

# Using a quasi-experiment to identify the effects of education spending on school resources

Marcelo Castro\*

July, 2015

## Abstract

In this article we propose an instrumental variable to estimate the causal impact of municipal spending in primary school on the quality of schools, measured by infrastructure conditions, and on the teacher's qualification. We use 2 Stages Least Squares regressions, where we regress the local education spending on local share of Municipalities Participation Fund (Fundo De Participação dos Municípios - FPM) in the first stage, and use the predicted value in the second stage. We use the law of FPM transfer according to population brackets, which generates an exogenous increase in primary education expenditures, which allows Regressions in Discontinuity Design (RDD) using samples of municipalities close to the thresholds. We found no significant impact of education spending on public schools.

Keywords: Program evaluation, School accountability, Fiscal Federalism

JEL-Classification: H52, H77, I22, I28

Anpec Classification : Area 12 - Social and demographic economics

## Resumo

Neste artigo nós propomos uma variável instrumental para estimar o impacto causal de gastos municipais no ensino fundamental sobre a qualidade das escolas, medida por condições de infra-estrutura, e sobre a qualidade dos professores, medida pelo grau de formação. Nós utilizamos regressões em Mínimos Quadrados de 2 Estágios, em que estimamos o gasto local em educação de acordo com a transferência do Fundo de Participação dos Municípios (FPM) no primeiro estágio, e utilizamos o valor estimado no segundo estágio. Nós usamos uma lei de repasse do FPM de acordo com faixas de população, o que gera um aumento exógeno nos gastos do ensino primário, o que permite a utilização de Regressões em Descontinuidade (Regressions in Discontinuity Design - RDD) em amostras de municípios próximos às mudanças de faixas. Nós não encontramos impactos significativos dos gastos em educação sobre a rede pública de ensino.

Palavras-chave: Avaliação de impactos, Metas educacionais, Federalismo Fiscal

JEL-Classification: H52, H77, I22, I28

Classificação Anpec: Área 12 - Economia social e demografia econômica

## 1 Introduction

Brazil is one of the worst countries in international standard tests and it is a natural consensus that the education quality is very bad and need to be improved. There are many doubts however on the needing to increases resources to education, as there are many doubts on how the money

---

\*Doutorando em Economia pela Escola de Economia de São Paulo (EESP/FGV-SP)

is spent. Many studies that try to measure the effects of increasing education spending on its quality and on schools and teachers, but in general it is difficult to make a causal interpretation from education spending impacts. The primary public education in Brazil is financed in various ways. The vast majority of schools that level are held by municipalities, so that they are funded through the budget of the municipalities, either through taxes and local taxes, or through transfers from other federate entities, such as the Municipalities' Participation Fund (FPM).

We want to assess this important question of public spending accountability using a quasi-experiment in a Regression Discontinuity Design (RDD), answering whether increasing education spending improve the quality of education analyzing the supply side of education, that is, schools and teachers' conditions. The legal rule of distribution of the FPM provides a sudden variation of the transfer at certain population distribution thresholds. We estimate the impact of this change, considered exogenous in the vicinity of the thresholds, on the quality of education. We guarantee the causal identification through the Regression Discontinuity Design - RDD.

Betts (1996) analyze many empirical evidences for USA and does not find a consensus for school spending on student learning. According to the author, this indicates that part of the expenditures may not impact on teaching quality, as teachers and school employee's wages, because of the great power of the syndicates. Also, there is not a consensus in the literature about the impacts of education spending on school quality. Menezes-Filho, N., Pazello, E. T. (2004) find no significant impact of the primary education spending on learning in the fourth and eighth grades of primary education, unless for cities with greatest scores in the fourth grade. Rocha et al (2013) finds inefficiency in the education spending among Brazilian municipalities. The authors estimate an waste of resources varying from 40,1% a 47,3% when they assume, respectively, variable and constant return to scale.

Litschig, S. (2008) uses RDD and the same population discontinuity to analyze the effects of FPM on education in the years 1982-1985, when the rule was a bit different from the present. From the 1980 and 1981 census, along with information on municipal finances, the author estimated a positive effect on literacy rate and years of schooling. The author argues that greater budgetary revenues could result in higher quality education by directly increasing spending in education, but also through the spending externality in areas such as health, early childhood education and transport - which may impact on the learning ability of students and therefore on the final quality of education. Thus, the increase in transfers can impact on various social areas social spending other than education, so it is not possible to identify the channel that FPM impacts on education learning, measured by standardized tests.

Many papers have found significant impacts of FPM on local education spending (Litschig, 2008; Castro and Regatieri, 2014; Castro et al, 2015, Arvate et al, 2015, Brollo et al, 2013). Also Castro and Regatieri (2014a) use the FPM population discontinuities and find an impact of FPM on spending in education functions, health, urban planning and transport between 2005 and 2011. The conclusion is that the FPM generates strong impact on budgetary expenditure of municipalities with up to 30,000 inhabitants, especially in the education function and sub-function primary school. After education, the role that more has increased spending is health, especially the Sub basic care. These spending on primary care in health can have a strong effect on families and cognitive ability of children.

Castro and Regatieri (2014b) show that there is a positive impact of per capita FPM on municipal cognitive education, measured by the index of primary school quality, the IDEB (Índice de Desenvolvimento da Educação Básica, in Portuguese) - composed by the municipal schools pass rate and the students' score in a proficiency exam. There is a strong effect on the approval rate, especially in the second grade, which was the former first until 2008. The authors could not identify to what extent the quality of education, according to standardized tests and pass rates, is due to increased spending on education, or other functions of municipal expenditures. Cognitive ability depends on factors associated with students' families and schools. Through health spending, for example, the government can directly improve the living conditions

of students, which may have an impact on learning. Transport costs can reduce the cost of going to school and reduce evasion. On the other hand, spending on education can improve the infrastructure conditions and teachers of public schools, improving the quality of teaching.

We use the fact that many authors have found a significant impact of FPM on education spending in a first stage regression, and we use the fitted values in a second stage to measure the impacts on school infrastructure and teachers conditions. In this way, we solve the identification issue in the literature that looks for measuring the impacts of education spending. Also, we try to answer if education spending is one of the factors that is driving the FPM impacts on education, which may occur due to education public goods and teachers qualification and motivation. If education spending is not impacting on school resources or teachers quality, there is no reason to believe that education spending impacts on education quality, measured by test score or passing rates.

## 2 Dados

We use data from local expenditures and FPM share of municipalities with up to 30,000 inhabitants in the years 2007, 2008 and 2009, released by the Treasury Secretariat of federal government from the city hall declarations. The values in reais were update to january, 2014, using the official inflation index (Índice de Preços ao Consumidor Amplo - IPCA).

Information about schools conditions and teachers teaching municipal public was collected from the school census survey conducted annually by the Ministry of Education in all public schools in the country. We collect variables on physical characteristics of schools, those relating to school infrastructure, such as the presence of library, laboratories, gym, and access to the sewage, water, internet and light systems. It is also possible to know if the classes take place in school own building, as well as information on the teaching staff of the school, as the number of teachers and the proportion of those who attended higher education, bachelor's or master's degree. We then calculate the mean values of these variables by all cities with less than 30,000 inhabitants.

Figure 1 shows the evolution of some items of municipal budget spending over municipalities with different populations. The curves were estimated by a local polynomial regression using per capita values:

[Figure 1 ]

Figure 2 shows the distribution of the estimated number of pupils per teacher according to the municipality's population. Smaller municipalities have classrooms with fewer students and fewer students for each teacher, but the variation among cities are not greater than 30%. Municipalities with about 5,000 inhabitants have about 6 students per teacher on average, while in municipalities with 30,000 inhabitants are almost 8 students per teacher.

[Figure 2 ]

Figure 3 shows the distribution of variables about primary elementary school schools and teachers' conditions. We analyzed the proportion of schools that have sewage, water supply, garbage collection, internet, libraries, sport courts, computer labs, as well as the proportion of teachers who attended undergraduate and higher education. Most schools operate in own buildings schools, as well as have some sewer collection system, but less than 30% have computer labs and less than 40% of these labs has Internet access. The figure shows little variation, on average, in the quality of schools infrastructure and teachers condition in municipalities with up to 30,000 inhabitants.

[Figure 3 ]

### 3 Empirical strategy

Our identification methodology relies heavily on the literature that uses RDD to estimate FPM impacts, like Listchig (2012), Brollo (2013), Arvate et al (2015) and Castro et al (2015). The main difference is that these authors estimate the impacts of per capita FPM due to the theoretical FPM, the value that should be transferred strictly according to the law. This is important because the FPM values are declared by the mayors, and so the first stage regression is important to avoid error declaration bias. In the second stage, the literature estimate FPM fitted values on education outcomes (Liscthig, 2008), education public goods (Gadenne, 2012) corruption (Brollo, 2013), local budget expenditures (Arvate, 2015) and neighboring cities expenditures (Castro et al, 2015).

Our contribution is to use the local education spending as the dependent variable in the first stage, using theoretical FPM as instrument, and we take the fitted values in the second stage. So, we can estimate the direct effect of education spending on education public goods, measured by schools resources and teachers qualification, that is, we estimate the effect of education spending on public education quality, measured in the supply side of education achievement.

The estimation relies on the exogenous FPM population thresholds. RDD estimates relies on the limit distribution of potential variables near the thresholds - we consider that all relevant variables follow continuous distribution in the vicinity of the thresholds, except the per capita transferred FPM. In this way, we expect that any discontinuous variation in the dependent variable in this regions should be caused by FPM variation. The manipulation possibilities are very reduced, as FPM distribution is done automatically monthly, according to the local population estimates released by IBGE. A careful explanation of the hypothesis validity for RDD estimates in the case of FPM impacts can be find in Castro et al (2015).

The population brackets are not the only rule for FPM distribution. It depends also on the total amount destined to FPM in Brazil, which is 23,5% do Imposto de Renda e do Imposto sobre Produtos Industrializados arrecados pela União, the state coefficient, tabulated by law, and the Financial Reducer when it is applied. This last formula was created in Complementary Law n 91, in 2007, and was applied until 2007 to a share of municipalities that lost population in the 90's. For this cities, previous year population coefficient, based on IBGE estimates, was progressively implemented, and the amount that was transferred was reduced until its convergence to the annual estimates.

We calculate the total FPM amount that should be transferred to municipalities strictly according to the law, which we call theoretical FPM. We use a 2 Stage Least Square 2SLS) Regression to correct in the first stage the declared FPM error bias, using theoretical in place of declared, and explore the exogenous FPM variation near the thresholds. As explained in Angrist and Lavy (1999), RDD can be consistently generated using 2SLS.

We can write the first stage regression as fitting the equation:

$$S_{it} = \beta_0 + \beta_1 FPM_{theoretical}_{it} + \beta_2 pop_{it} + \beta_3 pop_{it}^2 + v_{it}$$

In which  $it$  is the city  $i$  spending in primary education in year  $t$  and  $FPM_{theoretical}_{it}$  is the theoretical FPM that have been transferred. Local population and its quadratic term are added as control. In the second stage we estimate the impacts of  $S^*$ , the education spending fitted values in the first stage, on the education resources,  $Q_{it}$ , fitting the regression:

$$Q_{it} = \alpha_0 + \tau S_{it}^* + \alpha_1 pop_{it} + \alpha_2 pop_{it}^2 + u_{it}$$

The regressions are made using data of municipalities with 500 inhabitants to more and less

than the FPM populations. We also explore the panel of cities along the years to control for Fixed Effect on the city level, that is, we control for all variables that could bias the results and are invariant on time (Wooldridge, 2002). We also present estimate of Fixed Effect and 2SLS for all the data, following Angrist and Lavy (1999) approach. RDD is a local linear regression, so the estimated effects have strong internal validity to explain the results near the thresholds, but it is hard to extrapolate the results to all the data. Nevertheless, we use the 4 different population thresholds in cities with less than 30,000 inhabitants to analyze the impact variation to cities with different populations sizes.

## 4 RDD hypothesis verification

The main hypothesis for RDD is that the treatment (per capita FPM) varies exogenous near the forcing variable thresholds. Figure 1 shows the jumps in transferred FPM at the population thresholds, creating "steps" in FPM distribution, which shows that the forcing variable has the desired effect<sup>1</sup>.

[Figure 4]

In figure 5, we estimate the city per capita FPM on the left and on the right separately, using local polynomial regression, and we see strong impacts of population rule in the regions near the thresholds. The effects are not the same at all the thresholds and are not binary, as population brackets are not the only rule for FPM distribution - as the state and total national amount.

[Figure 5]

## 5 Results

### 5.1 FPM impacts on education spending

We present in Table 1 the RDD estimates of per capita FPM on education spending, separate by spending on childhood, primary, high school, professional and graduate education. The impacts are more close to Castro e Regatieri (2014a), but similar impacts were found in Arvate et al (2015) and Castro et al (2015). These authors find an overall significant impact on local budget spending, specially on education and health.

Column 1 of Table 1 shows a significant impact of FPM on education spending of at least 80 cents to each 1 real transferred. This impact is 1.4 real at threshold 4. Most of this extra spending is done on primary education, which varies from 0.6 to 1.06 reais, followed by childhood education, 0.10 to 0.18 reais.

[Table 1]

We estimate next the impacts of primary education on schools and teachers conditions, using the FPM as instrument. The correlations between per capita FPM and primary education are also strong when we use OLS regressions. All the spending in primary schools, investment or current spending, such teachers' wages, are computed as primary education spending, so any shock in schools and teachers conditions near the FPM population thresholds must be due the extra primary education and the extra FPM.

---

<sup>1</sup>We exclude cities that receive extreme values of per capita FPM, that is, more than 2,000 reais.

In this way, we want to analyze if the education spending increases the quality of teaching offered by the public system. Castro e Regatieri (2014b) find significant impacts of FPM on cognitive abilities measured by a standardized test, the IDEB, but it is not clear if the impacts are due to education spending. Health expenditures, for example, can spillover in education while improving students' health conditions and learning capacity. If we find impacts of education spending on school conditions should be a sign that the education spending is an important channel in which FPM affects education, whereas if we find no impact should be a sign that another kinds of spending, such as health, must be driving the measured education variation.

## 5.2 Primary education impacts on schools resources in cities with up to 30,000 inhabitants

Table 2 presents OLS estimates using all the cities with up to 30,000 inhabitants. We use the logarithm of the primary education spending in each city to measure the impact of schools and teachers conditions. The results do not have the expected signal in general. In the first group of regressions, spending on primary education is associated with lower coverage of sewage systems, electricity and garbage collection in the public network schools. In addition, the middle part shows that there seems to be a decrease in the percentage of schools with sports facilities, libraries, televisions, computers, internet and bathrooms in the inner area of the school. Finally, there seems to be increase in the number of students per teacher and a fall of teachers' qualification level. One hypothesis is that there is a negative correlation between per capita spending on education and municipality size, and larger municipalities have better conditions and scale to invest in schools.

[Table 2]

Table 3 shows the effects of spending on primary education on the quality of schools using fixed effects regressions. Thus, we estimate the average change of the schools' characteristics from one year to another due to variations in education spending in the period. The method eliminates variables that can lead to a bias in the estimation and which are fixed in the period considered, such as geographical conditions and population size (Wooldridge, 2002).

Most impacts are not significant or have a small magnitude, but generally have the expected signal. The effect on the physical characteristics of schools are small or non-existent, but there is a significant effect on education spending on the number of students per teacher: a reduction of almost 3 students for each 10% increase in education spending.

[Table 3]

The latest specification using all population in smaller municipalities than 30 thousand inhabitants will be done using instrumental variables - we consider spending on education induced by transferring funds via FPM. The regression will be done by Minimum Squares 2 Stages (2SLS), and the first stage corresponds to the estimates of expenditure in higher education due to the theoretical rule of distribution of the FPM.

Table 4 shows that the overall results are significant and have the expected signs. The increase of 1% in spending on primary education increase by 5 % the proportion of the network that provides power in 20% to 87% the proportion of schools that collect sewage and garbage respectively. There is also an increase of 68%, 66 % to 74% in proportion to network computer labs, sports facilities and libraries.

[Table 4]

### 5.3 Primary education RDD impacts on public schools and teachers' characteristics

The following Tables 5-8 show the 2SLS estimated effect of primary education spending on the school and teachers' characteristics for each of the population thresholds. The instrument is the theoretical FPM in the 500 inhabitants windows around the thresholds<sup>2</sup>. We use the percentage of schools with each of the resources as dependent variable, or the percentage of teachers with each of the qualification level, as dependent variables, and we use the logarithm of primary education spending as independent variable in the second stage. we also make regressions using the number of students per teacher and the number of computers as dependent variable.

We present the results for thresholds 1 to 4 in the Tables 5-8, respectively. For all the thresholds, there are no impacts of primary education spending on teachers' qualification and on the schools of this level. The results are quite different of those estimated by OLS and FE with all the data. These robust estimates do not indicate effects of public education spending on school resources, although the literature points to FPM impacts on education quality. One explanation is that other kind of expenditures is driving the FPM effect, as health expenditures. It is disturbing that the increase in education spending is not being spent on school resources and teachers qualification, which could increase the teaching quality and is a good indicative, although preliminary, that increase education spending do not impact on education quality.

[Table 5]

[Table 6]

[Table 7]

[Table 8]

## 6 Conclusions

We estimate the impacts of primary education spending on schools's structures and teachers' qualification of this level. Many papers make this estimation for Brazil, but most of them lack on causal identification issues. We use the FPM transference discontinuities as instrument for exogenous shocks on local revenue and spending on education. We want to know if more money to education reverts on better teaching conditions in the public education system.

The results are not conclusive when we use all the municipalities with less than 30,000 inhabitants in OLS. In some cases the estimates have the opposite signals, because per capita FPM and education spending is negative correlated with local population, and smaller cities have worst schools and teachers' conditions. When we use FE and 2SLS there is in general a positive impact of education spending on schools' conditions.

The robust estimates uses the FPM population rule that generates discontinuities in the transfers as the principal identification hypothesis for causal inference. In the cities with population near the thresholds, the impacts of education spending on public teaching quality, measured by schools' structure and teachers' qualification, are not significant for all the thresholds and variables.

A particular explanation that should be explored latter is that education spending, even when increased, is wasted on others ways that do not improve education teaching. That is reasonable because small cities have worst structure conditions and it is hard to attract more qualified teachers to them. The competition between schools and teachers are very restricted

---

<sup>2</sup>We use alternative estimation windows with 250 and 1,000 inhabitants around the thresholds, but the results are not substantially different.

in these areas, in such a way that extra money to education may be deviated to rent-seeking activities.

## References

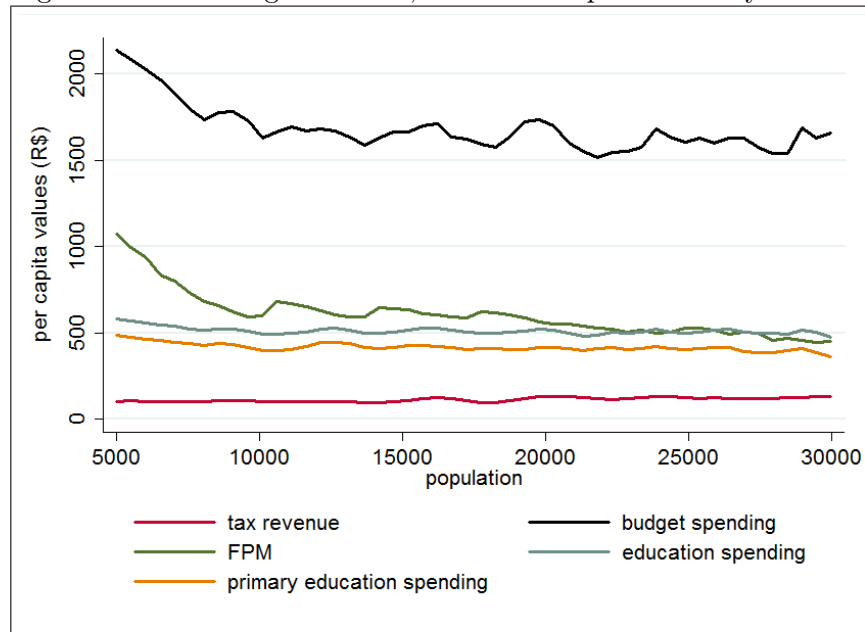
- [1] Angrist, J., Lavy, V. (1999) *Using Maimonides' Rule To Estimate The Effect Of Class Size On Scholastic Achievement* The Quarterly Journal of Economics, MIT Press, vol. 114(2), 533-575, Maio
- [2] Angrist, J., and S. Pischke (2008), *Mostly Harmless Econometrics: An Empiricists' Companion* Princeton University Press, Princeton, NJ.
- [3] Brollo, F., Nannicini, T., Perotti, R., Tabellini, G. (2013) *The Political Resource Curse* American Economic Review, 103(5): 1759-96.
- [4] Campos, B. C., Cruz, B. P. A. (2009) *Impactos do Fundeb sobre a qualidade do ensino básico público: uma análise para os municípios do estado do Rio de Janeiro* Rev. Adm. Pública [online] vol.43, n.2 [cited 2014-06-21], pp. 371-393
- [5] Castro, M., Regatieri, R. (2014a) *Impacto do Fundo de Participação dos Municípios sobre os gastos municipais por função e subfunção: análise através de uma regressão em descontinuidade* Working Paper
- [6] Castro, M., Regatieri, R. (2014b) *Mais dinheiro, mais qualidade? Impacto do Fundo de Participação dos Municípios sobre taxa de aprovação, notas na prova Brasil e IDEB* Working Paper
- [7] Diaz, M. D. M. (2012) *Qualidade do gasto público municipal em ensino fundamental no Brasil*. Rev. Econ. Polit , vol.32, n.1 [cited 2014-06-21], pp. 128-141
- [8] Epple, D., Romano, R. (1998) *Competition between Private and Public Schools, Vouchers and Peer-Group Effects* American Economics Review. Vol. 88 (1), pp. 33-62
- [9] Epple, D., Romano, R. (2004) *Competition between private and public schools: testing stratification and pricing predictions* Journal of Public Economics, Volume 88, Issues 7-8, July 2004, Pages 1215-1245
- [10] Epple, D. Newlon, E., Romano, R. (2002) *Ability tracking, school competition, and the distribution of educational benefits* Journal of Public Economics, Volume 83, Issue 1, January 2002, Pages 1-48
- [11] Gordon, N. (2004) *Do federal grants boost school spending? Evidence from Title I* Journal of Public Economics, Elsevier, vol. 88(9-10), pages 1771-1792, August.
- [12] Haegeland, T., Raaum, O., Salvanes, K. G. (2012) *Pennies from heaven: Using exogenous tax variation to identify effects of school resources on pupil achievement* Economics of Education Review, 31(5), 601-614
- [13] Hakkinen, I., Kirjavainen, T., Uusitalo, R. (2003) *School resources and student achievement revisited: New evidence from panel data* Economics of Education Review, 22(3), 329-335
- [14] Hanushek, E. A. (2006) *School Resources* Handbook of the Economics of Education, Vol. 2



- [15] - *Assessing the Effects of School Resources on Student Performance: An Update* Educational Evaluation and Policy Analysis, Vol. 19, No.2, pp. 141-164
- [16] Holmlund, H., McNally, S., Viarengo, M. (2010) *Does money matter for schools?* Economics of Education Review, 29(6), 1154-1164.  
Holmlund, H., McNally, S., Viarengo, M. (2010). Does money matter for schools?. Economics of Education Review, 29(6), 1154-1164.
- [17] Imbens, G., Wooldridge, J. (2009) *Recent Developments in the Econometrics of Program Evaluation* Journal of Economic Literature 47 1 5-86
- [18] Imbens, G., Lemieux, T. (2007) *Regression Discontinuity Designs: A Guide to Practice* NBER Technical Working Papers. National Bureau of Economic Research, Inc.
- [19] Krueger, A. (1999) *Experimental Estimates of Education Production Functions* The Quarterly Journal of Economics (1999) 114 (2): 497-532
- [20] Litschig, S. (2008) *Intergovernmental Transfers and Elementary Education: Quasi-Experimental Evidence from Brazil* Available at SSRN
- [21] Litschig, S., Morrison, K. (2012) *Government Spending and Re-election: Quasi-Experimental Evidence from Brazilian Municipalities* 515, Barcelona Graduate School of Economics. Working Papers
- [22] Litschig, S. (2012) *Are rules-based government programs shielded from special-interest politics? Evidence from revenue-sharing transfers in Brazil* Journal of Public Economics, v. 96, n. 11-12, p. 1047-1060, Dec.
- [23] Mation, L.; Miranda, R. B.; Monasterio, L. M. (2012) *Multiplicai-vos e crescei: FPM, emancipação e crescimento econômico municipal* IPEA
- [24] Mcrary, J. (2008) *Manipulation of the running variable in the regression discontinuity design: a density test* Journal of econometrics, v. 142, n. 2, p. 698-714
- [25] Mendes, C. C., Sousa, M. C. (2006) *Estimando a demanda por serviços públicos nos municípios brasileiros* Rev. Bras. Econ. vol.60, n.3 , pp. 281-296
- [26] Menezes-Filho, N., Pazello, E. T. (2004) *Does money in schools matter? Evaluating the effects of FUNDEF on wages and test scores in Brazil*. Seminários: Departamento de Economia, PUC-RIO. Maio.
- [27] Menezes-Filho, N. (2007) *Os Determinantes do Desempenho Escolar do Brasil* Instituto Todos Pela Educação
- [28] Menezes-Filho, N., Amaral, L. F. L. (2008) *A Relação entre Gastos Educacionais e Desempenho Escolar* ANPEC - Associação Nacional dos Centros de Pósgraduação em Economia
- [29] Ministério da Fazenda (2012) *O que você precisa saber sobre as transferências constitucionais e legais: Fundo de Participação dos Municípios – FPM* Secretária do Tesouro Nacional, Cartilha do FPM
- [30] Monastério, L. (2013) *O FPM e a Estranha Distribuição da População dos Pequenos Municípios Brasileiros* Texto para discussão 1818, IPEA

- [31] Ribeiro, M. B., Rodrigues Jr., W. (2006) *Eficiência do gasto público na América Latina*, Boletim de Desenvolvimento Fiscal, n. 3: 43-56.
- [32] Rocha, F., Duarte, J., Gadelha, S., Oliveira, P., Pereira, L. (2013) *É possível atingir as metas para a educação sem aumentar os gastos? Uma análise para os municípios brasileiros*. Secretária do Tesouro Nacional, Texto para discussão n15
- [33] Sakurai, S. (2013) *Efeitos assimétricos das transferências Governamentais sobre os gastos públicos locais: Evidências em painel para os municípios brasileiros* pesquisa e planejamento econômico — ppe — v. 43 — n. 2 — ago.
- [34] Soares, F.; Alves, M. (2012) *O nível socioeconômico das escolas de educação básica brasileiras* Grupo de Avaliação e Medidas Educacionais (GAME) da Universidade Federal de Minas Gerais (UFMG)
- [35] Van der Klaauw, Wilbert (2008) *Breaking the link between poverty and low student achievement: An evaluation of Title I* Journal of Econometrics, Elsevier, vol. 142(2), pages 731-756, February.
- [36] Wooldridge, J. (2002) *Econometric Analysis of Cross Section and Panel Data* MIT Press, Cambridge, MA

Figure 1: Local budget revenue, FPM and expenditures by function



Valores *per capita* atualizados para janeiro de 2014 pelo IPCA

Figure 2: Class size - number of students per teacher

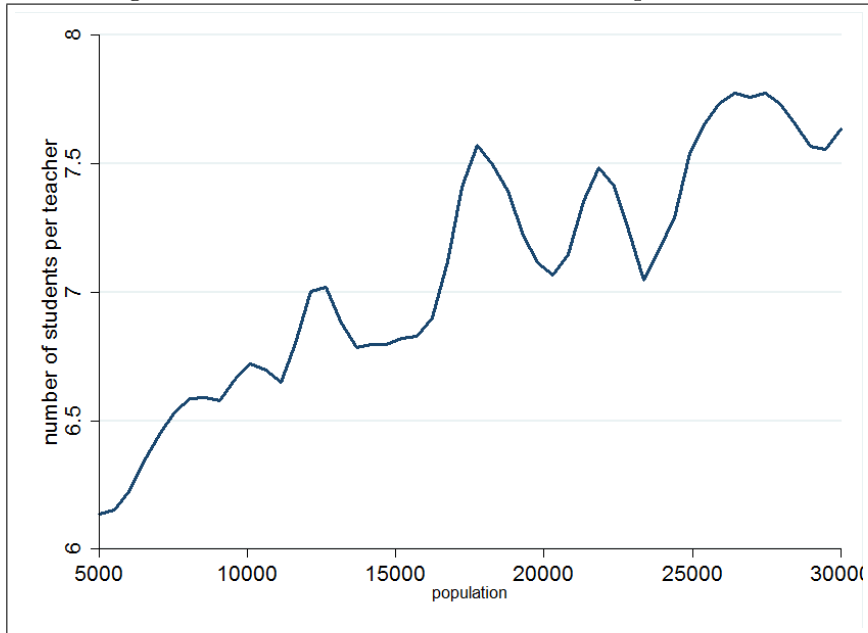


Figure 3: Percentage of public schools / teachers according to quality characteristics

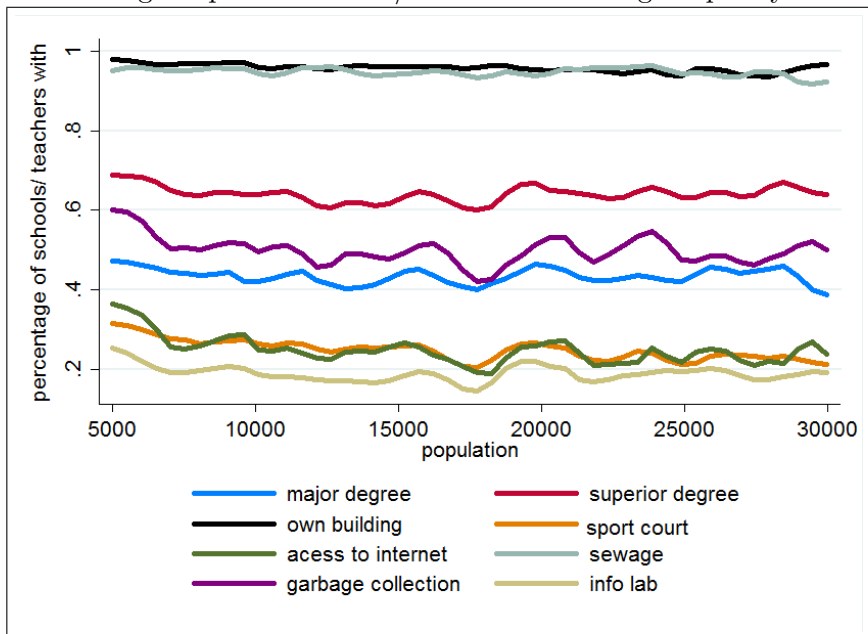


Figure 4: FPM municipal share and population

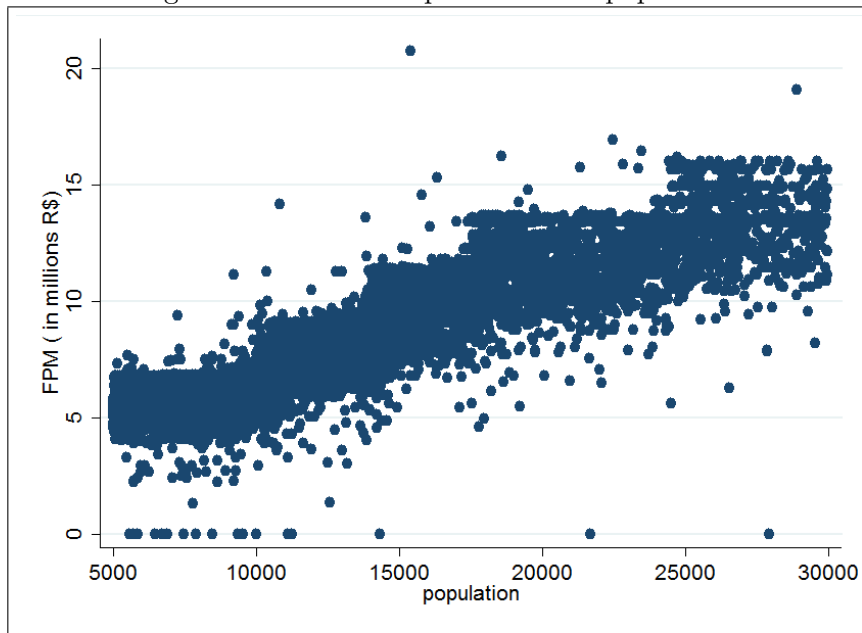


Figure 5: FPM distribution near the population thresholds

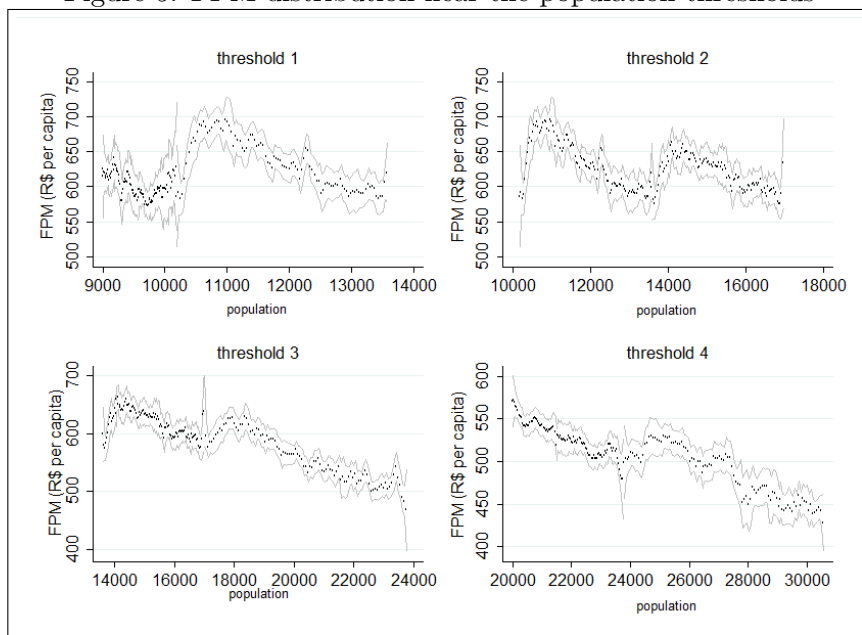


Table 1: Impacts of FPM on education spending - RDD estimates

R\$/R\$	education level					
	education	primary	secondary	professional	high	childhood
threshold 1: 10,188						
FPM	0.81***	0.61***	0	0	0.02***	0.11***
R <sup>2</sup>	0.03	0.05	0	0	.	.
Obs	1487	1487	1487	1487	1487	1487
threshold 2: 13,584						
FPM	0.84***	0.69***	0.01	0	0.01***	0.10***
R <sup>2</sup>	0.09	0.08	.	0	.	.
Obs	1079	1079	1079	1079	1079	1079
threshold 3: 16,980						
FPM	1.13***	0.89***	0.01	0.01	0.03*	0.09***
R <sup>2</sup>	0.06	0.08	0	0	.	.
Obs	807	807	807	807	807	807
threshold 4: 22,772						
FPM	1.40***	1.06***	0	-0.01	-0.02	0.18***
R <sup>2</sup>	0.07	.	0.01	0	0.03	.
Obs	530	530	530	530	530	530

\* $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$  We use per capita values of FPM, in logarithm.

Table 2: Impacts of primary education spending on public schools conditions - OLS with all the data

	schools' services						
	alimentation	sewage	water	light	garbage collection	lab info	
primary education	0.01***	-0.03***	-0.00*	-0.04***	-0.11***	-0.02***	-0.07***
population	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***
pop <sup>2</sup>	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
constant	0.91***	1.15***	1.01***	1.26***	1.53***	1.12***	0.90***
R <sup>2</sup>	0.08	0.01	0.01	0.04	0.06	0.02	0.04
Obs	12445	12445	12445	12445	12445	12445	12445
	schools' structure						
	sport court	biblio	tv	tv projector	number pc	internet	
primary education	-0.09***	-0.12***	-0.10***	-0.10***	-1.05***	-0.11***	-0.07***
population	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***
pop <sup>2</sup>	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
constant	1.07***	1.40***	1.52***	1.23***	14.79***	1.23***	1.41***
R <sup>2</sup>	0.04	0.07	0.06	0.07	0.04	0.04	0.04
Obs	12445	12445	12445	12445	12445	12445	12445
	teacher's qualification						
	number of students per teacher	major degree	bachelor	secondary	primary	professional course	
primary education	0.43***	0	-0.12***	0.12***	0.00***	-0.06***	-0.00*
population	0.00***	-0.00***	-0.00***	0.00***	0.00***	-0.00**	-0.00***
pop <sup>2</sup>	-0.00***	0.00***	0.00***	-0.00***	-0.00***	0.00**	0.00***
constant	2.17***	0.58***	1.67***	-0.65***	-0.02***	1.01***	0.01***
R <sup>2</sup>	0.08	0.01	0.08	0.08	0	0	0
Obs	12445	12445	12445	12445	12445	12445	12445

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$  We use per capita values of primary education spending, in logarithm.

Table 3: Impacts of primary education spending on public schools conditions - FE with all the data

	schools' services						
	alimentation	sewage	water	light	garbage collection	lab info	
primary education	0.02***	0	0	0.00**	0.01***	0	0.02***
population	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***
pop <sup>2</sup>	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
constant	0.88***	0.97***	1.00***	0.97***	0.67***	0.99***	0.31***
Obs	12445	12445	12445	12445	12445	12445	12445
	schools' structure						
	sport court	biblio	tv	tv projector	number pc	internet	
primary education	0	-0.05***	0.03***	0.01***	0.46***	0.02***	0
population	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***
pop <sup>2</sup>	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
constant	0.42***	0.92***	0.67***	0.48***	4.60***	0.38***	0.95***
Obs	12445	12445	12445	12445	12445	12445	12445
	teacher's qualification						
	number of students per teacher	major degree	bachelor	secondary	primary	professional course	
primary education	-0.27***	0	-0.02***	0.02***	0.00**	-0.06***	0
population	0.00***	-0.00***	-0.00***	0.00***	0.00**	-0.00**	-0.00***
pop <sup>2</sup>	-0.00***	0.00***	0.00***	-0.00***	-0.00**	0.00**	0.00***
constant	6.79***	0.58***	0.98***	0.01	0	1.01***	0.01***
Obs	12445	12445	12445	12445	12445	12445	12445

\* $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$  We use per capita values of primary education spending, in logarithm.

Table 4: Impacts of primary education spending on public schools conditions - 2SLS with all the data

	schools' services						
	alimentation	sewage	water	light	garbage collection	lab info	
primary education	0.05***	0.20***	0	0.18***	0.87***	0.11***	0.68***
population	-0.00***	0.00***	-0.00***	0.00***	0.00***	0.00***	0.00***
pop <sup>2</sup>	0	-0.00***	0.00***	-0.00***	-0.00***	-0.00***	-0.00***
constant	0.71***	-0.34**	1.03***	-0.17	-4.81***	0.26**	-3.93***
Obs	12445	12445	12445	12445	12445	12445	12445
	schools' structure						
	sport court	biblio	tv	tv projector	number pc	internet	
primary education	0.66***	0.74***	0.65***	0.77***	12.51***	0.97***	0.41***
population	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
pop <sup>2</sup>	-0.00***	-0.00**	-0.00**	-0.00***	-0.00***	-0.00***	-0.00***
constant	-3.83***	-4.21***	-3.32***	-4.42***	-73.12***	-5.74***	-1.72***
Obs	12445	12445	12445	12445	12445	12445	12445
	teacher's qualification						
	number of students per teacher	major degree	bachelor	secondary	primary	professional course	
primary education	-4.27***	0.80***	0.26***	-0.25***	-0.02***	0.59***	0.01***
population	0	0.00***	0	0	-0.00***	0.00***	0
pop <sup>2</sup>	0.00***	-0.00***	0	0	0.00***	-0.00***	0
constant	32.64***	-4.59***	-0.84***	1.72***	0.12***	-3.22***	-0.04***
Obs	12445	12445	12445	12445	12445	12445	12445

\* $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$  We use per capita values of primary education spending, in logarithm.



Table 5: Impacts of primary education spending on public schools conditions - threshold 1

	schools' services					
	alimentation	sewage	water	light	garbage collection	lab info
primary education	0.13	0.42	-0.01	0.3	0.53	0.44
population	0	0.01	0	0.01	0.01	0
pop <sup>2</sup>	0	0	0	0	0	0
constant	5.34	-31.48	2.03*	-26.85	-56.67	-22.01
Obs	461	461	461	461	461	461
	schools' structure					
	sport court	biblio	tv	tv projector	number pc	internet
primary education	0.25	0.04	0.08	0.22	8.08	0.77
population	0	0	0	0	0.08	0.01
pop <sup>2</sup>	0	0	0	0	0	0
constant	-7.17	-2.24	-19.41	-13.7	-417.77	-38.73
Obs	461	461	461	461	461	461
	teacher's qualification					
	number of students per teacher	major degree	bachelor	secondary	primary	professional course
primary education	-5.28	1.83	-0.47	0.5	-0.03	1.72
population	0.04	0	-0.01	0.01	0	0.03
pop <sup>2</sup>	0	0	0	0	0	0
constant	-178.92	13.56	29.51	-28.75	0.25	-141.63
Obs	461	461	461	461	461	461

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$  We use per capita values of primary education spending, in logarithm.

Table 6: Impacts of primary education spending on public schools conditions - threshold 2

	schools' services					
	alimentation	sewage	water	light	garbage collection	lab info
primary education	-0.53	1.64	-0.08	0.12	6.46	3.74
population	-0.01	0.01	0	0	0.06	0.04
pop <sup>2</sup>	0	0	0	0	0	0
constant	59.77	-111.14	2.46	-21.05	-471.12	-292.58
Obs	356	356	356	356	356	356
	schools' structure					
	sport court	biblio	tv	tv projector	number pc	internet
primary education	4.23	4.47	3.81	4.34	96.39	4.44
population	0.04	0.04	0.04	0.04	0.97	0.05
pop <sup>2</sup>	0	0	0	0	0	0
constant	-297.21	-332.76	-285.35	-330.06	-7267.76	-343.39
Obs	356	356	356	356	356	356
	teacher's qualification					
	number of students per teacher	major degree	bachelor	secondary	primary	professional course
primary education	-36.22	3.86	-1.43	1.8	-0.37	4.99
population	-0.32	0.04	-0.01	0.01	0	0.04
pop <sup>2</sup>	0	0	0	0	0	0
constant	2401.55	-286.08	69.32	-89.81	21.49	-297.95
Obs	356	356	356	356	356	356

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$  We use per capita values of primary education spending, in logarithm. We use the percentage municipal primary schools for each variable, except

Table 7: Impacts of primary education spending on public schools conditions - threshold 3

	schools' services					
	alimentation	sewage	water	light	garbage collection	lab info
primary education	0.05	-0.13	-0.1	0.13	0.72	0.31
population	0	0	0	0	-0.01	0
pop <sup>2</sup>	0	0	0	0	0	0
constant	12.73	17.68	5.18	34.3	57.73	13.35
Obs	242	242	242	242	242	242
	schools' structure					
	sport court	biblio	tv	tv projector	number pc	internet
primary education	-0.04	-0.25	0.22	-0.04	2.27	0.19
population	0	0	-0.01	-0.01	-0.04	0
pop <sup>2</sup>	0	0	0	0	0	0
constant	25.41	40.97	106.25	67.31	303.92	11.86
Obs	242	242	242	242	242	242
	teacher's qualification					
	number of students per teacher	major degree	bachelor	secondary	primary	professional course
primary education	-7.51	0.11	-0.65	0.65	0	0.18
population	0.03	0	0.01	-0.01	0	0.01
pop <sup>2</sup>	0	0	0	0	0	0
constant	-224.29	-19.84	-82.41	84.75	-1.34	-48.17
Obs	242	242	242	242	242	242

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$  We use per capita values of primary education spending, in logarithm.

Table 8: Impacts of primary education spending on public schools conditions - threshold 4

	schools' services					
	alimentation	sewage	water	light	garbage collection	lab info
primary education	-0.82	-2.89	-0.45	-1.02	3.24	-3.93
population	-0.01	-0.03	0	-0.01	0.05	-0.04
pop <sup>2</sup>	0	0	0	0	0	0
constant	129.89	371.77	60.21	95.21	-549.03	435.84
Obs	189	189	189	189	189	189
	schools' structure					
	sport court	biblio	tv	tv projector	number pc	internet
primary education	-5.36	-6.61	-5.08	-1.89	-78.45	0.16
population	-0.06	-0.06	-0.05	-0.01	-0.63	0.01
pop <sup>2</sup>	0	0	0	0	0	0
constant	674.27	743.45	581.54	176.77	7760.84	-78.03
Obs	189	189	189	189	189	189
	teacher's qualification					
	number of students per teacher	major degree	bachelor	secondary	primary	professional course
primary education	12.03	5.62	-4.29	4.22	0.07	14.88
population	-0.12	0.04	-0.05	0.05	0	0.15
pop <sup>2</sup>	0	0	0	0	0	0
constant	1347.13	-537.9	608.79	-600.57	-7.22	-1869.65
Obs	189	189	189	189	189	189

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$  We use the logarithm of primary education spending.