Working Paper | 387 | Abril de 2015

FGV | SAO PAULO SCHOOL OF ECONOMICS

Accountability and yardstick competition in the public provision of education

Rafael Terra

Enlinson Mattos

Accountability and yardstick competition in the public provision of education

Rafael Terra *
University of Brasilia

Enlinson Mattos †
São Paulo School of Economics

April 21, 2015

Abstract

This paper explores the institutional change introduced by the public disclosure of an education development index (IDEB, Basic Education Development Index) in 2007 to identify the effect of education accountability on yardstick competition in education spending for Brazilian municipalities. Our results are threefold. First, political incentives are pervasive in setting the education expenditures. The spatial strategic behavior on education spending is estimated lower for lame-ducks and for those incumbents with majority support at the city council. This suggests a strong relation between commitment and accountability which reinforces yardstick competition theory. Second, we find a minor reduction (20%) in spatial interaction for public education spending after IDEB's disclosure — compared to the spatial correlation before the disclosure of the index. This suggests that public release of information may decrease the importance of the neighbors' counterpart information on voter's decision. Third, exploring the discontinuity of IDEB's disclosure rule around the cut-off of 30 students enrolled in the grade under assessment, our estimates suggest that the spatial autocorrelation — and hence yardstick competition — is reduced in 54%. Finally, an unforeseen result suggests that the disclosure of IDEB increases expenditures, more than 100% according to our estimates.

Keywords: education spending; yardstick competition; electoral and educational accountability.

JEL classification: C21; H72; H73.

*Address: University of Brasília, Economics Department, FACE,Campus Darcy Ribeiro, Brasilia, Brazil, 70910-900 , telephone: 55-61-3107-0807, e-mail: *rterra@unb.br*.

†Address: São Paulo School of Economics, Getúlio Vargas Foundation 474 Itapeva St., 01332-000, São Paulo, Brazil, telephone: 55-11-3799-3350, e-mail: *Enlinson.Mattos@fgv.br*.

1 Introduction

Information asymmetry between voters and politicians is known to be a building block for the well-established models of political agency.[1] In this framework, voters try the best that they can to find ways to improve their information on the incumbent. One possibility to determine the quality of the incumbents (agents), consists of voters (principals) evaluating the incumbents' performance in terms of tax levels and amount (and/or quality) of public services by comparing them to those of neighboring jurisdictions, where information is easily accessible. In turn, the incumbents, the better informed part, would then engage in yardstick competition to signal their performance to the voters (Salmon 1987).

A large empirical literature interested in testing the nature of strategic interaction between jurisdictions, both in case of expenditure and tax-setting, has been produced.[2][3] Most of these studies relates the degree of yardstick competition to a range of political incentives (Bordignon et al. 2004, Geys 2006, Allers and Elhorst 2005). However, exogenous changes to the information asymmetry are something much less explored and, to the best of our knowledge, there is no empirical study that has explicitly investigated yardstick competition in the context of education expenditures [4], nor verified the effect of reinforcing the educational accountability on the strategic choice of this type of expenditure. The only exception is Revelli (2006) which exploits an institutional reform taking place in the UK to address that the spatial pattern observed in welfare policy is at least partially driven by yardstick competition. [5] Our work contributes to the literature by providing additional evidence on the role of national disclosure of performance ratings of local governments on their relative performance.

This paper uses a panel of Brazilian municipalities (ranging from 2003 to 2011) to test whether the local level disclosure occurred in mid-2007 of the Brazilian Basic Education

[1] See Ferejohn (1986), Alesina and Cukierman (1990), and Persson et al. (1997).

[2] For studies on strategic spending-setting, see Revelli (2006), Elhorst and Fréret (2009), Case et al. (1993) and Bivand and Szymanski (2000). For studies on strategic tax-setting, see Besley and Case (1995), Bordignon et al. (2003), Revelli (2008), Allers and Elhorst (2005), Sollé Ollé (2003), Revelli (2002), Ladd (1992) and Revelli (2001).

[3] Other dimensions of public policy can be of interest to voters. Geys (2006) notes that voters may care about the efficiency in the production of local public services, i.e. about the level of public services given the taxes they face. Rincke (2009), on the other hand, observe that voters may also value the adoption of new technologies for public services provision, thus evaluating the incumbents' relative performance also in terms of their innovative ability.

[4] Although Rincke (2009) relates the adoption of educational innovations with yardstick competition, the author overlooks the phenomenon in the expenditure-setting.

[5] Similar effects can be found by changing the rules for the concession to operate a public service (Bivand and Szymanski 2000).

Development Index (IDEB, in its Portuguese acronym) diminished the spatial interaction between jurisdictions in terms of education spending, which could be attributed to the reduction of the information asymmetries regarding the quality of education. A robustness tests is conduct with legislative expenditures, a category that tends to present little complementarity with education. This is carried on so as to rule out the possibility that the estimates are the result of a phenomenon that is common to any type of expenditure in the post-disclosure period. We also estimate the effect of IDEB disclosure on yardstick competition using a cross section of data and exploring a rule defined by the Ministry of Education. This exogenous rule prevents schools with less than 30 students enrolled in the grade under evaluation from participating in the exam that measures the proficiency levels that will make up the IDEB. In fact, even schools that participate in the exam, but where less than 30 students attended school in the day of the exam, did not have their IDEB disclosed. Thus, we estimate an alternative version of regression discontinuity design, where our interest lies on shifts in the spatial correlation coefficient rather than on the intercept. This approach also admits that IDEB disclosure may not be exogenous. Decisions to participate on the assessment and disclosure of the index may be endogenous as jurisdictions are free to participate or not (even though the vast majority do participate).

The usual framework in this literature is the political agency-model, where voters (principals) are not aware of the true costs of providing public services and are imperfectly informed about the quality of incumbents (agents). Besley and Case (1995) argue that because of this information asymmetry, the voters can mistake the incumbents' attempt at rent appropriation for negative economic shocks, thus being unable to distinguish the "good" and the "bad"-type incumbents, i.e., those that will or will not try to charge rent on top of the provision cost of the public services. Thus, the incumbents that are considered to be the bad type, if they are willing to try for reelection, should not set taxes to a point where it becomes evident to the voters that they are trying to charge rent. To evaluate the incumbent's performance (or the incumbents' type), the voters then compare own levels (or quality) of public services and/or taxes with those of the neighboring jurisdictions, where information is more easily accessible from the media or through other means.[6][7] To signal their performance to their voters, the perfectly informed incumbents then engage in competition with

[6]See Strömberg (2004) and Revelli (2008) about the role of the media in providing the voters with information.

[7]Salmon (1987) and Case et al. (1993) stress that voters and incumbents do not necessarily need to compare their jurisdiction's performance to the neighboring jurisdictions. Instead, the comparison can occur between similar jurisdictions, where similarity is defined in terms of a wide range of characteristics such as population, income and ethnic composition, to name a few.

the neighboring jurisdictions by mimicking each other's fiscal behavior.[8] Finally, if yardstick competition improves voters' power to discipline politicians and make bad incumbents willing to pool with good ones, it can be shown that it will be welfare enhancing compared to a situation where voters ignore the fiscal performance of the neighboring jurisdictions.

Conversely, Bordignon et al. (2004) warn that yardstick competition might not necessarily lead to greater interaction between jurisdictions. The existence of yardstick competition could dampen the incentives for the bad incumbents to pool with good ones, i.e., to choose a level of rent that is not so high as to allow the voters to perfectly identify them. Bad incumbents could prefer to extract the most rent that they can in the first term and then be voted out of office rather than mimic the good incumbents' behavior to increase the odds of an uncertain reelection (and only then divert the most rent that they can). Thus, yardstick competition can in fact decrease the amount of strategic interaction between local governments.

Besley and Smart (2007) also observe that yardstick competition can be welfare diminishing when compared to a situation where the voters ignore the fiscal performance of their neighbors. When the voters know both the reputation of the neighbors' incumbents and their fiscal situation, it becomes harder for the bad incumbents to hide their type, thus inducing them to extract the most rent that they can while in office.

In case the officials are not running for reelection by force of law, i.e., they are lame-ducks, voting will no longer enforce discipline, and some will set the level of taxes and expenditures that maximizes rent extraction. Thus, the lame-duck incumbents, in principle, should not have incentives to use their neighbors' performance as a benchmark (Besley and Case 1995). The same reasoning could be applied to the incumbents on the edge of retirement and those not running for reelection because of the determination of the party. As argued by Alesina and Spear (1988), it could be the case that the lame-ducks have some partisan interest that prevents them from attempting the maximum rent extraction, but the expected amount of spatial interaction should still be smaller. Considering that holding the majority of seats at the city council implies having the support of the majority of voters, the size of the majority can also change the pattern of interaction among the jurisdictions (Allers and Elhorst 2005, Elhorst and Fréret 2009). Other factors that can induce changes in the interaction between

[8]The same conclusions can be reached using other frameworks. Revelli and Tovmo (2007), for example, rely on a bureaucracy agency-model with welfare-maximizing politicians (principals) and self-interested bureaucrats (agents). The information about the true cost of providing public services is asymmetric, and to attain efficiency, the principals compare their own public service production with that observed in neighboring jurisdictions.

jurisdictions are the votes received in the last election (Besley and Case 1995, Sollé Ollé 2003), the existence of coalition (Geys 2006) and the ideology (Allers and Elhorst 2005, Sollé Ollé 2003). These aforementioned political and institutional features are necessary to identify yardstick competition because the presence of fiscal spatial interaction in itself may reflect competing phenomena, such as tax or welfare competition (Brueckner 2003). [9]

The results show, first, that political motivation seems to be pervasive in setting the education expenditures. Incumbents with majority support in the legislative and in their last term in office are less engaged in strategic interaction. These are evidence that yardstick competition is present in education spending. Second, the spatial interaction in the education spending has reduced in the post disclosure period, suggesting a decrease in the importance of local information spillovers. A robustness test suggests that the legislative expenditure — that is usually neither substitute nor complementary with education — do not present the same behavior, reinforcing the validity of the results. Finally, we find that the spatial correlation is higher where the number of students is smaller. This means that only within a sufficiently small bandwidth around the cut-off of 30 students we can rely on the independence between the disclosure variable and other observable and non-observable variables. We assess the results in small bandwidths of $h = 5, 6$ and 7 students around the cut-off and find evidence of higher spatial correlation between municipalities to the left of the cut-off,i.e. where IDEB was not disclosed.

In principle, the effects of disclosing the standardized tests results on the spending interaction patterns are unclear. The relationship between education spending and education quality (measure by students achievement) still remains largely unknown to the voters, public officials and even to the academics. As noted by Hanushek (1986, 1996, 2006), the lack of information about the educational production function causes officials to employ financial resources on inputs that have little or no role in determining the educational output. Besides, the officials' objective is not necessarily to be efficient in educational matters. Not surprisingly, educational spending and students' performance do not necessarily go together.[10]

[9] See Brueckner (2003). A tax reduction on capital, for example, raises the net-of-tax return on capital. As a mobile factor within a limited geographic area, there will be an inflow of capital to the jurisdiction to equalize the net-of-tax return. To avoid loosing tax base, the other jurisdictions engage in a local "race to the bottom" in terms of taxes, which reflects on a tax-mimicking process and greater spatial autocorrelation. Finally, if there is a balanced budget, the expenditures will follow the pattern verified in the taxes. Similarly, with mobile labor force within a limited geographic area, an increase in the value of welfare benefits distributed to the poor (occupied in low-skilled jobs) in one jurisdiction will attract unskilled labor from the surroundings so as to equalize the gross income across jurisdictions, which can ruin the program. In order to keep their welfare programs functioning, local governments must not set their benefits higher than others. This also produces benefits-mimicking and spatial autocorrelation in expenditures.

[10] See Menezes-Filho and Pazzello (2007), Card and Payne (2002), Leuven et al. (2007) and Revelli (2009).

Thus, the effect of student's performance disclosure on yardstick competition is far from obvious, making it an empirical matter.

It is likely that prior to the disclosure of the students' achievement, the incumbents did not pay much attention to education quality because it was not objectively measured. Officeholders may have changed their attitudes after the average students' performances were made public at the local level. In fact, Firpo et al. (2011) find evidence for the Brazilian municipalities that higher average achievement increases the odds of the incumbents' reelection. Thus, once the schools' and the municipalities' performances were made public, one could ask whether the incumbents changed the patterns of education spending as though there was a deterministic relationship between students' achievement and expenditures or even if they did nothing because they lack the knowledge on what is effective in improving education quality.

This paper is organized as follows. Section 2 discusses the institutional background of Brazilian' IDEB. Section 3 presents the data set description. Section 4 presents the estimation strategy and Section 5 shows the results of the spatial models and the robustness tests. Finally, section 6 concludes.

2 Institutional background

Below we describe the institutional aspects of Brazil that help to understand this paper. First we briefly describe the recent accountability experience in Brazil. Then we describe the public finance of local governments and the political system.

2.1 Educational Accountability

Educational accountability is a relatively new concept in Brazil. Only after 1995, with the implementation of the National System of Basic Education Assessment (known by its Portuguese acronym SAEB), we could follow the quality of the Education, but only at the state level. It was only after the creation of IDEB that we could follow the educational quality at the school or municipality level.

The IDEB is an index that measures the overall quality of education in schools and municipalities in a intelligible and direct manner. The index is defined as $IDEB_{ijt} = P_{ijt}A_{ijt}$,

where P_{ijt} stands for the average performance in the math and reading exams of *Prova Brasil* in unit i in stage of education j in period t.[11] The term A_{ijt} reflects the school passing rate and varies between 0 and 100%.[12] The index has been standardized to lie in the interval between 0 and 10, wherein 6 corresponds to the average achievement of the OECD students (based on the results of the 2003 edition of PISA).

The index was first released on April 26th, 2007 by the decree n. 6094, known as the "Plan of Goals All Committed to Education". This decree established goals for the IDEB of each school and municipality. The plan envisaged sub national governments voluntarily signing an agreement wherein they commit themselves to achieve gradually increasing goals. The Federal Government, in exchange, provides the municipalities with technical support and orientation about the best practices that could increase students' achievement. The idea is to make society monitor the accomplishment of the goals, reinforcing the sense of accountability towards local educational quality and diminishing the information asymmetry regarding the incumbent's quality. The final purpose of the Federal Government is that, by 2021, the average IDEB in Brazil equals to 6.0, i.e., the average performance of the OECD students. [13]

2.2 Local Public Finance and Education Funding

Brazil is a federal state that is characterized by the union of 27 states (including the Federal District) and 5,565 municipalities. There is substantial decentralization in the provision of public services. The municipalities are primarily in charge of the provision of urban sanitation, roads conservation, traffic control, health services, regulation of land use, early childhood and fundamental education (the last being equivalent to the first 9 years of K-12 education). The states' provision of public services focuses on high school (although in some municipalities, the states also maintain fundamental education schools), higher education, public safety, water provision and sewage collection and treatment. The National Govern-

[11] Every two years, the exam assesses the math and the reading skills of 5^{th} and 9^{th} graders (in primary education) of public schools.

[12] Note that there is a trade-off between the performance and the passing rate. Artificially increasing the pass rates to obtain a higher IDEB will cause the less prepared students to be promoted to the next grade, thus reducing the component of the IDEB that measures the performance on the standardized exams. This methodology used to build the index (combining achievement and passing rate) intended exactly that, i.e., to improve the students' achievement and lower grade retention simultaneously.

[13] This spontaneous participation in the "Plan of Goals" fits perfectly with the objectives of the present work. If the participation was legally enforced, the jurisdictions could still reduce the interactions in the provision of public education, but less because of the incumbents' need to signal their type to the voters and more because non-compliance with the law could bring them legal consequences.

ment focuses on the provision of services of broad interest such as social security, energy, defense, higher education and the public policies aimed at economic development.

Conversely, the power to tax is only weakly decentralized. As of 2011, the majority of municipalities raised very little revenue through own instruments, amounting to only 6.6% of total revenue. The municipalities' main instruments of taxation are the property tax (1.15% of total revenue), the tax on services (2.97% of total revenue), the payroll tax on own employees (1.04% of total revenue), fees regarding services such as garbage collection, street lighting among others (0.62% of total revenue), the tax on the transmission of property ownership (0.76% of total revenue), and other sources of revenue (0.07% of total revenue).[14]

The municipalities' main sources of revenues are intergovernmental transfers, such as the block grant known as the Municipalities' Participation Fund or FPM (40% of total revenue); the categorical grant for the financing of health services also known as the Unified Health System or SUS (7.26% of total revenue); the categorical grant for education known as the Fund for the Maintenance and Development of Basic Education and Valuation of Teaching or FUNDEB (18.07% of total revenue); and 1/4 of all of the state indirect tax on the circulation of goods and services (also known as ICMS) collected within the municipality's borders (18.14% of total revenue).

Local education spending is financed by FUNDEB (a categorical grant) and by sources over which the municipalities have discretion; therefore, it can vary according to the local demand for education. The discretionary sources come from FPM — which is funded by 22.5% of the total federal income tax and the same percentage of the total federal indirect tax on industrialized products known as IPI —, the municipalities' share of the ICMS, and the revenues collected through own instruments.

FUNDEB funding scheme is quite complicated in that a different fund is formed by each state and several sources make up the funds. It gathers 15% of its revenues from both the FPM and the States' Participation Fund (also known as FPE), 15% of the IPI owed to states, the same share of the ICMS owed to both the states and the municipalities, among other less important sources. This latter source provides the most important contribution to the fund, at approximately 60% of the total.

After each state receives all of the resources that make up FUNDEB, they divide the amount by the number of students to proportionally distribute the money to the municipalities. If the amount per student is inferior to a minimum value that is defined each year by

[14]Data are obtained from the National Treasury Office.

executive act, the Federal Government complements the state fund to reach this minimum. Before 2007, FUNDEB, then known as "Fund for the Maintenance and Development of Fundamental Education and Valuation of Teaching or FUNDEF", was targeted at students in the primary education. From 2007 on, FUNDEB was reformulated to encompass also preschool, kindergarten and high school students.[15] The legal minimum amount of funds destined to the students changed significantly over the period we analyze. As of 2002 the minimum value to be transferred to students in the first stage (cycle) of the primary education was 418 reais (or 118.30 USD), whereas in 2011, this figure was equal $1.722,05$ reais (or 920.85 USD). The minimum values differ (though not by much) according to the educational stage that the students are enrolled in, whether they attend urban or rural schools and the state they reside.

Despite the importance of the categorical grants for educational financing, the large majority of the municipalities spend considerably more than the amount that they receive in the form of transfers.[16] In 2011, the total educational categorical grants amounted (on average) to 57,76% of the total educational expenditure of the municipalities. This spending in excess of the categorical grants indicates that the demand for education is higher than the grant would allow. To finance this difference, the municipalities rely mainly on revenues from the FPM (the main source) and from the share of ICMS that belongs to the municipality.

Finally, this overview shows the importance of the national and state indirect taxes for financing not only education but also all goods and services that are provided by the local governments. Contrary to many countries, where property tax is crucial for the determination of the local tax price and the demand for public services, in Brazilian municipalities this tax is of minor importance. Tax price must be mainly a function of the state and the national indirect taxes.

2.3 The Political System and Budget Approval

The municipalities in Brazil are governed by a mayor incumbent who is elected for a 4-year term. Since the 2000 election, the incumbents have been allowed to run for a second and final term. The jurisdictions have elections decided by majority rule, with only 1 round

[15]The reformulation process involved an increase in the amount of resources devoted to constituting the fund. The per pupil amount, however, may have increased, decreased or stayed the same depending on the number of students in each stage of education, if they study in rural or urban areas, or if they study in full-time schools.

[16]In 2011, only 1.04% of the municipalities spent less than the amount received as educational categorical grant.

where there are less than 200,000 voters and 2 rounds otherwise.

Aldermen are elected for 4-year terms by an open-list proportional system and face no term limits. The same system applies to the state and federal legislatures, ultimately favoring the proliferation of parties. There are 29 parties that are currently active in Brazil, and even though some of them are identified with some ideology by the occasion of their foundation, once in office, they often must form coalitions with parties of different ideologies to build majorities in the legislature. This process ends up producing inconsistency between the public policies of the party in office and their ideology. In addition, Desposato (2006) shows that the party switching rate in the Brazilian chamber of deputies is higher than 40% (on average). Much of the switching can be attributed to the deputies' desire to broaden their access to public funds to finance pork barrel projects and to increase their odds of reelection. Thus, even though ideology is the driving force for a few parties, it is of secondary importance in general. At the local level, the inconsistency between party ideology and public policies is even more explicit because the local governments have a limited capacity to raise revenues; most of the resources come from intergovernmental transfers. This characteristic of the local public finance in Brazil favors studies on yardstick competition on spending rather than on tax-setting.

The aldermen are responsible for creating and changing the municipality's Organic Law, legislating on local subjects, and judging the budget that is submitted by the executive. The budget process is enforced by the Fiscal Responsibility Act, which requires the local executives to elaborate a 4-year plan of action (multi-annual plan) with objectives, units in charge of the execution of the projects, amount to be spent, total period of execution and revenue sources. The budget process also requires the elaboration and approval of a Budgetary Guidelines Law with the goals and priorities for the subsequent fiscal year (beginning in January). The final step consists of the local executive submitting the Annual Budget Law with the detailed revenues and expenditures that are expected for the next fiscal year to be voted and approved by the city council until the end of the fiscal year (in December). Thus, the new expenditures usually take a certain amount of time before being executed, which means that after the IDEB was disclosed in mid-2007, the effects on the spending behavior must have been observed only in the following year.

3 Data and Variables

Data on the Brazilian municipalities range from 2003 to 2011. This period was one with little institutional change in the education sector besides the introduction of Prova Brasil, IDEB and the "Plan of Goals All Committed to Education". Thus, restricting the analysis to this period we avoid confounding institutional changes that may affect the estimates. Data are available for 3,723 — out of the 5,565 — municipalities. The dependent and independent variables are described in Table 1, and the descriptive statistics are presented in Table 2. The continuous variables (and indexes) enter the econometric model (see equation 1 below) in their logarithmic form, whereas the proportions and the dummy variables enter the model unchanged.

The educational spending per pupil is made available by the National Treasury Office (STN). Figure 1 shows the remarkable evolution of education spending over the period. Several factors contributed to this increase. The economic growth and the increasing efficiency of tax collection ultimately increased the available revenue. Additionally, over the last decade, there has been a growing concern regarding investment in basic education.

Table 1: Description of the variables

variable	**Description**	**source**
Dependent Variable (y)		
education spending	Education spending per pupil enrolled at the local public school system per year.	FINBRA-STN
Controls (X)		
IDEB Disclosure Period (T_{0811})	IDEB disclosure variable equal to 1 from 2008 on and 0 otherwise	-
IDEB disclosure(D)	Refers to the year of 2008. It consists of a dummy variable equal to 1 for municipalities that had their IDEB disclosed — in the previous year — and 0 otherwise.	INEP-MEC
gdp	Gross domestic product per capita (net of public sector activity). It is a proxy for total income (unavailable for the period) and for own revenue raising capacity.	IBGE
wage	Average wage of formal sector workers. It is a proxy for total income (unavailable for the period).	RAIS-MTE
occupation	Is given by the following expression $occupation = (occupied_j/total\ pop_j) \times 100$, where $occupied_j$ is the number of individuals between 25 and 65 years old occupied in the formal sector of municipality j, and $total\ pop_j$ is the total individuals of the same age living in the municipality j. It intends to control for the bias resulting from considering only the wage in the formal sector when that is used as a proxy for total income.	RAIS-MTE
categorical grant	Total grant per pupil received by the municipality with the specific purpose of education financing. Includes FUNDEB (previously FUNDEF) grants as well as any categorical grant targeted at education, such as the ones from intergovernmental agreements and voluntary (non-mandatory) transfers.	FINBRA-STN
block grant	Total grants per capita received through FPM. These general purposes block grants consist of the main source of municipal revenue.	FINBRA-STN

Continued on next page

Table 1 – *Continued from previous page*

variable	**Description**	**source**
tax price	$tax\ price = 100 \times (collected_j / municipal\ revenue_j)$, where $collected_j$ consists of taxes collected in the municipality$j$ by all levels of government through mostly indirect taxes on final goods and services, and $municipal\ revenue_j$ is the total revenue of the jurisdiction. It consists of a proxy for the real "tax price".	FINBRA-STN and IBGE
schooling	Average years of schooling.	RAIS-MTE
men	Percentage of male individuals.	DATASUS-MS
population	Total population.	IBGE
elderly	Percentage of individuals over 65 years old.	DATASUS-MS
young	Percentage of individuals under 18 years old.	DATASUS-MS
rural	Percentage of the local public schools' students attending schools in the rural area.	Education Census-MEC
second cycle	Percentage of local public schools' students attending the second cycle of fundamental education.	Education Census-MEC
competition	Number of candidates running for office.	TSE
incumbent's age	Age of the incumbent.	TSE
incumbent's education	Dummy variable assuming value of 1 if the incumbent finished higher education and 0 otherwise.	TSE
left	Dummy variable assuming value of 1 if the incumbent belongs to a left wing party and 0 otherwise. The following parties were considered to be left wing (in acronyms): PC do B, PT, PDT, PSTU, PCB, PSB, PCO,PPS, PSOL.	TSE
incumbent women	Dummy variable assuming value of 1 if the incumbent is a woman and 0 otherwise.	TSE
majority of seats	Dummy variable equal to 1 if the incumbent coalition holds more than 50% of the city council's seats.	TSE
percentage of seats	Percentage of seats held by the incumbent coalition at the city council.	TSE
president's party	Dummy variable equal to 1 if the incumbent's party is the same as the president's and 0 otherwise.	TSE
governor's party	Dummy variable equal to 1 if the incumbent's party is the same as the governor's and 0 otherwise.	TSE
lame-duck	Dummy variable equal to 1 if the incumbent is in his or her second and final term and 0 otherwise.	TSE
aldermen's education	Percentage of aldermen with higher education.	TSE
aldermen's age	Average age of the aldermen.	TSE
women in council	Percentage of women in city council.	TSE
competition for seats	Ratio of the number of candidates to the number of seats available at the city council.	TSE
fragmentation	It is calculated by the following formula:$fragmentation = 100 \times (1 - \sum_{i=1}^{N} p_i^2)$, where p_i is the share of seats held by each party i at the city council.	TSE
Other		
More than 30 students (z)	It is the excluded instrument that identifies the endogenous variable of IDEB disclosure D. It equals 1 whenever the number of students exceeds 30, and 0 otherwise.	Education Census-MEC
legislative spending	Legislative spending per inhabitant. It is used in a robustness test that checks whether there is a common strategic pattern in the setting of education expenditures and other non-related expenditure categories.	FINBRA-STN

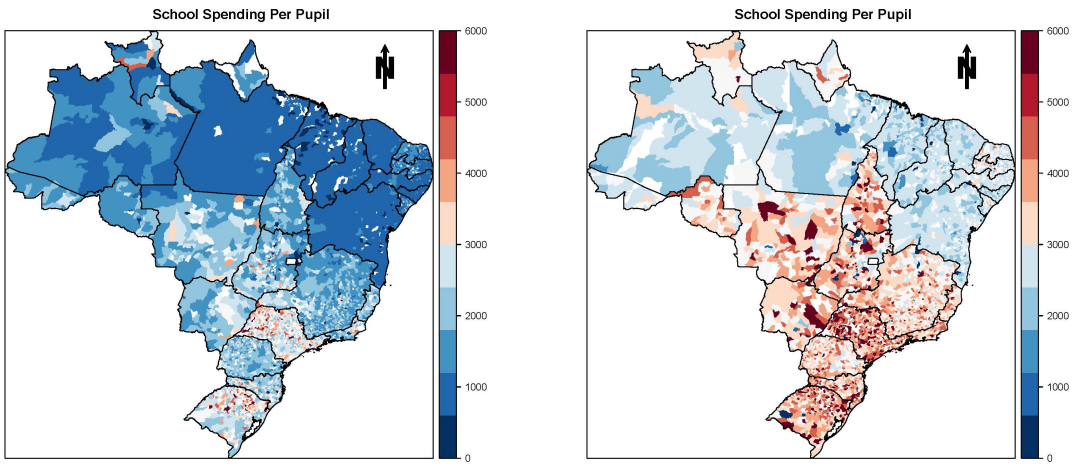
Notes: All monetary variables are measured in reais ($R$$).
In the econometric models, the continuous variables (and indexes) enter in their logarithmic form, whereas the proportions and the dummy variables enter the model unchanged.

On the left panel of figure 1, for the year of 2003, the spatial patterns are less clear due to the scale convention. The right panel, on the other hand, shows clearer spatial patterns and a striking difference in the levels of the per pupil spending between the municipalities to the north and those to the south.

Table 2 shows the descriptive statistics. There, we can see that the mean spending per pupil over the period between 2003 and 2011 was 3,157 reais (1,814 US dollars).[17] Note also that the standard deviation is expressive (2,094 reais or 1,203 US dollars), evidencing the large difference in education spending between Brazilian local governments.

Categorical and block grants are expected to have a positive impact on the level of education spending. For a number of municipalities that have a low revenue generating capacity, education grants are supposed to have a more pronounced impact because they cannot serve as substitutes for own revenue in the financing of other activities. Block grants, in turn, need not necessarily be employed on education; the amount directed to this area depends on the marginal propensity to spend on education, regardless of the fiscal capacity. Table 2 shows that the mean value of the categorical grants is 1,558 reais per pupil (or 895 US dollars). The block grant that is received by the municipalities amounts to 597 reais per capita (or 343 US dollars) on average. The variation in the grants' amounts between localities is also very expressive, as the standard deviations make clear.

[17]Prices are adjusted by the Amplified Consumer's Price Index (IPCA) to prices of December 2009. The exchange rate also refers to December 2009



(a) 2003 (b) 2011

Source: Elaborated by the author using FINBRA data for the years of 2003 and 2011.

Figure 1: Local level education spending per pupil

The "tax price" is an important variable in the public finance literature and usually reflects the share of local property taxes paid by the representative voter. However, property tax in Brazil is a minor source of local revenue. The most significant portion of revenues comes from block and categorical grants, — which are funded mainly through taxes such as the ICMS and the IPI — as well as from the direct participation of the municipality in the total ICMS revenue. The "tax price" we calculate for this paper takes these specificities into account by considering the ratio between the sum of the main taxes collected within the municipality's borders — whose main components are the state and federal indirect taxes known, respectively, as ICMS and IPI — and the total revenue of the jurisdiction. This variable tries to measure the cost of providing one monetary unit of public services that accrues to the local citizens. As observed from Table 2, the mean tax price is equal to 59.65%, which means that most of the municipalities are net receivers of public funds. The higher this ratio is, the less expenditure on education the citizens are expected to demand, as well as any other public service.

Table 2: Descriptive Statistics

	Obs	Mean	Std. Dev.	Min	Max
Dependent Variable (y)					
Education spending	33507	3157.905	2094.114	2.607	52239.800
Controls (X)					
IDEB disclosure (D)	3723	0.7810	0.4136	0	1
gdp	33507	10202.330	9950.686	1320.591	342932.900
wage	33507	809.635	252.696	133.823	4173.603
tax price	33507	59.656	127.829	1.484	9574.092
categorical grants	33507	1558.334	665.505	0.035	7228.740
block grants	33507	597.468	443.957	0.065	6088.622
schooling	33507	9.744	1.254	2.500	15.828
occupation	33507	21.701	15.334	0.033	386.523
men	33507	50.618	1.485	44.170	67.744
population	33507	29.015	85.330	0.811	2505.554
elderly	33507	7.613	2.392	0.548	21.564
young	33507	35.732	6.467	16.616	62.556
rural	33507	31.207	30.167	0.000	100.000
second cycle	33507	24.232	19.483	0.000	100.000
competition	33507	3.160	1.574	1.000	20.000
incumbent's age	33507	48.989	9.623	20.000	89.000
incumbent's Education	33507	0.434	0.496	0.000	1.000
left	33507	0.214	0.410	0.000	1.000
incumbent women	33507	0.071	0.258	0.000	1.000
aldermen's education	33507	16.968	16.521	0.000	100.000
aldermen's age	33507	43.755	3.879	28.617	59.999
women in council	33507	12.097	10.898	0.000	77.778
competition for seats	33507	6.031	3.687	1.000	30.333
fragmentation	33507	74.584	9.675	0.000	94.230
majority of seats	33507	0.610	0.488	0.000	1.000
president's party	33507	0.076	0.265	0.000	1.000
governor's party	33507	0.221	0.415	0.000	1.000
lameduck	33507	0.305	0.460	0.000	1.000
Other					
More than 30 students (z) 3723	0.832	0.374	0.000	1.000	
Legislative Expenditure (Sensitivity)	33507	49.538	38.451	0.000	535.800

The demand for public services is also a function of income. Borcherding and Deacon (1972) and Bergstrom et al. (1982) find that public education is a normal good, i.e., it is increasing in income. However, for the period under analysis, there is no information on the mean income of the municipalities. Fortunately though, some proxy variables are available, such as the GDP net of the public sector activities from IBGE, the average wage of formal sector workers from the Annual Relation of Social Information (RAIS) gathered by the Ministry of Labor and Employment, and an occupation index from the same source, which consists of the ratio between the number of formal sector workers between 25 and 65 years and the total number of individuals of the same age living in the municipality. Altogether, these three variables should capture the income effect on the demand for education. The average GDP per capita by municipality over the period is equal to 10,202 reais (5,859 US dollars) with significant dispersion. The average salary by municipality in the formal sector is 810 reais (465 US dollars), and the average percentage of people between 25 and 65 years

old employed in the formal sector is only 21.7%. [18]

Other variables are included as controls to capture the differences in taste for public education. For example, demographic variables such as the percentage of male, young and elderly individuals are related to tastes for public education. The proportion of men in the population is on average %50.62 and is included to account for the fact that men leave school for the labor market earlier than women.[19] Elderly people (that amount to 7.61% of the total population), in turn, often demand less education and more health expenditures. The predominance of young people (that amount to 35.73%), however, can have an ambiguous effect because it can either lead to a higher demand for education, as the localities will be populated by families with a strong preference for education expenditures, but it can diminish over time if the cohorts gets bigger and the amount of resources per pupil shrivels.[20] In addition, the years of schooling (9.74 years on average among the municipalities) is included to capture the preference of more educated individuals for more public education.

The population of the municipality (from IBGE) is considered in order to account for economies of scale in the provision of education. Thus, in principle, the greater the population, the lower the per pupil expenditure should be. However, big cities usually have higher costs of living that can affect the level of expenditures. Such phenomenon is difficult to be addressed because there are no indexes that capture such peculiarities for all municipalities.

The percentage of students enrolled in rural public schools and the percentage of students enrolled in the second cycle of the primary education (from 6th to 9th grade) at local public schools are included to take into account the differences in the amount of the categorical transfers that these students attending urban schools receive (from FUNDEF) in excess of those enrolled in the first cycle (from 1st to 5th grade) or in the Preschool. The proportion of rural students by municipalities is 31.2% on average. Of course, the majority of municipalities in Brazil have very small population with an important rural sector. On the other hand, few municipalities concentrates most of the population and are predominantly urban. Hence,

[18]Note that this proxy for occupation can be greater than the unity because the numerator refers to the total workers, while the denominator is restricted to the citizens living in the municipality. Since numerous cities are predominantly residential, while few concentrate the majority of the jobs, it is expected that few cities present indicators greater than the unity, whereas the majority present indicators smaller than 1. As we are averaging the indexes over the municipalities and since the small municipalities, that consist of the majority of the the municipalities, have a small proportion of formal jobs, the occupation rate in the formal sector must be underestimated.

[19]A report by the OECD (2009) shows that the difference in the upper secondary graduation rates of boys and girls in the appropriate age is especially remarkable in Brazil, at $71,9\%$ among girls and $53,2\%$ among boys.

[20]Poterba (1997) discuss briefly this subject.

the proportion of students in Brazil attending rural school is well bellow one third of the population.

The political variables included in the model are considered by the literature as important determinants of the level of expenditures. Left-wing governments, for example, prefer a larger public sector, i.e., higher expenditures[21], although in Brazil partisan ideology is not as well defined as in other countries.[22] Nevertheless, a dummy variable named "left" is included in the model to capture the possible differences in tastes for public expenditure in education. In addition, two dummy variables assigning incumbent's party alignment with presidents' or governors' parties account for the fact that the incumbents' partisanship is supposed to increase the amount of resources that they have access to.

We also include a variable of party fragmentation (see the description in Table 1). A more fragmented political system supposedly reflects the existence of various interest groups. According to Weingast et al. (1981), because the resources come from a common pool of taxation, any expenditure that is targeted at specific groups will have its costs equally divided among all groups, making the costs of the program not being fully internalize by the benefited groups, thus increasing the demand for public spending. Additionally, the incumbents can engage in pork barrel politics to overcome the difficulties imposed by a fragmented city council, increasing the spending level.

A dummy variable indicating the term of the incumbent (lame-duck or not) is also considered in the empirical model. Besley and Case (1995) argue that lame-duck incumbents have an adverse incentive to maximize rent extraction because they do not need to run for elections again, which would translate into higher taxes and expenditures in the last term in office.

Mukherjee (2003) estimates that the size of the majority can also affect the level of public spending.[23] Our strategy considers a dummy variable assigning the value of 1 when the party in office holds over 50% of the city council's seats (and 0 otherwise). This dummy variable controls for the average effect of the political majority on education spending. A set of incumbents' and aldermen characteristics that are intended to reflect their quality is also

[21] See Alt and Lowry (1994) and Sollé Ollé (2006).

[22] See Lucas and Samuels (2010).

[23] According to the author, weak majorities (greater than 50% and smaller than 56%) would lessen the need to engage in pork barrel politics and thus decrease the level of total expenditures. Conversely, strong majorities (between 56% and 68%) can diminish the risks of adopting loose fiscal policies and transfer the burden to non-majority members. However, when a super majority (greater than 68%) is reached, the burden cannot be passed on to the minority group because it is too small and increasing expenditures with a budget restriction means that the majority will have to cope with the costs of taxation.

included in the econometric model. One of these characteristics is the education of incumbents and aldermen, which can reflect their preferences regarding educational expenditures. Besley and Case (1995) also emphasizes the age of the incumbents as an important determinant of electoral outcomes and fiscal policy. Incumbents on the edge of retirement, who may be in office for a last term, have an incentive to extract more rents and thus increase taxes and spending levels. Therefore, both the age of incumbents and the mean age of the aldermen are used as additional controls.

Milyo and Schosberg (2000) demonstrates that because women face barriers to enter the office, and in the case they are chosen, they can be claimed to be of better quality. Therefore, we build two variables to capture this phenomenon: a dummy variable indicating whether the mayor is woman and the percentage of women in the city council.

Last, competition can lead to better quality incumbents as well. As the number of candidates for the position increases, the voters are better able to distinguish between good and bad candidates. As a result, the expected rent extraction is smaller, but we cannot determine unequivocally that better incumbents will tax and spend less. Accordingly, a variable that informs the number of candidates running for office and another that reflects the number of candidates per seat at the council are built.

4 Estimation Strategy

4.1 Post-IDEB Strategic Behavior

To identify changes in the expenditure-setting strategic behavior after the IDEB disclosure, the present paper rely on a Spatial Autorregresive model with an additional interaction term between the spatial lag and a dummy for the post-IDEB's disclosure period. The model below also represents the demand for education[24]. Assume

$$\begin{aligned} y_{it} = \alpha + \lambda_0 \sum_{j=1}^{N} W_{ij} y_{jt} + \lambda_1 D_{i,t} \sum_{j=1}^{N} W_{ij} y_{jt} + \\ X_{it}\beta + \mu_i + \tau_t + u_{it}, \end{aligned} \tag{1}$$

[24]See Borcherding and Deacon (1972) and Revelli (2006).

where y_{it} denotes education spending per pupil. Element $D_{i,t}$ represents a dummy that equals 1 from 2008 to 2011 and 0 otherwise (between 2003 and 2007). The W_{ij} term is the spatial weight assigned to unit j by the unit i defined by the contiguity criterion. The weights result from the row standardization of the $N \times N$ spatial weights matrix W_N such that $\sum_{j=1}^{N} W_{ij} = 1$ for the $i-th$ row. The neighbors' educational expenditure per pupil is represented by $\sum_{j=1}^{N} W_{ij} y_{jt}$. The coefficient λ_0 informs the spatial correlation before IDEB's disclosure and λ_1 informs the difference between the spatial correlation before and after the results of the index were made public, with $|\lambda_0|, |\lambda_1| < 1$ to ensure spatial stationarity. Vector X_{it} is $1 \times K$ and represents the demographic and political covariates, while β is a $K \times 1$ vector of corresponding parameters.

Element μ_i represents the spatial specific effects and is aimed at capturing the non-observable characteristics that do not vary over time but that are potentially correlated with the covariates in the model. A spatial Hausman test is performed to decide if μ_i is fixed or random. Common shocks to all municipalities at a given point in time are represented by τ_t, a set of year dummies, and the random component of the composite error is given by u_{it}.

We can estimate the spatial lag model in 1 either by maximum likelihood or by the instrumental variable approach. There are pros and cons with each method. The main advantage of the former method consists of being efficient and restricting the spatial parameter to lie between -1 and 1. On the other hand, if we have non-spherical disturbances, the maximum likelihood estimator of the spatial lag model will produce inconsistent standard error, unless we are able to model the disturbance autocorrelation and heterocedasticity.

If we estimate the model by maximum likelihood, we assume the error term is such that $u \sim \mathcal{N}(0, \sigma_u^2)$.[25] The Log Likelihood function that provides the estimates of the spatial parameters and the other coefficients is given by

$$\begin{aligned} lnL = & -NT/2 + ln(2\pi\sigma^2) + \sum_{t=1}^{T} ln|I_N - \lambda_0 W_N - \lambda_1 D_t W_N| \\ & - 1/(2\sigma^2) \sum_{i=1}^{N} \sum_{t=1}^{T} \Bigg[y_{it} - \lambda_0 \sum_{j=1}^{N} W_{ij} y_{jt} - \lambda_1 D_{it} \sum_{j=1}^{N} W_{ij} y_{jt} \\ & - \alpha - X_{it}\beta - \mu_i - \tau_t \Bigg]^2 \end{aligned} \tag{2}$$

[25] In fact, even if reject the null that the disturbances are normally distributed Lee (2004) shows that the parameters can be asymptotic and normally distributed under weak regularity conditions.

where D_t is a $N \times N$ diagonal matrix whose diagonal elements are the regime dummies D_{it} for each cross-sectional unit at time t. The parameters are then estimated by maximizing the profile likelihood function concentrated with respect to the parameters of the exogenous variables and the variance of the disturbance.[26]

Several other authors assume that voters react to the differences in fiscal policies due to observable characteristics, because they are not perfectly informed.[27] In this case the spatial lag model would be preferable. On the other hand, Bordignon et al. (2003) argue that the spatial correlation in the error term makes more sense than spatial correlation in the dependent variable. The authors reason that voters have enough information to not be influenced by differences between jurisdictions' tax and expenditure levels due to observable characteristics. Instead, they are more likely to evaluate neighbors' unexpected changes in public policies.[28] In this case, the appropriate model to identify yardstick competition would be one of the spatial error type. Ultimately, though, the choice of the model type can be seen as an empirical issue that is made based on the robust LM lag and the LM error tests proposed by Anselin et al. (1996).

If we confront spatial lag and spatial error models, the former has the advantage of producing consistent estimates of the coefficients even when it is not the correct model. If there is autocorrelation in the residuals, the coefficients' standard errors will be inconsistent. One safe alternative to get valid coefficients and standard errors is to estimate the spatial lag model by the Generalized Method of Moments with heterocedasticity and autocorrelation consistent covariance matrix (GMM-HAC). Note, however, that differently from the Maximum Likelihood model, the instrumental variable approach does not restrict the spatial parameter to lie between -1 and 1.

In order to represent the GMM model, let the spatial matrix be such that $W = I_T \otimes W_N$, and $H = [1,\ Wy,\ DWy,\ X,\ \tau]$ be the $NT \times L$ matrix of regressors, $\delta = [\alpha,\ \lambda_0,\ \lambda_1,\ \beta,\ \kappa]'$ be the $1 \times L$ vector of parameters, and let $Z = [1,\ WX,\ DWX,\ X,\ \tau]$ be the $NT \times M$ matrix of instrumental variables for H (with $M > L$), including first order spatial lags of the independent variables, their interactions with the regime dummy D, the matrix X, that serves as instrument for itself, and year dummies given by the vector τ. Model 1 can be

[26]Maximum likelihood models are estimated using Matlab routines for spatial panel problems developed by Paul Elhorst, available at `http://www.regroningen.nl/elhorst/software.shtml`. The spatial toolbox has advantages over other software because it allows working with large sparse matrices

[27]See Revelli (2006), Elhorst and Fréret (2009), Allers and Elhorst (2005), Sollé Ollé (2003), and Revelli (2002).

[28]See Besley and Case (1995) and Revelli and Tovmo (2007).

rewritten as

$$Y = H\delta + \mu + u \tag{3}$$

where μ represents the specific part of the composite error (i.e. the fixed effect), and u represents the random error. GMM estimation involves minimizing a quadratic function of the moment conditions

$$Q(\delta) = \overline{m}(\delta)'[Var(\overline{m}(\delta))]^{-1}\overline{m}(\delta) \tag{4}$$

where the moments $\overline{m}$ of the demeaned variables (represented by two dots over the variables) are given by

$$\overline{m}(\delta|\ddot{Y}, \ddot{H}, \ddot{Z}) = \frac{1}{NT}\ddot{Z}'\ddot{u} = \frac{1}{NT}\ddot{Z}'(\ddot{Y} - \ddot{H}\delta) \tag{5}$$

and the variance-covariance matrix $Var(\overline{m}(\delta))$ allows autocorrelation and heterocedasticity.

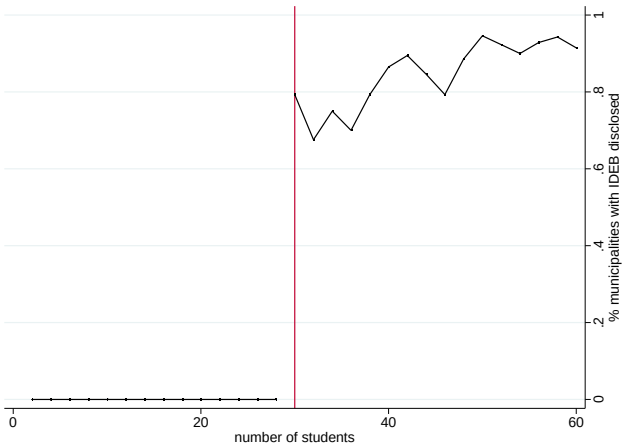
4.2 IDEB's Disclosure Rule: Identification Strategy

We still cannot rule out the possibility that some unknown confounding factor may have taken place concomitantly with the IDEB disclosure, which would render the model in the last subsection biased. Besides, as the participation in the "Plan of All Commited to Education" as well as in the standardized test of Prova Brazil — used to calculate IDEB — are voluntary, some municipalities can choose whether or not to have their IDEB disclosed. Thus, one could argue that the decision to participate and to have the index published is endogenous in the model.The strategy in the previous subsection — that measures spatial correlation in education spending before and after IDEB disclosure — would not provide consistent estimates if many municipalities had chosen not to participate in the exam and if the reason to not participate was non-observable but correlated with y and Wy. [29]

Fortunately though, in order to disclose the index, the Ministry of Education established a cut-off of 30 students enrolled and present in the day of Prova Brasil's Exam to minimize the sampling error of the school's average performance. This cut-off of 30 students provides

[29] A total of 496 municipalities — out of 5,564 — with more than 30 students enrolled in the municipal school system did not take part in the first wave of the assessment. A total of 942 municipalities did not have any students enrolled in the municipal school system, and were excluded from the initiative. Thus, a total of 1,438 municipalities did not participated in the first wave of assessment of the IDEB and its goals.

a natural jump in the probability of participating in the exam, and consists of a potentially good instrument for the IDEB's disclosure dummy. Within a sufficiently small bandwidth around this cut-off, both observable and non-observable characteristics are independent of the treatment status, as if the treatment (IDEB's disclosure) were randomly assigned.



Source: Elaborated by the author using data from the Ministry of Education.

Figure 2: Proportion of municipalities with IDEB disclosed according to the number of students

There are two types of IDEB for each school and municipality, one calculated with the average proficiency of the $5th$ graders, called "First cycle IDEB", and other calculated with the average proficiency of the $9th$ graders, called "Second cycle IDEB". We focus our analysis on the disclosure of the"First cycle IDEB" because in most of municipalities the "Second cycle" grades — $6th$ to $9th$ grades — are still under the administration of the states instead of the municipalities.

The first time IDEB and its goals were disclosed, in April 2007, it was calculated with data from the 2005 edition of Prova Brasil and data from the Education Census of the same year.[30] Since the education budget for 2007 were already defined when IDEB was first disclosed, we use 2008 cross-section data on Education Spending. Subsequent waves of IDEB and its goals are less useful in this case because, later on, the Ministry of Education changed the disclosure rule to 20 students, significantly diminishing the sample size around the cut-off. Besides, using only the first wave of data on IDEB reduces the possibility of manipulation of the number of students (forcing variable). In the first wave of IDEB — disclosed in mid-2007

[30]The 2005 edition of Prova Brasil was the first one, taken in november of that year.

— education accountability was still a novelty. In the following years, knowing the pros and cons of participating in the *Prova Brasil* exam, it is possible that some municipalities have manipulated the number of students to participate or not in that assessment.

In order to consistently estimate the effects of disclosing the IDEB on the strategic interaction in education spending we estimate the following two stage procedure

$$\begin{aligned} &\textit{Second Stage} \\ &\qquad y_i = \alpha_0 + \lambda_0 W_i y + \lambda_1 D_i W_i y + \gamma_0 D_i + X_i B_0 + u_i \end{aligned} \tag{6}$$

$$\begin{aligned} &\textit{First Stage} \\ &\qquad W_i y = \alpha_1 + W_i X \delta_1 + z_i W_i X \delta_2 + \gamma_1 z_i + X_i B_1 + \nu_i \\ &\qquad D_i = \alpha_2 + W_i X \delta_3 + z_i W_i X \delta_4 + \gamma_2 z_i + X_i B_2 + \eta_i \\ &\qquad D_i W_i y = \alpha_3 + W_i X \delta_5 + z_i W_i X \delta_6 + \gamma_3 z_i + X_i B_3 + \epsilon_i \\ &\qquad s_i \in S = \{c - h < s_i < c + h\} \end{aligned} \tag{7}$$

where W_i is a $1 \times N$ vector of the i-th municipality's neighbors, y is the $N \times 1$ vector of regressand observations, X is the $n \times K$ matrix of regressors, B is the vector of parameters and D_i is the dummy of IDEB publication. The first stage regressions generate exogenous fitted variables to enter the second stage regressions that provides the parameters of interest. As $W_i y$ and D_i can be endogenous (the former by construction and the later is a possibility, but we are conservatives) and so its interaction $D_i W_i y$, we need exogenous instruments to estimate the parameters consistently. The neighbors' K covariates in $W_i X$ are the natural candidates for instrumenting $W_i y$. The instrument for the IDEB disclosure dummy D_i is represented by z_i, which assigns the value of 1 for school systems with more than 30 students enrolled and 0 otherwise. The instruments for the interaction term $D_i W_i y$ are given by the vector $z_i W_i X$. Finally, the idea is to estimate this regression for municipalities with a number of enrollments $s_i \in S$, i.e. within a bandwidth h around the cut-off c. Such a procedure allows us to get similar municipalities in each side of the cut-off, minimizing differences in terms of non-observable characteristics correlated with the disclosure (treatment) variable.

5 Results

5.1 Spatial Interaction in education expenditures

Table 3 contrasts spatial and non-spatial models. The first two columns in Table 3 present models where the spatial parameters (in the error or in the dependent variable) are all set to zero. The first model (POLS) is estimated using ordinary least squares and is only illustrative of the importance of considering the fixed effects of the municipalities. As can be seen in the bottom of Table 3, the robust LM lag and the LM error test statistics performed with the residuals of the models reject neither a spatial lag nor a spatial error model as the most suited for the problem. The Moran's I calculated on the residuals indicates a spatial auto-correlation equal to 0.2831, significant at less than the minimum conventional level of 1%.

As noted in Elhorst (2010), failing to take fixed effects into account can result in spatially auto-correlated residuals. The Fixed Effect model (Within) in the second column clearly confirms that. The Moran's I that is calculated on the residuals of the fixed effects model is estimated as 0.1639, which is still significant at less than 1% but considerably smaller than the correlation observed in the residuals of the POLS model. We also obtain smaller statistics on both robust LM lag and LM error tests, reflecting the smaller spatial correlation after removing the fixed effect. In any case, there is still spatial auto-correlation, and we reject the hypothesis of no spatial lag at a higher significance level than we reject the null of no spatial error correlation, thus indicating the spatial lag as the most appropriate model.

Next, we estimate a fixed effects model with a spatial lag by maximum likelihood. The Hausman test at the bottom of Table 3 indicates that the fixed effects estimates are different from that of random effects, favoring the choice of the consistent estimator. Compared to the other models in Table 3 the ML model presents the higher log-likelihood value. So we could say that for normally distributed disturbances this would be the best model to fit the data. The estimated spatial correlation coefficient of 0.287 indicates a substantial amount of interaction in education spending, figure similar to that found by Revelli (2006) (estimated as 0.216) for welfare spending, and much higher than that found by Elhorst and Fréret (2009) (equal to 0.083). However, notwithstanding the fact that the log-likelihood statistics and the robust LM lag and LM error tests suggest the maximum likelihood spatial lag model would best describe the true model, we cannot ignore the spatial correlation in the error term. Ignoring that does not bias the coefficients, but produces inconsistent standard errors.

Table 3: Non-Spatial vs. Spatial models

	POLS	WITHIN	SARFE	
			ML	GMM-HAC
Wy			0.287***	0.791***
			(45.397)	(34.360)
gdp	0.260***	0.100***	0.087***	0.052***
	(50.420)	(9.045)	(11.421)	(5.631)
wage	0.356***	0.179***	0.141***	0.071***
	(33.262)	(13.137)	(16.032)	(7.378)
tax price	-0.075***	-0.060***	-0.055***	-0.034***
	(-20.157)	(-6.702)	(-12.895)	(-5.267)
categorical grants	0.183***	0.107***	0.100***	0.047***
	(11.109)	(5.869)	(32.008)	(3.340)
block grants	0.192***	0.040*	0.046***	0.032
	(15.182)	(1.798)	(5.080)	(1.523)
schooling	0.042***	0.023	0.003	-0.025
	(3.235)	(0.906)	(0.212)	(-1.443)
occupation	0.009***	0.005	0.004	0.001
	(2.623)	(1.356)	(1.605)	(0.291)
men	0.001	-0.016***	-0.012***	-0.005**
	(1.052)	(-5.396)	(-6.454)	(-2.260)
population	-0.003	0.090***	0.080***	0.027
	(-0.489)	(3.261)	(4.860)	(1.327)
elderly	-0.012***	-0.057***	-0.042***	-0.015***
	(-9.474)	(-17.756)	(-24.404)	(-6.931)
young	-0.036***	-0.034***	-0.025***	-0.008***
	(-56.255)	(-19.121)	(-22.782)	(-6.089)
rural	0.002***	0.001***	0.001***	0.001***
	(30.398)	(6.284)	(14.567)	(9.090)
second cycle	-0.004***	-0.001***	-0.001***	-0.001***
	(-45.514)	(-2.907)	(-6.756)	(-7.025)
competition	0.017***	0.077***	0.053***	0.013***
	(3.916)	(16.136)	(15.754)	(3.385)
incumbent's age	-0.028***	-0.005	-0.001	0.004
	(-3.786)	(-0.524)	(-0.101)	(0.529)
incumbent's Education	-0.005*	0.007	0.006**	0.004
	(-1.763)	(1.592)	(2.022)	(1.394)
left	0.023***	0.021***	0.018***	0.015***
	(5.366)	(3.515)	(5.030)	(3.801)
incumbent women	-0.030***	-0.011	-0.009*	-0.011**
	(-6.060)	(-1.405)	(-1.786)	(-2.179)
aldermen's education	0.001***	0.000**	0.0003**	0.000
	(12.424)	(2.352)	(2.395)	(0.525)
aldermen's age	-0.169***	-0.059**	-0.041**	-0.008
	(-8.838)	(-2.359)	(-2.304)	(-0.419)
women in council	-0.001***	0.000	0.0000	-0.000
	(-6.122)	(0.107)	(-0.084)	(-0.969)
competition for seats	0.016***	-0.021**	-0.016***	-0.005
	(3.430)	(-2.561)	(-2.811)	(-0.960)
fragmentation	-0.001***	-0.000	-0.0003*	-0.000
	(-4.737)	(-0.930)	(-1.807)	(-0.811)
majority of seats	-0.001	0.008**	0.006**	0.005*
	(-0.231)	(2.340)	(2.326)	(1.846)
president's party	0.032***	-0.000	-0.001	-0.005
	(4.587)	(-0.013)	(-0.158)	(-0.775)
governor's party	0.002	0.002	0.002	0.003
	(0.653)	(0.430)	(0.816)	(1.275)
lameduck	0.008**	0.009***	0.008***	0.006**
	(2.415)	(3.043)	(3.421)	(2.437)

Continued on next page

Table 3 – *Continued from previous page*

	POLS	WITHIN	SARFE	
			ML	GMM-HAC
Spatial Fixed Effects	No	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Excluded Instruments	-	-	-	WX
Robust LM no Spatial Lag χ^2	34668.448***	1178.3453***	-	-
Robust LM no Spatial Error χ^2	39285.841***	418.5705***	-	-
Spatial Hausman χ^2	-	-	1252.113***	
N	33507	33507	33507	33507
log-likelihood	-3496.3444	14543.129	15595.582	15076.04

Notes: t-statistics in parenthesis; *** significant at 1%; ** significant at 5%; * significant at 10%.
Dependent variable y is the education spending. The spatially lagged dependent variable Wy uses the contiguity criteria to assign neighborhood.
The endogenous variable is the spatially lagged dependent variable Wy.
The instruments are the first order spatial lags of the regressors in WX.
Full estimates can be obtained upon request to the authors.

One way to overcome this problem of spatially correlated residuals is to estimate the spatial lag model with robust standard errors, which can be implemented with the generalized method of moments with heterocedasticity and autocorrelation robust standard errors (GMM-HAC).[31] The instruments consists of the first order spatially lagged regressors. [32] The GMM-HAC model in Table 3 shows a spatial parameter of 0.791, considerably higher than the previously mentioned results, most likely because of the linear relationship between the endogenous regressor and the dependent variable that is peculiar to IV estimators.[33]

The coefficients on variables gdp, wage and occupation are all positive in the GMM-HAC model [34]. Since these variables serve as a proxy for income, we expect a positive sign. The magnitude of the elasticity of the GDP with respect to the education spending is quite small (0.052). The same is true for the wage elasticity (0.071).

Surprisingly, the estimated elasticity of the categorical grants with respect to the education spending is 0.047. That means that a marginal dollar increase in the earmarked transfers for education will be offset by a reduction of almost one dollar in the general purposes resources that have been put on education. One possible explanation for this phenomenon is that the

[31] Contrary to the maximum likelihood coefficients, the IV coefficients of the exogenous variables can be interpreted as marginal effects.

[32] We use only the first order spatial lag of the control variables as instruments so as we can make models comparable in this section and in the next ones. When we run models with observations within a small bandwidth, we have not enough degrees of freedom to use second order neighbors as instruments.

[33] Note that the test of overidentifying restrictions is not appropriate in the specific case of spatial models. The excluded instruments given by the spatially lagged regressors in WX can only identify the spatial lag Wy together. So we cannot perform a Hausman-like test that excludes different sets of instruments at a time and then compare the coefficients obtained using each set of instruments.

[34] Note that the coefficients in the GMM-HAC model can be interpreted as marginal effects.

income elasticity of the demand for public education is low, and/or that local governments already spent its optimal level, and therefore increasing the amount of money available will not lead an additional increase in public spending. The elasticity of the block grants is even smaller (0.032) and non significant, which reinforces this conclusion, i.e. an increase in grants that are not earmarked for education will not increase the spending level on education for this period and sample.

The tax price shows a negative effect on education spending per pupil, meaning that the higher the cost perceived by the citizens of spending an additional monetary unit on public education, the smaller the demand for this good will be. Schooling does not appear to have a significant effect once the fixed effects are controlled for. The same is true for the coefficient on population. A higher proportion of men in the municipality appear to reduce the education spending, possibly because they tend to leave school early to work and do not value education as much as women.

Both the percentages of the elderly and the young present negative coefficients. The first result is direct; elderly citizens demand less education and more health expenditures.[35] However, the second result has a less obvious interpretation. One would expect that a larger fraction of young people in a jurisdiction would increase the demand for education. But if municipalities with many young individuals raise little revenue — due the lower share of economically active individuals —, an increase in the share of young individuals could mean that there will be less resources per capita to finance education.

The coefficient on the percentage of students of the local public educational system enrolled in rural schools is positive, reflecting the legal determination that the rural school students receive a greater amount of transfers from FUNDEF. Conversely, the coefficient on the percentage of public school students enrolled in the 2nd cycle (6th to 9th grade of fundamental education) is negative, despite the fact that a higher amount of transfers to these students is determined by law. This could mean that the earlier stages of education demand more complementary expenditures than the later stages.

The characteristics of the incumbents do not seem to be important determinants of the education expenditures. For example, the age and education coefficients are not statistically significant.[36] The gender, on the other hand, appear to have a small effect. Women incumbents spend 1.1% less on education according to our estimates.

[35] See Poterba (1997) and Arvate and Zoghbi (2010).

[36] Actually, in the maximum likelihood model the incumbent's education has a positive influence on the expenditure level, but the standard errors of this model may not be reliable.

Leftist incumbents spend 1.5% more than the incumbents to the right and an increase of one candidate in the competition for the mayor's seat raises the education expenditure in 1.3%. Lame duck incumbents spend 0.6% more on education and incumbents holding the majority of seats in the council spend 0.5% more on this expenditure function. Party fragmentation, competition for seats in the legislative, and the alignment between the mayor's party and the governors' or the presidents' parties have not statistically significant coefficients. Finally, the aldermen personal characteristics also show little effect on education spending, e.g. the aldermen's age, education and gender do not significantly affect the education spending.

So far, we still cannot tell whether the spatial correlation is due to yardstick competition, welfare competition or other competing theories. The yardstick competition arises from information asymmetry between voters and incumbents and from the political incentives the incumbents face. Welfare competition models arises from efficiency concerns of the ruling officers. In Table (4) we present a test of the nature of the spatial process. We interact the spatial parameters with dummies of Lame-duck incumbents and mayors with majority support in the legislative. Each of these binary variables represent distinct political incentives for mimicking education spending of the neighbors. Both maximum likelihood models and GMM-HAC present similar results. The main difference lies in the magnitude of the spatial parameters estimated by each method.

The results bring evidence of yardstick competition in education spending. Lame-duck incumbents tend to not interact so much in a strategic way with their neighbors, i.e. the spatial correlation is smaller between these incumbents. This result is typical of yardstick competition. The incentive for a incumbent in his last term to mimic the neighbor to signal his quality to voters is weaker.[37] Likewise, when the incumbents hold the majority in the legislative, they tend to act less strategically, imitating less their neighbors. Incumbents without majority support will find advantageous to imitate their neighbors because of their uncomfortable political situation that requires them not to get behind their neighbors — that serve as benchmark to the voters.[38]

[37]This result is consistent with those of Besley and Case (1995) and Bordignon et al. (2003), who analyze interactions in the tax-setting and predict fewer incentives for incumbents in their last term in office to mimic their neighbors' behavior and signal their quality to the voters. Note also that an incumbent being a lame-duck does not eliminate spatial interaction completely, supporting the argument of Alesina and Spear (1988), according to which the parties have incentive mechanisms to prevent the lame-duck governors from pursuing only their own interests.

[38]Elhorst and Fréret (2009) also find similar results for welfare spending, but instead, they consider the majority governments to be those whose incumbents have the support of more than 75% of the aldermen.

Table 4: Heterogeneity of the spatial parameter and the political incentives to engage in Yardstick Competition

	Lame Duck		Majority Support Legislature	
	ML	GMM-HAC	ML	GMM-HAC
Wy	0.320***	0.797***	0.329***	0.790***
	(24.981)	(35.635)	(37.721)	(34.577)
Lame Duck $\times Wy$	-0.045***	-0.013***		
	(-2.775)	(-2.962)		
More than 50% $\times Wy$			-0.104***	-0.012**
			(-6.629)	(2.357)
Controls	Yes	Yes	Yes	Yes
Spatial Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Excluded Instruments	-	[WX, Lame Duck $\times$ WX]	-	[WX, More than 50% $\times$ WX]
N	33507	33507	33507	33507
log-likelihood	15597.963	14955.697	15619.869	15073.435

Notes: t-statistics in parenthesis; *** significant at 1%; ** significant at 5%; * significant at 10%.
Dependent variable y is the education spending. The spatially lagged dependent variable Wy uses the contiguity criteria to assign neighborhood.
Endogenous variables are the spatially lagged dependent variable Wy and the interactions Lame Duck $\times Wy$ and More than 50% $\times Wy$.
The control variables are: gdp, wage, tax price, categorical grants, block grants, schooling, occupation rate, % men, population, % elderly, % young, % rural, % second cycle, competition, incumbent's age, incumbent's Education, left, incumbent women, aldermen's education, aldermen's age, women in council, competition for seats, fragmentation, majority of seats, president's party, governor's party, lameduck.
The instruments are the first order spatial lags of the regressors and its interaction with the variables Lame Duck or More than 50%.
Full estimates can be obtained upon request to the authors.

5.2 Post-IDEB strategic behavior

This section brings a possible explanation as to whether the IDEB disclosure affects the strategic behavior between neighboring governments. We expect that spatial correlation in education spending resulting from yardstick competition have reduced after municipalities' education indexes and their goals were made public. This is because the IDEB and its goals consisted on new information to voters, about what is an education of good quality. This new information must have enabled voters to tell whether their mayors were good or not without having to look at what was happening in their neighbors.

Table 5 show maximum likelihood and GMM-HAC estimates. The signs of the estimated coefficients are identical, but the magnitude differ a little. The spatial correlation is high in the ML model, and even higher in the GMM-HAC model. Interestingly, both models sug-

gest that the spatial correlation has reduced after the disclosure of the indexes — captured by the coefficient on the interaction between the dummy of period T_{0813} and the spatial lag.[39] The ML estimator suggest that the reduction was equal to 0.075 correlation point. The GMM-HAC estimator, on the other hand shows an even higher reduction in the spatial autocorrelation after the disclosure of the IDEB. According to that estimator, the spatial correlation dropped 0.1242 point after the indexes became public information. With more information on education quality such as the national ranking provided by municipalities IDEB's and the yearly goals defined by the Ministry of Education, the distribution of information about education quality between voters and incumbents became less asymmetric. Our interpretation is that voters stopped trusting so much in the neighbor's education spending when setting their benchmarks of education quality. This provides a possible explanation for the reduction observed in the spatial correlation in education spending.

Table 5: Spatial interaction in the Post IDEB disclosure period

	Post IDEB disclosure	
	ML	GMM-HAC
Wy	0.332***	0.6166***
	(37.174)	(20.5862)
$T_{0813} \times Wy$	-0.075***	-0.1242***
	(-6.207)	(-10.9156)
Controls	Yes	Yes
Spatial Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Excluded Instruments	-	$[WX,\ T_{0813}WX]$
N	33507	33507
log-likelihood	15614.768	16226.001

Notes: t-statistics in parenthesis; *** significant at 1%; ** significant at 5%; * significant at 10%.
Dependent variable y is the education spending. The spatially lagged dependent variable Wy uses the contiguity criteria to assign neighborhood.
Endogenous variables are the spatially lagged dependent variable Wy and the interaction DWy. The control variables are: gdp, wage, tax price, categorical grants, block grants, schooling, occupation rate, % men, population, % elderly, % young, % rural, % second cycle, competition, incumbent's age, incumbent's Education, left, incumbent women, aldermen's education, aldermen's age, women in council, competition for seats, fragmentation, majority of seats, president's party, governor's party, lameduck.
The instruments are the first order spatial lags of the regressors $[WX,\ T_{0813}WX]$
Full estimates can be obtained upon request to the authors.

One could argue that this reduction in the spatial autocorrelation is merely a common tendency to various types of expenditures. In such a case, the disclosure of IDEB and the reduction in the spatial correlation would be just a coincidence. In order to evaluate that

[39] We consider the year of 2008 as the first year post-IDEB disclosure. Remember that the indexes were disclosed in mid-2007, but the education budgets were already defined for that year when the indexes were unveiled . Thus, the publication of the index must have produced effects from 2008 on.

possibility we re-estimate the same model with legislative expenditures, a spending function that do not usually present strong complementarity or substitutability with education.[40] Table (6) show the robustness test. The estimates suggest that there is spatial correlation on legislative expenditure measured by the GMM-HAC estimator (but also by maximum likelihood), which increased after IDEB was unveiled. This result reinforces the finding that the decrease in spatial correlation was specific to education expenditures or related expenditures, although we still can not say that this result is unequivocally a consequence of the disclosure of IDEB.

Table 6: Falsification test using a legislative expenditures to measure spatial interaction in the Post IDEB disclosure period

	Legislative	
	ML	GMM-HAC
Wy	0.155***	0.7078***
	(14.696)	(12.8306)
$T_{0813} \times Wy$	0.096***	0.1203***
	(6.961)	(4.5914)
Controls	Yes	Yes
Spatial Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Excluded Instruments	-	$[WX,\ T_{0813}WX]$
N	33507	33507
log-likelihood	-55770.072	-43895.268

Notes: t-statistics in parenthesis; *** significant at 1%; ** significant at 5%; * significant at 10%.

Dependent variable y_i is the education spending . The spatially lagged dependent variable Wy uses the contiguity criteria to assign neighborhood.

Endogenous variables are the spatially lagged dependent variable Wy and the interaction DWy. The control variables are: gdp, wage, tax price, categorical grants, block grants, schooling, occupation rate, % men, population, % elderly, % young, % rural, % second cycle, competition, incumbent's age, incumbent's Education, left, incumbent women, aldermen's education, aldermen's age, women in council, competition for seats, fragmentation, majority of seats, president's party, governor's party, lameduck.

The instruments are the first and second order spatial lags of the regressors $[WX,\ T_{0813}WX]$

Full estimates can be obtained upon request to the authors.

The results presented in this section agree with those of Revelli (2006) for welfare expenditures, i.e., the strategic interaction in education spending have reduced after the broad disclosure of the indexes that improved the information available on educational quality and diminished the importance of the local information spillovers in voters' decision. However, Revelli (ibid) recognizes that the empirical evidence found in his work reflects a situation at a given point in time, in the sense that he was able to build a panel with only one period immediately before and another immediately after the introduction of a national performance

[40]It is important to evaluate only those expenditure categories that are little or not at all related to education, since related goods are expected to present the same patterns as the education expenditures.

rating of social expenditures. Other factors occurring concomitantly with given institutional changes may playing some role.

5.3 IDEB's Disclosure Rule

Now we attempt to explore the discontinuity in the enrollment-based rule that determines the unveiling of the IDEB (in mid-2007) of the municipalities with more than 30 students. We take advantage of this discontinuity to estimate the heterogeneity of the spatial correlation coefficient around the cut-off of 30 students. As one gets closer to the cut-off, the differences in terms of non-observable characteristics correlated with the IDEB disclosure will vanish. Hence, we will be able to identify the effects of the IDEB disclosure on the spatial interaction pattern, at least for a subgroup of small municipalities. [41]

In the first column on Table 7 we can find the estimates for the coefficients in equation 6 without imposing a bandwidth. The coefficient of the disclosure variable D — equal to 1.808 — suggest a positive association with the education spending. The spatial parameter is equal to 0.291, and the interaction term — that address the heterogeneity in the spatial parameter according to the IDEB' disclosure status — suggests a spatial coefficient 0.238 correlation point smaller among those municipalities that have their IDEB unveiled in the year of 2008.

One way to verify whether the effects mentioned are causal or not is to perform a falsification (placebo) test based on the disclosure dummy variable evaluated in a period prior to IDEB's first publication. In the second column we carry on such a procedure. We evaluate the spatial parameters using data prior to 2008 according to the future disclosure status. In such a case, the spatial coefficient on Wy is equal to 0.409 between municipalities without IDEB, which is reduced by 0.240 correlation point between municipalities that would have their IDEB disclosed later on, in 2008. This means that the results in the first column are not exogenous, i.e. the spatial coefficients in the first column must be decreasing with the forcing variable determining disclosure (the number of students).

Graph 3 shows the negative association between the spatial coefficients and the number of students enrolled. One limitation of the Graph 3 analysis consists of the reduced number of bins we can form around the cut-off because of the number of observations. We end up

[41] Note that this is not a Regression Discontinuity Design, i.e. a method that estimates an effect of interest as the difference of intercepts of regressions adjusted to the right and to the left of a given cut-off that determines an intervention.

with bins that have few observations, increasing the error of the spatial coefficient estimated in each bin. In any case, there seems to be a negative association between the enrollments and the spatial correlation coefficients that should explain why we get smaller spatial autocorrelation between municipalities that would have their IDEB disclosed only years later. Moreover, at least in this graphical analysis, we can not conclude there is a significant jump at the cut-off. Nonetheless, the few observations in each bin may be increasing the error of the estimates and hiding a significant effect.

Table 7: Heterogeneity of the Spatial coefficients according to the IDEB's Disclosure Status without imposing bandwidths around the cut-off

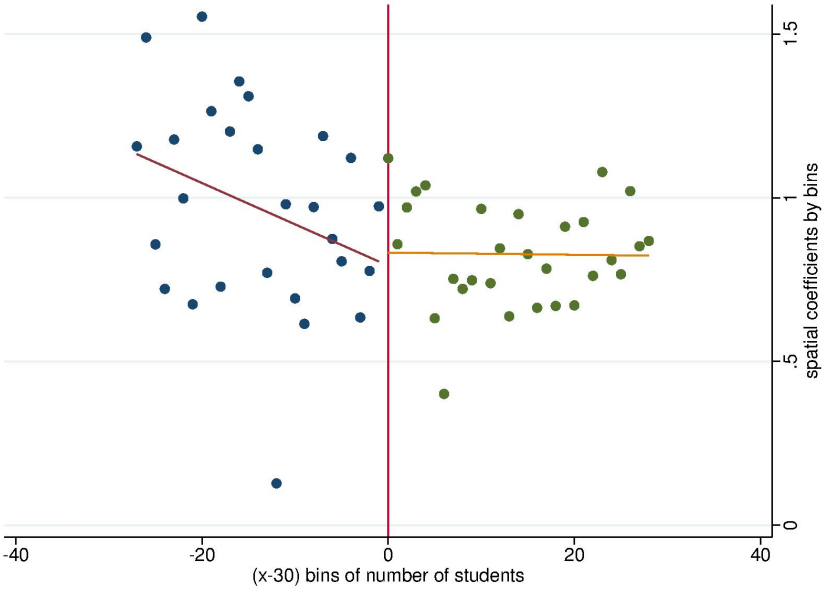
	GMM-HAC (no bandwidth)	
	Data from 2008 (Immediately after IDEB disclosure)	Data from 2003 to 2007 (Falsification - Before IDEB disclosure)
Wy	0.291***	0.409***
	(7.418)	(21.634)
DWy	-0.238***	-0.240***
	(-7.565)	(-16.017)
D	1.808***	1.679***
	(7.170)	(14.666)
$x-c$	0.000*	-0.000
	(1.773)	(-0.845)
Controls	Yes	Yes
Excluded Instruments	$[WX,\ z,\ zWX]$	$[WX,\ z,\ zWX]$
R-squared	0.5056	0.5266
N	3723	18615

Notes: t-statistics in parenthesis; *** significant at 1%; ** significant at 5%; * significant at 10%.

Dependent variable y is the education spending. The spatially lagged dependent variable Wy uses the contiguity criteria to assign neighborhood.

Endogenous variables are the spatially lagged dependent variable Wy, the disclosure variable D, and their interaction DWy. The control variables are: gdp, wage, tax price, categorical grants, block grants, schooling, occupation rate, % men, population, % elderly, % young, % rural, % second cycle, competition, incumbent's age, incumbent's Education, left, incumbent women, aldermen's education, aldermen's age, women in council, competition for seats, fragmentation, majority of seats, president's party, governor's party, lameduck. The additional control variable $x-c$ represents the forcing variable that is the number of students enrolled in the 4^{th} grade centered around the cut-off of 30 students that determines participation in Prova Brazil.

The instruments are the first order spatial lags of the regressors WX, the dummy variable z, that equals 1 whenever the number of enrollments in the 4^{th} grade is greater than 30 students (and 0 otherwise), and their interaction zWX. Full estimates can be obtained upon request to the authors.



Source: Elaborated by the authors.

Figure 3: Spatial coefficients and the number of students enrolled

Note, however, that if one gets close enough to the cut-off point, one can identify not only the direct effect of the disclosure variable D on the education spending, but also the effect of its interaction with the spatial lag Wy. The models on Table 8 use data within bandwidths of $h = 5, 6$ and 7 around the cut-off of $c = 30$ students.[42] In the first column of Table 8 we can see that, within the bandwidth of $h = 5$, the spatial coefficient in 2008 is larger among municipalities where IDEB was not disclosed, and is estimated as 0.243, whereas the spatial correlation in municipalities where the indexes became public information is estimated as 0.131 smaller. We can see at the bottom of the table that there is only 65 degrees of freedom. If we restrict our sample to $h = 4$ the degrees of freedom drop to 34, which greatly increases the variance of the estimator.

Again, we conduct the falsification (placebo) test in the fourth column of Table 8. We use data prior to the period when IDEB was known to show that there is no systematic difference in spatial correlation between municipalities that had their IDEB disclosed later on in 2008 and those that had not. Indeed, the estimated spatial coefficient is equal to 0.233 and there is no statistically significant difference between coefficients of those with and without IDEB.

[42]These bandwidths cannot be smaller because, otherwise, we would have to leave out some control variables and instruments to gain degrees of freedom, which harms our strategy of estimation of the spatial parameter.

In the second and third columns of Table 8 we present the models with slightly wider bandwidths. For $h = 6$, the spatial correlation coefficient of the municipalities without their index disclosed in 2008 is equal to 0.254, whereas that is 0.128 correlation point smaller between the municipalities that had their indexes disclosed. Likewise, for $h = 7$, the spatial correlation among the localities with no IDEB in 2008 is equal to 0.256, while that is 0.132 correlation point smaller between those municipalities where the education quality index went public. The placebo tests for $h = 6$ and 7 present no statistical significance, which reinforces the finding around the cut-off of 30 students.

Thus, around the cut-off, our estimates suggest that the effect of the disclosure variable D on the education spending can be claimed as causal. The coefficient on the disclosure variable D alone suggests that the expenditure on education increases more than 100% compared to those localities where the IDEB was not disclosed. As expected, the falsification tests suggests that, with data prior to 2008, the disclosure variable has no statistically relevant association with the education spending. Finally, the results in Table 8 reinforce our hypothesis that more public information reduces (information asymmetry and) yardstick competition.

Table 8: Heterogeneity of the Spatial coefficients according to the IDEB's Disclosure Status imposing bandwidths $h = 5, 6, 7$ around the cut-off

	GMM-HAC					
	Data from 2008 (Immediately after IDEB disclosure)			Data from 2003 to 2007 (Falsification - Before IDEB disclosure)		
	bandwidths			bandwidths		
y=education spending	h=5	h=6	h=7	h=5	h=6	h=7
Wy	0.243***	0.254***	0.257***	0.233***	0.212***	0.206***
	(4.112)	(4.249)	(4.249)	(5.896)	(5.350)	(5.235)
DWy	-0.131***	-0.128**	-0.132**	0.038	0.003	-0.012
	(-2.889)	(-2.309)	(-2.371)	(1.277)	(0.108)	(-0.375)
D	1.080***	1.072**	1.126**	-0.275	-0.028	0.090
	(2.941)	(2.348)	(2.453)	(-1.179)	(-0.114)	(0.364)
$x - c$	0.006	0.002	-0.003	-0.009***	-0.005	-0.007**
	(1.628)	(0.555)	(-1.111)	(-2.734)	(-1.530)	(-2.491)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Excluded Instruments						
	$[WX,\ z,\ zWX]$	$[WX,\ z,\ zWX]$	$[WX,\ z,\ zWX]$	$[WX,\ z,\ zWX]$	$[WX,\ z,\ zWX]$	$[WX,\ z,\ zWX]$
R-squared	0.654	0.572	0.574	0.609	0.580	0.602
N	173.00	205.00	230.00	865.00	1025.00	1150.00
Degrees of Freedom	65.00	97.00	122.00	757.00	917.00	1042.00

Notes: t-statistics in parenthesis; *** significant at 1%; ** significant at 5%; * significant at 10%.

Dependent variable y is the education spending. The spatially lagged dependent variable Wy uses the contiguity criteria to assign neighborhood.

Endogenous variables are the spatially lagged dependent variable Wy, the disclosure variable D, and their interaction DWy. The control variables are: gdp, wage, tax price, categorical grants, block grants, schooling, occupation rate, % men, population, % elderly, % young, % rural, % second cycle, competition, incumbent's age, incumbent's Education, left, incumbent women, aldermen's education, aldermen's age, women in council, competition for seats, fragmentation, majority of seats, president's party, governor's party, lameduck. The additional control variable $x - c$ represents the forcing variable that is the number of students enrolled in the 4^{th} grade centered around the cut-off of 30 students that determines participation in Prova Brazil.

The instruments are the first order spatial lags of the regressors WX, the dummy variable z, that equals 1 whenever the number of enrollments in the 4^{th} grade is greater than 30 students (and 0 otherwise), and their interaction zWX. Full estimates can be obtained upon request to the authors.

6 Concluding Remarks

Yardstick competition arises from the asymmetric information between voters and incumbents. The later are the better informed part, whilst the former are imperfectly informed. In order to better choose the local rulers, the voters assess the neighbors' policies and take those as benchmark. The incumbents whose policies are relatively better will be reappointed and those that are relatively worst than their neighbors will not. This forces incumbents to "mimic" their neighbors to not get behind them.

We explore the nation-wide public release of the Brazilian Basic Education Development Index (IDEB) for Brazilian municipalities in 2007 to estimate whether spatial strategic interaction among those municipalities have decreased after the disclosure. Moreover, we take advantage of IDEB's discontinuity in the enrollment-based rule that determines the unveiling of the IDEB of those municipalities only with more than 30 students. As one moves closer to the cut-off, the differences in terms of non-observable characteristics correlated with the IDEB disclosure vanishes and we can identify the effects of the IDEB disclosure on the spatial interaction pattern.

For the first exercise, this paper uses a panel of Brazilian municipalities (ranging from 2003 to 2011) to test whether the local level disclosure in mid-2007 of the IDEB diminished the spatial interaction between jurisdictions in terms of education spending, which could be attributed to the reduction of the information asymmetries regarding the quality of education. The results suggest that spatial correlation diminished 0.124 (20% of the total spatial correlation) correlation points after IDEB was disclosed.

A robustness test is conducted with legislative expenditures, a category that presents little complementarity or substitutability with education. This is carried on so as to rule out the possibility that the estimates are the result of phenomena non specific to education in the post-disclosure period. Indeed, the spatial correlation in legislative expenditures seems to increase rather than decrease after 2007. Such a finding suggests that other non-related spending category did not follow the same pattern as education, so we cannot say the reduction in the spatial correlation in the education expenditures was a spurious tendency.

For the second exercise, we use the discontinuity in the number of enrollments — equal to 30 students — that determines the IDEB disclosure. We restrict our analysis to a bandwidth close enough to the cut-off to find causal evidence linking the IDEB disclosure and yardstick competition. We carry on falsification tests to check whether the IDEB disclosure has a causal effect on the strategic behavior of the incumbents. Around the cut-off, our estimates

suggest that the IDEB disclosure has causal effect and induced an increase on education expenditure and a reduction of 0.131 correlation points in the spatial autocorrelation (54% of the observed spatial correlation). Altogether, the results reinforce our hypothesis that more information on education quality reduces information asymmetry and, consequently, reduces yardstick competition.

An unforeseen result refers to the increase in the education expenditure per pupil resultant form the disclosure of IDEB, which shows greater worry about the education after the information on education quality came to public's knowledge. Second, we identify an heterogeneity in the spatial parameter associated with the political factors that we know must change incumbents' incentives to mimic their neighbors. Lame-duck mayors and those with support of the majority are less competitive with their neighbors, whereas those in their first term in office or without support of the majority are more competitive. This result suggest that voters and incumbents worry about education quality and act strategically in this matter and change their behavior whenever the relevant incentives change.

As Revelli (2006) points out, if there is some institutional change that reduces information asymmetry, the yardstick competition will be discourage, reducing spatial interaction. This paper aims to complement this literature by establishing the relationship between performance evaluation, accountability and yardstick competition in the specific case of education spending. On top of this, considering the uniqueness of the Brazilian framework, the results also reinforce the external validity of the phenomenon.

References

Alesina, A. & Cukierman, A. (1990), 'The Politics of Ambiguity', *Quarterly Journal of Economics* **105**(4), 829–850.

Alesina, A. & Spear, S. (1988), 'An overlapping generations model of electoral competition', *Journal of Public Economics* **37**(3), 359–379.

Allers, M. & Elhorst, P. (2005), 'Tax Mimicking and Yardstick Competition Among Local Governments in the Netherlands', *International Tax and Public Finance* **12**(4), 493–513.

Alt, J. & Lowry, R. (1994), 'Divided Government, Fiscal Institutions, and Budget Deficits: Evidence from the States', *The American Political Science Review* **88**(4), 811–828.

Anselin, L., Bera, A., Florax, R. & Yoon, M. (1996), 'Simple diagnostic tests for spatial dependence', *Regional Science and Urban Economics* **26**(1), 77–104.

Arvate, P. & Zoghbi, A. (2010), 'Intergenerational conflict and public education expenditure when there is co-residence between the elderly and young', *Economics of Education Review* **29**(6), 1165–1175.

Bergstrom, T. C., Rubinfeld, D. L. & Shapiro, P. (1982), 'Micro-Based Estimates of Demand Functions for Local School Expenditures', *Econometrica* **50**(5), 1183–1205.

Besley, T. & Case, A. (1995), 'Incumbent behavior: vote seeking, tax-setting and yardstick competition', *The American Economic Review* **85**(1), 25–45.

Besley, T. & Smart, M. (2007), 'Fiscal restraints and voter welfare', *Journal of Public Economics* **91**(3-4), 755–773.

Bivand, R. & Szymanski, S. (2000), 'Modelling the spatial impact of the introduction of compulsive competitive tendering', *Regional Science and Urban Economics* **30**(2), 203–219.

Borcherding, T. E. & Deacon, R. T. (1972), 'The Demand for the Services of Non-Federal Governments', *The American Economic Review* **62**(5), 891–901.

Bordignon, M., Cerniglia, F. & Revelli, F. (2003), 'In search of yardstick competition: a spatial analysis of Italian municipality property tax-setting', *Journal of Urban Economics* **54**(2), 199–217.

Bordignon, M., Cerniglia, F. & Revelli, F. (2004), 'Yardstick competition in intergovernmental relationships: theory and empirical predictions', *Economics Letters* **83**(3), 325–333.

Brueckner, J. (2003), 'Strategic interaction among governments: an overview of empirical studies', *International Regional Science Review* **26**(2), 175–188.

Card, D. & Payne, A. (2002), 'School finance reform, the distribution of school spending, and the distribution of student test scores', *Journal of Public Economics* **83**(1), 49–82.

Case, A., Hines, J. & Rosen, H. (1993), 'Budget spillovers and fiscal policy interdependence: Evidence from the States', *Journal of Public Economics* **52**(3), 285–307.

Desposato, S. (2006), 'Parties for Rent? Ambition, Ideology, and Party Switching in Brazil's Chamber of Deputies', *American Journal of Political Science* **50**(1), 62–80.

Elhorst, P. (2010), 'Applied Spatial Econometrics: Raising the Bar', *Spatial Economic Analysis* **5**(1), 9–28.

Elhorst, P. & Fréret, S. (2009), 'Evidence of political yardstick competition in France using a two-regime spatial Durbin model with fixed effects', *Journal of Regional Science* **49**(5), 931–951.

Ferejohn, J. (1986), 'Incumbent Performance and Electoral Control', *Public Choice* **50**(1-3), 5–25.

Firpo, S., Pieri, R. & Souza, A. (2011), Electoral Impacts of Quality Improvements in Basic Education: Evidence from Brazilian Municipalities, *in* 'Annals of the 33rd meeting of the Brazilian Econometric Society', pp. 1–31.

Geys, B. (2006), 'Looking across borders: a test of spatial policy interdependence using local government efficiency ratings', *Journal of Urban Economics* **60**(3), 443–462.

Hanushek, E. (1986), 'The Economics of Schooling: Production and Efficiency in Public Schools Reviewed', *Journal of Economic Literature* **24**(3), 1141–1177.

Hanushek, E. (1996), *Does Money Matter? The Effect of School Resources on Student Achievement and Adult Success*, first edn, Brookings Institution Press, Washington, chapter 2, pp. 43–73.

Hanushek, E. (2006), *Handbook of the Economics of Education*, Vol. 2, first edn, Elsevier, Washington, chapter 14, pp. 865–908.

Ladd, H. (1992), 'Mimicking of local tax burdens among neighboring counties', *Public Finance Quarterly* **20**(4), 450–467.

Lee, L. (2004), 'Asymptotic Distributions of Quasi-Maximum Likelihood Estimators for Spatial Autoregressive Models', *Econometrica* **72**(6), 1899–1925.

Leuven, E., Lindahl, M., Oosterbeek, H. & Webbink, D. (2007), 'The effect of extra funding for disadvantaged pupils on achievement', *Review of Economics and Statistics* **89**(4), 721–736.

Lucas, K. & Samuels, D. (2010), 'The Ideological Coherence of the Brazilian Party System, 1990-2009', *Journal of Politics in Latin America* **2**(3), 39–69.

Menezes-Filho, N. A. & Pazzello, E. (2007), 'Does money in schools matter? Evaluating the effects of a funding reform on wages and test scores in Brazil', *Economics of Education Review* **26**(6), 660–672.

Milyo, J. & Schosberg, S. (2000), 'Gender bias and selection bias in House elections', *Public Choice* **105**(1-2), 41–59.

Mukherjee, B. (2003), 'Political parties and the size of government in multi party legislatures: examining cross-country and panel data evidence', *Comparative Political Studies* **36**(6), 699–728.

OECD (2009), Equally prepared for life?: How 15-year-old boys and girls perform in school, Technical report, The Organization for Economic Co-operation and Development, Brasília.
URL: *http://www.oecd.org/dataoecd/59/50/42843625.pdf*

Persson, T., Roland, G. & Tabellini, G. (1997), 'Separation of Powers and Political Accountability', *The Quarterly Journal of Economics* **112**(4), 1163–1202.

Poterba, J. M. (1997), 'Demographic structure and the political economy of public education', *Journal of Policy Analysis and Management* **16**(1), 48–66.

Revelli, F. (2001), 'Spatial patterns in local taxation: tax mimicking or error mimicking?', *Applied Economics* **33**(9), 1101– 1107.

Revelli, F. (2002), 'Local taxes, national politics and spatial interactions in English district election results', *European Journal of Political Economy* **18**(2), 281–299.

Revelli, F. (2006), 'Performance rating and yardstick competition in social service provision', *Journal of Public Economics* **90**(3), 458–474.

Revelli, F. (2008), 'Performance competition in local media markets', *Journal of Public Economics* **92**(7), 1585–1594.

Revelli, F. (2009), 'Spend more, get more? An inquiry into English local government performance', *Oxford Economic Papers* **62**(1), 185–207.

Revelli, F. & Tovmo, P. (2007), 'Revealed yardstick competition: local government efficiency patterns in Norway', *Journal of Urban Economics* **62**(1), 121–134.

Rincke, J. (2009), 'Yardstick competition and public sector innovation', *International Tax and Public Finance* **16**(3), 337–361.

Salmon, P. (1987), 'Decentralization as an Incentive Scheme', *Oxford Review of Economic Policy* **3**(2), 24–43.

Sollé Ollé, A. (2003), 'Electoral Accountability and Tax Mimicking the Effects of Electoral Margins, Coalition, Government Ideology', *European Journal of Political Economy* **19**(4), 685–713.

Sollé Ollé, A. (2006), 'The effects of party competition on budget outcomes: Empirical evidence from local governments in Spain', *Public Choice* **126**(1), 145–176.

Strömberg, D. (2004), 'Mass Media Competition, Political Competition, and Public', *The Review of Economic Studies* **71**(1), 265–284.

Weingast, B., Shepsle, K. & Johnsen, C. (1981), 'The Political Economy of Benefits and Costs: A Neoclassical Approach to Distributive Politics', *The Journal of Political Economy* **89**(4), 642–664.