More money, more quality? Impact of an unconditional transfer on approval rates, national exam results and IDEB

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July, 2015

Abstract

This paper estimates the impact of a compulsory transfer from central to local governments on the official index of basic education quality, IDEB, and on the variables that compose the index : passing rate and scores on a standardized exam. The identification hypothesis uses a rule of a federal transference to municipalities according to population brackets, which ensures an exogenous variation on the estimation of a Regression in a Discontinuity Design (RDD). The results indicate that the transfer has positive effects on IDEB of first cycle primary schools, especially on second grade passing rate, but also on mathematics and Portuguese scores.

Keywords: fiscal federalism, public spending, education outcomes, school accountability
JEL-Classification: H52, H77, I22, I28.
Anpec Classification: Area 5 - Economics of the public sector.

Resumo

Este artigo estima o impacto de uma transferência obrigatória do governo central para os governos locais sobre o indicador da qualidade da educação básica nesses municípios, o IDEB, e sobre as variáveis que compõe o índice: taxa de aprovação e notas em um exame padronizado. A hipótese de identificação explora uma regra de transferência federal para os municípios de acordo com faixas de população, o que garante uma variação exógena para a estimação de uma regressão em um design de descontinuidade (RDD). Os resultados indicam que a transferência tem efeitos positivos sobre o IDEB do primeiro ciclo, especialmente sobre a aprovação no segundo ano, mas também sobre as notas em matemática e Português.

Palavras-chave: federalismo fiscal, gastos públicos, desempenho educacional, accountability
Classificação JEL: H52, H77, I22, I28.
Classificação Anpec: Área 5 - Economia do setor público.

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1 Introduction

In recent years, the debate on the need to increase public spending on education was intensified in Brazil. This defense based the approval of National Education Plan (PNE - PL 8035/10) by National Congress, which states that the spending on education, as a percentage of the GDP, will be at least 10% in ten years (Law 13005, 2014). There is controversy, however, if the increase on education spending is sufficient to increase its quality. On the other hand, federal government publicly released in 2007 a standard national index for the basic education accountability, IDEB[1], calculated for all Brazilian elementary schools and also for the municipal public schools jointly. The index is calculated from the passing rate and the scores of students in a national exam, Prova Brasil (Fernandes, 2007).

There is little evidence on significant effects of public spending on IDEB. Menezes-Filho and Amaral (2008), for example, used panel data of Brazilian municipalities to estimate this effect, but the identification hypothesis was not robust to estimate a causal impact. In general, the endogeneity issues hinders the determination of the causal effect. Our paper is the first to examine the effect of public spending on IDEB using a Regression Discontinuity Design - RDD. Our methodology consists in analyzing the effect of a federal transfer to municipalities, FPM[2], which is done according to certain population brackets and generates exogenous variations on local expenditures near the thresholds. There are several evidences, using RDD method, that FPM impacts on local social spending, especially on education and health (Brollo et al, 2013; Arvate et al, 2013).

FPM is distributed according to a compulsory and unconditional transfer rule, that is, the transfer is done monthly in an automated manner and the transfer is not conditioned to any specific destination. At first, the municipality share on FPM fund depends on factors that can not be influenced by politicians (Finance Ministry, 2012a). This legal distribution rule provides an exogenous variation on certain population groups, allowing the identification of the causal impact of the transfer on education quality in cities near the thresholds. Thus, we use a Regression Discontinuity Design (RDD) to identify the causal effect of the transfer on student outcomes.

Litschig and Morrison (2013) is the most close to us. The authors use the same discontinuity rule to analyze the effects of FPM on education over 1982-1985, when the rule was a bit different from the present. From the 1980 and 1981 census data, plus information on municipal finances, the authors estimate a positive effect on literacy rate and years of schooling due to one thousand reais per capita transferred. The authors argue that more budget expenditures may result on higher quality of education, through increased spending on education, but also by spending on areas such as health, child education and transportation - which may indirectly impact on student cognitive capacity. Healthier children, for example, have better conditions to have a good academic performance. A good public transportation system, on the other hand, can reduce the cost of access to school.

Public basic education in Brazil is funded in different ways. The vast majority of schools of this level are municipal, funded through the budget of the municipalities, either through local taxes, or through transfers from federal entities, such as Fundo de Desenvolvimento da Educação Básica e Valorização do Magistério[3] (FUNDEB) and FPM

[1] Índice de Desenvolvimento da Educação Básica, in Portuguese.
[2] Fundo de Participação dos Municípios, in Portuguese.
[3] Fund for Basic Education Development and Teaching Enhancement, in Portuguese.

(Oliveira and Santana, 2010). In general, public finance literature points to the need for decentralization of education spending because local governments have more condition to assess local population demands. In addition, it is considered that the expenses of different cities among different social areas depend on the preference of each electorate (Tiebout, 1956).

Many empirical studies do not find positive significant effect of per student spending on performance measured by standardized tests (Menezes-Filho and Amaral, 2008; Chaudhary, 2009). However, these results do not show conclusively that per student spending does not affect student achievement. Joint deployment of different policies within an educational sphere may cause adverse impacts. Thus, the simple increase on per student spending does not guarantee better performance because this effect depends on the combination of various inputs and practices adopted (Hanushek, 1989).

In Brazil, most studies coincide with the international literature that highlights the family background as the major determinant of years of schooling and cognitive learning (Barros et al, 2001; Menezes-Filho and Amaral, 2008; Diaz, 2012). Diaz (2012) does not find impacts of municipal education spending on 2005 IDEB (Basic Education Development Index), as Menezes-Filho and Amaral (2008), who also use 2007 and 2009 IDEB. Using a quantile regression, the authors find that cities that benefit from spending increases are those with higher fourth grade scores. Barros et al (2001) shows that family background is correlated with the average schooling in years of study. Furthermore, the author finds evidence of a negative relationship between labor market attraction and years of schooling. The quality of educational services do not seem to explain school attendance. Menezes-Filho and Pazello (2004), in turn, estimate a significant impact of a 90 decade educational transfer on proficiency, and there is indirect evidence that this occurred due to school and teacher improvements.

We describe in the next section the data used in the regressions. We resume in section 3 the theoretical literature on school performance determinants and we suggest a simple model to interpret the estimated effects. Section 4 introduces the strategy to be adopted to identify the causal effect of FPM on IDEB and details the equations to be estimated. Section 5 analyzes the validity of the assumptions necessary for causal identification. In section 6 we analyze in detail the results and in section 7 we make the closing remarks.

2 Database

We use information about FPM shares of Brazilian municipalities with up to 30,000 inhabitants in 2005, 2007, 2009 and 2011 available on Finance System of Brazil (FINBRA) - Accounting Data of Municipalities, of National Treasury Secretariat (STN). The municipalities declare independently expenditures on different functions and the amounts of FPM received to a federal bank, while National Treasury Secretariat (STN) compiles such information. We update the values in reais (R$) to January of 2014 using the official rate of inflation - IPCA[4], calculated by the federal institute of statistics, IBGE[5].

Supplementary Law No. 91 of 1997 established a formula applied to the FPM transfers for part of the municipalities, the financial reducer, which was calculated from 2000 to 2007. The FPM is transferred according to municipal population brackets, but municipalities that lost population in the 90s had their transfers unchanged. The reducer gradually

[4]Índice Nacional de Preços ao Consumidor Amplo, in Portuguese.

[5]Instituto Brasileiro de Geografia e Estatística, in Portuguese.

adjusted the FPM distributed to those municipalities to the annual population estimated by the IBGE.

We also use the federal government official index for basic education accountability, IDEB, calculated for the municipal elementary schools. The index, released in 2007 by Ministery of Education to assess the quality of brazilian basic schools, is calculated separately for the first cycle, corresponding to the current first grade to the fifth of primary education, and for the second cycle, extending from the sixth grade to the ninth. We also analyze the impact on two variables that compose the index: the passing rate and the average scores on Portuguese and Mathematics in Prova Brasil exam, evaluation created in 1995 under the basic education evaluation system, SAEB[6]. This test is applied every 2 years to all students of the fifth and ninth grades, and follows the Item Response Theory (IRT), making possible to monitor the progress of municipal public schools over the years. The IDEB for each school is calculated by multiplying the performance indicator (indicator constructed from the passing rate) by the average score of the grades evaluated in Prova Brasil[7]. The IDEB was calculated for the years 2005, 2007, 2009 and 2011.

However, there is evidence that this is not a good indicator of the education quality offered by the school, the school-effect, because the index is quite correlated with the socioeconomic characteristics of the students' families (Soares and Alves, 2012, 2013; Portela and Curi, 2012). Thus, its utility as a form of accountability and encourage competition between schools is limited (Alves and Soares, 2013). We must consider that the indicator represents the interaction between various factors that affect learning, such as family background and the characteristics of schools and education management in a city.

3 Basic model of learning

The empirical evidences for Brazil point to a great importance of the students' families conditions on IDEB results. On the other hand, there are situations in which schools contribute to student cognitive achievement by providing appropriate conditions and incentives for learning (Soares and Alves, 2013).

Theoretical models in education consider that cognitive learning can be expressed as a function of school characteristics and socioeconomic conditions of students' families (Cunha, Heckman and Schennach, 2010; Carvalho Filho and Litschig, 2013). The distribution of these variables over the schools reveals a synthetic picture of education in a municipality (Epple and Romano, 1998).

We consider a simplified model in which cognitive achievement is a function of schools and students' families background:

$$IDEB = q(S(s, \frac{G_i}{p_i}, \nu), B(f, \frac{G_{-i}}{p_{-i}}, \eta))$$

IDEB score of municipal elementary schools is given by q, a function relating the inputs of education to cognitive proficiency in a given municipality. $S(s, \frac{G_i}{p_i}, \nu)$ determines the impact of public school resources on IDEB. s is a vector of variables that affect the quality of school teaching and can not be influenced by the government, such as the organization

[6]Sistema de Avaliação do Ensino Básico, in Portuguese.

[7]More information on the calculation of IDEB can be found in Fernandes (2007).

of teacher unions and the technology available for teaching. p_i is the cost of school resources, as teacher wages, and G_i is the municipal expenditure on education. $\frac{G_i}{p_i}$ is the supply of educational resources, as school physical infrastructure and qualified teachers. ν is a idiosyncratic term of teaching quality offered by the municipality, not correlated with the other variables.

$B(f, \frac{G_{-i}}{p_{-i}}, \eta)$ is a function relating family characteristics and IDEB. f is a vector that summarizes the city social and economic conditions that are not influenced by the mayors, as macroeconomic conditions of all the country. $\frac{G_{-i}}{p_{-i}}$ represents all municipal expenditures in real terms not made on education, which can directly influence the families and impact on academic achievement capacity, such as spending on health. η is a idiosyncratic term of local socioeconomic conditions, not correlated with the other variables.

For simplicity, we consider that expenditures are made on education and health. The analyses can be directly extended to more functions. A simplified local budget constraint can be expressed as $G = \sum G_j = G_i + G_{-i} = I + T$, where I is the sum of municipal taxes and fees and T is the amount of FPM transferred. We consider a linear specification for the education production function and that q is a identity function:

$$S(s, G_i, \nu) = \delta_0 + \delta_1 s + \delta_2 \frac{G_i}{p_i} + \nu$$

$$B(f, G_{-i}, \eta) = \gamma_0 + \gamma_1 f + \gamma_2 \frac{G_{-i}}{p_{-i}} + \eta$$

δ_2 and γ_2 are indicators of spending efficiency on education and health systems, respectively, in terms of impacts on IDEB. The index of local public education, IDEB, can be expressed as:

$$IDEB = \delta_0 + \gamma_0 + \delta_1 s + \gamma_1 f + \delta_2 \frac{G_i}{p_i} + \gamma_2 \frac{G_{-i}}{p_{-i}} + \nu + \eta$$

We consider an exogenous variation on FPM transfer, T, and that spending on function i can be expressed as a function of this transfer: $G_i = \beta_0 + \beta_i T$. β_i is correlated with local preferences for goods of function i, which should be a function of δ_2 in a more general framework. IDEB can be rewritten as:

$$IDEB = \Theta + \Gamma + \varphi T$$

Where $\Theta = \delta_0 + \gamma_0 + (\frac{\delta_2}{p_i} + \frac{\gamma_2}{p_{-i}})\beta_0$, $\Gamma = \delta_1 s + \gamma_1 f$ and $\varphi = \frac{\delta_2 \beta_i}{p_i} + \frac{\gamma_2 \beta_{-i}}{p_{-i}}$

We estimate the effect of an exogenous variation of T on IDEB as:

$$E(IDEB|G = I + T) - E(Q|G = I) = (\frac{\delta_2 \beta_i}{p_i} + \frac{\gamma_2 \beta_{-i}}{p_{-i}})T$$

The impact of FPM on IDEB depends on two channels. The first corresponds to the effects on the quality of teaching. The effect of education spending on school quality is summarized by the parameter δ_2, weighted by the cost of goods in education, p_i, and the additional amount invested in education is givens by $\beta_i T$.

On the other hand, additional FPM increases spending on other social areas. The impact of public health provision on student learning capacity is expressed as γ_2 and β_{-i} is the electorate preferences for health services. In a more general setting, the parameters of education production function must be non-linearly related, which implies interactions between school and family effects, as well as between spending on different functions.

4 Econometric Methodology

The methodology used to estimate the causal effect of an involuntary and unconditional transfer, FPM, on local public education, measured by IDEB, uses the legal rule of transference according to population brackets. We argue that this legislation ensures a random variation of FPM near the thresholds, which prevents the pre-selection of municipalities or rule deviations.

There is some evidence of population manipulation (Monasterio, 2013), but this possibility, made legally or not by local politicians or government bureaucrats, is limited and marginal, ensuring the RDD estimation (Lee and Lemieux, 2010). Municipalities can receive more FPM if the population grow enough to change the population brackets stipulated by the law. More than that, the population is estimated based on population growth estimated by IBGE, which depends on the variation between the two previous population counts (IBGE, 2013). So, the ability of actual politicians manipulate population growth is very low and, principally, not complete, which validate the RDD estimations (Lee and Lemieux, 2010). In order to exclude this limited possility of influence, we perform regressions with fixed effects, using a panel of municipalities over the years, to use the continuous variation of population over the years as the forcing variable of FPM variation.

This quasi-natural experiment allows us to asses whether more money available to municipalities in fact causes an improvement on the quality of education. An ordinary regression indicates only correlation between the variables and may hide other variables correlated with the size of population - for example, per capita income or the competition between schools. We consider that these correlations can be approximated by continuous functions in cities with similar populations.

The increase of population to a point above the thresholds provides a significant increase on per capita FPM received by these municipalities. The real effect of FPM per capita on IDEB is equal to the potential IDEB when the city do not have the money plus the IDEB difference relative to when the city receives the transfer. The identification problem is that we do not observe the potential effect of treatment for all municipalities, but only for the treatment group. Thus, we can not guarantee, in a regression with all municipalities, the balancing of potential effects, on average, between the treatment and control groups .

The only factor that determines the change on transfers outlined in this paper is the city population. Whereas transfers follow a continuous distribution conditional on local population, unless exceptionally in the thresholds, the effect can be estimated by a regression of the transfer on IDEB in a vicinity of the thresholds, that are 10,189; 13,585; 16,981 and 23,773 inhabitants. The population rule is not the only variable used for FPM transfer, so the instrument effect is heterogeneous among municipalities - basically, it also depends on the state to which the municipality belongs.

In order to compare the effectiveness of FPM Legislation, we calculate, for each municipality, the amount that should have been transferred following the established rules, the theoretical FPM. This value depends on four variables: the total for the FPM in Brazil; the state coefficient, according to the Court's resolution (TCU) No 242/90; the county coefficient, established by Decree Law No. 1,881 / 1981; the sum of the coefficients of state's municipalities; and the financial reducer which lasted until 2007, determined by Complementary Law No. 91/1997 (Ministry of Finance, 2007). The total for the FPM corresponds to 23.5% of Income Tax and Excise Tax[8] collected by the Union. 86.4% of this total are destined to municipalities of the interior and with population fewer than 142,633 inhabitants, and the remaining amount is distributed between the capitals and cities with more than 142.633 inhabitants (Ministry of Finance, 2012a). The reducer is applied to a portion of the municipalities which were identified as population size lower than had been estimated on 1996 IBGE Population Count (Ministry of Finance, 2012b).

We implement RDD through a 2nd Stage Least Squares Regression (2SLS), wherein the theoretical FPM is used as the instrument in the first stage, as performed in Brollo et al(2013), following the methodology exposed in Angrist and Lavy (1999). Following this approach, we present estimates using Ordinary Least Square (OLS), and also using the panel regressions in Fixed Effects. The estimation of the RDD in a fuzzy design can be consistently estimated using 2SLS (Imbens and Lemieux, 2007; Angrist and Lavy, 1999). The 2SLS regression ensures efficient estimation if some assumptions about the distribution of standard deviations is attended (Wooldrigde, 2002).

In the first stage, we regress the value of FPM per capita declared by the mayors on theoretical FPM per capita, that is, the value that should have been transferred if there were no deviations from the rule. The specification of the first stage can be described as:

$$FPM = \pi_0 + \pi_1 FPMteorico + \pi_2 g_n(pop) + v$$

All the variables were taken into logaritmos. $\pi's$ are coefficients to be estimated. $g_n(pop)$ is a polynomial of degree n of the local population and FPMteorico is the FPM calculated to be distributed to the municipality, according to the legal rules. The second stage checks the impact of FPM per capita estimated on the first stage, FPM *, on school performance measured by IDEB:

$$IDEB = \alpha_0 + \alpha_1 g_n(pop) + \alpha_2 FPM^* + u$$

where the dependent variable is IDEB or one of its components: passing rates and scores in Portuguese and mathematics in a national exam. $(FPM)^*$ is the per capita amount provided by the first stage and α_2 is the estimated coefficient of interest. All variables were log-transformed, with the exception of theoretical FPM and the population polynomial. Estimator variances are clustered by municipality and corrected to the generated estimator.

We use a 2SLS specification with Fixed Effects as a robustness test, to explore the variation of treatment status over the years, as local politicians can not completely control population growth, validating RDD estimations (Lee and Lemieux, 2010). We estimate regressions using a 500 inhabitants windows around the thresholds and a 2 degree population polynomial. We performed additional specifications where we consider variations on the estimation windows and on the population polynomial degree, but the results overall were very similar and were omitted.

[8] Imposto de Renda (IR) and Imposto sobre Produtos Industrializados (IPI), in Portuguese.

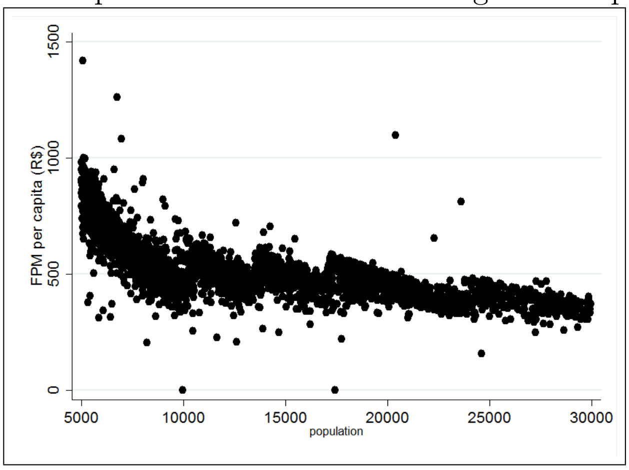
5 Testing the identification hypothesis

5.1 FPM transfer rule

The main hypothesis of identification is that FPM transferred to Brazilian cities may be considered exogenous in certain ranges aroun the population thresholds. Assuming that the variables correlated with the FPM and the quality of education follow continuous distributions over the thresholds, and so are balanced compared to the instrument change, the local impact of FPM can be estimated using the IDEB variation in these regions (Imbens and Lemieux, 2007).

Figure 1 shows the FPM per capita discontinuities on population thresholds. Smaller cities are most dependent on FPM because the larger cities have a higher potential of own revenue, through municipal taxes. In addition, as the population coefficients are constants within each band, cities with smaller population within each group receive more per capita FPM.

Figure 1: Per capita FPM received according to local population



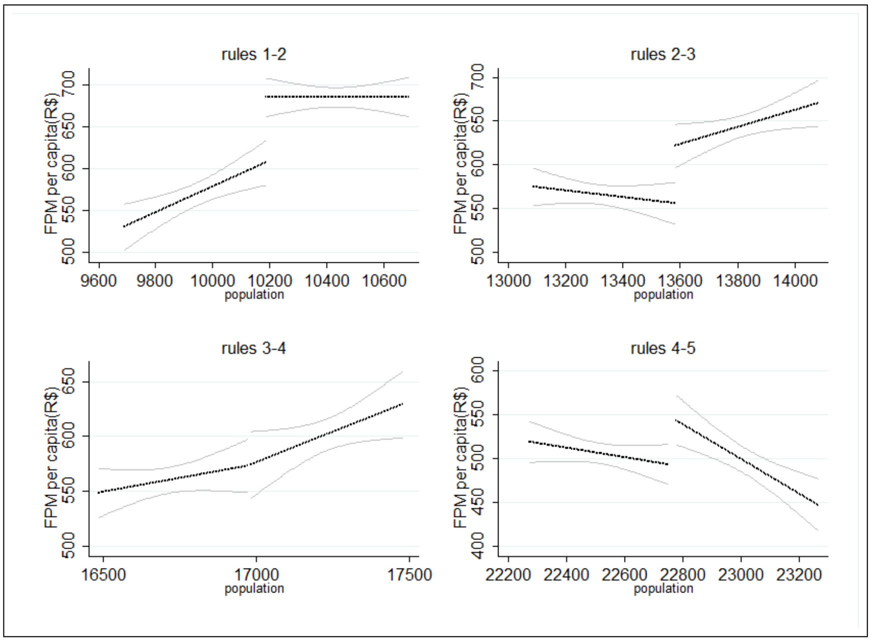
Note: FINBRA, 2005, 2007, 2009, 2011 - National Treasury.

Figure 2 shows the effect of population coefficient variation on FPM per capita received by brazilian municipalities with up to 30,000 inhabitants, estimated by local linear regressions on the left and on the right of the thresholds and using a 500 inhabitants window. The increase in FPM per capita is strong, especially on first and second thresholds, and statistically significant at 95 % confidence.

5.2 Pre-treatment covariates balancing

We use as covariates, to verify the balancing of treatment and control groups, educational information from the regions of the current municipalities in 1970, when the population thresholds for FPM transfers were different. We test if the educational conditions between actual treatment and control municipalities previously diverged. A similar strategy was used by Litschig and Morrison (2013), whom don't find differences due to the population brackets on literacy rate in 1980, but the authors used only the cities which frontiers were unchanged during the period. As many cities has been created in Hrazil during the 90 decade, we prefer to compare actual municipalities by the geographic area they belonged in 1970 and still belong now, the 1970 Minimum Comparable Areas (AMCs), because many

Figure 2: FPM per capita estimates, by population brackets, in municipalities with up to 30,000 inhabitants



Note: Municipalities in which municipal IDEB was calculated. Observations for the years 2005, 2007, 2009, 2011. 95% confidence interval.

of them have emancipated or had their frontiers modified during the last decades[9]. We analyze the educational conditions of AMCs in the 70's through the variables illiteracy rate, evasion rate, and average years of schooling and of age/grade lagging. Thus, we test if the municipalities of treatment and control groups in 2005 were in AMCs that were significantly different in terms of educational outcomes in 1970, before the actual thresholds have been established.

Table 1 shows the results for the municipalities in 2005 that were in the population windows considered on the regressions. We consider windows of 500 inhabitants around the actual thresholds, and compare the pairs of values - the first with the second, the third with the fourth through the eight windows. The 70's AMCs of treatment and control cities did not diverged previously on any educational factors analyzed by considering the four pairs of population windows.

We performed bilateral t-Student tests, which do not reject, by 10% of significance, the null hypothesis that the means of adjacent windows are equal for all variable. We cannot reject the null hypothesis at 5 % for any specification using unilateral tests. The number of municipalities in 2005 who were in treatment and control groups for each of the 4 considered groups, also were not substantially different. These results are evidence that the cities were previously balanced in terms of education's characteristic between treatment and control before the thresholds have been defined.

[9]The number of municipalities increased from 3.951 in 1970 to 5.507 em 2000. To more informations about the construction of AMC's, see Reis et al, 2007.

Table 1: Education covariates balance before the definition of the thresholds

	illiteracy (%)	evasion (%)	lag (years)	schooling (years)	illiteracy (%)	evasion (%)	lag (years)	schooling (years)
threshold 1								
9,689-10,188					10,189-10689			
mean	29.76	28.03	2.24	0.81	35.63	30.87	2.6	0.99
sd	25.66	24.71	1.78	0.81	24.65	21.52	1.59	0.79
observations	87	87	87	87	81	81	81	81
threshold 2								
13,084-13,584					13,585-14085			
mean	40.5	39.03	2.96	1.04	33.38	32.02	2.54	0.93
sd	26.2	25.47	1.56	0.92	23.25	23.87	1.61	0.85
observations	63	63	63	63	67	67	67	67
threshold 3								
16,481-16,980					16,981-17481			
mean	39.95	36.72	2.76	0.89	36.21	34.19	2.6	0.8
sd	26.04	25.46	1.66	0.76	27.84	27.84	1.78	0.78
observations	43	43	43	43	60	60	60	60
threshold 4								
23,273-23,772					23,773-24273			
mean	34.92	33.86	2.66	1.34	40.64	37.68	3.07	1.41
sd	23.19	23.38	1.41	0.94	22.23	22.86	1.21	0.98
observations	26	26	26	26	28	28	28	28

6 Results

6.1 FPM effect on IDEB using municipalities with less than 30,000 inhabitants

Table 2 presents the results of OLS (OLS), Fixed Effects (FE) and Least Squares 2 Stages (2SLS) regressions using all municipalities with less than 30,000 inhabitants. The variable of interest is the effect of FPM per capita on IDEB calculated for the first and second cycle of municipal elementary school, but we also use the passing rate in each grade and the standardized average score on Portuguese and Mathematics in Prova Brasil as dependents variables. This exam is applied on last grades of first and second cycles, namely the fifth and ninth year.

The results show a strong impact of FPM on passing rates. For the first cycle, the greatest impact occurs in the second grade, where 1% increase in FPM per capita increases by about 13% the probability of passing the grade, when we consider the OLS and 2SLS regressions. When we consider the results by Fixed Effect, this impact increases to 19%. Fixed effects method eliminates omitted variables that are constant over time that may bias the result (Wooldrigde, 2002), so in this case its estimating the impact of population coefficient changing during the period. The impact on the average passing rate in the first cycle ranges from 8.44% in OLS model to 14.45% in Fixed Effects model. The impact on scores, even though significant at 1%, is considerably smaller than the impact on passing rates. Again, the greatest effects on first cycle scores occur using Fixed Effects regressions: about 0.18% on math note, 0.13 % on Portuguese, 0.24% on the average grade of the subjects and 0.43% on the aggregate index IDEB.

The impacts estimated for the second cycle are still significant, but the absolute values are small. The effect on passing rates varies from 2.63% to 3.33% using OLS regressions, which occurs in the third grade of the cycle. Using Fixed Effect regressions, the values range from 5.4% in the fourth grade to 8.4% in the first. 2SLS estimates, in which we use the theoretical FPM as an instrument for the declared FPM, have intermediate values between OLS and Fixed Effect, but also indicate a positive effect on first grade passing rate of 7.23%. The average impact in the second cycle passing rate as a whole is 8.16% in the more robust specification (FE), 5.81% in IV estimations and just 3.05% with OLS estimations.

Table 2: FPM impacts on IDEB in cities up to 30,000 inhabitants

	pass rate						scores			
%/%	grade 1	grade 2	grade 3	grade 4	grade 5	cycle	math	Portuguese	mean	IDEB
First cycle										
OLS										
FPM	3.11***	13.16***	6.52***	5.96***	4.72***	8.44***	0.12***	0.09***	0.15***	0.25***
	(0.311)	(0.425)	(0.331)	(0.324)	(0.296)	(0.298)	(0.004)	(0.004)	(0.005)	(0.008)
R^2	0.02	0.07	0.06	0.04	0.04	0.08	0.08	0.05	0.07	0.09
observations	11076	14841	14869	14836	14905	14925	14711	14711	14709	14709
FE										
FPM	4.47***	19.54***	11.33***	9.86***	8.59***	14.45***	0.18***	0.13***	0.24***	0.43***
	(0.320)	(0.406)	(0.307)	(0.286)	(0.271)	(0.256)	(0.004)	(0.003)	(0.004)	(0.006)
observations	11076	14841	14869	14836	14905	14925	14711	14711	14709	14709
2SLS										
FPM	3.49***	13.66***	7.93***	7.69***	5.67***	8.99***	0.14***	0.11***	0.18***	0.29***
	(0.471)	(0.685)	(0.534)	(0.523)	(0.476)	(0.479)	(0.006)	(0.006)	(0.008)	(0.012)
observations	11076	14841	14869	14836	14905	14925	14711	14711	14709	14709
Second cycle										
OLS										
FPM	2.63***	2.65***	3.33***	2.74***	.	3.05***	0.03***	0.05***	0.07***	0.11***
	(0.599)	(0.497)	(0.441)	(0.408)	.	(0.458)	(0.004)	(0.003)	(0.006)	(0.010)
R^2	0	0.01	0.02	0.02	.	0.01	0.02	0.03	0.03	0.02
observations	8509	8544	8543	8538	.	8562	8104	8104	8104	8104
FE										
FPM	8.42***	6.63***	6.58***	5.42***	.	8.16***	0.04***	0.09***	0.12***	0.22***
	(0.494)	(0.457)	(0.433)	(0.405)	.	(0.376)	(0.003)	(0.003)	(0.004)	(0.008)
observations	8509	8544	8543	8538	.	8562	8104	8104	8104	8104
2SLS										
FPM	7.23***	4.86***	4.51***	3.79***	.	5.81***	0.08***	0.09***	0.14***	0.21***
	(1.012)	(0.836)	(0.740)	(0.687)	.	(0.770)	(0.006)	(0.006)	(0.010)	(0.017)
observations	8509	8544	8543	8538	.	8562	8104	8104	8104	8104

Note: $*p < 0.10, **p < 0.05, ***p < 0.01$. Covariates omitted. Standard errors in parenthesis.

The effect on second cycle scores are very small numerically, but significant with 1% of significance. OLS regressions indicate an effect of 0.03% on math, 0.05% on Portuguese and 0.07% on the mean score. Fixed Effects estimates are 0.04% on Portuguese, 0.09% on mathematics and 0.12% on the mean score, which are lower than those found in 2SLS estimations: 0.08% , 0.09% and 0.14% on Portuguese, mathematics and mean score, respectively. The effect on IDEB index using OLS regressions is only 0.11%, while using 2SLS regression method is 0.21% and 0.22% with Fixed Effects model.

6.2 FPM impacts on IDEB using a discontinuity design

Table 3 shows the effect of FPM per capita on IDEB of first and second primary school cycle and on its components, estimated by 2SLS regressions in which we explore the discontinuity due to FPM rule. The instrument considered is the theoretical FPM per capita, and the regressions are made in a window of 500 inhabitants around the thresholds.

The results indicate a significant effect of FPM on all components of the index in the first cycle, especially in the groups of cities with population around 13,585 and 16,981 inhabitants. Column 1 shows positive effects of a 1% increase of FPM per capita on first grade cycle passing rate, specially in cities with about 23,773 and 13,584 inhabitants, about 16.71% and 7.68% respectively, but there is also a significant impact with 10% of significance in the first threshold, 5.64%.

The impacts on passing rates of the first cycle follow the pattern observed with all data and are concentrated in the second grade. The estimated effects, significant at 1%, shown in column 2 are 22.83%, 26.11%, 34.88%, 28.44% to the threshold 1 to 4, respectively, which indicate a strong numerical effect on first cycle passing rates, even in this robust specification. The impacts on the third, fourth and fifth grades are concentrated in intermediate-size cities, especially in the fourth grade, whose passing rate increases 17.94% in cities with about 16,981 inhabitants.

Table 3: FPM impacts on school performance

2SLS - RDD %/%	pass rate grade 1	grade 2	grade 3	grade 4	grade 5	cycle	scores math	Portuguese	mean	IDEB
First Cycle										
threshold 1: 10,189										
FPM	5.64*	22.83***	8.37**	7.47**	4.62	11.38***	0.25***	0.20***	0.33***	0.47***
	(2.999)	(4.537)	(3.286)	(3.500)	(2.878)	(3.082)	(0.040)	(0.037)	(0.055)	(0.085)
observations	466	634	643	641	643	643	638	638	638	638
threshold 2: 13,585										
FPM	7.68***	26.11***	12.66***	14.83***	14.35***	18.08***	0.28***	0.21***	0.35***	0.57***
	(2.881)	(4.755)	(3.673)	(3.480)	(3.300)	(3.354)	(0.038)	(0.035)	(0.052)	(0.084)
observations	362	503	505	507	506	507	504	504	504	504
threshold 3: 16,981										
FPM	2.37	34.88***	12.28***	17.94***	11.79***	20.88***	0.26***	0.21***	0.35***	0.61***
	(4.549)	(5.442)	(4.120)	(3.903)	(3.574)	(3.955)	(0.046)	(0.043)	(0.064)	(0.102)
observations	257	382	382	382	383	383	381	381	381	381
threshold 4: 23,773										
FPM	16.71***	47.81***	17.43***	20.26***	15.21***	27.87***	0.19***	0.12**	0.23**	0.57***
	(4.316)	(8.268)	(6.447)	(5.790)	(4.813)	(5.685)	(0.065)	(0.060)	(0.089)	(0.143)
observations	159	211	211	211	211	211	209	209	209	209
Second cycle										
threshold 1: 10,189										
FPM	-1.54	3.3	1.73	-2.44	.	0.41	0.07**	0.11***	0.16***	0.16*
	(5.490)	(4.770)	(4.071)	(3.773)	.	(4.314)	(0.032)	(0.034)	(0.057)	(0.094)
observations	403	405	405	404	.	406	384	384	384	384
threshold 2: 13,585										
FPM	8.99	2.39	5.62	0.49	.	5.62	0.07*	0.09***	0.14**	0.21**
	(6.400)	(5.176)	(4.655)	(4.247)	.	(5.001)	(0.035)	(0.035)	(0.060)	(0.103)
observations	345	347	347	347	.	347	340	340	340	340
threshold 3: 16,981										
FPM	4.53	6.57	5.04	3.04	.	5.99	0.08*	0.11**	0.17**	0.25**
	(7.154)	(5.792)	(5.503)	(4.852)	.	(5.560)	(0.043)	(0.043)	(0.075)	(0.125)
observations	268	271	271	271	.	271	264	264	264	264
threshold 4: 23,773										
FPM	8.66	8.2	14.03**	17.09***	.	12.38*	-0.01	0.03	0.01	0.13
	(9.341)	(7.225)	(6.308)	(6.509)	.	(7.216)	(0.059)	(0.058)	(0.102)	(0.165)
observations	166	165	165	165	.	166	163	163	163	163

Note: $*p < 0.10, **\, p < 0.05, ***p < 0.01$. Covariates omitted. Standard errors in parenthesis.

The effects on scores in the first cycle are smaller than the impact on passing rates, but are significant at 1% in all regressions. The largest effects on scores occur in the group of cities with biggest population, perhaps because they have better conditions to improve education quality, due to economies of scale, for example. Considering the cities with population close to 23,773 inhabitants, the effects are 0.31% 0.23% to 0.40% on scores in Portuguese, mathematics and on the mean score of the subjects, respectively. For all the thresholds, the effects on IDEB is greater than the estimated effects in the regressions with all the towns smaller than 30,000 inhabitants (Table 1), ranging from 0.47% to 0.61% for each 1% transferred via FPM per capita.

The effects on the second cycle are again smaller. There are no significant impacts on the passing rates in any grade and for all the thresholds. The effects are concentrated on scores, especially in Portuguese. There is a 0.16% increase in the mean score in the first group and 0.17% in the third - significant values at 5%. Impacts on global index IDEB range from 0.16% to 0.25%, significant values at 5%, but there is no impact on the group of cities with more population.

We present robust estimates using 2 Stages Least Squares controlling for municipality Fixed Effects in Table 4. In this case, we estimate the impact of population coefficient transition and hence the impact of an exogenous FPM variation on municipal IDEB variation. This shift depends on the population growth estimated by IBGE from previous counts, which can not be completely influenced by the actual mayor, ensuring a continuous variation of the forcing variable. The identification of the treatment in this case is possible even with population manipulation, since the mayors and politicians do not have a complete control of this process (Van der Klaauw, 2002; Lee and Lemiuex, 2010).

The results indicate an even greater effect on the overall first cycle passing rate, ranging from 19.42% to 26.85%. Again, there is no effect on the first grade passing rate, unless in the first population group, and the effect on passing rates is concentrated in the second grade, about 30% in the first threshold and reaching 44.7% in the largest population group. Its effects on passing rates for the third, fourth and fifth grades of the first cycle are not much larger than the 2SLS specification without fixed effects, and the values are generally significant at 1%.

The effects on the first cycle scores, on the other hand, are generally smaller than estimated in the foregoing specification. The effects on the mean score in Portuguese and mathematics in Prova Brasil vary between 0.27% to 0.34% for each 1% increase in FPM per capita. The overall effect on IDEB, using 2SLS in Fixed Effects, has the greatest values of all used specifications, ranging from 0.53% to 0.6%, probably due to the strong impacts on passing rates.

The results for the second cycle follow the pattern of the previous 2SLS results without fixed effects correction. The effects on passing rate are not significant at 1%, except for the second grade (or sixth year of primary school) of municipalities with population close to 16,981, about 17.26%. The effect on second cycle passing rate is positive, significant at 5%, and ranges from 7.97 % to 14.98 %, except for the largest population group. The effects on scores is positive and similar to those previously estimated. The effect on IDEB reaches 0.35%. The results for cities with population of about 23,773 are insignificant for all dependent variables used.

The robust specification confirm that the effect of additional FPM concentrates on the first cycle of basic education. In 2006, the Senate approved the Law n 144/2005, which added one year to the basic education formation, and required the adequacy of states and municipalities by 2010 - so that the former first grade corresponds to today second grade. There is a sharp increase on passing rates, specially for the second grade. This is a indicative that school managers favor the maintenance of children in school at this stage, and they did not adequate to the new law yet. These results are evidences that the municipalities concentrate efforts on literacy of young children, while keeping them at school.

Table 4: FPM impacts on school performance - robust specification

2SLS FE RDD	pass rate						scores			
%/%	grade 1	grade 2	grade 3	grade 4	grade 5	cycle	math	Portuguese	mean	IDEB
First cycle										
threshold 1: 10,189										
FPM	9.89***	30.16***	20.97***	12.38***	11.48***	19.42***	0.26***	0.22***	0.34***	0.59***
	(3.113)	(4.528)	(3.077)	(3.226)	(2.716)	(2.525)	(0.033)	(0.029)	(0.042)	(0.059)
observations	466	634	643	641	643	643	638	638	638	638
threshold 2: 13,585										
FPM	4.74	29.37***	14.88***	15.69***	13.08***	19.72***	0.25***	0.16***	0.29***	0.53***
	(4.498)	(5.813)	(3.808)	(3.279)	(2.903)	(3.175)	(0.031)	(0.030)	(0.041)	(0.068)
observations	362	503	505	507	506	507	504	504	504	504
threshold 3: 16,981										
FPM	0.51	42.05***	22.75***	22.24***	11.93***	26.85***	0.22***	0.15***	0.27***	0.60***
	(5.311)	(5.888)	(4.421)	(3.885)	(3.747)	(3.820)	(0.038)	(0.037)	(0.052)	(0.077)
observations	257	382	382	382	383	383	381	381	381	381
threshold 4: 23,773										
FPM	15.61*	48.85***	22.64***	22.47***	10.91*	29.45***	0.23***	0.18***	0.29***	0.66***
	(8.582)	(10.662)	(6.744)	(5.961)	(6.109)	(6.051)	(0.062)	(0.061)	(0.084)	(0.127)
observations	159	211	211	211	211	211	209	209	209	209
Second cycle										
threshold 1: 10,189										
FPM	10.89**	8.33	6.01	0.98	.	7.98**	0.08***	0.11***	0.16***	0.29***
	(5.298)	(5.173)	(4.546)	(4.499)	.	(3.858)	(0.030)	(0.029)	(0.048)	(0.085)
observations	403	405	405	404	.	406	384	384	384	384
threshold 2: 13,585										
FPM	12.35**	10.82**	11.57**	5.07	.	11.28***	0.06**	0.12***	0.15***	0.30***
	(5.780)	(5.322)	(5.379)	(4.925)	.	(4.261)	(0.029)	(0.033)	(0.050)	(0.085)
observations	345	347	347	347	.	347	340	340	340	340
threshold 3: 16,981										
FPM	9.25	17.26***	12.21**	14.16**	.	14.97***	0.07**	0.11***	0.17***	0.35***
	(6.852)	(6.632)	(6.208)	(5.809)	.	(5.286)	(0.033)	(0.036)	(0.057)	(0.105)
observations	268	271	271	271	.	271	264	264	264	264
threshold 4: 23,773										
FPM	12.21	13.84*	7.06	7.45	.	12.06**	0.15***	0.18***	0.29***	0.43***
	(7.493)	(7.791)	(6.965)	(7.028)	.	(6.043)	(0.049)	(0.055)	(0.087)	(0.118)
observations	166	165	165	165	.	166	163	163	163	163

Note: $*p < 0.10, **p < 0.05, ***p < 0.01$. Covariates omitted. Standard errors in parenthesis.

7 Conclusions

We use a quasi-experiment to measure the effect of an exogenous increase of an unconditional transfer to municipalities, FPM, on municipal IDEB, the offical index to measure primary education quality. We explore the institutional rule of distribution according to population brackets, which allows the estimation of regressions using a discontinuity design (RDD).

We find a positive effect of FPM on IDEB, specially in the first cycle. The effect is concentrated on passing rates, specially in the second grade of the first cycle. Second grade was the former first grade until 2008, when the government added one year to primary education and children started going to school one year early. The passing rate of new first grade, in turn, is the last that has increased due to transferred FPM. These results suggest that school managers still concentrate their efforts on reducing evasion of young children, and they have not adapted to the new law yet.

The positive and significant estimates for all the data are confirmed by more robust estimations using RDD regressions. The impact on second grade passing rate reaches 48% in municipalities with about 23,773 inhabitants using 2SLS with fixed effects. Passing rates in the third and fourth grades increase due to FPM, but at a lower rate than occurs in the second grade. The lower impact is in first grade, a maximum of 16.71%.

The effect on Prova Brasil scores, test applied to students of the fifth and ninth elementary grades, are numerically small, but in general are significant, reaching a maximum of 0.35%. The effect on the aggregate index IDEB is small but significant in all specifications, ranging from 0.53% to 0.66% in 2SLS regressions with Fixed Effects, for each 1% increase on FPM per capita.

An important question to be investigated further latter is whether spending on functions other than education, are more efficient to improve the ability of students than spending on schools and teachers. Health expenditures, for example, which are made especially on primary care in the cities of our data, positively influence social and health conditions of families, thus increasing passing rate and the learning capacity of students. The impacts of health expenditures is crucial because its the second biggest local expenditure, just after education. We cannot attest causality of education and health spending separately, because they are all correlated with FPM transfers, but we already did OLS estimations exploring discontinuity on education and health spending to estimate the correlation of these particular expenditure and the quality of education. The results suggest that health expenditures are more efficient to increase education quality than educational expenditures itself.

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