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QUALITY OF EDUCATION AND PUBLIC RESOURCES ALLOCATION IN BRAZIL

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Resumo: O Brasil está sob o foco da mídia internacional devido as suas elevadas taxas de crescimento econômico e programas sociais. O Brasil faz parte dos países do BRIC, e tem o Bolsa família (BF), um programa social de transferência de renda condicionada que é famoso mundialmente. Dentro desse contexto, o governo federal deve examinar cuidadosamente como a qualidade da educação está relacionada com a formação e acumulação de capital humano. Esse é o foco deste trabalho que aborda a seguinte pergunta: os recursos públicos estão sendo alocados, no Brasil, a fim de minimizar as perdas? Crianças beneficiadas pelo BF podem não estar tendo a qualidade educacional esperada. Alocação de recursos escassos pode não estar sendo gerida a fim de minimizar as perdas. Esses aspectos são extremamente importantes para: 1) a gestão de recursos públicos escassos; 2) a formação de capital humano; e 3) a sustentabilidade do BF, o qual deve continuar pelos próximos quatro anos sob a administração da Presidente Roussef. Este estudo utiliza dados em painel (2005 e 2007) para entender a relação entre o desempenho em matemática e português, investimentos públicos em educação, a alocação do BF. Os resultados indicam que os municípios que recebem verba do BF não apresentam bom desempenho nos testes de proficiência. Há também algumas evidências que os gastos públicos em educação afetam os testes de desempenho, porém com coeficientes muito pequenos em magnitude.

Palavras-chave: Transferência de Renda Condicionada, Bolsa Família, Brasil, Educação Fundamental, Investimento Público, Efeitos Fixos.

Abstract: Brazil is under the spotlight of international media because of its high economic growth rates and its social programs. Brazil is part of the BRIC countries, and has the Bolsa Família (BF), a worldwide famous cash transfer social program. Within this context, the federal government should be closely examining how quality of education is related to human capital formation and accumulation. That is the focus of this paper, which addresses the following question: are public resources being allocated in Brazil in order to minimize lost? Children who benefit from *BF* may not be having the quality of education that they should be having. Scarce resources allocation may not being managed to minimize lost. These issues are extremely important for: 1) the management of scarce public resources; 2) the formation of human capital; and 3) the sustainability of BF, which is intended to continue for the next four years under President Roussef administration. This study uses panel data (2005 and 2007) to understand the relationship between student scores in math and Portuguese, public investments in education, and *BF* allocation. Results indicate that municipalities that are receiving BF funds do not present a good performance in tests scores. There is also some evidence that public spending in education affect tests scores; however these returns to education have very low coefficient magnitude.

KEYWORDS: Conditional cash transfer, Bolsa Família, Brazil, basic education, public investment, fixed effects

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1. INTRODUCTION

Brazil is currently in the headlines of international media because of its economic growth rates, and its investments in social development. In the context of the global economy, the BRIC countries (Brazil, Russia, India, and China) are growing in a higher rate than most of other countries, attracting many investors and new businesses to their territories. These growing economies, in the long run, are seen as the future developed countries. In addition to that, under President Lula leadership (2002-2010), social investments were a priority allowing many Brazilians who were under poverty to have a better quality of life. Clearly, these two facts should be seen as good news for the Brazilian economy. However, in between them, there should be included another dimension to make history more successful: the quality of education. In other words, fostering human capital should also be a priority for the Brazilian federal government. First, human capital would allow growth in a sustained and steady manner. Second, human capital would assure the beneficiaries of social investments would not only have more purchasing power, but also be part of the economy.

From the economic growth perspective, it is known that growth should go hand to hand with investments in human capital. Human capital plays an important role in the economic growth theory, and investments in education are considered the main ingredient to produce human capital accumulation. In many countries, governmental programs that focus on investments in basic education are proving to be effective to accumulate human capital.

Social spending promotes a more equitable income distribution because most government spending benefits the poorest. Programs based on conditional cash transfers have been a major focus of policies implemented by governments in developing countries. In Latin America, several countries like Colombia, Ecuador, Mexico and Brazil have implemented social programs of this kind to improve the quality of life of the poor and eliminate poverty trap observed in the poorest households. One such a program is the Bolsa Família (*BF*), being implemented in Brazil for almost a decade now. The Bolsa Família program has two goals: poverty reduction and social inequality minimization. It is based on direct cash transfer to poor families who agree to keep their children in school, and it also provides basic health care. According to data released by IPEA, *BF* has benefited 8.7 million families in 2005 at a cost of 550 million Reais. In 2010, approximately 12.8 million families were benefited at a cost of 1.2 billion Reais. Under the new President Dilma Roussef, the Brazilian government continues to allocate public resources for the *BF* program.

This paper has two objectives. First, to understand the relationship between quality of education, education-related spending, and *BF* cash transfer for Brazilian municipalities, during the period of 2004-2007. Second, to examine if scarce public resources are being allocate in an efficient and effective manner. The overall research question it attempts to answer follows: are public resources being allocated in Brazil in order to minimize losts? *Prova Brasil*, a national test administered by the Brazilian Minister of Education, is used to create a proxy for quality of education. The research hypothesis this paper focus on is as follows: if there is a coincidence of high BF allocation and higher scores in *Prova Brasil*, than the federal government is doing a good job in terms of public spending efficiency and effectiveness.

2. LITERATURE REVIEW

a) Education and Economic Growth

Various approches that demonstrate how education may affect economic growth can be found in the literature. First, some scholars (see Lucas, 1988; Mankiw, Romer, and Weil, 1992; Texeira and Fortura, 2004; Oketch, 2006; Fleisher, 2011) empirically showed that education fostered human capital, which increased labor productivity, and as a consequence, economic growth moved to a higher level. Second, various studies (see Nelson and Phelps, 1966; Lucas, 1988; Aghion and Howitt, 1998; Ranis Ramirez 2000; Wolff 2000; Lin 2003; Benhabib and Spiegel, 2005; Park, 2008) indicated that education boosted innovation capacity and new knowledge about technology, products, and processes, and led to growth. Third, "education can facilitate […] the spillovers and skill-based technical changes" (Fleisher, 2011, p. 89). This type of approach is well documented (see Acemoglu 1996 and 1998; Ciccone and Peri, 2006). All these studies lead to the statement that investments in education can be an important ingredient in the process of economic growth, being responsible for differences in levels of development between countries and regions.

These global differences can be illustrated by the work Hanushek and Wossmann (2007). They developed an international comparison showing that educational deficits were larger in developing countries, where programs mostly focused only on enrollment and attendance. Hanushek and Wossmann (2007) showed that there is a need to decrease the economic deficit among countries, and changes in the structure of educational institutions in developing countries should take place. They advocated that by using a simple analytical approach one can observe that educational levels vary drastically between developing and developed countries. They also stated that returns to investments in quality of education were even greater in developing countries than in developed countries.

Barro (1996) also contributed to this discussion. He used panel data for 100 countries from 1960 to 1990, and showed that for a given initial level of GDP per capita, growth rate was enhanced by a higher level of primary education. In another, Barro (2001) explored the importance of quality education to explain the development and economic growth. Barro's results indicated that quality of education measured by the knowledge of students on tests of cognitive abilities, were more important for the growth of the country than measures such as enrollment and attendance.

In the same direction, Baldacci et al (2007) explored the links between social spending, human capital and growth, and compared the effects of economic policy interventions. They used panel data for 118 developing countries in 1971-2000. Their study found that public spending on health and education was positive and significantly related to human capital, allowing for more economic growth.

Specifically focusing on the Brazilian context, Mello and Hoppe (2005) studied the evolution of public expenditure in education in Brazil, assessing the FUNDEF. The authors showed that, when compared to the OECD countries, Brazil spent a higher share to finance public education programs. They pointed out that despite high spending on education, the poor performance of students indicated a problem of quality. Indeed, international comparisons showed that some countries can achieve better outcomes than Brazil with lower public spending over time. However, as the author stated, these discrepancies could reflect a lack of efficiency. As empirical evidence suggested, quality, rather than the level of public expenditure, is a determinant of performance and more powerful strategy.

The studies presented above are part of the mainstream. However, there are studies in which the relationship between government spending on education and growth indicate different results. For instance, Blankenau and Simpson (2004) showed that even when public expenditure is an important tool for the production of human capital, these costs may not increase economic growth. Teles and Andrade (2007) showed that there is no consensus on empirical evidences with regards to the relationship between government spending on education and growth. For instance, on the one hand, a positive relationship was observed (see Cullison, 1993; Barro and Sala-i-Martin, 1999); on the other hand, Levine and Renelt (1992) concluded that government spending on public education is not robustly related to growth rates. Moreover, Judson (1998) and Vandenbussche et al. (2004) argue that the composition of human capital between basic and higher education is important to explain the relationship between human capital and economic growth.

b) Inequality and Cash Transfer Strategies

Soares et al (2006) evaluated the contribution of cash transfer programs for the observed decrease in inequality and poverty in Brazil between 1995 and 2004. The design of the incidence curve of the Bolsa Família (BF) reveals that the program is responsible for 21% drop in the Gini inequality. In addition, the study showed that 80% of total income going to the *BF* beneficiaries, goes to the population below the poverty line. Within the Brazilians in extreme poverty, 14% of the population was driven 48% of the total income of the *BF*. According to the authors, these statistics suggested that the BF is an income transfer program very well designed and implemented and proved to be particularly important for low-income families. However, Soares et al do not relate the BF program to quality of education, which would make it even better designed if it could improve human capital formation for these low income classes.

Lindert et al (2007) described *BF* considering its various aspects and processes of implementation. With respect to social inequality, the author found similar results as Soares et al (2006), showing that the program had a significant impact on reducing poverty and inequality. According to their study findings, BF is responsible for a significant portion of 20% to 25% of reduction in inequality, and 16% in the decline of extreme poverty. They suggested that BF incentives should go beyond school attendance, and provide incentives to incorporate degrees of learning, completion, and performance. Lindert et al (2007) stated that cash transfer programs are important, and should focus on breaking the poverty trap through links to education, which has proven to be a sustainable investment for growth and poverty reduction in the long term.

Table 1 showns various empirial studies that examined BF and also other cash transfer program from Latin American countries.

Table 1. Emproical Studies about BF and other cash tranfer program sin Latin America

Authors	Dependent Variables	Metodology	Data	Period	Importante Results
Skoufias e Parker (2001)	child labor and frequency	Diff-in Diff	Panel	2000	Increases in the frequency of students are accompanied by significant reductions in work activities.
Osório et al (2009)	Dropout and enrollment	Radon experiment	Panel	2003 and 2004	Increase in enrollment without reducing school attendance.

Barrientos e DeJong (2006)	Child poverty	Theoretical Analysis	-	-	The evidence suggests strongly that cash transfers are effective tools in reducing child poverty.
Schady e Araujo (2006)	Enrollment	Radon experiment	Panel	January to March 2005	Importance of conditionalities to explain most of the effect of the programs of conditional cash transfer in the school environment.
Haddad (2008)	Natural log of enrollment	Spacial Analysis	Panel	2003 and 2006	The resources allocated to the Bolsa Familia program contributed to greater social equality.
Bourguignon et al (2003)	Enrollment and poverty	Logit	PNAD	1999 to 2002	Increased enrollments and decreased little by poverty.
Kassouf e Glewwe (2008)	Enrollment and poverty	Fxed-effect panel	Panel of Censo Escolar	1998 to 2005	Bolsa Familia Program growth enrollment rates and adoption and decreased dropout rates.
Cardoso e Souza (2004)	Dropout school	propensity score e matching	Censo, PNAD e IBGE	1992 to 2000	Children who are not in school or at work or just work, start going to school or to work concurrently.
Ferro e Kassouf (2005)	Child labor	FGLS	PNAD	2001	Scholarship contribute to the reduction of 3 hours on average working hours of children 6 to 15
Pedrozo (2007)	Child labor	OLS in two steps	PNAD	2000	The inclusion of families in income transfer programs provides the reduction of child labor
Camelo, Tavares e Sainai (2009)	Nutrition and health	Propensity Score e Matching	PNAD, PNDS	2006	The PBF contributes to the households leaving the condition of mild food insecurity.
Vale et al (2010)	Dropout school ratio	Spacial Analysis	-	2000 to 2007	The income transfer programs, especially the Bolsa Familia, are important lever for poverty reduction.
Silva, Brandão e Dalt (2007)	Education and poverty	Enterviews	data from UFF	2008	Growth in enrollment and regular attendance of poor children to schools, the program generated benefits representative.
Tavares et al (2009)	Poverty and income inequality	Simulation	PNAD	2004	The success in targeting depends on the budget available in the states, as well as the efficiency of local selection.
Landin (2009)	Poverty and income inequality	First differences	Panel	1999 to 2006	Existence of positive program impacts on GDP growth per capita in the municipalities.

Romero e Hermetto (2009)	Dropout, enrollment, fail, child labor and schoolar attendance	RD *Sharp*	Panel	2004 and 2005	Improvement in dropout rates, approval and repetition. The school attendance in the last month, showed no significant difference.
Liso (2010)	School performance	First differences	Panel of Prova Brasil and Censo Escolar	2004 to 2007	Worsening of quality of teaching in public schools with enrollment increases impacted by the program.

3. METHODOLOGY

a) Variables

Table 2 displays all the dependent and independent variables to be use in the regressions. The descriptive statistics, i.e., mean standard deviation, minimum and maximum are included.

Table 2 .Descriptive Statistics of all Dependent and Independnet Variables

Variable	Year	Obsers.	Mean	Stand. Dev.	Min.	Max.
Dependent variables						
Natural log of Prova Brasil Math average score - 4th grade (Math_4)	2005 & 2007	10,143	5.21	0.10	4.87	5.68
Natural log of Prova Brasil Portuguese average score - 4th grade (Port_4)	2005 & 2007	10,221	5.13	0.10	4.78	5.54
Natural log of Prova Brasil Math average score - 8th grade (Math_8)	2005 & 2007	10,255	5.47	0.07	5.20	5.80
Natural log of Prova Brasil Portuguese average score - 8th grade (Port_8)	2005 & 2007	10,255	5.41	0.07	5.14	5.70
Independent variables of interest						
Ratio of amount invested in Bolsa Família - in Brazilian currency - divided by number of poor people (BF_poor)	2004, 2006 & 2000	10,981	51.14	77.90	0.02	3,527
Ratio of public spending with basic education divided by number of enrollment in basic education (Spend_edu)	2004 & 2006	9,447	1,313.70	682.91	0.17	8,899
Student-related control variables						
Proportion of students who took Prova Brasil whose family owns a car (Stud_car)	2005 & 2007	10,087	0.396	0.179	0	1
Proportion of students who took Prova Brasil who live in a place with internet access (Stud_int)	2005 & 2007	10,143	0.102	0.075	0	0.558

Proportion of students who took Prova Brasil and work (Stud_wor)	2005 & 2007	10,143	0.159	0.068	0	0.625
Proportion of mother -of students who took Prova Brasil - who attened 4th grade or higher (Mother_edu)	2005 & 2007	10,077	0.433	0.124	0	1
School-related control variables						
Proportion of publis schools in a municipality that have computer lab (Sch_comp)	2004 & 2006	10,222	0.174	0.224	0	1
Proportion of public schools in a municipality that have a library (Sch_lib)	2004 & 2006	10,218	0.308	0.315	0	1
Proportion of public schools in a municipality that offer snacks to students (Sch_snack)	2004 & 2006	10,222	0.974	0.056	0	1
Teacher-related control variables						
Proportion of teachers working in public schools with undergraduate degree (Teach_edu)	2004 & 2006	10,222	0.59	0.28	0	1
Ratio student to teacher in public schools (Stu_teach)	2004 & 2006	10,222	18.55	4.68	6.18	48.57
Average income of teachers with undergraduate degree who work in public schools at the basic education level (Teach_sal)	2004 & 2006	11,117	554.91	535.91	0	7,870
Municipality-related control variables						
GDP per capita (GDP)	2004 & 2006	11,117	7,676	9,053	1,064	216,844
FIRJAN health index (Health_Index)	2005 & 2007	11,108	0.74	0.13	0.34	1
FIRJAN education index (Income_Index)	2005 & 2007	11,108	0.40	0.16	0.03	0.99
Latitude of municipality (LAT)	-	11,121	-16.45	8.28	-33.69	4.60
Longitude of municipality (LON)	-	11,121	-46.22	6.43	-72.90	-34.8

Sources: Various databases from the Prova Brasil (2005/2007),Censo Escolar (2004/2006), FINBRA(2004/2006), FIRJAN (2005/2007), RAIS (2004/2006), Minitério do Desenvolvimento (2004/2006), Censo (2000).

b) Model Specification

The econometric approach aims to capture the relationship between quality of education, government spending on basic education, and the Bolsa Família Program, in the period of 2004-2007. Panel of Brazilian municipalities for the years 2005 and 2007 are used, according to *Prova Brasil* availability. The panel data approach allows the inclusion of some specific characteristics for each municipality that could influence *Prova Brasil* average scores. Examples of these characteristics could be public policies that motivate reading, community engagement in early childhood education, and other social factors that may influence, in some way, school performance. Knowing that municipalities may have specific characteristics that may influence their quality of education, these characteristics may affect the dependent variable. These characteristics

may be difficult to measure, but still, when estimating a simple panel ordinary least squares (POLS) without accounting for them, could lead to biased coefficients estimations. Therefore, this paper makes use of panel data with specific effects of municipalities. This micro-econometric technique can be used to obtain consistent estimators in the presence of omitted variables. If the presence of these unobserved omitted fixed variables is identified, and these omitted fixed variables are correlated with the explanatory variables, then the Fixed Effects model should be used. The fixed-effects model is showed below:

$$Y_{it} = \beta_1 BF_{it} + \beta_2 Spending_{it} + \beta_3 Student_{it} + \beta_4 School_{it} + \beta_5 Teacher_{it} + \beta_6 Municipality_{it} + C_i + U_{it}$$

Where:

Y_{it}, is the natural log of the students' average test proficiency in Brazil, representing the dependent variable of interest in the study, i.e. a proxy for quality of education;

BF_{it}, is the amount of Bolsa Família Program divided by the number of poor people in the municipalities, representing an explanatory variable of interest in the study;

$Spending_{it}$, is the amount spent on public basic education divided by total enrollment in public basic education in the municipalities, representing another variable of interest in the study;

$Student_{it}$, which is the vector of control variables with characteristics of the students in municipalities, extracted from *Prova Brasil*;

$School_{it}$, which is the vector of control variables with characteristics of schools by municipalities, extracted from *Prova Brasil*;

$Teacher_{it}$, which is the vector of control variables with characteristics of public school teachers by municipalities;

$Municipality_{it}$, which is the vector of control variables with socio-economic characteristics of municipalities;

C_i, corresponds to the specific (fixed) effects of each municipality;

U_{it}, the error term.

The estimations in this paper, using the statistical software Stata, use the regressions of fixed-effects model with robust analysis, along with Breush Pagan and Hausman tests. The Breush Pagan test helps to identify if there are specific effects that the POLS does not capture. The Hausman test helps to identify if these specific effects are random, or fixed. The estimation results are presented in the next section.

4. ESTIMATION RESULTS

The results of the regressions that examine the relationship between the quality of education and government spending with education and Bolsa Família Program are

presented using two models of estimation. Table 3 displays the results of a simple regression of ordinary least squares for panel data (POLS). Table 4 presents the findings using the fixed-effect model. It is important to highlight that all coefficients that were estimated do present a very low value of magnitude.

Table 3. Results of natural log of Prova Brazil average scores estimated by Pooled OLS

	POLS			
Dependent variables	Math_4	Port_4	Math_8	Port_8
Independent variables of interest				
BF_poor	-0.000041***	0.000006	0.000002	-0.000009
	(0.000)	(0.000)	(0.000)	(0.000)
Spend_edu	0.000012***	0.000001	0.000000	0.000001
	(0.000)	(0.000)	(0.000)	(0.000)
Student-related control variables				
Stud_car	0.009729	0.076822***	0.073498***	0.009375**
	(0.007)	(0.006)	(0.005)	(0.005)
Stud_int	0.137893***	0.033624**	0.056136***	0.095154***
	(0.015)	(0.013)	(0.008)	(0.008)
Stud_wor	-0.280513***	-0.277974***	-0.026950***	-0.062874***
	(0.012)	(0.011)	(0.006)	(0.006)
Mother_edu	0.008067	0.028540***	0.005735	0.026747***
	(0.007)	(0.006)	(0.005)	(0.005)
School-related control variables				
Sch_comp	0.007327*	0.031383***	-0.012690***	-0.008566***
	(0.004)	(0.004)	(0.003)	(0.003)
Sch_lib	0.010576***	0.019295***	0.036048***	0.027612***
	(0.003)	(0.002)	(0.002)	(0.002)
Sch_snack	0.051862***	0.025366**	-0.009574	-0.004266
	(0.014)	(0.012)	(0.010)	(0.009)
Teacher-related control variables				
Stud_teach	-0.001230***	-0.000575***	-0.001218***	-0.000626***
	(0.000)	(0.000)	(0.000)	(0.000)
Teach_edu	0.056086***	0.025423***	0.029167***	0.033269***
	(0.004)	(0.003)	(0.003)	(0.003)
Teach_sal	0.000000	-0.000001	0.000001	0.000001
	(0.000)	(0.000)	(0.000)	(0.000)
Municipality-related control variables				
GDP	-0.000000*	-0.000000	-0.000000	-0.000000
	(0.000)	(0.000)	(0.000)	(0.000)
Health_Index	0.106075***	0.079047***	0.051171***	0.050777***
	(0.010)	(0.009)	(0.007)	(0.007)
Income_Index	-0.003662	0.035998***	0.005344	0.011786***
	(0.006)	(0.006)	(0.005)	(0.004)
LAT	-0.003036***	-0.003088***	-0.001731***	-0.001821***
	(0.000)	(0.000)	(0.000)	(0.000)
LON	-0.000468***	-0.000499***	-0.000811***	-0.000904***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	5.010696***	4.941999***	5.341241***	5.272176***
	(0.016)	(0.015)	(0.012)	(0.011)
Observations	9,227	9,295	9,386	9,386
R-squared	0.512	0.556	0.503	0.463

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

From Table 3 one can observe a negative and significant relationship (*p*-value = 0.01) only between *BF_poor* and *Math_4* showing that this explanatory variable negatively affects the math average score for 4th grade. When considering *Spend_edu*, there is a positive relationship only with *Math_4* (*p*-value = 0.01).

When focusing on student-related control variables, *Stud_car* shows a positive and significant relationship with *Port_4*, *Math_8* (*p*-value = 0.01), and *Port_8* (*p*-value = 0.05). *Stud_int* presents a positive and significant relationship with *Math_4*, *Math_8*, and *Port_8* (*p*-value = 0.01), and *Port_4* (*p*-value = 0.05). These findings show that the higher the economic status of students, the higher their scores. With regards to *Stud_wor*, negative and significant (*p*-value = 0.01) relationships with *Math_4*, *Port_4*, *Math_8*, and *Port_8* are observed. Assuming that BF program was created to eliminate child labor, these findings are intriguing because 4th grade children should not be working. In addition, to make things worse, when they work, working activities negatively affect their scores. *Mother_edu* has a positive and significant (p-value = 0.01) relationship with *Port_4*, and *Port_8*. This indicates that the higher the level of the mother's education, the higher the probability of children doing a better job in school.

For school-related control variables, *Sch_comp* has a negative relationship (*p*-value = 0.01) with *Math_8*, and *Port_8*; and a positive sign when the dependent variable are *Port_4* (p-value = 0.01), and *Math_4* (p-value = 0.1). These mixed results may be related to children maturity to work with computers; older children may be more disperse when in front of a computer, looking for other issues rather than courses-related materials. When observing the relationship of *Sch_lib*, it has a positive (p-value = 0.01) relationship with *Math_4*, *Port_4*, *Math_8*, and *Port_8*. Logistic of schools, such as the existence of libraries, is important factor to improve scores. The variable *Sch-snack* shows a positive relationship with *Math_4* (p-value = 0.01) and *Port_4* (p-value = 0.05), indicating that good nutrition improves scores for younger children.

Considering teacher-related control variables, *Stud_teach* shows a negative (p-value = 0.01) relationship with *Math_4*, *Port_4*, *Math_8*, and *Port_8*. These findings may indicate that, in the Brazilian context, smaller classroom would be more efficient to improve students' scores. *Teach_edu* has a positive and significant (p-value = 0.01) relationship with *Math_4*, *Port_4*, *Math_8*, and Port_8. The higher the education level of teachers, the better will be students' performance in tests. *Teach_sal* shows no significant relationship with any of the dependent variables included in the analyses. This is confirmed by the Brazilian literature with regards to teacher salary (Menezes, 2007): only private schools show significant relationships between students' performance, and teachers' salaries. This may be an opportunity to be explored in the future if the public sector is willing to award better teachers.

The municipality-related control variables are now analyzed. *GDP* shows a negative relationship with *Math_4* (p-value = 0.10) with a very low coefficients` magnitude. The *Health_Index* shows a positive relationship (p-value = 0.01) with *Math_4*, *Port_4*, *Math_8*, and *Port_8*. The healthier children from a municipality are, the better they do in school. *Income_Index* shows a positive and significant (p-value = 0.01) relationship with *Port_4* and *Port_8*. The higher the economic status of a municipality, the better their students do in Portuguese tests. The inclusion of variables that represent the municipalities' cardinal coordinates, i.e. latitude and longitude, is a strategy to capture geographic location, which can be interpreted as an alternative to capture observed specific characteristics of a municipality. *LAT* and *LON* show a negative and significant (p-value = 0.01) relationship with *Math_4*, *Port_4*, *Math_8*, and *Port_8*. These results especially show that as one moves from the north of Brazil to the south, test scores improve. In the same way, as one moves from the east of Brazil to the west, test scores improve.

After estimating the POLS, the Breush Pagan and Hausman tests were performed. First, the Breush Pagan indicated that the null hypothesis of non existence of specific effects

was rejected. There are indeed specific effects in the dataset. Second the Hausman test showed that the fixed-effects are better specification than the random-effects for the dataset used in this paper.

Table 4. Results of natural log of Prova Brazil test scores estimated by fixed-effect

	LSDV			
Dependent variables	Math_4	Port_4	Math_8	Port_8
Independent variables of interest				
BF_poor	-0.000078***	-0.000019	0.000003	-0.000013
	(0.000)	(0.000)	(0.000)	(0.000)
Spend_edu	0.000022***	-0.000002	0.000004*	0.000008***
	(0.000)	(0.000)	(0.000)	(0.000)
Student-related control variables				
Stud_car	-0.090742***	-0.002164	0.028458***	-0.023025***
	(0.011)	(0.010)	(0.007)	(0.007)
Stud_int	0.207426***	0.012460	0.009985	0.072507***
	(0.020)	(0.018)	(0.010)	(0.010)
Stud_wor	-0.173554***	-0.150687***	-0.061496***	-0.093164***
	(0.016)	(0.014)	(0.008)	(0.008)
Mother_edu	0.080213***	0.064451***	0.077389***	0.068714***
	(0.010)	(0.009)	(0.007)	(0.007)
School-related control variables				
Sch_comp	-0.020972***	0.019310***	0.002023	0.005839
	(0.007)	(0.006)	(0.004)	(0.004)
Sch_lib	-0.005902	0.010339***	-0.020543***	-0.017078***
	(0.004)	(0.004)	(0.003)	(0.003)
Sch_snack	0.066934***	-0.013548	0.002559	0.003287
	(0.022)	(0.019)	(0.014)	(0.014)
Teacher-related control variables				
Stud_teach	-0.001298***	-0.000574	0.000507*	-0.000018
	(0.000)	(0.000)	(0.000)	(0.000)
Teach_edu	0.071485***	0.001739	0.014458***	0.031965***
	(0.007)	(0.007)	(0.005)	(0.005)
Teach_sal	0.000007**	-0.000002	-0.000003*	0.000000
	(0.000)	(0.000)	(0.000)	(0.000)
Municipality-related control variables				
GDP	0.000001***	-0.000000	-0.000000***	-0.000000
	(0.000)	(0.000)	(0.000)	(0.000)
HEALTH_Index	0.110749***	0.007522	0.005562	0.023957*
	(0.020)	(0.018)	(0.013)	(0.013)
INCOME_Index	-0.033951***	-0.024210**	-0.004385	-0.004902
	(0.011)	(0.010)	(0.007)	(0.007)
Constant	5.038721***	5.153627***	5.430429***	5.363018***
	(0.030)	(0.027)	(0.019)	(0.019)
Observations	9,227	9,295	9,386	9,386
R-squared within	0.340	0.052	0.087	0.200

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results from the fixed-effect regressions show a negative and significant relationship only between *BF_poor* and *Math_4* (same as POLS results). This finding does not contribute to the sustainability of BF since what is expected for the relationship is a positive and significant one, indicating that poor children are attending good quality schools. On the contrary, these findings indicate that BF beneficiaries are not having good education as they should, if human capital formation and accumulation needs to be taking place in Brazil. When considering *Spend_edu*, there is a positive relationship between *Math_4* and *Port_8* (p-value = 0.01). *Math_8* is also positive and significant (p-value = 0.10). When compared to POLS results, one can observe that more tests scores are positive related to spending. These findings confirm what the literature says

with regards to spending in education. Brazil is experiencing the stage in which there is still a positive outcome when investing in education.

From the student-related control variables, *Stud_car* only shows a positive and significant (p-value = 0.01) relationship with *Math_8*. When the dependent variables are *Math_4* and *Port_8*, *Stud_car* has a negative and significant relationship with them (p-value = 0.01). This change from positive in POLS to negative in fixed-effects may be explained by the fact that public schools may not be delivering the quality of education that higher economic status students should be expected to get. When considering *Stud_int*, this variable presents a positive and significant (p-value = 0.01) relationship only with *Math_4* and *Port_8*. This change in number significances from four in POLS and two in fixed-effects may be explained by the same reason stated above.

The control variable *Stud_wor* shows a negative and significant (p-value = 0.01) relationship with *Math_4*, *Port_4*, *Math_8*, and *Port_8* (same as POLS). As expected from the literature, students who work outside their houses have a lower proficiency in school. In this specific regression, for 4th grade, when the ratio of students working outside home increases by 1%, the average math scores decrease by 15% in Portuguese and 17% in math. The variable *Mother_edu* has a positive and significant (p-value = 0.01) relationship with *Math_4*, *Port_4*, *Math_8*, and *Port_8*. One can observe an increase from two significances in POLS to all four in fixed-effects. These finding are in accordance with empirical literature showing that mothers' education is one of the most important variables to explain the higher students' proficiencies. For instance, the 4th grade math regression, an increase of 1% in *Mother_edu*, there is an increase of 8% in the mean test.

For school-related control variables, *Sch_comp* has a negative relationship (p-value = 0.01) with *Math_4*, and a positive (p-value = 0.01) relationship when the dependent variable is *Port_4*. When comparing POLS and fixed-effects many changes happened. These results go in the same direction as Menezes-Filho (2007) findings. He stated that the digital inclusion in schools is still an unclear independent variable in literature of education. Menezes-Filho (2007) results showed that the presence of computers for students, and school staff has a little impact on students' proficiency and the sign varies: they are occasionally positive, and sometimes negative.

When analyzing the relationship between *Sch_lib* and the dependent variables, this school-related control variable has a positive (p-value = 0.01) relationship when the results for *Port_4* are observed. However, *Sch_lib* shows a negative (p-value = 0.01) relationship with *Math_8*, and *Port_8*. In the POLS all four were positive and significant as expected. In the fixed-effects the observed changes in signs and significance may be explained by municipal administration of libraries. They may not be doing a good job and this may be affecting students' tests scores. The variable *Sch-snack* has a positive (p-value = 0.01) relationship with *Math_4*. The lost of significance in *Port_4* may be explained by inefficiency in delivering meals from students.

Considering teacher-related control variables, *Stud_teach*, as expected, it shows a negative (p-value = 0.01) relationship with *Math_4*. This same control variable is positive related with *Math_8* (value = 0.10). In the POLS all four were negative and significant. When specific unobserved characteristic of the municipalities were included, changes were observed. This can be explained by the idea that as students get older, class size may not be so relevant to their performance. The *Teach_edu* variable shows a positive and significant (p-value = 0.01) relationship with *Math_4*, *Math_8*, and

Port_8. *Teach_sal* shows a positive (p-value = 0.05) relationship with *Math_4*. *Teach_sal* is negative related to *Math_8* (p-value = 0.10).

Finally, the municipality-related control variable *GDP* shows a positive relationship with *Math_4* (p-value = 1%), and a negative relationship with Math_8 (p-value = 0.01). *Health_Index* shows a positive relationship with *Math_4* and also with *Port_8* (p-value = 0.10). *Income_Index* shows a negative and significant (p-value = 0.01) relationship with *Math_4* and *Port_4*.

5. FINAL REMARKS

Based on the findings from the previous section, a few conclusions can be addressed. First, municipalities that are receiving BF do not seem to have good quality of education, when using Prova Brasil as a proxy for that. This may indicate that Bolsa Família is not a sustainable social program. It is indeed increasing enrollment, diminishing inequalities in the country, but it is not contributing to the formation of human capital as it should. Efforts between the ministries of education and social development to allocation resources should be done in a more coordinated manner. What one should expect is that low income families, who are the beneficiaries of BF, should be having good education to participate in the economy, and not just be waiting for the federal check to com to their pockets.

Second, public spending in education shows a positive effect when controlling for specific characteristics of municipalities, however the coefficients have very low magnitudes. This may indicate that returns for education do exist in the Brazilian context, but not so strong as some studies have demonstrated. Future studies should address the current programs that the federal governments is implementing to improve quality of education. The focus should be more qualitative and at the municipal level.

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