



Faculdade de Economia,
Administração e Contabilidade
de Ribeirão Preto
Universidade de São Paulo

Texto para Discussão

Série Economia

TD-E 02 / 2012

**Yardstick Competition in Education
Spending: a Spatial Analysis based
on Different Educational and
Electoral Accountability Regimes**

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Yardstick Competition in Education Spending: a Spatial Analysis based on Different Educational and Electoral Accountability Regimes

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Resumo

Este artigo testa a existência de *yardstick competition* nos gastos em educação por meio de um modelo Spatial Durbin com dois regimes e efeitos fixos estimado por máxima verossimilhança. Os regimes podem representar diferentes cenários institucionais de *accountability* educacional e eleitoral. Os resultados mostram evidências de *yardstick competition* nos gastos educacionais. A autocorrelação espacial é menor entre prefeitos *lame-ducks* (em oposição aos prefeitos de primeiro mandato) e maior entre prefeitos com apoio da minoria na câmara de vereadores (em oposição àqueles com apoio da maioria). Além disso, a mudança institucional introduzida pelo IDEB (Índice de Desenvolvimento da Educação Básica) reduziu a interação espacial nos gastos educacionais e também na definição de insumos escolares. Uma possível interpretação para esse resultado se baseia nos novos incentivos introduzidos pelo índice para que os prefeitos sigam as melhores práticas nacionais a fim de sinalizarem suas competências para os eleitores, reduzindo assim a importância de *spillovers* de informação locais.

Palavras-chave: gasto em educação; yardstick competition; accountability educacional e eleitoral.

Abstract

This paper tests the existence of yardstick competition in education spending using two-regime spatial Durbin models with time and spatial fixed effects estimated by maximum likelihood. The regimes can represent different educational and electoral accountability institutional settings. The results show evidence for yardstick competition in education spending. Spatial auto-correlation is lower among the lame-ducks (opposed to those in the first term in office) and higher among the incumbents with minority support at the city council (opposed to incumbents with majority support). In addition, the institutional change introduced by the IDEB (Basic Education Development Index) reduced the spatial interaction in education spending and also in the school input-setting. One possible interpretation for such a result is based on the new incentives introduced by the index for incumbents to follow the national best practices in order to signal their competence to voters, thus reducing the importance of local information spillovers.

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

JEL classification: C21; H72; H73.

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1 Introduction

Information asymmetry between the voters and the politicians is known to be a building block for the well-established models of political agency.¹ Nevertheless, a new outlook on these models is provided by Salmon (1987) in the context of tax and expenditure-setting. The author argues that to determine the quality of the incumbents (agents), the voters (principals) evaluate the incumbents' performance in terms of tax levels and the amount (and the quality) of public services provided by comparing them to those of the neighboring jurisdictions, where information is easily accessible. Having perfect information, the incumbents would then engage in a sort of yardstick competition to signal their performance to voters.

This discussion resulted in a number of empirical studies that were interested in testing the nature of strategic interaction between jurisdictions, both in the case of expenditure² and tax-setting.³ In an attempt to complement the literature, the present study aims to test the presence of yardstick competition in the specific case of education expenditures using panel data from Brazilian municipalities from 2002 to 2008. For this purpose, the present paper first exploits the distinct electoral accountability regimes, which are expected to change the incumbents' incentives for signaling their quality to voters. This change of incentives is measured by the shift induced by each of the regimes on the jurisdiction's spending reaction function, i.e., the change in the amount of spatial auto-correlation between the neighboring jurisdictions.

Next, the present paper relies on an institutional change that was provided by the local level disclosure in 2007 of an educational index known as the Basic Education Development Index (also known by its acronym in Portuguese IDEB), which was based on the results of a new national standardized test (termed *Prova Brasil*). Along with the yearly goals that provide guidance to the municipalities, this index possibly reduced the information asymmetries regarding the quality of education, thus diminishing the spatial interaction between jurisdictions. Nonetheless, in theory, the effects of disclosing the standardized tests results on the spending interaction patterns are unclear. Revelli (2006) argues that the national disclosure of local performance ratings leads the voters and the officeholders to adopt the national best practices instead of the practices that have been verified among their neighbors, thereby reducing yardstick competition. However, the author analyzes welfare

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

²Regarding strategic spending-setting see Revelli (2006), Elhorst & Fréret (2009), Case et al. (1993) and Bivand & Szymanski (2000).

³Regarding strategic tax-setting, see Besley & Case (1995), Bordignon et al. (2003), Revelli (2008), Allers & Elhorst (2005), Sollé Ollé (2003), Revelli (2002), Ladd (1992) and Revelli (2001).

spending, which is fundamentally different from education expenditures.

The problem in this case is that the relationship between education spending and students' achievement still remains largely unknown to the public officials and 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. Contrary to the profit and efficiency maximizing behavior of a firm in a competitive market, the officials' objective is not necessarily to be efficient in educational matters. Efficiency will be pursued only if it helps the officials to reach their political goals. Not surprisingly, the effect of educational spending on students' performance presents mixed results.⁴ Consequently, 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 this aspect of the educational quality because it was unfeasible to measure it in a proper manner. This behavior of the officeholders may have changed 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, the question is whether the incumbents tried to change the patterns of education spending as though there was a deterministic relationship between achievement and expenditures, or if they resorted to other means such as changing the allocation of school inputs and the management practices, or even if they chose to do nothing knowing they lack the knowledge on what is effective for increasing students' achievement.

To the best of our knowledge, no empirical study has explicitly associated education expenditures with yardstick competition,⁵ or verified how the introduction of an educational index (with results disclosed at the school and municipality levels) changes the strategic interaction between jurisdictions through education expenditures or through other means.

⁴Menezes-Filho & Pazzello (2007) use data on the 1998 Brazilian Fundamental Education reform to identify the effect of teachers' wages on students' achievement and find evidence that higher salaries translate into higher student performances. Similarly, Card & Payne (2002) use data on funding reform across richer and poorer US districts and find evidence that the narrowing of the spending gap between the low- and the high-income districts has led to a decrease in the SAT performance gap between the poor and the rich districts. However, Leuven et al. (2007) find that subsidies aimed at personnel and computer or software acquisition have a negative effect on Dutch students' achievement. Revelli (2009), in turn, analyzes the effects of general expenditure in England - in excess of centrally set spending standards - on performance ratings (with higher weights to education and other services areas such as child care, health and safety) and finds evidence of a negative association between expenditures and performance.

⁵In fact, Rincke (2009) finds evidence for yardstick competition in the provision of public education, but through the adoption of educational innovations instead of through education spending.

Besides, the fact that Brazil is a country with a huge educational gap⁶ that is still struggling to identify which priority educational inputs deserve investment provides an interesting case that is worth analyzing.

A final motivation for the present work is provided by Bordignon et al. (2003), who argue that if yardstick competition is a real phenomenon and depending whether this behavior is beneficial or detrimental, then it could be possible to reassign the tax and spending responsibilities to the local governments in such a manner as to encourage or discourage this behavior.

The empirical exercises in the present work are based on maximum likelihood two-regime spatial Durbin models with time and spatial fixed effects, where the regimes represent different electoral and educational accountability institutional settings. The results show evidence for yardstick competition in education spending. Spatial auto-correlation is lower among the lame duck incumbents and higher among the incumbents with minority support (a smaller vote margin) at the city council. In addition, the institutional change introduced by the IDEB reduced the spatial interaction both in the case of education spending as in the case of educational input-setting, thus diminishing the importance of local information spillovers.

This paper is organized as follows. Section 2 provides an overview of the features of yardstick competition. Section 3 describes the basic institutional settings of the Brazilian political system and Brazil's public finance and education funding. It also describes the recent educational accountability experience in Brazil, focusing on IDEB and its dissemination process. Section 4 presents the estimation strategy, which includes the decision on the nature of the spatial process of the spatial econometric model. Section 5 describes the dataset and justifies the inclusion of the variables in the model. Section 6 presents the results of the two-regime spatial Durbin model for education spending in an attempt to evaluate strategic interaction under different regimes of electoral and educational accountability. This section also provides robustness tests that assess the effects of the IDEB disclosure on jurisdictions' strategic interaction when setting school inputs. Finally, section 7 presents the concluding remarks.

⁶For example, Brazil ranked 53rd (out of 65 countries) in PISA 2009 reading and science exams and 57th in the math exam. As of 2010, only 50.2% of 19-year-old individuals finished high school, and the illiteracy rate among individuals older than 15 years is 9.6% (data from the Brazilian Institute of Geography and Statistics).

2 Yardstick Competition: General Features

Yardstick competition theory was first introduced by Salmon (1987) and further developed by Besley & Case (1995).⁷ The theory consists of a relatively new research branch within Fiscal Federalism theory, but on the contrary it considers that voters are non-mobile and that their tastes are similar across geographical units. Thus, the voters do not behave like the Tiebout (1956) “voting with their feet” mechanism but instead use voting as a tool for disciplining politicians, removing them from office when dissatisfied.

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 & 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.⁸⁹ To signal their performance to their voters, the perfectly informed incumbents then engage in competition with the neighboring jurisdictions by mimicking each other’s fiscal behavior.¹⁰ 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.

⁷The idea was inspired by the literature about multi-agent incentive schemes, wherein agents take the performance of similar others as a benchmark to make their decisions about their own desired performance (Shleifer 1985).

⁸See Strömberg (2004) and Revelli (2008) about the role of the media in providing the voters with information.

⁹Salmon (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.

¹⁰The same conclusions can be reached using other frameworks. Revelli & 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.

Conversely, Bordignon et al. (2004) warn that yardstick competition might not necessarily lead to greater interaction between jurisdictions, making it an empirical issue. 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 & 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 this type of political agency-model, anything that changes the incumbents' incentive to seek reelection will affect the way that the jurisdictions interact. The literature points to several political, economic and institutional features that can alter these incentives. One of these features is the existence of term limits. 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 & 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 & 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 & Elhorst (2005) and Elhorst & Fréret (2009) argue that the localities that are governed by a local official with a small political majority tend to mimic the neighboring expenditures because reelection is uncertain. Conversely, in those jurisdictions that are governed by large majorities, the incumbents are pretty confident about their reelection and do not feel the need to signal their quality to the voters by mimicking the neighbors.

Another related measure of majority support is noted by Besley & Case (1995) and Sollé Ollé (2003) and consists of the total votes received by the incumbent in the last election. In this case, the incumbents that are backed by a large number of voters in the previous suffrage could feel less compelled to set taxes and expenditures strategically, while those backed by a small share of voters must interact strategically to raise their odds of reelection.

Allers & Elhorst (2005) and Sollé Ollé (2003) also highlight the influence of partisan ideology. According to the authors, rightist incumbents should be less willing to mimic the increases in tax rates and, thus, the increases in expenditures. The latter author also argues that the mimicking behavior is expected to be higher in election years because the incentives for the incumbents to signal their quality to the voters become stronger as the election year approaches.

In the same way, the existence of a coalition government can affect yardstick competition. However, Geys (2006) claims that the direction of this influence is ambiguous. In theory, coalition governments should be less willing to mimic the neighboring jurisdictions because it would be harder to assign the blame for being less efficient (or extracting rents) to one or the other party. However, the uncertainty regarding the role that each coalition party would play in the government, could increase the importance of coalition negotiations and stimulate the need for mimicking.

Institutional settings that change information asymmetry can also affect yardstick competition. Regarding this aspect, Revelli (2006) claims that by making information about the quality of local public services nationally available, the local citizens would not have to rely on the neighbors' information to know if their officials are competent. Thus, the officials would have an incentive to set the expenditure at such a level as to produce a public service quality that could place their jurisdiction among the highest rated jurisdictions, attenuating the role of local information spillover and, perhaps, eliminating yardstick competition.

Similar effects can be produced by changing the rules for the concession to operate a public service. Bivand & Szymanski (2000) rely on a bureaucracy agency model to conclude that monopoly privileges in the provision of local public services such as garbage collection can induce the local authorities to compare their costs with those of the neighboring jurisdictions, a form of yardstick competition. The authors then find evidence that allowing compulsory competitive tendering for the provision of a specific service (even with the public departments as contenders) changes the quality-cost standards from the local to the national best practices, thus eliminating strategic interaction in the provision of that service.

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) classifies models of strategic interaction in two categories: resource-flow models and spillover. Resource-flow models assume the mobility of capital and labor among jurisdictions, following the reasoning of Oates (1972) and Tiebout (1956). Tax and welfare competition models fall in this category.¹¹ The second category comprises the models wherein the strategic interaction results from the spillovers between jurisdictions. Models of yardstick competition can also be considered spillover models because the uninformed voters use the readily available information that spills over from the neighboring jurisdiction to make their decision.

Despite the differences between the two categories, sometimes it can be difficult to determine if the problem is one of spillovers or resource-flow, e.g., governments can set expenditure levels strategically because of yardstick competition or because of welfare competition and the reaction function will be the same in both cases. The difference lies in the hypothesis regarding the mobility of factors. Thus, a simple empirical test, such as including a spatial lag or a spatial error in the regression model, is not enough to differentiate the underlying reason that produces spatial autocorrelation. The key for an empirical test is to explore the heterogeneity of the spatial parameter induced by political factors or informational asymmetries, in the case of yardstick competition models, or migration or firm location decisions, in the case of tax or welfare competition models.

Finally, note that the previously mentioned studies usually conduct empirical exercises that evaluate yardstick competition through the tax or expenditure levels. However, 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.¹²

¹¹A tax levied on capital, for example, diminishes the net-of-tax return on capital. As a mobile factor, the capital will move to the other jurisdictions to equalize the net-of-tax return. Similarly, 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 elsewhere to equalize the gross income across jurisdictions.

¹²The author considers the introduction of charter schools in California's school districts as the innovation variable and uses the differences in electoral competition as a means to identify yardstick competition. The intuition is that in highly competitive districts, the incumbents should mimic the neighbors' innovative behavior more in order to signal their quality to voters.

3 Institutional Setting

This section presents brief characterizations of the local public finance, the political system and the budget elaboration process in Brazil. It also describes the recent educational accountability experience in the country, focusing on the educational index known as IDEB and on the standardized test known as *Prova Brasil*. This contextualization helps to understand the estimation strategy and the results to be presented.

3.1 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 Government 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 2008, the majority of municipalities raised very little revenue through own instruments, amounting to only 6.06% of total revenues. The municipalities' main instruments of taxation are the property tax (1.11% of revenues), tax on services (2.51% of revenues), payroll tax on own employees (1.10% of revenues), fees regarding services such as garbage collection, street lighting among others (0.63% of revenues), taxes on the transmission of property ownership (0.60% of revenues), and other sources of revenue (0.10% of the total).¹³

The municipalities' main sources of revenues are intergovernmental transfers, such as the block grant known as the Municipalities' Participation Fund or FPM (42.51% of revenues); the categorical grant for the financing of health services also known as the Unified Health System or SUS (7.19% of revenues); the categorical grant for education known as the Fund for the Maintenance and Development of Fundamental Education and Valuation of Teaching or FUNDEF (18.22% of revenues); and 1/4 of all of the state indirect tax on the circulation of

¹³Data are obtained from the National Treasury Office.

goods and services (also known as ICMS) collected within the municipality's borders (18.03% of revenues).

Local education spending is financed by FUNDEF (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.

FUNDEF 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, and the same share of the ICMS owed to both the states and the municipalities. 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 FUNDEF, they divide the amount by the number of students enrolled at the fundamental education level 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 executive act, the Federal Government complements the state fund to reach this minimum. As of 2002, the minimum value to be transferred to students from 1st to 5th grade of fundamental education was 418 reais (or 118.30 USD), whereas in 2008, this figure was equal 1,132.34 reais (or 639.27 USD). The minimum values differ (though not by much) according to the educational stage that the students are enrolled in and whether they attend urban or rural schools. Nevertheless, from 2007 on, FUNDEF was reformulated to encompass also preschool, kindergarten and high school students, being renamed as the Fund for the Maintenance and Development of the Basic Education and Valuation of Education Workers (also known as FUNDEB).¹⁴

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.¹⁵ In 2008, the total educational categorical grants amounted (on average)

¹⁴The 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.

¹⁵In 2008, only 1.58% of the municipalities spent less than the amount received as educational categorical grant.

to 63.84% 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 on revenues that are raised primarily through the FPM (the main source) and 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.

3.2 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 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, and their power to produce deficits is restricted by the Fiscal Responsibility Act of 2000, which somewhat eliminates the debates on topics such as more versus less state intervention.

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.

3.3 The Recent Education Accountability Experience in Brazil

Prova Brasil (or Brazil's Exam) is a standardized test created in 2005 by the Ministry of Education with the objective of providing political representatives, policy makers, education workers and society with information about the quality of education. Every two years, the exam assesses the math and the reading skills of 5th and 9th graders (in fundamental education) of public schools with over 20 students, allowing the evaluation of the average performance of the schools and the local education systems. The first results were not disclosed until September 2006, when the Ministry of Education sent the summary reports with the average performance of the students to the local and state Education Offices and to each of the schools. The period immediately after the disclosure of the results was marked by the Ministry of Education's attempt to explain to the media, the local officials and the teachers, how the results should be interpreted and how they could be used to improve students' performances. However, the subnational governments presented difficulties when interpreting *Prova Brasil*'s new information and implementing appropriate educational policies.

By April 24th, 2007, the recently reelected President Lula signed decree n. 6094, known as the "Plan of Goals All Committed to Education" (hereinafter referred to as Plan of Goals). This decree established a set of priority goals whose intent was to improve the students' achievement.¹⁶ The plan was centered on the index known as the Basic Education

¹⁶This plan of goals is part of a broader set of measures called the Education Development Plan (or PDE in its Portuguese acronym), which also includes 29 other actions, goals and policies that are aimed not only at Fundamental Education but also at other stages. However, as Saviani (2007) notes, most of these additional measures were already part of the federal programs, and thus, we can consider the "Plan of Goals All Committed to Education" as the main novelty of the PDE.

Development Index (IDEB) whose purpose was to measure the overall quality of education in schools and municipalities in a more 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 . 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 term A_{ijt} reflects the school passing rate and varies between 0 and 100%.¹⁷

The Plan of Goals envisaged subnational governments voluntarily signing an agreement wherein they commit themselves to achieve gradually increasing annual goals for IDEB that are specific to each school and jurisdiction according to their initial situation. The Federal Government, in exchange, provides the municipalities with the technical and financial 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 be equal to 6.0, i.e., the average performance of the OECD students.

In principle, because of the broad disclosure of the students' achievement, the voters would tend to consider all of the other jurisdictions as the benchmark, instead of only their neighbors. Such a disclosure would force the incumbents to adopt the national best practices to improve academic performance so that they could signal their quality to their voters. Another possibility is that the voters are aware of the difficulties of increasing educational quality and that they demand that the incumbents at least participate in the Plan of Goals, making the necessary efforts to achieve their yearly goals and prove that they are competent. Either way, the jurisdictions would tend to interact less with their neighbors in terms of education provision.

The crucial aspect of the Plan of Goals is that the participation is not enforced by law; it is completely voluntary. Thus, if the incumbents change their spending interaction pattern in response to the plan, it would only be to signal their quality to the voters. This spontaneous participation fits perfectly with the objectives of the present work. If this institutional change

¹⁷Note 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.

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.

Brazil has experienced one such legally enforced institutional change early in the 2000 decade. The National Education Plan (also known as PNE) was enacted by law number 10,172 on January 9th, 2001. The plan affected the municipalities, especially in what concerns preschool and fundamental education, the stages of education that are predominantly under the responsibility of this level of government. The PNE set 26 goals for preschool and 30 goals for fundamental education.

The first and primary goal for each of these stages of education envisioned increasing the supply of school places. To accomplish this increase in school places, the municipalities would have to buy the appropriate pedagogical equipment, build, expand or improve the buildings and all of this while respecting the minimum standards established by the Federal Government. From the beginning of 2002, any new building designed to house preschool or fundamental education students should meet the minimum requirements, and, no later than 2006, all schools should meet the code's standards. These goals exerted great pressure on the finances of the municipalities, which had to cope with the requirements using their own resources. Another goal that required great financial effort from the municipalities referred to the qualification of Preschool professionals. Since 2001, only professionals with at least a high school education and specialization in early childhood education could be hired, with preference to those with higher education. By the end of 2005, all municipalities should also ensure qualification and updating of the professionals of preschools already under contract.

Aguiar (2010) emphasizes that, at first (prior to 2003), part of the municipalities did try to accomplish the goals, but the others were challenged to even start trying because of the budget constraints they faced. Saviani (2007) notes that the vetoes that the PNE suffered before it was enacted were particularly prejudicial to the points involving the financial support necessary for the fulfillment of the goals. In addition, because the Worker's Party members participated actively in the elaboration of the original proposal of the PNE, the vetoes caused them to disregard the plan as feasible. After winning the 2003 presidential election, the government of the Workers' Party did not try to overturn the vetoes and did not monitor or enforce the achievement of the goals by the subnational governments. The Workers' Party focused its efforts on the improvement of the educational quality that ultimately led to the approval of the "Plan of Goals All Committed to Education" in 2007.

Table 1 presents the evolution of selected variables that clearly show the stronger im-

Table 1: PNE effects on selected variables

	2000	2001	2002	2003	2004	2005	2006
enrollments at higher education courses for preschool teachers	1103	2308	8033	5518	4539	1364	1508
% teachers with specialized high school or higher education.	79.0	80.5	83.2	84	85.4	85.6	85.3
% new schools with gymnasium	12.6	15.1	21.0	21.1	19.7	19.2	20.8
% new schools with library/study room	22.5	22	28.3	28.2	20.5	22.1	25.9
% new schools with science lab	4.5	3.8	5 .9	5 .8	6.1	5.7	6.3

Source: Inep (2009).

pact that the PNE had in 2002 and the loosening in the enforcement of the plan observed after 2003. Interestingly, because of the PNE qualification requirements, the number of enrollments in higher education courses aimed at preschool teachers’ training exploded in 2002. With the advent of the new government and the signal that the requirements would not be enforced, enrollment fell sharply in 2003. The percentage of teachers with a higher education degree in the field increased from 80.5% in 2001 to 83.2% in 2002, stabilizing at approximately 85% thereafter. Other evidence that the PNE had its greatest impact in 2002 is that the percentage of new schools meeting the minimum infrastructure requirements (represented by percentage of schools with a gymnasium, library and science labs) increased significantly that year. However, this percentage was still much lower than that required by law, meaning that only a few local governments sought to follow the PNE directions. Moreover, this percentage even decreased after 2003, confirming that the law was not enforced by the new government.

All things considered, the PNE and the IDEB disclosure are two institutional changes with the potential to have negatively affected the strategic interaction between jurisdictions but whose natures are completely different. While the PNE in 2002 “tied the hands” of the incumbents who were obliged to comply with the law requirements on a tight budget, the disclosure of the IDEB in mid-2007 changed the incentives of the incumbents, who were compelled to follow the national best educational practices to signal their quality to the voters. These contextual factors have important implications for the analysis of the results, as we shall see further ahead.

4 Estimation Strategy

The strategies for identifying yardstick competition can be classified into two categories, direct or indirect. In the direct strategies, the dependent variables of the econometric models capture the voters’ preferences for their incumbents, which is usually represented by the

incumbents' electoral performance (vote share or reelection status); and the explanatory variables refers to own and neighbors' levels of tax and expenditures.¹⁸ The indirect strategies are the most commonly found in the literature, and consist of models that have tax and expenditure levels as the dependent variables of spatial econometric models. These indirect strategies explore the heterogeneity in the spatial parameters due to different political incentives for incumbents (Bordignon et al. 2003).

To identify yardstick competition using indirect strategies, the variables capturing the differences in the institutional framework (which affect the incumbents' incentive to react to their neighbors' policy) should enter the econometric model, either interacting the spatial term together with the spatial term itself, or interacting the spatial term with each of the different regimes that assign the different institutional frameworks.¹⁹ The model should then be estimated by maximum likelihood (ML) or instrumental variables (IV) approach. If there are only two possible regimes, there will be two interaction terms in the model, one for each regime. A less appealing econometric procedure consists of estimating the same model for different restricted samples, in which different strategic behaviors are expected.

The present paper rely on a two-regime Spatial Durbin²⁰ model to identify the existence of yardstick competition in education spending.²¹ This model can also be viewed as one representing demand for education²². Let

$$y_{it} = \alpha + \lambda_1 d_{it} \sum_{j=1}^N w_{ij} y_{jt} + \lambda_2 (1 - d_{it}) \sum_{j=1}^N w_{ij} y_{jt} + X_{it} \beta + \sum_{j=1}^N w_{ij} X_{jt} \theta + \mu_i + \tau_t + u_{it}, \quad (1)$$

where y_{it} denotes education spending per pupil. Element d_{it} represents the regime dummy equal to 1 in 2008 and 0 otherwise, or assumes the value of 1 from 2007 on, depending whether you consider the IDEB's results and goals or *Prova Brasil*'s scores as the turning point that could have affected how the municipalities interact. The term d_{it} can also represent different

¹⁸See Besley & Case (1995) and Revelli (2002).

¹⁹Remember that the presence of spatial correlation by itself can be evidence for competing theories of strategic interaction (such as yardstick and tax competition), hence the need for empirical applications to take the heterogeneity of the incumbents' incentives into account.

²⁰Term coined by Anselin (1988).

²¹See Elhorst & Fréret (2009).

²²See Borchering & Deacon (1972).

electoral accountability regimes, taking on the value of 1 in the case where the incumbents are lame-ducks and 0 if they are in their first term in office. Alternatively, if the regimes are defined by the size of the government majority, it assumes the value of 1 for the jurisdictions where the incumbent's government does not have the majority of the seats in the legislative, i.e., holds less than $x\%$ of the total seats (with x varying from 45% to 75%), and 0 otherwise. Moreover, to take the possible differences in the mimicking behavior over the political cycle into account, the present study consider that the regime variable assume the value of 1 in the election years (2004 and 2008) and 0 in the other years. The second regime (or the complement of the first regime) is represented by the element $(1 - d_{it})$.

The w_{ij} term is the spatial weight assigned to unit j by the unit i defined by the contiguity criterion.²³ The weights result from the row standardization of the $N \times N$ spatial weights matrix W_N such that $\sum_{j=1}^N w_{ij} = 1$. The neighbors' educational expenditure per pupil is represented by $\sum_{j=1}^N w_{ij} y_{jt}$. The coefficients λ_1 and λ_2 on the interaction terms are the parameters of interest (as well as their difference $\lambda_1 - \lambda_2$) that inform the spatial correlation under each regime d and $(1 - d)$, with $|\lambda_1|, |\lambda_2| < 1$ to ensure spatial stationarity. Vector X is $1 \times K$ and represents the demographic and political covariates, while β is a $K \times 1$ vector of corresponding parameters. The neighbors' characteristics $\sum_{j=1}^N w_{ij} X_{jt}$ and their parameters θ are also included in (1). Inserting spatially lagged covariates can help to capture the spillover effects of neighbors as well as to obtain unbiased estimates in case neighbors' characteristics are correlated with the included covariates (LeSage & Pace 2009).

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 variables that are included 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. Additionally, by assumption, the error term must be such that $u \sim \mathcal{N}(0, \sigma_u^2)$.

Equation (1) is estimated using maximum likelihood. Despite being computationally intensive for large samples such as that of Brazilian municipalities, maximum likelihood has advantages. One advantage is that the dependence parameters are restricted to the interval given by the minimum and maximum eigenvalues. Maximum likelihood also produces smaller standard errors than the IV estimators if the disturbances are spherical. Elhorst & Fréret (2009) derive the Log Likelihood function that provides the estimates of the spatial parameters and the other coefficients.

²³Attempts with distance-based weights were also carried on and virtually the same results.

$$\begin{aligned}
LogL = & -NT/2 + \ln(2\pi\sigma^2) + \sum_{t=1}^T \ln|I_N - \lambda_1 D_t W_N - \lambda_2 (I_N - D_t) W_N| \\
& - 1/2\sigma^2 \sum_{i=1}^N \sum_{t=1}^T \left[y_{it} - \lambda_1 d_{it} \sum_{j=1}^N w_{ij} y_{jt} - \lambda_2 (1 - d_{it}) \sum_{j=1}^N w_{ij} y_{jt} \right. \\
& \left. - \alpha - X_{it}\beta - \sum_{j=1}^N w_{ij} X_{jt}\theta - \mu_i - \tau_t \right]^2,
\end{aligned} \tag{2}$$

where D_t is a $N \times N$ diagonal matrix whose diagonal elements are the regime dummies d_{it} . 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.²⁴ Lee (2004) shows that the parameters are asymptotic and normally distributed under weak regularity conditions, e.g., the disturbances need not be normally distributed.

As far as the error term u_{it} is concerned, the literature usually admits the possibility that it follows a spatial error structure. In fact, Bordignon et al. (2003) argue that the 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.²⁵ In this case, the appropriate model to identify yardstick competition would be one of the spatial error types. On the other hand, several other authors assume that the voters react to the differences in fiscal policies due to observable characteristics, perhaps because they are not as well informed as one might think.²⁶ Ultimately, the choice of the model type is an empirical issue that is made based on the robust LM lag and the LM error tests proposed by Anselin et al. (1996).

In standard one-regime specifications, it can be shown that the spatial Durbin model has the spatial error model as a special case (when the common factor restrictions hold), which makes the former a more attractive procedure.²⁷ However, if the error structure follows a two-regime spatial pattern, this relationship is no longer valid unless all of the spatially lagged independent variables enter the right hand side of (1) interacting with each regime dummy. A two-regime spatial error term can be represented as follows:

²⁴The models' estimates are obtained using Matlab routines for spatial panel problems developed by Paul Elhorst, available at <http://www.regroningen.nl/elhorst/software.shtml>.

²⁵See Besley & Case (1995) and Revelli & Tovmo (2007).

²⁶See Revelli (2006), Elhorst & Fréret (2009), Allers & Elhorst (2005), Sollé Ollé (2003), and Revelli (2002).

²⁷See LeSage & Pace (2009).

$$u_{it} = \rho_1 d_{it} \sum_{j=1}^N w_{ij} u_{jt} + \rho_2 (1 - d_{it}) \sum_{j=1}^N w_{ij} u_{jt} + \varepsilon_{it}, \quad (3)$$

where u_{it} is a spatially correlated error term, d_{it} represents the same regime dummy variables, ρ_1 and ρ_2 are the spatial parameters of interest, with $|\rho_1|, |\rho_2| < 1$, and the *iid* disturbance component is represented by $\varepsilon_{it} \sim \mathcal{N}(0, \sigma_\varepsilon^2)$.

If the disturbance u_{it} is not spherical, i.e., whether there is spatial correlation in the error term, autocorrelation or heteroskedasticity, in principle, the Instrumental Variables estimators (IV) would be the natural alternative to obtain robust standard errors and consistent estimates of the coefficients of the main equation. Kelejian & Prucha (1998) show that the first and higher order neighbors' characteristics, i.e., $(I_T \otimes W_N)X$, $(I_T \otimes W_N^2)X$, \dots , $(I_T \otimes W_N^q)X$, consist of ideal instruments for the spatially lagged dependent variable, but advise that using up to the second order neighbor characteristics should be enough.

However, the IV estimators have a major limitation as regards the linear relationship between the dependent variable and the spatial lag, which can produce estimates of the coefficients out of its parameter space, e.g., correlations greater than 1. An additional problem, specific to the spatial Durbin model, is that the ideal instruments given by the neighbors' characteristics already enter the model as explanatory variables. In this case, Elhorst (2010) suggests using the characteristics of the higher order neighbors (given by W_N^q with $q \geq 2$) as the instruments. However, as noted by Pace et al. (2011), weak instruments will often be a concern in the spatial Durbin model because of the smaller explanatory power of the set of excluded instruments.

The estimation strategy in the present work follows a specific to general approach to select the best estimation strategy, and it is carried out as follows. First, the present study present a baseline model with spatial parameters θ , λ_1 , λ_2 , ρ_1 , ρ_2 set to zero using pooled ordinary least squares and fixed effects within estimators, and evaluate the spatial dependence in the error term before and after controlling for fixed effects. Then, the robust versions of the LM lag and LM error tests are performed for each case to decide the nature of the spatial interaction process. Spatial Hausman tests are also calculated to decide whether fixed or random effects are more appropriate. Subsequently, the present paper estimate a standard spatial Durbin model with time and spatial fixed effects using maximum likelihood and show its advantages compared with the IV estimators. Finally, two-regime models are estimated for the various

types of regimes and robustness test that uses school inputs in place of education spending are conducted in order to assess the mechanisms by which IDEB disclosure affects strategic interaction in education provision.

5 Data and Variables

Data on the Brazilian municipalities range from 2002 to 2008. Before 2002, spending on education and cultural activities are jointly reported and after 2008 some of the control variables are not available, ultimately restricting the analysis to the referred period. Of the 5,565 municipalities, there are complete data for 3,604 of them. The dependent and independent variables used to estimate (1) are described in Table 2, and the descriptive statistics are presented in Table 3. The continuous variables (and indexes) enter the econometric model in (1) 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) through a database of self-reported records known as Finance of Brazil (FINBRA). 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 growing concern regarding investment in basic education.

Table 2: Description of the variables

variable	Description	source
education spending	Education spending per pupil enrolled at the local public school system per year	FINBRA-STN
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 FUNDEF (and later on FUNDEB) 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

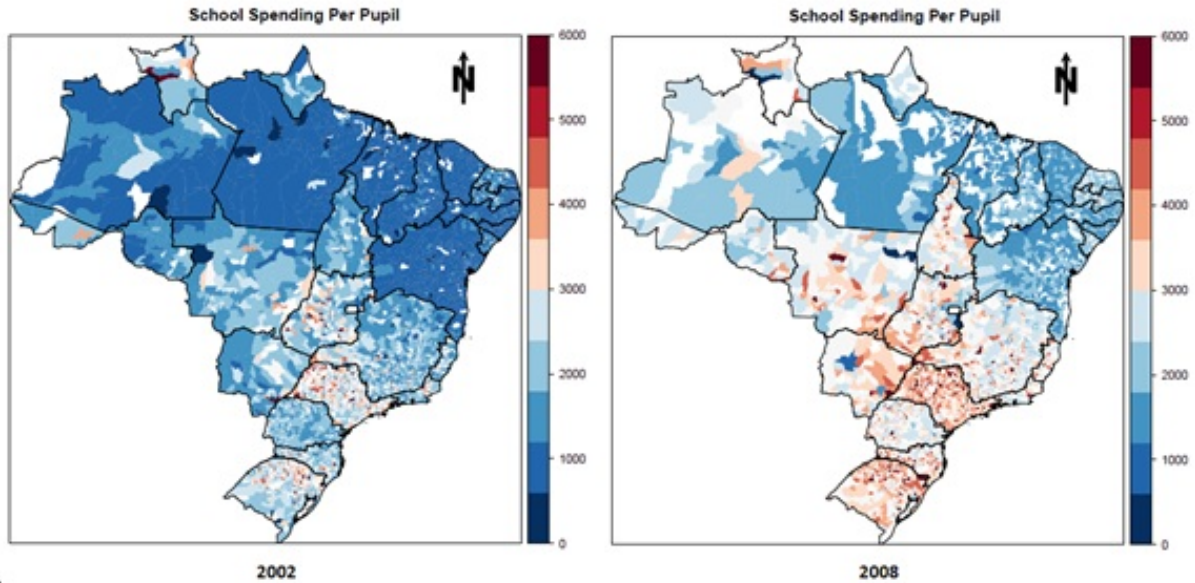
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Table 2 – *Continued from previous page*

variable	Description	source
perceived cost	$perceived\ cost = 100 \times (collected_j / municipal\ revenue_j)$, 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 “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 cicle	Percentage of local public schools’ students attending the second cycle of fundamental education.	Education Census-MEC
competition	Number of candidates running for office.	Canelew - TSE
incumbent’s age	Age of the incumbent.	Canelew - TSE
incumbent’s education	Dummy variable assuming value of 1 if the incumbent finished higher education and 0 otherwise.	Canelew - 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.	Canelew - TSE
incumbent women	Dummy variable assuming value of 1 if the incumbent is a woman and 0 otherwise.	Canelew - TSE
majority of seats	Dummy variable equal to 1 if the incumbent coalition holds more than 50% of the city council’s seats.	Canelew - TSE
percentage of seats	Percentage of seats held by the incumbent coalition at the city council.	Canelew - TSE
president’s party	Dummy variable equal to 1 if the incumbent’s party is the same as the president’s and 0 otherwise.	Canelew - TSE
governor’s party	Dummy variable equal to 1 if the incumbent’s party is the same as the governor’s and 0 otherwise.	Canelew - TSE
lame-duck	Dummy variable equal to 1 if the incumbent is in his or her second and final term and 0 otherwise.	Canelew - TSE
aldermen’s education	Percentage of aldermen with higher education.	Canelew - TSE
aldermen’s age	Average age of the aldermen.	Canelew - TSE
women in council	Percentage of women in city council.	Canelew - TSE
competition for seats	Ratio of the number of candidates to the number of seats available at the city council.	Canelew - 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.	Canelew - TSE

On the left panel of figure 1, for the year 2002, 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 per pupil spending between the municipalities to the north and to the south.

Table 3 shows descriptive statistics. There, it is possible to see that the mean spending



Source: Elaborated by the author using FINBRA data for the years of 2002 and 2008.
Figure 1: An overview of the geographical distribution of the education spending per pupil

per pupil is 2,612.13 reais (1,500.19 US dollars).²⁸ Note also that the standard deviation is expressive (1,782.79 reais or 1,023.89 US dollars), evidencing the large difference in education spending between the Brazilian local governments.

Categorical and block grants are also obtained from FINBRA. These variables 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, the educational categorical 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 for education; the amount destined for this area depends on the marginal propensity to spend on education, regardless of the fiscal capacity. Table 3 shows that the mean value of the categorical grants is 1,188.35 reais per pupil (or 682.49 US dollars), while the block grant that is received by the municipalities amounts to 521.43 reais per capita (or 299.47 US dollars) on average. The variation in the value of grants between localities is also very expressive, as the standard deviations make clear.

²⁸Prices are adjusted by the Amplified Consumer's Price Index (IPCA) to prices of December 2009.

Table 3: Descriptive Statistics

variable	Obs	mean	sd	min	max
education spending (reais per pupil/year)	25228	2612.13	1782.79	440.55	33465.82
gdp (reais per capita)	25228	9091.28	9314.83	1301.01	218000.00
wage (reais per worker)	25228	736.67	252.09	101.58	5745.16
occupation (index)	25228	19.99	14.67	0.03	386.52
categorical grant (reais per pupil)	25228	1188.35	460.24	167.78	7228.74
block grant (reais per capita)	25228	521.43	384.41	0.54	5395.86
perceived cost (index)	25228	61.48	119.95	1.58	9574.09
schooling (years)	25228	9.34	1.29	1.46	15.59
men (%)	25228	50.68	1.49	44.88	67.03
population (in 1000 inhab.)	25228	37.22	231.98	0.75	11104.71
elderly (%)	25228	7.01	2.15	0.58	20.92
young (%)	25228	37.98	6.22	17.43	61.79
rural (%)	25228	33.76	31.12	0.00	100.00
second cicle (%)	25228	23.78	19.30	0.00	100.00
competition (number of candidates)	25228	2.78	1.12	1.00	16.00
incumbent's age (years)	25228	49.81	9.73	21.21	86.80
incumbent's education (dummy)	25228	0.41	0.49	0.00	1.00
left (dummy)	25228	0.19	0.39	0.00	1.00
incumbent women (dummy)	25228	0.06	0.24	0.00	1.00
majority of seats (dummy)	25228	0.59	0.49	0.00	1.00
proportion of seats (%)	25228	53.10	17.90	0.00	100.00
president's party (dummy)	25228	0.08	0.27	0.00	1.00
governor's party (dummy)	25228	0.23	0.42	0.00	1.00
lame-duck (dummy)	25228	0.27	0.45	0.00	1.00
aldermen's education (%)	25228	15.62	16.24	0.00	90.00
aldermen's age (years)	25228	44.38	3.96	28.62	60.00
women in council (%)	25228	12.04	10.85	0.00	77.78
competition for seats (candidates/seats)	25228	6.08	3.81	1.00	30.33
(index)	25228	73.83	10.15	0.00	93.36

Another variable calculated with FINBRA data is the “perceived cost.” The literature on public finance usually relies on the share of local property taxes paid by the representative voter as a measure of the tax price. However, as already discussed, property tax in Brazil is a minor source of revenue. The most significant portion of revenues comes from block and categorical grants, - which are funded mainly through the ICMS and the IPI taxes - as well as from the local participation in the ICMS. The “perceived cost” takes these specificities into account by considering the ratio between the sum of the local services tax and the taxes on production collected within the municipality’s borders - whose main components are the state and federal indirect taxes ICMS and IPI - and the total revenue of the jurisdiction (then multiplied by 100). This variable reflects the cost perceived by the local citizens of providing one monetary unit of public services. As observed from Table 3, the mean perceived cost is equal to 61.48, 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.

Demand for public services is also a function of income. Borcharding & Deacon (1972) and

Bergstrom et al. (1982) show 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 total income by municipalities. Fortunately though, some proxy variables are available, such as the GDP net of the public sector activities from the Brazilian Institute of Geography and Statistics (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 (multiplied by 100). Note that the index can be greater than 100 because the numerator refers to the total workers, while the denominator is restricted to the citizens living in the municipality. Altogether, these three variables should capture the income effect on the demand for education.

Other variables are included as controls in (1) 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. All of these variables are gathered from DATASUS, a database from the Ministry of Health. The proportion of men in the population is included to account for the fact that men leave school for the labor market earlier than women.²⁹ Elderly people, in turn, usually demand less education and more health expenditures. The predominance of young people, 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, or to a lower demand because bigger cohorts of young people can decrease the amount of resources per pupil.³⁰ In addition, the average years of schooling (obtained from RAIS) is included to capture the preference of more educated individuals for more public education.

The population of the municipality (from IBGE) is included as a control 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. This 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 fundamental education (from 6th to 9th grade) of the local

²⁹A report by the OECD (2009) shows that the difference in the upper secondary graduation rates of boys and girls is especially remarkable in Brazil, at 71,9% among girls and 53,2% among boys.

³⁰See Arvate & Zoghbi (2010) and Poterba (1997).

public schools are included in (1) to take into account the differences in the amount of the categorical transfers that these students receive (from FUNDEF) in excess of those enrolled in the first cycle (from 1st to 5th grade) or in the Preschool attending urban schools.

The electoral variables included in equation (1) are all gathered from the Canelew database, which is organized by the Electoral Supreme Court. The political features of the local governments are important determinants of the level of expenditure on education. Left-wing governments, for example, prefer a larger public sector, i.e., higher expenditures.³¹ In Brazil, however, partisan ideology is not as well defined as in other countries.³² 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 whether the incumbent’s party is the same as the presidents’ or the governors’ are included in (1) to account for the fact that the partisanship of incumbents is supposed to increase the amount of resources that they have access to.

Another frequently explored variable refers to party fragmentation (see the description in Table 2). 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 benefited groups not fully internalize the costs of the program, 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.

The existence of term limits can also influence the level of expenditures. Besley & 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 affect the level of public spending in a non-linear fashion. 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

³¹See Alt & Lowry (1994) and Sollé Ollé (2006).

³²See Lucas & Samuels (2010).

expenditures with a budget restriction means that the majority will have to cope with the costs of taxation. Because the purpose here is not to estimate this effect, but just to control it, the strategy adopted consider only 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 should be enough to control 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 included in (1). One of these characteristics is the education of the incumbents and aldermen, which can reflect their preferences regarding educational expenditure. Besley & Case (1995) also emphasize 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 & Schosberg (2000) demonstrate that because women face barriers to entry into office, if they are chosen, they are of better quality. Therefore, two variables are included in (1) to capture this phenomenon: a dummy variable indicating whether the mayor is woman and the percentage of women in the city council.

A last factor that can lead to better quality incumbents is competition. As the number of candidates for the position increases, the voters will be better able to distinguish between the good and bad candidates and vote for the good ones. As a result, the expected rent extraction will be smaller, as will taxes and expenditures. 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 included in (1).

6 Results

6.1 Standard One-Regime Models

Before presenting the estimates of (1), this section shows an analysis the results of basic non-spatial and standard one-regime spatial models following a specific to general approach to determine the best estimation strategy.

The first two columns of Table 4 present models where the spatial parameters λ, ρ and θ 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 observed at the bottom of Table 4, 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 0.237, with a statistic of 54.58, significant at less than the minimum conventional level of 1%.

As noted by Elhorst (2010), failing to take fixed effects into account can result in spatially auto-correlated residuals. The model FE in the second column clearly confirms that. The Moran's I that is calculated on the residuals of the fixed effects model is equal to 0.117, which is still significant at much less than 1% but considerably smaller than the correlation observed in the residuals of the POLS model. More importantly, the robust LM test of no spatial lag rejects this hypothesis at a 1% significance level, whereas the robust LM test of no spatial error cannot reject the null hypothesis at the conventional levels, thus indicating the spatial lag as the most appropriate model.

Next, the spatial lag and the spatial Durbin models are estimated through the generalized method of moments (GM) and contrast them with the maximum likelihood (ML) estimates. The GM procedure is estimated along with the HAC estimator of the variance-covariance matrix to obtain consistent estimates of the standard errors. The GM spatial lag model (SARFEGM) in Table 4 shows a spatial parameter of 0.513 that cannot be interpreted as elasticity because the dependent variable is in its logarithm form and the spatial lag is the average of the log spending per pupil of neighboring jurisdictions. Note that this figure is very high compared to the results of other studies such as in Elhorst & Fréret (2009) and Revelli (2006) (coefficients of 0.083 and 0.216 in welfare spending, respectively), possibly because of the linear relationship between the endogenous regressor and the dependent variable that is peculiar to IV estimators. Additionally, even though we reject the null of under-identification and weak identification (see the statistics at the bottom of Table 4), the test for over-identification rejects the null hypothesis of no correlation between the excluded instruments and the residuals of the main equation, indicating that the instruments are not exogenous.

The rejection of the null of exogeneity appears to be caused by omitted variables, as it becomes clearer when we look at the results of the Spatial Durbin model (SDFEGM). By including the characteristics of the contiguous neighbors in the model and instrumenting the spatial lag by the second order neighbors' characteristics, we no longer reject the null of

exogeneity of the instruments (χ^2 statistic equal to 24.2). However, the size of the spatial lag parameter of the SDFEGM model is unusually large, especially compared to those found in the previously mentioned studies. One unit increase in the neighbors log spending per pupil makes the jurisdiction react with an astonishing 0.865 unit increase in own spending. Weak instruments appear to be the most likely explanation for the increase in the magnitude of the spatial parameter, just as Pace et al.2011) warned in the case of a spatial Durbin model. Looking at the test result at the bottom of Table 4, we cannot reject the presence of weak instruments at the more rigorous levels (F statistic equal to 8.4). In view of these disadvantages, the maximum likelihood estimator appears to be the most appropriate choice.

Table 4: Results of standard one regime models of log education spending in Brazilian municipalities

	OLS	WITHIN	GM	GM	ML	ML
	POLS	FE	SARFEGM	SDFEGM	SARFE	SDFE
λ			0.513*** (12.969)	0.865*** (8.991)	0.180*** (23.866)	0.177*** (22.558)
gdp	0.252*** (47.494)	0.104*** (11.806)	0.059*** (4.800)	0.066*** (4.341)	0.092*** (9.746)	0.085*** (8.139)
wage	0.319*** (36.000)	0.096*** (10.764)	0.063*** (5.748)	0.054*** (4.579)	0.084*** (8.852)	0.075*** (7.780)
perceived cost	-0.101*** (-29.996)	-0.064*** (-13.136)	-0.045*** (-6.050)	-0.054*** (-6.304)	-0.061*** (-11.868)	-0.064*** (-11.802)
categorical grants	0.411*** (61.682)	0.288*** (50.071)	0.188*** (5.038)	0.282*** (6.294)	0.280*** (45.702)	0.285*** (45.452)
block grants	0.069*** (16.232)	0.024*** (8.421)	0.017** (2.528)	0.015** (2.127)	0.022*** (7.469)	0.021*** (6.945)
schooling	0.027** (1.981)	0.006 (0.364)	-0.011 (-0.558)	-0.020 (-0.931)	-0.001 (-0.033)	-0.016 (-0.938)
occupation	0.039*** (9.779)	0.017*** (4.112)	0.007 (1.383)	0.004 (0.654)	0.015*** (3.268)	0.010** (2.280)
men	-0.008*** (-5.333)	-0.003 (-1.033)	0.002 (0.360)	-0.003 (-0.605)	-0.003 (-0.842)	-0.004 (-1.216)
population	-0.045*** (-11.941)	0.098*** (4.921)	0.039 (1.593)	0.033 (1.116)	0.081*** (3.797)	0.066*** (2.894)
elderly	-0.017*** (-11.525)	-0.050*** (-21.053)	-0.024*** (-7.168)	-0.017*** (-3.752)	-0.040*** (-15.872)	-0.021*** (-5.517)
young	-0.038*** (-61.244)	-0.024*** (-15.498)	-0.011*** (-5.933)	-0.006*** (-2.635)	-0.019*** (-11.845)	-0.009*** (-4.466)
rural	0.002*** (36.617)	0.001*** (8.724)	0.001*** (4.744)	0.001*** (5.958)	0.001*** (8.086)	0.001*** (8.266)
second cicle	-0.004*** (-44.943)	-0.001*** (-5.185)	-0.001*** (-4.329)	-0.002*** (-6.229)	-0.001*** (-5.765)	-0.001*** (-7.045)
competition	0.028*** (4.291)	-0.003 (-0.461)	0.003 (0.490)	0.002 (0.266)	-0.001 (-0.225)	0.0001 (-0.018)
incumbent's age	-0.022** (-2.358)	0.017** (2.032)	0.014 (1.340)	0.024** (2.154)	0.018** (2.081)	0.018** (2.036)
incumbent's Education	0.00023 (-0.063)	0.009** (2.561)	0.012*** (2.983)	0.010** (2.283)	0.008** (2.335)	0.009** (2.481)
left	0.027*** (5.474)	0.004 (1.083)	0.006 (1.223)	0.002 (0.319)	0.004 (0.970)	0.003 (0.720)
incumbent women	-0.035*** (-4.826)	0.012** (1.979)	0.010 (1.364)	0.008 (1.012)	0.012* (1.767)	0.013* (1.912)
aldermen's education	0.001***	0.0001	0.0001	0.00001	0.0001	0.0001

Continued on next page

Table 4 – *Continued from previous page*

	OLS	WITHIN	GM	GM	ML	ML
	POLS	FE	SARFEGM	SDFEGM	SARFE	SDFE
	(7.997)	(0.833)	(0.739)	(0.074)	(0.646)	(0.657)
aldermen's age	-0.155***	-0.002	0.030	0.017	0.007	0.013
	(-6.848)	(-0.097)	(1.068)	(0.572)	(0.295)	(0.529)
women in council	-0.001***	0.0001	0.00004	0.0002	0.00002	0.00003
	(-3.945)	(0.483)	(-0.201)	(-1.082)	(0.104)	(0.211)
competition for seats	0.005	0.010	0.005	0.013	0.008	0.011
	(0.876)	(1.481)	(0.649)	(1.443)	(1.101)	(1.500)
fragmentation	-0.001***	0.001**	0.0002	0.0002	0.0004**	0.0004*
	(-4.295)	(2.514)	(0.931)	(0.671)	(1.983)	(1.740)
majority of seats	-0.001	-0.005*	-0.002	-0.005	-0.005	-0.005*
	(-0.134)	(-1.767)	(-0.578)	(-1.336)	(-1.449)	(-1.696)
president's party	0.022***	0.018***	0.013**	0.012*	0.017***	0.016***
	(3.110)	(3.616)	(1.980)	(1.706)	(3.306)	(3.031)
governor's party	-0.003	-0.003	0.0002	-0.005	-0.003	-0.003
	(-0.813)	(-0.871)	(0.048)	(-1.225)	(-0.828)	(-0.855)
lameduck	0.003	0.001	0.004	0.008**	0.002	0.003
	(0.769)	(0.317)	(1.278)	(2.154)	(0.668)	(0.888)
Spatially Lag. Indep. Var. (WX)	No	No	No	Yes	No	Yes
Spatial Fixed Effects	No	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Robust LM no Spatial Lag χ^2	22530.3***	47.1***				
Robust LM no Spatial Error χ^2	24993.1***	0.6				
Kleibergen-Paap χ^2 (Underid.)			882.3***	196.8***		
Kleibergen-Paap F (Weak Id.)			31.6(a)	8.4(c)		
Hansen J statistics χ^2 (Overid.)			192.9***	24.2		
R-squared	0.389	0.929	0.631	0.601	0.931	0.932
N	25228	25228	25228	25228	25228	25228
log-likelihood			12573.8	11540.7	12725.1	12898.4
Notes: t-statistics in parenthesis. *** significant at 1%; ** significant at 5%; and * significant at 10%. a-significant at 5% IV maximal relative bias; c- significant at 20% IV maximal relative bias . Instruments are first and second order neighbors' characteristics for model SARFEGM, and only second order neighbors' characteristics for model SDFEGM . Full estimates can be obtained upon request to the author.						

Maximum likelihood estimates of the spatial lag model (named SARFE in Table 4) show a spatial parameter that is much more plausible, with a magnitude that is closer to those found in the literature. A 1 unit increase in the log neighbor's spending per pupil makes the jurisdiction react through a 0.18 unit increase in own expenditures . In addition, as observed at the bottom of the table, the log-likelihood of this model is higher than its IV counterpart (SARFEGM). The Spatial Hausman test also reject the null that the coefficients of the spatial fixed effects (consistent) and the random effects (efficient) estimators are equal (χ^2 statistic is equal to 828.0 and statistically significant at much less than 1%), which indicates that the fixed effects estimator is the most appropriate choice.

Still, SARFE estimates can suffer from omitted variable bias. Thus, a fixed effects spatial

Durbin model is estimated, termed SDFE in Table 4. Spatial Hausman for such model also indicates that the spatial fixed effects estimator is the most appropriate method (the χ^2 statistic is equal to 117.7 and statistically significant at less than 1%). The spatial parameter on the SDFE model indicates that a 1 unit increase in the neighbors' log spending per pupil leads to a reaction of a 0.177 units increase in own municipality log spending. This result is much lower than those found using the GM procedure and much more coherent with the results of other studies.

Note that the maximum likelihood coefficients of the exogenous variables cannot be interpreted as the marginal effects because the latter consist of the sum of the direct and indirect effects.³³ However, in general, the coefficients can inform the direction of these effects. In the SDFE model, the variables gdp, wage and occupation serve as a proxy for income. As expected, all of these variables present positive coefficients, pointing out that education is a normal good. Categorical and block grants also show positive coefficients, with the former having the stronger impact. The perceived cost 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 percentage of men in the municipality. The coefficient of population, on the other hand, shows a positive sign once the fixed effects are considered, which goes against the hypothesis of economies of scale and supports the hypothesis of differences in the cost of living or even congestion effects.

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 expenditure.³⁴ However, the second result has a less clear-cut interpretation. One would expect that a larger fraction of young people in a jurisdiction would increase the demand for education. Possibly because municipalities in Brazil where there are a greater share of young individuals have very little revenue generating capacity - due the lower share of economically active individuals -, an increase in the share of young individuals could mean that they will have to share a fixed amount of own revenues among a higher number of people, decreasing the per capita amount available.

The coefficient on the ratio of students enrolled in rural schools of the local public educational system is positive, reflecting the legal determination that the rural school students

³³See LeSage & Pace (2009, pp.69).

³⁴See Poterba (1997) and Arvate & Zoghbi (2010).

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 that they also should receive a higher amount of transfers.

Among the political variables, the incumbent’s characteristics appear to play an important role in determining the educational expenditure. As expected, the age of the incumbent positively affects the spending per pupil, suggesting that the willingness to extract rent increases as the incumbents get older. More educated and female incumbents also show stronger preferences for education expenditures, although the coefficient of the latter only shows weak significance at the 10% level. The party fragmentation coefficient suggests (only weakly) that the more party fragmented a municipality is, the higher the expenditure level will be, either because of the need for pork barrel politics to build a majority or because the parties will tend not to internalize the full cost of their projects in a more fragmented system. Incumbents of the same party as the presidents’ also seem to spend more on education according to the estimated coefficient, which can be accredited to the greater access they enjoy to federal transfers.

On the other hand, weak evidence suggests that the incumbents holding the majority of seats in the council spend less on education, possibly because of the lesser need to engage in pork barrel politics. In contrast, variables denoting the number of candidates running for office (variable “competition”), the left wing parties, the aldermen’s education and age, the percentage of women in the council, the competition for seats in the council, the incumbents of the same party as the governors’ and the lame-duck incumbents do not show statistically significant coefficients.

6.2 Two-Regime Models

The last section followed a specific to general approach to select the best estimation strategy. Ultimately, the test results indicated that the maximum likelihood spatial Durbin model is the best alternative. Next, to identify the yardstick competition, this section generalizes this conclusion and uses two-regime spatial Durbin models estimated through maximum likelihood, where the regimes reflect different electoral and education accountability scenarios.

Table 5 summarizes the main results. In model 1, the regime variable d assumes the value of 1 for lame-duck incumbents and 0 otherwise, while the second regime $(1 - d)$ takes the value of 1 for incumbents in their first term and 0 otherwise. The spatial parameter λ_1 on lame-ducks indicates a spatial auto-correlation of 0.163. The incumbents in their first term

Table 5: Two regime models for determination of log education spending in Brazilian municipalities

	1	2	3	4	5
	d= dummy of lame-ducks	$d=1(x < 50\%$ of the seats)	d= dummy of <i>Prova Brasil</i> 2007-2008	d = dummy of IDEB 2008	d = dummy of election years
λ_1	0.163*** (16.766)	0.197*** (17.899)	0.166*** (18.068)	0.160*** (18.904)	0.154*** (16.717)
λ_2	0.208*** (12.439)	0.146*** (10.741)	0.203*** (14.760)	0.264*** (14.608)	0.233*** (17.277)
$\lambda_1 - \lambda_2$	-0.045** (-2.194)	0.051*** (2.736)	-0.037** (-2.331)	-0.104*** (-5.361)	-0.079*** (-4.986)
Controls (X)	Yes	Yes	Yes	Yes	Yes
Spatially Lagged Var. (WX)	Yes	Yes	Yes	Yes	Yes
Spatial Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.9324	0.9324	0.9324	0.9324	0.9324
N	25228	25228	25228	25228	25228
log-likelihood	12899.917	12901.504	12899.984	12912.246	12909.956

Notes: t-statistics in parenthesis;

*** significant at 1%;

** significant at 5%;

* significant at 10%;

Full estimates can be obtained upon request to the author.

react more intensively, with a spatial auto-correlation of 0.208. The difference between the spatial coefficients of the two groups $\lambda_1 - \lambda_2$ is equal to -0.045, statistically significant at the 5% level. This difference suggests that there is weaker strategic interaction in education spending among the lame-duck governments. This result is consistent with those of Besley & 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 & Spear (1988), according to which the parties have incentive mechanisms to prevent the lame-duck governors from pursuing only their own interests.

Model 2 of Table 5 uses another electoral accountability variable to identify yardstick competition. In this case, the regime variable d takes the value of 1 for incumbents holding less than 50% of the seats at the city council and 0 otherwise, while the second regime ($1 - d$) takes the value of 1 for those incumbents holding more than this share of seats. The spatial parameter of the first regime λ_1 indicates that the localities where the incumbents hold less than 50% of the seats present spatial auto-correlation of log education spending per pupil of 0.197. This response is less pronounced in the municipalities that are governed by the incumbents with the majority at the council; equal to 0.146. The difference $\lambda_1 - \lambda_2$ equals

Table 6: Two regime models: varying the cut-offs of voting margin held by the incumbent at the city council

	2a	2b	2c	2d	2e	2f	2g
	$d=1(x < 45\% \text{ of the seats})$	$d=1(x < 50\% \text{ of the seats})$	$d=1(x < 55\% \text{ of the seats})$	$d=1(x < 60\% \text{ of the seats})$	$d=1(x < 65\% \text{ of the seats})$	$d=1(x < 70\% \text{ of the seats})$	$d=1(x < 75\% \text{ of the seats})$
λ_1	0.189*** (17.947)	0.197*** (17.899)	0.196*** (17.111)	0.172*** (11.017)	0.172*** (10.320)	0.164*** (6.683)	0.162*** (6.226)
λ_2	0.153*** (10.594)	0.146*** (10.741)	0.152*** (11.745)	0.178*** (17.612)	0.177*** (18.121)	0.178*** (20.513)	0.178*** (20.755)
$\lambda_1 - \lambda_2$	0.037* (1.923)	0.051*** (2.736)	0.045** (2.398)	-0.005 (-0.264)	-0.005 (-0.238)	-0.014 (-0.504)	-0.016 (-0.557)
Controls (X)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatially Lagged Indep. Vars. (WX)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.9324	0.9324	0.9324	0.9324	0.9324	0.9324	0.9324
N	25228	25228	25228	25228	25228	25228	25228
log-likelihood	12900.274	12901.504	12900.41	12895.754	12895.351	12901.532	12902.677

Notes: See notes on table 5.

0.051 and is statistically significant at the 1% level, meaning that the incumbents ruling with majority support are more confident about their reelection (or the election of the candidates they support), and thus feel less compelled to mimic their neighbors' policies.

Elhorst & 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. The authors then re-estimate their model varying the cutoff from 55% to 85% of the seats to show that the maximum difference is reached at the 75% cutoff. Here a similar approach is used, re-estimating the model for several cutoffs. Table 6 presents the results of this exercise. Model 2a shows that the jurisdictions whose incumbents are supported by less than 45% of the aldermen tend to mimic the neighbors' behavior to a greater extent; 0.037 correlation points more to be precise. When we consider the cutoff of 50% (models 2 of Table 5 and 2b of Table 6) the difference reaches a value of 0.051 is statistically significant at 1%. Raising the cutoff to 55% of the seats (model 2c), we obtain a difference of 0.045. Thus, it appears that the difference in spatial interaction between the minority and majority governments reaches its peak when the incumbents hold between 50% and 55% of the city council's seats.

The divergence on the peak level estimated for the Brazilian municipalities and those estimated by Elhorst & Fréret (2009) for the French departments could be due to the country-specific differences in the incumbents' incentives. In Brazil, it appears that once the local rulers obtain the support of the council's absolute majority, aside from being more confident about their reelection (or the maintenance of the ruling coalition in office), they also gain

the power to approve all of their projects and the opportunity to extract more rent, thus discouraging mimicking behavior. In France, it could be the case that rent extraction is more severely punished if unveiled, and only the expectancy of electoral success plays a role in determining the need for mimicking.

Models 3 and 4 of Table 5 refer to the case where regime d denotes the disclosure of the average students' achievement. The regime variable takes a value of 0 from 2002 to 2006 and 1 from 2007 to 2008 (model 3) if we consider the disclosure of *Prova Brasil*'s results; or instead, assume a value of 1 only in 2008 (model 4) if we consider the disclosure of IDEB and its goals.

The results of models 3 and 4 show that from 2007 on, spatial coefficient in education spending decreased. Model 3 suggests that the spatial interaction after 2007 fell 0.037 correlation points, while model 4 indicates that the spatial interaction between neighboring jurisdictions was reduced by impressive 0.104 points in 2008. These results agree with those of Revelli (2006) for welfare expenditures, i.e., the broad disclosure of educational quality indexes reduces the strategic interaction in education spending by improving the information available and diminishing 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 rating of social expenditures. The author admits that had he had access to information for the subsequent years, it could have been possible to evaluate whether the observed decrease on spatial interaction was indeed resultant from the introduction of performance ratings or due to other conjunctural factors.

Even though there are not complete data for the most recent years after IDEB disclosure, it is possible to use information from previous years to evaluate whether the spatial patterns over time are coherent with the hypothesis being tested. Therefore, to check the validity of the results in models 3 and 4 of Table 5, several two-regime models are estimated with regime variables based on year dummies, i.e., $d = 1_t$ and $(1 - d) = 1 - 1_t$, where 1_t is a indicator function that depends on the year t . The results are reported in Table 7.³⁵

³⁵In principle, it could be possible to compare the spatial coefficients using an N -regime model. The log-likelihood function in (2) could be extended to include several spatial parameters (one for each regime). However, further investigation is still necessary to derive the properties of the estimator and to implement the routines, which is beyond the scope of this study.

Table 7: Two regime models: assigning year dummies as different regimes

	4a	4b	4c	4d	4e	4f	4g
	d= dummy of PNE (2002)	d= dummy of 2003	d= dummy of 2004	d= dummy of 2005	d= dummy of 2006	d= dummy of 2007	d= dummy of IDEB (2008)
λ_1	0.153*** (17.948)	0.179*** (21.231)	0.174*** (20.576)	0.185*** (22.002)	0.194*** (23.128)	0.183*** (21.893)	0.160*** (18.904)
λ_2	0.257*** (13.849)	0.159*** (7.990)	0.190*** (9.662)	0.088*** (4.188)	0.067*** (3.192)	0.116*** (5.853)	0.264*** (14.608)
$\lambda_1 - \lambda_2$	-0.105*** (-5.225)	0.020 (0.914)	-0.016 (-0.772)	0.097*** (4.314)	0.127*** (5.670)	0.067*** (3.180)	-0.104*** (-5.361)
Controls (X)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatially Lagged In- dep. Vars. (WX)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.9324	0.9323	0.9323	0.9324	0.9325	0.9324	0.9324
N	25228	25228	25228	25228	25228	25228	25228
log-likelihood	12914.594	12897.732	12897.523	12905.047	12897.523	12901.902	12912.246

Notes: See notes on table 5.

Spatial parameters λ_1 of models 4a to 4g have a more direct interpretation. The parameters show the spatial correlation in each year. The spatial parameter λ_2 , on the other hand, has a less clear meaning because it reflects the average spatial correlation for all of the other years. Looking at these results, we can see that the spatial correlation was lower in 2002 (equal to 0.153) if compared to the period between 2003 and 2007. As discussed in Section 3, the explanation for that lies in the enactment of the National Education Plan (PNE) in 2001, which had its greatest impact in 2002. A portion of the incumbents felt compelled to make adjustments in the school infrastructure and the qualification of personnel on a tight budget. Consequently, the freedom to set expenditure levels was greatly limited, reducing the room for spending mimicking. From 2002 to 2006, i.e., from model 4a through model 4e, the spatial coefficient λ_1 increased until it reached its maximum of 0.194 in 2006. In 2007 (model 4f), the spatial coefficient decreased to 0.183, possibly because of the disclosure of *Prova Brasil* results in the previous year. Finally, after the IDEB disclosure in 2008, the spatial coefficient declined to 0.160.

Note that the results exclude political cycles as the cause of spending interaction variability. According to Sollé Ollé (2003), in election years, we should observe higher spatial interaction. To test this hypothesis, in model 5 of Table 5, we consider the election years of 2004 and 2008 as one regime and the remaining years as another. The difference of -0.079 correlation points between both regimes is clearly influenced by the significantly smaller spatial parameter observed in 2008 (models 4 and 4g). Model 4c, in its turn (Table 7), indicates that the spatial parameter in 2004 is not too different from those of the previous and subsequent years.

In general, the evidence obtained using the electoral accountability variables and the IDEB disclosure in a two-regime spatial Durbin model suggests that there is yardstick competition in education expenditures. The strategic interaction is found to be smaller among lame-duck incumbents compared to those in their first term, which the literature credits to the lesser urge to signal their type to the voters. Moreover, the local rulers with minority support at the local council appear to interact more with their neighbors because they are less certain about the odds of reelection and thus they put more effort into signaling their type to the voters to increase the odds of reelection. Additionally, the Federal Government, by disclosing the IDEB results and goals, helped to reduce the information asymmetry between the voters and the incumbents, which led to the decline observed in the strategic interaction between local governments when setting education expenditure levels and can be interpreted as a reduction in yardstick competition. This evidence also suggests that the incumbents do not assume that “money does not matter,” but identify (or at least believe in) a relationship between educational quality and education spending. The guidance provided by the Federal Government, academia, educational organizations, and media campaigns can also have helped to improve local governments’ ability to distinguish what could be effective in improving students’ achievement. However, it is not possible to tell whether this reduction in strategic interaction is associated with an improvement in the effectiveness of education expenditures in increasing students’ performance.

6.3 Mechanisms by which IDEB Disclosure Affects Strategic Interaction in Education Spending

This section seek to ascertain whether the decline in spending interaction that is observed after the IDEB disclosure reflects a true concern of the incumbents about pursuing national’s best educational practices, i.e., the practices that can improve educational quality. For this purpose, it identifies whether strategic interaction in the use of selected school inputs is also affected by the disclosure of the index and its goals. Favorable evidences are further signs of the existence of yardstick competition.

Unlike the strategic interaction in education spending, which benefits from the mandatory disclosure of budget information in the local newspapers or websites, strategic interaction in the setting of school inputs and other educational policies is facilitated by the way that the regional offices of the National Union of Municipal Leaders in Education (also known as UNDIME) are organized, covering the groups of geographically close municipalities. These regional offices hold periodic meetings with the secretaries of education of the nearby juris-

dictionaries to discuss experiences, conduct training, and exchange information on the successful or unsuccessful policies in their municipalities.³⁶

The chosen variables are known, or at least expected, to be important in improving students' achievement: computer to pupil ratio, TV to pupil ratio, log average school day length, log teacher to pupil ratio and log average size of class.³⁷ All of these variables are considered to be a school input to some extent. The TV and computer to pupil ratios are considered to be important pedagogical resources that can complement the usual blackboard teaching methods.³⁸ The school day length is expected to affect the students' achievement through the longer exposure of the students to all of the other educational inputs.³⁹⁴⁰ It is also related to the intensity of use of all of the school resources and to the amount of the other inputs used for teaching purposes. A higher number of teachers per pupil can be indicative of a lower workload and longer time spent in class preparation for the teachers, which is expected to increase the students' performance.⁴¹ Moreover, the teacher to pupil ratio is related to the effective teaching time (or effective school day length) because it accounts for the availability of substitute teachers that can cover the absences of regular staff. Finally, the average class size can account for the amount of attention that teachers can give to each student and the difficulty in delivering instruction to them.⁴²

Both the education spending and the school inputs can be used to measure the provision of education. To see this relationship, it suffices to note that varying the amount of one input employed in the school environment, with the other inputs held constant, generates additional expenditures. Given this relationship, the same specification of equation (1) is

³⁶Regarding strategic interaction between same regional office municipalities, see Gemignani (2011).

³⁷The reason for not expressing some of the variables in their logarithm form is due to the fact that some of these variable have some concentration of values at 0.

³⁸Authors such as Leuven et al. (2007) and Rouse & Krueger (2004) cast doubt on the effectiveness of the use of Information and Communication Technologies in improving students' achievement. However, Carnoy (2004) argues that these types of findings often result from the difficulty for teachers in mastering the ICT Technologies and using them for teaching purposes in a proper manner.

³⁹See Bellei (2009) for favorable evidence regarding school day length on students' performance using data from a natural experiment in Chile.

⁴⁰Note that this variable informs the official length of a school day, which is only a proxy for the actual time students spend learning. Recent study by the Brazilian Institute of Public Opinion and Statistics (IBOPE 2011) using a random sample of 36 high school classrooms distributed in 18 schools shows that the average time spent learning after discounting interruptions, teacher and student absences and time spent organizing the classroom and enforcing students to pay attention is, on average, less than 2 hours (out of an average of 4 official hours).

⁴¹Hedges & Greenwald (1996) perform a meta-analysis of a sample of longitudinal studies and obtain evidence of a positive effect, i.e., the greater the number of teachers per student, the higher their achievement.

⁴²Note that there are fundamental differences between the class size and the teacher-pupil ratio, especially in secondary schools (equivalent to the 2nd cycle in Brazil) where each discipline is taught by a different teacher, who usually deliver instruction to several classes in several school grades.

kept, replacing the dependent variable (and thus the spatial lag) with the input variables. However, it is important to observe that the expenditures are flow variables, while the inputs are stock measured. In addition, because the provision of each input has its idiosyncrasies, the estimates with input variables are not expected to be the same as the estimates with education expenditures.

Table 8 shows the models' estimates with school inputs using a two-regime spatial Durbin model that considers spatial and time fixed effects. Model 6 has the computer to pupil ratio as the dependent variable and assigns a value of 1 for the regime dummy in the years of 2007 and 2008, i.e., the period after the disclosure of the *Prova Brasil* results. As we can see, before the results' disclosure, the jurisdictions reacted to an increase of 1 computer per pupil in the neighboring jurisdictions by increasing their own inputs by 0.284 computer per pupil. After the results were made public, the input reaction declined by 0.131 computers per pupil. Model 7, on the other hand, indicates that the response to a 1 computer per pupil increase in the neighboring jurisdictions has dropped by 0.246 computers per pupil after the disclosure of the IDEB and its goals in 2008. Looking at the evolution of the spatial interaction over time, represented by the parameter λ_1 of models 7a through 7g of Table 9, it can be seen that the spatial parameter was lower in 2002, equal to 0.191, and then increased until it reached the maximum of 0.229 in 2007, dropping sharply in 2008, to 0.143. This result is consistent with the model of education expenditures, where we observe a smaller strategic interaction in 2002 due to the PNE, and in 2008 due to the disclosure of the IDEB and its goals.

Model 8 shows the estimates using the TV to pupil ratio as the dependent variable. After the *Prova Brasil* results were made public, the spatial correlation declined by 0.170 TVs per pupil in response to a 1 TV per pupil in neighboring jurisdictions. Model 9 indicates that the spatial coefficient reduced by 0.125 TVs per pupil after the IDEB disclosure. Table 10 shows the evolution of the spatial correlation in the provision of the input over the entire period. In this case, we observe own jurisdiction's reaction to 1 unit increase in the neighbors' inputs gradually diminishing over time, with a stronger decline in 2007 and 2008.

Table 8: School inputs as dependent variables

	Computer to pupil ratio		TV to pupil ratio		Log avg. school-day length		Log teacher to pupil ratio		Log average class size	
	6	7	8	9	10	11	12	13	14	15
	d= dummy of <i>Prova</i> <i>Brasil</i> 2007- 2008	d = dummy of IDEB 2008	d= dummy of <i>Prova</i> <i>Brasil</i> 2007- 2008	d = dummy of IDEB 2008	d= dummy of <i>Prova</i> <i>Brasil</i> 2007- 2008	d = dummy of IDEB 2008	d= dummy of <i>Prova</i> <i>Brasil</i> 2007- 2008	d = dummy of IDEB 2008	d= dummy of <i>Prova</i> <i>Brasil</i> 2007- 2008	d = dummy of IDEB 2008
λ_1	0.153*** (16.357)	0.143*** (16.565)	0.104*** (10.902)	0.142*** (16.463)	0.054*** (5.494)	0.062*** (6.965)	0.087*** (8.969)	0.097*** (11.016)	0.108*** (11.263)	0.109*** (12.356)
λ_2	0.284*** (21.003)	0.389*** (22.775)	0.275*** (20.145)	0.267*** (14.159)	0.095*** (6.219)	0.093*** (4.308)	0.162*** (11.100)	0.180*** (8.939)	0.114*** (7.552)	0.118*** (5.542)
$\lambda_1 - \lambda_2$	-0.131*** (-8.060)	-0.246*** (-13.076)	-0.170*** (-10.349)	-0.125*** (-6.115)	-0.041** (-2.265)	-0.031 (-1.316)	-0.075*** (-4.357)	-0.083*** (-3.819)	-0.006 (-0.321)	-0.009 (-0.400)
Controls (X)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatially Lagged Independent Variables (WX)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.7508	0.752	0.7922	0.7916	0.8549	0.8549	0.8319	0.8319	0.8922	0.8922
N	26334	26334	26334	26334	26334	26334	26334	26334	26334	26334
log-likelihood	-37053.15	-36988.69	-8328.64	-8360.13	54247.27	54245.59	14716.98	14715.35	15680.83	15680.88

Notes: See notes on Table 5.

Table 9: Two regime models: assigning year dummies as different regimes and computer to pupil ratio as dependent variable

	7a	7b	7c	7d	7e	7f	7g
	d= dummy of PNE (2002)	d= dummy of year 2003	d= dummy of year 2004	d= dummy of year 2005	d= dummy of year 2006	d= dummy of year 2007	d= dummy of IDEB (2008)
λ_1	0.191*** (22.657)	0.216*** (25.880)	0.224*** (26.966)	0.225*** (27.063)	0.223*** (26.723)	0.229*** (27.692)	0.143*** (16.565)
λ_2	0.299*** (15.844)	0.152*** (7.340)	0.064*** (2.971)	0.053** (2.412)	0.091*** (4.210)	0.097*** (4.631)	0.389*** (22.775)
$\lambda_1 - \lambda_2$	-0.108*** (-5.246)	0.064*** (2.877)	0.160*** (6.989)	0.172*** (7.389)	0.132*** (5.702)	0.132*** (5.958)	-0.246*** (-13.076)
Controls (X)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatially Lagged In- dep.Variables (WX)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.7507	0.7504	0.7507	0.7508	0.7506	0.7509	0.752
N	26334	26334	26334	26334	26334	26334	26334
log-likelihood	- 37073.812	- 37083.102	- 37068.961	- 37067.236	- 37074.181	- 37068.195	- 36988.687

Notes: See notes on Table 5.

Models 10 and 11 of Table 8 consider the log average school day length as the dependent variable but the spatial parameters cannot be interpreted as elasticities because in the right hand side of the model we have the neighbors' average log dependent variable. The results of model 10 suggest that before 2007, a 1 unit increase in the neighbors' log school day length caused the municipalities to react with a 0.095 increase in own log school day length. After the disclosure of the *Prova Brasil* results, the municipalities' reaction to the same change in the neighbors' input declined 0.041 correlation points. Model 11 shows that after the IDEB disclosure, the spatial coefficient reduced by 0.031 points in response to the same change, although this difference is not statistically significant at the conventional levels. In Table 11, parameter λ_1 of models 10a through 10g show the same pattern that is observed in the education expenditures model; i.e., between 2002 and 2006, the spatial coefficients increased from 0.059 to 0.070, and then, in 2007 and 2008, it declined to 0.061 and 0.062, respectively, reinforcing the previous findings.

Models 12 and 13 of Table 8 have the log teacher to pupil ratio as a dependent variable. Model 12 indicates that, prior to 2007, the spatial correlation was equal to 0.162. After the referred period, spatial correlation declined by 0.075 points. In model 13, we can observe that after the IDEB disclosure, the spatial interaction declined 0.083 points. Table 12 shows that over the 2002 to 2008 period, the spatial parameter is the smallest in 2008.

Models 14 and 15 of Table 8 have the log average class size as the dependent variable. The differences between the spatial interaction after and before the disclosure of the *Prova*

Table 10: Two regime models: assigning year dummies as different regimes and TV to pupil ratio as dependent variable

	9a	9b	9c	9d	9e	9f	9g
	d= dummy of PNE (2002)	d= dummy of year 2003	d= dummy of year 2004	d= dummy of year 2005	d= dummy of year 2006	d= dummy of year 2007	d= dummy of IDEB (2008)
λ_1	0.191*** (22.584)	0.177*** (20.760)	0.173*** (20.308)	0.166*** (19.363)	0.164*** (19.121)	0.142*** (16.520)	0.142*** (16.463)
λ_2	-0.007 (-0.311)	0.086*** (4.013)	0.096*** (4.504)	0.159*** (7.636)	0.171*** (8.282)	0.275*** (14.565)	0.267*** (14.159)
$\lambda_1 - \lambda_2$	0.198*** (8.401)	0.091*** (3.943)	0.077*** (3.363)	0.007 (0.304)	-0.007 (-0.332)	-0.133*** (-6.470)	-0.125*** (-6.115)
Controls (X)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatially Lagged In- dependent Variables (WX)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.792	0.7914	0.7913	0.7912	0.7912	0.7916	0.7916
N	26334	26334	26334	26334	26334	26334	26334
log-likelihood	- 8346.6284	- 8371.7517	-8374.364	- 8378.4992	- 8378.4895	- 8359.2063	- 8360.1332

Notes: See notes on Table 5.

Table 11: Two regime models: assigning year dummies as different regimes and log average school-day length as dependent variable

	11a	11b	11c	11d	11e	11f	11g
	d= dummy of PNE (2002)	d= dummy of year 2003	d= dummy of year 2004	d= dummy of year 2005	d= dummy of year 2006	d= dummy of year 2007	d= dummy of IDEB (2008)
λ_1	0.059*** (6.645)	0.071*** (7.922)	0.076*** (8.503)	0.070*** (7.868)	0.070*** (7.867)	0.061*** (6.878)	0.062*** (6.965)
λ_2	0.108*** (5.014)	0.047** (2.138)	0.008 (0.363)	0.045** (2.056)	0.047** (2.119)	0.097*** (4.492)	0.093*** (4.308)
$\lambda_1 - \lambda_2$	-0.048** (-2.075)	0.024 (1.001)	0.068*** (2.830)	0.025 (1.052)	0.024 (0.993)	-0.035 (-1.516)	-0.031 (-1.316)
Controls (X)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatially Lagged In- dependent Variables (WX)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.8549	0.8549	0.8549	0.8549	0.8549	0.8549	0.8549
N	26334	26334	26334	26334	26334	26334	26334
log-likelihood	54246.897	54245.172	54248.187	54245.145	54245.112	54245.877	54245.59

Notes: See notes on Table 5.

Table 12: Two regime models: assigning year dummies as different regimes and log teacher to pupil ratio as dependent variable

	13a	13b	13c	13d	13e	13f	13g
	d= dummy of PNE (2002)	d= dummy of year 2003	d= dummy of year 2004	d= dummy of year 2005	d= dummy of year 2006	d= dummy of year 2007	d= dummy of IDEB (2008)
λ_1	0.110*** (12.589)	0.117*** (13.337)	0.120*** (13.777)	0.118*** (13.542)	0.115*** (13.160)	0.107*** (12.284)	0.097*** (11.016)
λ_2	0.121*** (5.782)	0.081*** (3.781)	0.061*** (2.829)	0.061*** (2.785)	0.090*** (4.152)	0.138*** (6.721)	0.180*** (8.939)
$\lambda_1 - \lambda_2$	-0.011 (-0.492)	0.036 (1.548)	0.059** (2.545)	0.058** (2.468)	0.026 (1.105)	-0.030 (-1.377)	-0.083*** (-3.819)
Controls (X)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatially Lagged In- dependent Variables (WX)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.8318	0.8318	0.8319	0.8318	0.8318	0.8318	0.8319
N	26334	26334	26334	26334	26334	26334	26334
log-likelihood	14707.186	14708.107	14710.151	14709.444	14707.559	14708.014	14715.353

Notes: See notes on Table 5.

Table 13: Two regime models: assigning year dummies as different regimes and log average class size as dependent variable

	15a	15b	15c	15d	15e	15f	15g
	d= dummy of PNE (2002)	d= dummy of year 2003	d= dummy of year 2004	d= dummy of year 2005	d= dummy of year 2006	d= dummy of year 2007	d= dummy of IDEB (2008)
λ_1	0.103*** (11.663)	0.112*** (12.789)	0.113*** (12.881)	0.116*** (13.205)	0.110*** (12.528)	0.111*** (12.608)	0.109*** (12.356)
λ_2	0.154*** (7.358)	0.098*** (4.575)	0.092*** (4.285)	0.065*** (2.990)	0.114*** (5.314)	0.109*** (5.141)	0.118*** (5.542)
$\lambda_1 - \lambda_2$	-0.051** (-2.263)	0.014 (0.610)	0.021 (0.929)	0.051** (2.159)	-0.004 (-0.156)	0.001 (0.051)	-0.009 (-0.400)
Controls (X)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatially Lagged In- dependent Variables (WX)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.8922	0.8922	0.8922	0.8922	0.8922	0.8922	0.8922
N	26334	26334	26334	26334	26334	26334	26334
log-likelihood	15683.445	15680.946	15681.132	15682.621	15680.784	15680.775	15680.883

Notes: See notes on Table 5.

Brasil and the IDEB results, though negative, are not statistically significant. The evolution of the spatial parameter λ_1 from 2002 to 2008 in Table 13 shows the same pattern as the other inputs' models, i.e., the spatial interaction reached the smallest values, smaller in 2002 and 2008.

Overall, the results using school inputs confirm those of the educational expenditure model. After the IDEB disclosure (and the disclosure of the *Prova Brasil* results to a lesser extent) the strategic interaction on input-setting declined significantly. This change of behavior by the incumbents when setting the levels of school inputs suggests a decrease in the relevance of local information spillovers and, thus, a decline in yardstick competition. This decline can be attributed to the incumbents' greater concern for pursuing the best educational practices that could improve educational quality in order to signal to voters that they are competent. The enactment of the PNE in 2001 also appears to have affected the strategic interaction in school inputs in the year of 2002, just as in the expenditure model.

7 Concluding Remarks

This paper aims to test the existence of yardstick competition in education spending. For this purpose, it relies on a panel data from Brazilian municipalities from 2002 to 2008 and estimates the ML two-regime spatial Durbin models with time and spatial fixed effects, where the regimes represent different electoral and educational accountability institutional settings.

The results using the electoral accountability variables suggest that the lame-duck incumbents mimic their neighbors' expenditures by 0.045 correlation points less than those in their first term. This difference can be explained by the lower incentives - caused by the impossibility of reelection - for the second term incumbents to signal their type (good or bad) to the voters. Moreover, the findings suggest that the incumbents with minority support at the city council tend to mimic their neighbors' spending by 0.051 points more than those with majority support at the council. That is, the minor political support at the council is related to the lack of support by the electorate, which leads the incumbents to mimic their neighbors to a greater extent to signal their quality and to increase their chances of reelection. These results are evidence of yardstick competition in education spending.

In addition, this paper estimates the effects of the institutional change introduced by the "Plan of Goals All Committed to Education" with the disclosure of the IDEB and its goals

on the strategic interaction in local education provision. This relationship is not obvious, as observed from the discussion about the effects of education expenditures on students' achievement. Nevertheless, the evidence suggests that this institutional change did in fact reduce spatial interaction by 0.104 correlation points in 2008, i.e., when the effects of the IDEB disclosure were felt more intensely. The introduction of this institutional change potentially increased the incentives for the incumbents to follow the national (and perhaps international) best practices to signal their quality to voters, reducing the importance of local information spillover.

A further result indicates that the institutional change introduced by the PNE law (in 2001) reduced the spatial interaction in 2002 by setting the educational goals that required additional expenditure for the municipalities on tight budgets. However, this change could not resist the election of a new government in 2003, which did not enforce the goals established in that plan. Thus, we observe two institutional changes provided by the plans for the improvement of education, which produce the same result - i.e., which reduce the strategic interaction between the neighboring municipalities - but that are of different natures, in that one is legally enforced and the other is voluntary.

The same model is tested using school inputs that are believed to improve students' performance in place of education spending. The results confirm those obtained in the expenditure model, i.e., the introduction of IDEB and its goals reduced interaction in input-setting. The results using inputs even show a smaller spatial interaction in 2002 due to the PNE. Thus, it is possible to conclude that the change observed in the spending mimicking was accompanied by changes in the mimicking of inputs that are supposed to improve students' performance, suggesting a greater concern from incumbents with educational quality after the introduction of the IDEB. Taken altogether, these findings suggest that the institutional change introduced by the IDEB and the Plan of Goals did incentive the incumbents to pursue higher standards, ultimately leading to the reduction of reduce yardstick competition.

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