hanushek & Kimko, 2000; Reis & Barros, 1991, among others). Thus, the aim of the present study is:

- *To analyze the relationships that direct school costs and the organization of school supply have with the performance of public schools, as measured by the National High School Examination (Enem).*

Or, in other words, it is proposed to investigate whether:

- *Direct school costs are able to explain and (to what extent) school performance in high school?*

As a theoretical reference for the analyzes, the "School Effect" (Fuller & Clarke, 1994; Lee, 2000; Soares, 2003, 2007; Soares & Collares; 2006) applied to the Brazilian reality, was the model used as proposed in Soares (2007). For Soares (2007), the factors that could explain school performance or quality of learning can be broken down into 'characteristics of students and their families', 'school

characteristics' and 'the society'. Among the school characteristics, direct school costs and some aspects of school organization were highlighted as the object of research analysis, using the characteristics of students and their families, as control variables. The influence of society was captured through the use of panel data.

In Brazil, the relationships that direct school costs establish with school performance are presented as opportunities to be widely explored (Amâncio-Vieira, Borinelli, Negreiros, & Dalmas, 2015), since most surveys explored the school expenses (such as direct and indirect school costs) and the school performance (Delgado & Machado, 2007; Menezes-Filho, 2007; Menezes-Filho & Pazello, 2007; Monteiro, 2015; Zoghbi, Matos, Rocha, & Arvate, 2009).

The academic contributions of this article are related to the observation of great oscillation in direct school costs between units of the same educational system, suggesting great inequality in the distribution of financial resources; that, however, more financial resources spent in a specific school do not necessarily mean better results in such school performance, as measured by the National High School Examination (Enem); that direct school cost variables are probably less amenable to analysis bias because they consider the specificities of each school unit in its calculation than average school expenditures; the presentation of a method of measuring direct school costs in public high schools; evidences that the effect of the analyzed variables is related to the average performance of the students of the school unit. For school managers, considering that direct school costs may be affected by public managers, the present study suggests possibilities of using public resources in a more efficient way, based on policies related to a better planned and focused resources mobilization, viewing greater equality between schools.

2. THEORETICAL BACKGROUND

2.1 School performance determinants

Pioneer work on explanatory factors of school performance of elementary school students with public funding was conducted in the 1960s in the USA (Coleman Report) and England (Plowden Report). The Cold War and the deepening of discussions on democracy in Western countries have, to a great extent, motivated the quest for expanding the quality of education and its equity (Brooke & Soares, 2008).

The results of these surveys arouse great discussion, since they suggested that schools "made no difference". Thus, from 1970 on new studies were conducted using other methodologies and adding more variables that could explain school performance students (Rutter, 1982, 1983; Shea, 1976). So, as taking into account the "school processes," that is, the influence of social and cultural characteristics of schools on outcomes, those studies began to observe that although the effects of students' socioeconomic status could be overlooked, they made little or no difference in the students' school performance.

Thus, the 80`s publications were mainly focused on so-called "school effect", which includes Fuller and Clarke (1994), Lee (2000), Soares (2003, 2007) and Soares and Collares (2006). From this point of view, a school unit is said to be effective if, given the initial school performance of a

particular student, such school is able to provide the necessary knowledge so that, at the end of each school stage, the student performance is above the expected for a student in similar socioeconomic conditions. The notion of "school effect" allows the comparison of the performance of students of similar socioeconomic status, enrolled in different schools (Soares, 2003, 2007).

2.2 School performance determinants in Brazil

The studies developed by aforementioned authors (Albernaz, Ferreira and Franco (2002), Menezes-Filho (2007), Soares (2007) and Riani and Rios-Neto (2008)) seem appropriated to synthesize the discussions carried out so far on the explanatory factors of school performance, especially in the Brazilian contextwhich is the central focus of the present study, as they use the "school effect" in the analyzes. In the research conducted by Albernaz, Ferreira and Franco (2002), the general form of the educational production function would be given by the equation:

$$Y = F (c, m, g, p, s), \tag{1}$$

Where: Y would denote the student's school performance, which may depend on: his / her personal characteristics (c) of age, color / race, gender; characteristics of their family (m), income and level of schooling of the parents; characteristics of their schoolmates (g); characteristics of their teachers (p) schooling, experience and salary; and other organizational characteristics of school supply (s) - number of students per classroom, proportion of repeat students, average income of school students, proportion of airy and quiet classrooms and volume of financial resources managed directly by schools. All information was extracted from the contextual questionnaires applied together with the Saeb (Basic Education Assessment System) evaluation in schools.

The empirical application of this function, carried out with a sample of Saeb 1999, involved information on school performance in the following disciplines science, geography, history, Portuguese and mathematics of 89,671 8th grade students from 2,588 schools. Based on Albernaz, Ferreira and Franco (2002) findings, it was possible to observe that the variance of the performance between the schools was mainly due to differences on the average of students' socioeconomic status, suggesting a significant effect of selection (80.4% of the observed variance). Moreover, once this effect is controlled, the results points out that differences in school inputs - represented by teachers' level of education, the existence of airy and quiet classrooms and the amount of financial resources managed directly by schools - still accounted for a significant portion of the differences in performance observed between schools.

Menezes-Filho (2007) conducted a study using data from the Saeb 2003 to examine the academic performance in mathematics of the Brazilian students of 4th and 8th grades of Elementary School, and the 3rd grade of High School. The authors observed that 1) there is a large heterogeneity between schools' grades within the same school system, even controlling the characteristics of students and their families. Such findings suggest the importance of school management in the outcome; 2) the variables that better explained school performance are those related to the students' and their families' characteristics; 3) school variables, such as schooling, age and teachers 'salaries, ´resented very small

effects on students' school performance; 4) Size of the class did not affect the student's academic performance in any of the analyzed series.

The conceptual model of Soares (2007), in turn, adds the external environment, or society, in the analysis of explanatory factors of Brazilian school performance (figure 1). In this model, the factors closer to the student's school performance are their personal characteristics and attitudes towards the school. Besides these, according to the author, three other structures influence the proficiency (or school performance): the school, the family and the society.

The empirical test of the Soares model (2007) involved a sample from 2001 Saeb, comprising 50,300 students, 4,922 teachers and 4,065 elementary schools. The results indicated that the model containing all measured factors could only explain 12.3% of the total variance, a similar proportion found by Albernaz, Ferreira and Franco (2002), which was 19.6%. Among the analyzed school characteristics that presented statistically positive correlations with the school performance at the level of 5% were the salary of the teachers, security, the School's cleanliness, and the Principal's education level.

FIGURE 1   EXPLANATORY FACTORS OF SCHOOL PERFORMANCE IN BRAZIL
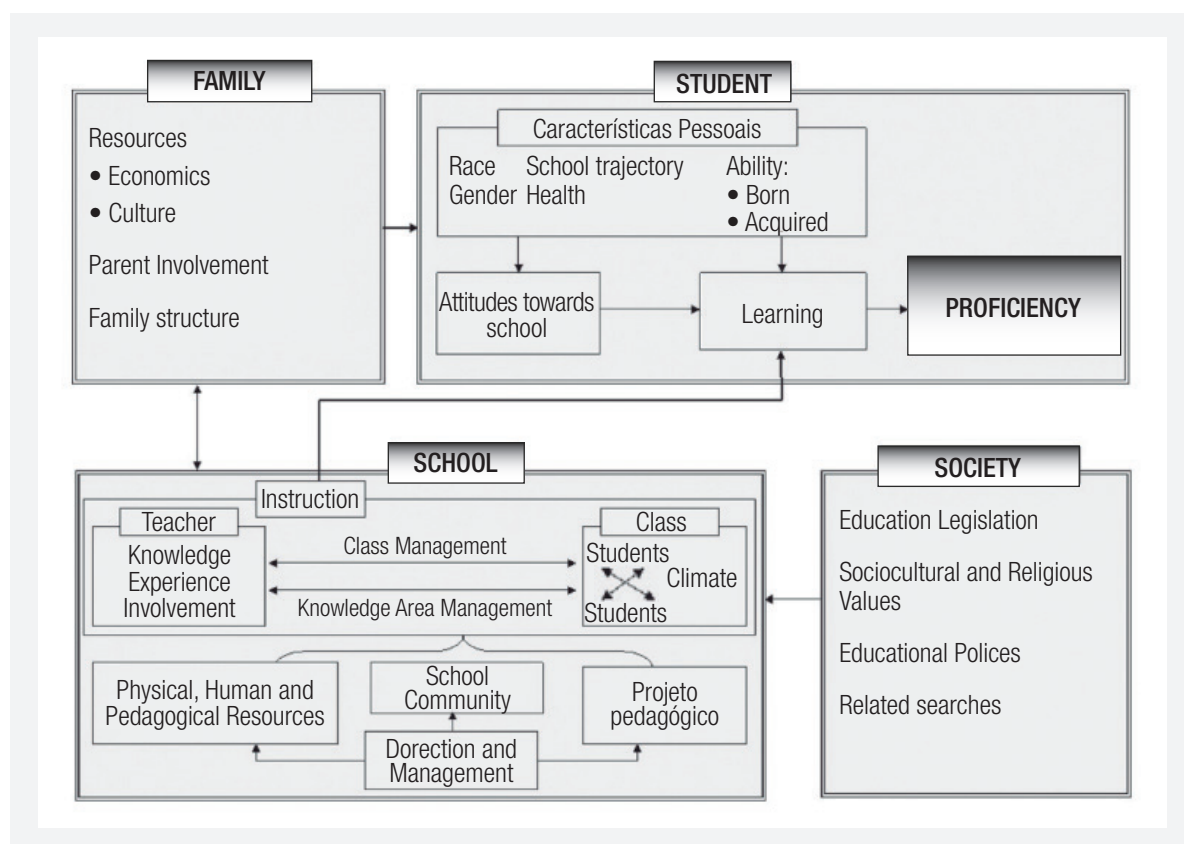
Source: Soares (2007, p. 141).

Similarly, Riani and Rios-Neto (2008), using data from the School Census and the IBGE Demographic Census from 2000, investigated the determinants of school performance in elementary/Middle school and high school in Brazil. The authors observed that 1) the quality of human resources and school infrastructure increased the probability of the student attending school at the correct age; 2) there was a "substitution" effect between the student's mother education level and the quality of human resources and school infrastructure, that is, an adequate school structure would be able to "neutralize" the possible negative effects of a low level of education of the student's mother.

The studies of Albernaz, Ferreira and Franco (2002), Menezes-Filho (2007), Soares (2007) and Riani and Rios-Neto (2008) bear similarities with each other as they focus on understanding the determinants of Brazilian elementary school from the "school effect", as recognize the importance of the characteristics of the students, their families and school aspects in this context. However, they do not mention these same determinants in High School, which is also one of the levels of basic education, according to the Law of Guidelines and Bases of Education - Law 9,394 of December 20, 1996. Likewise, they also do not comprehensively evaluate the role of financial costs as explanatory variables.

2.3 Average costs and direct school costs as explanatory variables of Brazilian school performance

As Soares and Alves (2013) point out, academic research from the point of view of financial costs is highly controversial, probably originated from ecological studies comparing developed countries × developing countries, or maybe from the types of databases available for research.

For Amâncio-Vieira et al. (2015), the studies analyzing the relations between financial costs and school performance could use two of database types:

1. **Average of school School expenses:** comprising the sum of all financial expenditure with the educational system (including administrative units), in a given period of time, divided by the total number of schools, since the unit of analysis is the average expenditure;
2. **Direct school costs (or actual costs):** sum of all financial expenses that directly affect the functioning of each school, except for investments, involving payment of personnel, teaching materials, maintenance and cleaning, surveillance, water, electricity, telephone, transportation and school feeding - being unique and real for each school analyzed.

However, it is important to mention the limitations on carry out in Brazil studies evaluating the effect of direct school costs on the school performance (Amâncio-Vieira et al., 2015). Grouping budget information would be the main reason even though the adoption of cost accounting is mandatory by the Law No. 4,320, of 1964, in Decree-Law no. 200 of 1967, and in Complementary Law No. 101 of 2000, , which would make it possible to know the real value allocated in each school, such data is not yet available in Brazil.

Thus, the majority of Brazilian studies use mean-cost databases (Delgado & Machado, 2007; Menezes-Filho & Amaral, 2009; Menezes-Filho & Pazello, 2007; Monteiro, 2015; Zoghbi et al., 2009), which correlate the average of school expenses and school performance. However, these studies did not observed statistically significant correlations between these two variables.

On the other hand, studies evaluating with direct school costs are rare in Brazil. An example is the study of Amâncio-Vieira et al. (2015) that explored the relationships between direct school costs and school performance in Elementary School, involveing 67 elementary schools in Paraná. The authors observed that the average school performance of students in the Brazilian / Saeb Examination of Portuguese and mathematics positively correlated with the teacher's experience; and negatively correlated with the school's social cost (represented by the sum of the costs of school meals and transportation) and administrative costs (represented by the costs of the unit's administrative team).

The academic controversy over the relationship between average school spending and school performance (Delgado & Machado, 2007; Menezes-Filho & Pazello, 2007; Menezes-Filho & Amaral, 2009; Monteiro, 2015), and direct school costs and performance (Amâncio-Vieira et al., 2015), especially in the Brazilian context, opens an opportunity for further studies, which could contribute to a more consistent and objective view on such outcome, especially in high school education system, where there is a lack of specific studies (Amâncio-Vieira et al., 2015).

According to the Indicator of Development of Basic Education (Ideb), yearly published by the Ministry of Education in Brazil, from information flow and school performance of students of public schools, Brazil reached, in 2015, 3.7 points in Education Medium, on a scale ranging from 0 to 10, and has remained stagnant since 2011. Understanding how such elements influence this dynamics could help Brazilian managers to be more assertive in their choices. On the other hand, from the academic point of view, it makes it possible to expand understanding about determinants of school performance, in a field that can be directly intervened by public policies (direct school costs), while other determinants of school performance - such as characteristics of the students and their families - are not.

3. METHODOLOGY

This is a quantitative research, adopting the "school effect" approach conceptual model proposed by Soares (2007), and developing a method to calculate direct school costs. As research techniques, multiple and quantum regressions model was proceeded. In addition, the Stepwise method was used to select the most statistically significant variables to the final model.

Secondary data were extracted from the State Secretariat of Education of Espírito Santo (Sedu/ES) database and from the School Census of the National Institute of Studies and Educational Research Anísio Teixeira (Inep/Ministry of Education-MEC), from 2012 to 2015.

The study sample consisted of the 32 high schools of Espírito Santo state, representing 100% of the units that maintained the exclusivity of this type of offer from 2012-2015. Espírito Santo state was chosen based on two factors: 1) availability of direct school cost control database, which are not widely available in Brazil; 2) Since in Espírito Santo state taking the Enem test is mandatory in order to obtain a High School certificate from 2009 on (Portaria Sedu no. 71-R, of 06/26/2009), the average of participation in Enem test is 81% among the students of the 3rd grade in the studied years.

Enem test database was chosen as a benchmark because until 2015 there were no national large-scale school performance assessment, that would allow estimating and comparing neither high schools' learning outcomes nor school performance across the state.

Database was organized by school / year in three groups of information - "school performance", "direct school costs" and "student characteristics", as proposed by Albernaz, Ferreira and Franco (2002), Soares (2007) and Amâncio-Vieira et al. (2015) (appendix A).

Educational production function was used (Albernaz, Ferreira & Franco, 2002) considered the "school effect" approach as the conceptual model (Soares, 2007), in where 'proficiency' is explained by: 1) characteristics of students and their families; 3) school characteristics; and 4) society, as expressed in equation 2.

$$ENEM\ SCHOOL\ PERFORMANCE_{it} =$$
$$\alpha_i + \sum_k \beta_k\ Directs\_Costs_{it}^k + \sum_k \delta_k\ Supply\_Organ_{it}^k + \sum_k \beta_k\ Students\_Caract_{it}^k + \varepsilon_{it} \qquad (2)$$

Where:

$ENEM\ SCHOOL\ PERFORMANCE_{it}$ is the dependent variable, being represented by the average of students' performance (i) of certain school (t), enrolled in the 3rd grade of the High School, in the evaluations of "languages and codes" and "mathematics" of the Enem; i is the fixed unit, and each dependent variable is tested for the fixed effect as the "school" itself; t is the time component, in years, from 2012 to 2015; t is the temporal component, in years, from 2012 to 2015; $k\ \alpha_i$ is the fixed component connected to the unit i; $Directs\_Costs_{it}^k$ (represented by all the costs necessary for each school to function - salaries of teachers in class regency, salaries of staff in the administrative area of the school, salaries of the Principal, leave of absence, patrimonial surveillance, school meals, Direct in School, water and energy - as well as the total direct school cost (represented by the sum of all cost variables necessary to the school's operation); $Supply\_Organ_{it}^k$ (which corresponds to the average number of students per school classroom) and $\sum_k \beta_k\ Students\_Caract_{it}^k$ (proportion of students up to 18 years of age, gender, color / race, and schooling of the mother or responsible student) represent the sets of explanatory variables, described in detail in appendix A of this research; ε_{it} are normal and independent random shocks over time.

The Stepwise method was used to select the statistically significant variables, which better explained the "school performance in the Enem test". Final model was composed by the variables with a statistical significance level lower than 5%. In addition, quantum regressions were used to evaluate differences between quantiles 10, 25, 50, 75 and 90 of the sample, through robust and grouped standard errors.

4. RESULTS

4.1 Enem Test: Explanatory factors of school performance in Reading

The model presented R^2 equal to 0.3934, which indicates that the set of measured factors is able to explain 39.34% of the total variance in the data. This result is above those found by Soares (2007) of 12.3%, and Albernaz, Ferreira and Franco (2002), who observed an R^2=19.6% (table 1). Our sample presented a positive correlation between Enem Reading performance and school cleanliness and

conservation costs. Such result corroborate with the findings of Soares (2007), who observed a positive contribution of school cleanliness to the mean performance of students score in Saeb 2001. Such findings suggest that this kind of expenditure may impact the school environment and triggering a feeling of well-being in the students, resulting in a better school performance, although playing a very limited effect, considering the determinant coefficient.

On the other hand, it should be noted that the variables related to wages of teachers, administrative personals, and of Principals; work leave, property security system, school meals, school transportation, Direct Money in School Program, water and energy availability, and annual total cost per student, showed no correlation with the Enem Reading scores. That is, they showed no significant correlation with the performance of schools. These results contrast with the findings of Amâncio-Vieira et al. (2015), which identified negative relationships between school performance in elementary schools, social cost of school and administrative costs. Such findings suggest that, regardless of negative correlations or absence of expressive correlations, the wide availability of inputs of certain schools was not necessarily translated into quality in such school

TABLE 1   **ESTIMATED REGRESSIONS, WITH PANEL DATA MODEL, OF FIXED EFFECTS, OF EXPLANATORY VARIABLES OF SCHOOL PERFORMANCE IN READING**

R^2	0.3934
Observations	116
Variable group	**Coefficients**
Direct school costs	
Cleaning and conservation costs	0.0314**
Organization of school supply	
Schools with Principal	11.2939**
Student Characteristics	
Mother with no education or educated up to 4th grade	-54.6303**
Black students	-65.6019**
Students - female gender	49.8373**
Constant	443.5302**

Source: Elaborated by the authors.
Note: Matrix of variance-robust covariance to heteroskedasticity and serial autocorrelation.
Significance of coefficients: ** P value <0.01; * P value <0.05.

Regarding to the costs of teachers` wages or the cost of teachers' hourly wages, no significant correlation was observed, corroborating with the findings of Menezes-Filho and Pazello (2007). The authors argue that such findings might be explained by the fact that, according to current legislation in Brazil, the teachers' wages are based on the length-time of service and long-term training regardless of school performance.

The existence of a school with a Principal showed to be statistically significant to explain the average school performance. In this sense, to have a principal in the school added, in average, 11.29 points in the Enem test. Considering that the mean performance score of the students in the sampled schools was 473.18 points, which was approximately 2.39% of the total points of the evaluation. As has been pointed out since 1970, such result seems to reinforce the importance of school management in the school performance scores, and that it also play a central role in using more efficiently and adequately the school resources (Riani e Rios-Neto, 2008; Rutter, 1982, 1983; Shea, 1976). It was also observed that the variables *total enrollment*, *enrollment per shift*, *students per class*, and *proportion of effective teachers* were not statistically significant to explain the student's performance.

On the other hand, the variables *mother with no education or up to 4th grade education level, black students and female students* - comprising the characteristics of the students group, which were all controlled in the model - were statistically explained the school performance in Reading Enem test.

Regarding the variable *mother with no education or up to 4th grade education level*, it negatively affect the performance in Enem test, in such a way that for every 1% of mothers of students in this condition at school, it would represents, in average, a negative effect of approximately -0.546 points in the Enem test. At the limit, if 100% of the mothers of students have this characteristic, the average negative impact on the exams would be around 54.63 points in the Enem test.

The explaining power of *family characteristics* in the school performance (in this case, the mother's schooling) had already been observed by Shea (1976); Rutter (1982, 1983); Lee (2000); Albernaz, Ferreira and Franco (2002); Menezes-Filho (2007); Soares (2007); Riani and Rios-Neto (2008). In addition, the research developed by Hart and Risley (2003), which followed the routine of 42 families for a period of two and a half years, observed that low-income children listen, on average, 30 million less words that children from high-income families, which has direct influence on the development of language.

Similarly, the proportion of black students showed a negative effect on the school performance in Reading. That is, for every 1% of black students, there would be in average, a performance of -0.656 lower point in the Enem test - or, if 100% is black, there would be a reduction of -65.60 points. These results seem to highlight the importance of educational policies that seek equity. In other words, policies to guarantee that all students have equal opportunities to learn in fact, independently of socioeconomic conditions and skin color.

The proportion of female students presented a positive effect on the results of Enem test, in such a way that for every 1% of female students in the school, there was an increment of approximately 0.49 points in the avarege of Enem test score. In a hypothetical scenario in which all students were female, the average increment would be of 48.83 points. Such observation suggests that gender issues may also have links to learning and need attention in policy formulation in the area.

4.2 Enem Test: Explanatory factors of school performance in mathematics

The model presented R^2 of 0.3704, being slightly smaller than the "languages and codes" model (table 2). However, the group of *direct school costs* variables group presented a larger number of significant variables that explained school performance in mathematics. Such findings suggest that internal factors linked to the school environment could have more significant effects on performance since, as pointed by Hart and Risley (2003), mathmatics is an area where knowledge is not as closely related to the family environment as that of Reading.

TABLE 2   ESTIMATED REGRESSIONS, WITH PANEL DATA MODEL, OF FIXED EFFECTS, OF THE EXPLANATORY VARIABLES OF SCHOOL PERFORMANCE IN MATHEMATICS

R^2	0.3704
Observations	116
Variable group	**Coefficients**
Direct school costs	
Costs with teacher salaries	0.0299**
Principal salary costs	0.0432**
School transportation costs	0.0505**
Pedde costs	0.0628**
Water and energy costs	0.0577**
Organization of school supply	
Matriculation per shift - night	-15.9991**
Student Characteristics	
Students - female gender	-62.2382
Constant	567.2683**

Source: Elaborated by the authors.
Note: Matrix of variance-robust covariance to heteroskedasticity and serial autocorrelation.
Significance of coefficients: ** P value <0.01; * P value <0.05.

The costs of teacher wages and principal wages were positively associated with school performance in mathematics, with coefficients of 0.0299 and 0.0432. This findings were similar to that registered in relation to transportation costs, State Direct Money in School Program (Pedde), water and energy. Thus, in average, for each R\$100.00 spent on each of these cost items would be expected in terms of school performance in mathematics an increment of 2.99 points for teacher salary costs, 4.32 points for costs with director salary, 5.05 points for transportation costs, 6.28 points for Pedde costs, and 5.77 points for water and energy costs would be: plus. Those findings suggest that math results seems to be more sensitive to direct school cost items than language and code assessed by Enem test, which had not been highlighted in studies conducted so far involving elementary school assessments.

Among the variables related to the organization of school supply, only night shift enrollment appeared negatively correlated with the mathematics in Enem test, showing that schools with a higher enrollment ratio tend to negatively affect school performance in math. It suggest that there would be probably an association between the lower hours of classes during the school year as compared to the day shift, as well as being a great deal of working students, whose school productivity that could be affected by physical and/or mental tiredness.

Among the characteristics of the students, only female students consistently explained the performance in mathematics. Although female gender incremented up to 49.84 points in languages and school codes scores in the Enem test; when considering the math score, we observed an inverse effect. Thus, the results suggest that the higher the number of female students, the lower the school performance in math. In a scenario where 100% of the students were women, it would represent a decrease of up to -62.24 points in the math school performance score. Such evidences support the need of specific public policies aiming to promote greater educational equity between genders.

4.3 Explanatory factors of school performance per quantile

In terms of the 10, 25 and 50 quantile of the sample, tables 3 and 4 show that, as for the groups of variables of *direct school costs* as for the *organization of school supply* group, few variables related to these groups significantly explained math performance in Enem test.

TABLE 3   **REGRESSIONS ESTIMATED, BY QUANTILE REGRESSIONS, OF THE EXPLANATORY VARIABLES OF SCHOOL PERFORMANCE IN READING**

Group / Explanatory Variable	Average Coefficient	Quantil 10 Coefficient	Quantil 25 Coefficient	Quantil 50 Coefficient	Quantil 75 Coefficient	Quantil 90 Coefficient
Cleaning and conservation costs	0.0314**	-	-	-	0.0059**	0.0048**
School with Principal	11.2939**	-	-	-	14.6972**	21.0485**
Mother with no education or educated up to 4th grade	**-54.6303****	-120.0869**	-116.6908**	-116.9232**	-105.0485**	-119.7853**
Black students	**-65.6019****	-	-	-	-	-61.5899**
Students - female gender	**49.8373****	91.4620**	-	76.5536**	-	3.7512*
Constante	**443.5302****	406.0113**	442.1965**	455.8466**	488.3869**	496.8588**

Source: Elaborated by the authors.
Note: Result of quantile regression, with robust and grouped standard errors.
Significance of coefficients: ** P value <0.01; * P value <0.05.

Such results suggests that financial expenditures carried out in these units, as well as the organization of school supply, were not able to produce any statistically significant effect on the performance under analysis. Once all the studied schools presented less favorable conditions, the question is how public policies could actually contribute to better performance results in such contexts, since the mobilization of resources by itself could not change the reality.

Concerning to Reading assessment specifically, , it was observed that *cleaning and conservation costs* tended to positively affect the performance of the schools that reached 90% better results in the exams between 2012 and 2015. Similar findings were observed in relation to the variable *school with principal*. For these schools, the resources mobilization seemed to be more adequate, producing the intended results.

Regarding the characteristics of the students, the fact that the *mother never studied or did not complete the 4th grade of elementary school* negatively impacted all quantiles analyzed, with a variation of the coefficients between -105.0485 and -120.0869. As for the proportion of *black students*, a negative impact was observed only for the average performance of the schools in the 90th quantil. Anyway, it should be noted that for each group of 10% of students who declared that they were black, there was a decline of -6.15899 points from the average. As for the *gender*, the proportion of girls enrolled in school appeared to affect positively the 10 and 50 quantiles, with coefficients of 91.4620 and 76.5536.

TABLE 4   **REGRESSIONS ESTIMATED BY QUANTILE REGRESSIONS OF THE EXPLANATORY VARIABLES OF SCHOOL PERFORMANCE IN MATHEMATICS**

Group / Explanatory Variable	Average Coefficient	Quantil 10 Coefficient	Quantil 25 Coefficient	Quantil 50 Coefficient	Quantil 75 Coefficient	Quantil 90 Coefficient
Teacher salary costs	0.0299**	-	-	-	-0.0224*	-0.0208**
Principal salary costs	0.0432**	-	-	-	-0.0225*	-0.0321**
School transportation costs	0.0505**	-	-	-	-	-
Pedde costs	0.0628**	-	-	-	-	-
Water and energy costs	0.0577**	-	-	-	-	-
Matriculation per shift - night	-15.9991**	-	-38.4768**	-37.8847**	-33.1930**	-30.5881**
Mother with no education or educated up to 4th grade		-	-	-75.363*	-64.3798**	-70.2513**
Black students		-	-	-	-	-
Students - female gender	-62.2382**	-	-	-	-	-
Constant	**567.2683**	434,0296**	515,9145**	547.9504**	580.7983**	570.3414

Source: Elaborated by the authors.
Note: Result of quantile regression, with robust and grouped standard errors.
Significance of coefficients: ** P value <0.01; * P value <0.05.

As for math evaluation in Enem test, the analysis of the *group direct costs*, by quantile, showed that the costs of teacher wages and costs of principal wages affected only the results of the schools that concentrated the 75% and 90% higher averages in the evaluation.

As for the variables of the organization *group of school supply*, only night shift enrollment significantly explained the average performance of the 25, 50, 75 and 90 quantiles. Thus, for every 10% of students enrolled in the night shift in school, it would represent in average, -3.05881 (for the 90th quantile) to -3,84768 points lower (for the 25th quantile), than the school average in the math evaluation in the Enem test.

From the *group characteristics of the students*, only the *mother with no education or up to 4th grade education level* presented a differences between the analyzed quantiles, concentrating the effects from quantiles 50 or above.

5. CONCLUSION

The objective of the research was to analyze the relationships between *direct school costs* in the performance of public schools in the National High School Examination (Enem). Using disaggregated data by school allowed us to observe a great oscillation of direct school costs between state public high schools - varying from R$ 1,631.55 to R$ 18,464.65, with average of R$ 4,977.17 (+R$ 2,819.00). Such findings suggest that using average school expenses as independent variable may introduce bias in analyzis.

On average, it was observed that there were statistically significant correlations between school performance in the Enem test and *direct school costs* and *organization of school supply* group of variables. Such result diverges from previous surveys that *school expenditures* and found no correlation with school performance in the Enem test. However, it was observed that the magnitude of the coefficients presented poorly explained the distributions of school performance in the Enem test.

Using the *direct school costs* as independent variable allowed us to observe that the amount of financial resources of a given educational units, managed by the state, would not necessarily be translated into better school performance in the Enem test. In other words, the school planning, adequacy, and clear purpose before mobilizing the money is more important than the amount of money invested in the school.

Concerning to the organization of the school supply group of variable, the *school principal* has shown to significantly explain the average of school performance in Reading in the Enem test corroborating previous argument. On the other hand, the proportion of enrollment in the night shift has a negative effect on math results, which may be associated with shorter class times or even lower student productivity at night, since most of the students are student work. Otherwise, the number of students per class, one of the items with the greatest financial impact on direct school costs, did not expressively explained the average performance of the school in both languages and mathematics in Enem test. Corroborating the hypothesis that the way resources are mobilized is more important than the amount of money allocated in the schools in order to achieve a good school performance in the Enem test.

The group of variable *student's characteristics* was relevant to explain the school performance, justifying their use as control variables. The variables color/race, gender and mother education level significantly explained the school performance in the Enem test.

The quantile regression analyzes revealed a convergent behavior of schools with the lower average scores in the Enem tet. That is, the variables related to direct school costs and organization of school supply were not statistically significant to explain performance in the Enem test in those units. This fact indicates the need of attention from public managers to understand the specific dynamics of each variable in that group, such as school environment, that influence the school performance in Enem test in each one of these units.

Thus, the results indicate that "more resources" do not always mean "better results". Improving performance results seems to be associated with the quality of resource management rather than with the amount of money given to the school. Such findings are very important and they must be taken into consideration by both researchers in education field and public education managers on decision making in order to advance in terms of the quality of services provided.

Finally, in order to complement the evidence presented and as a form of contribution in the theoretical and practical field, this study presents a methodology for calculating direct school costs in state public high schools that can be replicated in other places. Such strategy opens an opportunity for future studies in the school performance assessment. Another possible approach provided by this study also include the use of other domains included in the Enem test as outcomes, as well as factors related to equity in school performance. In addition, the scope of costs can be expanded to other financial expenditures, such as investments in the unit over a given period of time. Otherwise, comparisons between the impact of direct costs and/or investments in partial shift and full shift schools are also worthy of attention, especially in a in Brazil, where one of the goals of the Education is to expand the supply of full-time education by 2024.

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APPENDIX

APPENDIX A   VARIABLES AND CALCULATION METHODOLOGY

GROUP	VARIABLES	DETAILS	SOURCES
1. Enem school performance	**1.1 Enem Reading**	Simple average of the grades of the 3rd grade high school students who did the evaluation of the Enem Reading **Measure: Points**	Inep/Mec
	1.2 Enem Mathematics	Simple average of the grades of the 3rd grade students of the high school who did the evaluation of the Enem Mathematics **Measure: Points**	Inep/Mec
2. Direct school costs	**2.1 Costs with teacher salaries**	Sum of the gross wages paid, over the course of each year, to the teachers of each school divided by the total enrollment **Measure: in Reais**	Sedu/ES and Inep/Mec
	2.2 Costs salary / hour contracted teacher	Sum of the gross wages paid each year to the teachers contracted from each school divided by the total hours contracted **Measure: in Reais**	Sedu/ES
	2.3 Costs with administrative salaries	Sum of the gross salaries paid each year to the administrative and management staff (Principal, coordinators and supervisors) of the school divided by the total enrollment **Measure: in Reais**	Sedu/ES and Inep/Mec
	2.4 Principal salary costs	Sum of the gross wages paid, over the course of each year, to the head of school divided by total enrollments **Measure: in Reais**	Sedu/ES and Inep/Mec
	2.5 Costs of absences from work	Sum of amounts paid, over each year, for days not worked, by school servers, divided by total enrollments **Measure: in Reais**	Sedu/ES and Inep/Mec
	2.6 Patrimonial surveillance costs	Sum of amounts paid, over the course of each year, related to the school's property surveillance services divided by total enrollments **Measure: in Reais**	Sedu/ES and Inep/Mec
	2.7 Cleaning and conservation costs	Sum of amounts paid over the course of each year for school cleaning and maintenance services divided by total enrollment **Measure: in Reais**	Sedu/ES and Inep/Mec
	2.8 School feeding costs	Sum of amounts paid over the course of each year for school feeding services divided by total enrollment **Measure: in Reais**	Sedu/ES and Inep/Mec
	2.9 School transportation costs	Sum of the amounts paid, over the course of each year, related to school, urban and rural transport, divided by total enrollments **Measure: in Reais**	Sedu/ES and Inep/Mec
	2.10 Costs with State Program Direct Money in School (Pedde)	Sum of the amounts passed through each year, as a function of the State Direct Money Program in Schools, divided by the total number of school enrollments **Measure: in Reais**	Sedu/ES
	2.11 Water and energy costs	Sum of amounts paid, over the course of each year, for contracts for water and energy supply, divided by total school enrollment **Measure: in Reais**	Sedu/ES

Source: Elaborated by the authors.

Note: Pedde transfers financial resources annually to the School Council of each state unit to be used in the acquisition of consumer and / or capital goods, necessary for the development of its pedagogical projects.

APPENDIX B VARIABLES ORGANIZATION OF SCHOOL SUPPLY AND CHARACTERISTICS OF STUDENTS

GROUP	VARIABLES	DETAILS	SOURCES
3. Organization of school supply	3.1 Total enrollment	The number of high school enrollments in the school each year, from 1st to 3rd grade, considering approved and disapproved, including regular high school and high school integrated to vocational education **Measure: number of students**	Inep/Mec
	3.2. Matriculation per shift - morning	Sum of total enrollment in the high school morning shift each year, from 1st to 3rd grade, including regular high school and high school education integrated into vocational education, divided by the total number of students in grades 1 through 3, including regular high school and High School integrated with vocational education **Measure:% morning shift students**	Inep/Mec
	3.3 Matriculation per shift - afternoon	Sum of the total enrollment in the high school afternoon shift of the school each year, from 1st to 3rd grade, including regular high school and high school integrated to vocational education, divided by the total number of students from 1st to 3rd grade, including regular high school and High School integrated with vocational education **Measure:% students of the afternoon shift**	Inep/Mec
	3.4 Matriculation per shift - night	Sum of total enrollment in the school's high school night shift each year, grades 1 through 3, including regular high school and high school education integrated into vocational education, divided by the total number of students in grades 1 through 3, including regular high school and High School integrated with vocational education **Measure:% night shift students**	Inep/Mec
	3.5 Matriculation per shift - integral	Sum of full-year high school enrollment in each year, from 1st to 3rd grade, including regular high school and high school integrated to vocational education, divided by the total number of students in grades 1 to 3, including regular high school and high school integrated into vocational education **Measure:% full-time student**	Inep/Mec
	3.6 Students per class	Sum of the number of high school enrollments divided by the number of high school classes **Measure: number of students**	Inep/Mec
	3.7 Schools with Principal	*Dummy* which indicates whether there is a principal or not at school **Measure: Principal**	Inep/Mec
4. Student Characteristics	4.1 Student Characteristics	Total number of students of the genre (male or female) in the 3rd grade of High School divided by the total enrollment of the 3rd grade of the High School of the school **Measure:% students of each gender**	Sedu/ES
	4.2 Students by color / race	Sum of the total number of students by color / race in the 3rd grade of High School divided by the total enrollment of the 3rd grade of the High School of the school **Scale: 0 to 100%** **Measure:% students by color / race (white, brown, black, yellow and indigenous)**	Sedu/ES
	4.3 Students up to 18 years of age	Sum of the total number of students up to 18 years of age in the 3rd year of high school, completed until December 31 of the year analyzed, divided by the total enrollment of the 3rd grade of the high school **Measure:% students up to 18 years of age**	Sedu/ES
	4.4 Schooling of the mother or responsible student	Proportion of 3rd year high school students, allocated according to the following bands: never studied or did not complete 4th grade / 5th grade; completed 4th grade / 5th grade, but did not complete 8th grade / 9th grade; completed 8th grade / 9th grade, but did not complete High School; completed high school, but did not finish college; completed the faculty. **Measure:% students per track**	Sedu/ES

Source: Elaborated by the authors.