# Electoral impacts of uncovering public school quality: Evidence from Brazilian municipalities ☆

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## Abstract

Sistemas de school accountability que estabelecem a adoção de incentivos para professores e gestores geralmente impactam positivamente o desempenho dos alunos. No entanto, em muitas circunstâncias, sistemas de school accountability podem enfrentar restrições institucionais para estabelecer recompensas e sanções para os administradores. Nesse aspecto, o sistema brasileiro de school accountability é um exemplo interessante: a maioria das escolas públicas com primário são administradas por funcionários municipais e o governo federal não pode impor a adopção de incentivos ao nível local. Entretanto, devido ao fato de os prefeitos dos municípios brasileiros serem os principais responsáveis pela educação primária pública, evidencia-se nas eleições locais de 2008, apenas alguns meses após a publicação da segunda onda de uma nova avaliação das escolas públicas pelo governo federal, prefeitos tornaram-se eleitoralmente responsáveis por não melhorar a qualidade da escola. Os resultados mostram que, em média, um aumento de um ponto em um índice de escala 0-10 entre 2005 e 2007 aumentou cerca de 5 pontos percentuais a probabilidade de reeleição dos prefeitos. Este efeito é ainda maior em localidades com menor renda per capita e aquelas em que a fração de crianças em idade escolar é maior. Portanto, a responsabilização eleitoral pode desempenhar um papel complementar em sistemas de school accountability, algo que ainda não foi totalmente explorado pelas literaturas de educação, economia política e ciência política.

## 1. Introduction

It is now a well-established fact in the empirical education literature that unobserved school quality plays an important role in explaining learning gains for elementary school pupils (Hanushek, 2005). As a result, parental school choices cannot be fully informed, since schools will likely differ in unobserved quality. In many countries, however, parents of children in public schools have benefited from the implementation of a school accountability system (SAS) that, among

other goals, establishes learning targets, runs assessments and publicizes school performances, decreasing therefore the uncertainty on public school quality.[1] A SAS is usually called 'strong' if it additionally adopts incentives (rewards and/or punishments) for teachers and school principals as a function of the school performance on assessment tests (Carnoy and Loeb, 2002). According to Hanushek and Raymond (2002), a strong SAS tends to have larger impacts on students' performance than a weak one,[2] especially in contexts where there are students' mobility restrictions that create local monopolies for public schools.

Even under a weak SAS, there exist other channels for rewarding and punishing school managers. The Brazilian SAS is an interesting case: most of elementary public schools are run by municipal officials and federal government cannot enforce the adoption of incentives at local level. However, elected mayors of Brazilian municipalities are the ultimate responsible for public elementary education and they can, in principle, be electorally accountable for the relative poor performance of the municipal school system.

In this paper, we provide evidence that in 2008 local elections, which occurred just after the publication of the evaluation of public schools by the federal government, mayors became electorally accountable for not improving school quality during the four years of their mandates. The results show that, on average, one point increase in a 0–10 scale index from 2005 to 2007 increased by around 5% points the probability of mayoral reelection. This effect is even greater in localities with lower per capita income (higher demand for public education) and those where the fraction of children at school age is larger.

The electoral accountability channel, that we show is useful in practice in reinforcing the Brazilian SAS, in theory does not always produce positive effects on the quality of the public good being delivered. Besley and Smart (2007) present a game of incomplete information between the incumbent politician and voters, in which more information is not necessarily better for voters. In their model, there are two components, a discipline and a selection component, affecting voter's welfare. If information on incumbent's actions increases before election, in equilibrium, some incumbents will commit themselves to higher levels of quality in public goods whereas others will maximize rents in the first term lowering the quality of public goods provided. Thus, there is an ambiguous theoretical result on what happens to the quality level of the public good after increases in the information on incumbent's actions. We show that the discipline component of Besley and Smart (2007)'s model is empirically more relevant than the selection one, at least in what concerns public elementary education in Brazilian municipalities. When voters have better information they reward (punish) mayors that improve (deteriorate) the provision of the public education.

Our results are novel in bridging the gap between the otherwise unrelated literatures on electoral accountability and on school accountability.[3] In fact, to the best of our knowledge, there are no studies that directly relate school quality and electoral accountability of incumbent mayors.[4]

The key theoretical argument for a bold link between electoral and school accountability is that parents care about the quality of education and that people in fact react when they have more information on quality of schools. Fortunately, empirical evidence on these two facts already exists.[5] Hastings and Weinstein (2007) explore two experiments in a school district in US where schools were randomly selected to distribute information about their quality to the parents. They find evidence that receiving information increases the fraction of parents choosing higher performance schools. Figlio and Rouse (2006) investigate the threat of vouchers and stigma in Florida on the performance of low performing schools after the introduction of an accountability system. They find that the lower performing schools

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[1] School accountability systems were introduced in the UK during the 80's and rapidly became an important educational managing tool in the US. For example, in 1996, 12 states in the US had some sort of school accountability whereas in 2000 39 states were adopting it. In 2001 federal government created the "No Children Left Behind" (NCLB) program.

[2] The empirical evidence that SAS produces positive impacts on learning has been extensively documented. See, for example Carnoy and Loeb (2002), Hanushek and Raymond (2004), Jacob et al. (2003), Ladd (1999), Peterson and West (2003) and Springer (2008). Hanushek and Raymond (2002) argue that the positive effects from NCLB are mainly due to the existence of direct rewards to the best schools and punishment to the worse ones.

[3] According to the recent review on electoral accountability by Trounstine (2010), the vast majority of the research on electoral accountability is concentrated on federal level and to some extent state level elections, even though most of policies are clearly locally determined.

[4] The only piece of empirical evidence of school quality being electorally rewarded has been documented by Berry and Howell (2007) who show results linking students' assessments and of school board elections over three electoral cycles in South Carolina. They present evidence that in the 2000 local elections for school boards, when public and media attention to testing and accountability systems was at its peak, voters held school board members accountable for the past performance of their schools.

[5] See, for example, Nushimura and Yamano (2013).

present significant gains in performance after the voucher threat. These gains are more due to the stigma of receiving a low grade than the voucher threat itself.

The electoral channel could also be weak were the Brazilian SAS strong and voting in local elections not mandatory. In Brazil, principals of public schools do not have direct incentives based on their students' performance, exception being the very recent adoption of incentives by local governments.[6] Moreover, every Brazilian adult has to vote in all elections, and local ones occur every four years. Therefore, it seems that the electoral channel in the Brazilian educational system is the only available way to establish rewards and punishments as a function of school performance on assessment tests.

It may also be of a surprise that Brazilian mayoral elections are affected by changes in the quality of education given existing worldwide evidence that infrastructure expenditures are better paid electorally.[7] We investigate whether after controlling for school quality measures the effects of school infrastructure on reelection chances were relevant. School quality measures were publicized between the 2004 and 2008 local elections. Before that, for the 2004 election, the only visible expenditures in education, such as school construction, were indeed electorally important. However, once voters have more precise information on school quality, those "physical capital" investments in education lose part of their relevance for reelection.[8]

Our identification strategy uses the timing of the publication of school quality measures and of the local elections. In 2005 and 2007 the federal government, through its Ministry of Education, ran assessment tests on almost every public school in Brazil. In 2007 there was the first publication of the results of IDEB,[9] a public school quality index based on the 2005 assessments. The indices at the national, state and municipal levels, and more importantly, at the school level, became publicized that year. In 2008, just some months before local elections, 2007 IDEB at all levels was publicized as well. We combine information on municipal 2005 and 2007 IDEB results and on 2004 and 2008 municipal election outcomes to investigate how the publication of the school quality index affected the relationship between school quality improvements and the probability of mayoral reelection. Our results show that gains in school quality in municipal schools between 2005 and 2007 increased chances of reelection among eligible (for a second term) mayors in the 2008 election when we compare to a 'placebo experiment'. In our placebo experiment, we run the same regression but using the 2004 election outcomes when, of course, information about school quality improvements between 2005 and 2007 were not available, and find no evidence of a positive relationship between those improvements and reelection in 2004. Voters in 2004 election were unable to use information on school quality to update their voting choices, but when that information became available, as in the 2008 election, they seem to have fully used it to punish and reward mayors.[10]

This paper is divided as follows. Section 2 describes the Brazilian educational accountability system and how local elections are organized. In Section 3, we propose an empirical methodology to identify the impact of increasing information on school quality on electoral outcomes and present the datasets. In Section 4 we present and discuss results. Finally, in Section 5, we conclude.

## 2. Institutional background

### 2.1. Brazilian basic educational system and school quality measures

Brazilian public basic education system is composed by elementary, middle, and high schools. They respectively correspond to first–fifth grades, sixth–ninth grades and tenth–twelfth grades, respectively. They are publicly and

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[6] Although the federal government cannot reward and punish directly municipal school teachers and principals, that does not rule out that mayors themselves, responding to the electoral channel, implement municipal school accountability systems, creating direct incentives for teachers and school principals.

[7] See for instance Akhmedov and Zhuravkaya (2004) and Veiga and Veiga (2007). Construction and infrastructure investments typically suffer manipulation along the electoral cycle as described in Drazen and Eslava (2010) and Gonzalez (2002).

[8] Another potential reason for changes in school quality not being electorally relevant would be the context where voters incorrectly associate public goods provided by different government levels with their voting choices. Arceneaux (2006) finds evidence that voters, however, typically associate the public good provision to its responsible provider.

[9] Basic Education Development Index (*Índice de Desenvolvimento da Educação Básica*). In 2007, according to the Ministry of Education, 99% of the public school systems were covered by these assessment tests.

[10] Leme et al. (2011) show that, in order to improve school quality, mayors all over the country have recently hired services from private schools to introduce in municipal public schools pedagogical changes involving restructuring curriculum contents, elaboration and use of teachers and students textbooks, and training and supervision of the teachers. That evidence can be interpreted as an anticipation effect of electoral accountability.

privately provided, although more than 90% of the students are in public schools. Public education has passed in the last twenty years for reforms that have increased access and attempted to improve its quality. Part of the increased access can be explained by initiatives that allocated more resources for basic education such as FUNDEF (*Fundo de Desenvolvimento do Ensino Fundamental e Valorização do Magistério*) approved in 1996. FUNDEF leveled spending on education between states and municipalities in elementary schools (primary and middle schools) through transfers from a national fund. This initiative rose spending sharply in poorer states and municipalities. Increasing in enrollment followed because the municipality's education funding is based on the number of registered students. This created incentives for schools to recruit and retain students to fill vacancies (Carnoy, 2007).

Although the problem of access to education has been solved with a quick but somewhat disorganized growth of public school system in the 1990's, performance of Brazilian students' proficiency in national and international exams shows that the growth of the educational system was not matched by improvements in quality (OECD, 2010). However, there were two combined movements in the basic public education whose goals were to increase the quality of education: management decentralization and the introduction of a federal school accountability system.

School decentralization was characterized by transfers in the school authority level from state to municipalities.[11] The decentralization of schools was a process that has begun in the 1990's and it was incentivized by the federal government through various laws and resource funds like FUNDEF, creating the legal basis and generating financial resources to enable the municipality to run its local education system. There are evidences that this funding have a significant impact on school resources and student outcomes. Indeed, Ferraz et al. (2011) find that negative variation of this school resource from federal transfers (due to corruption) reduced student proficiency and increased dropout and failure rates across Brazilian municipalities. Menezes-Filho and Pazello (2007) have also shown that the creation of FUNDEF increased local teachers' salaries and, as a consequence, a positive impact on students learning.

School Census data reveal that of all students enrolled in primary school in 1995, 56% were studying in state schools and 32% in municipal schools. In contrast in 2010, the share of primary school students in state schools decreased to 31% and of those in municipal schools increased to 52%.[12] This process was more pervasive among the first years of the primary education. In fact, of all students in elementary schools in 1995, 48% of them were enrolled in state schools and 42% in local schools. In 2010, 18% and 68% were attending state and municipal schools, respectively. On the other hand, of all students enrolled in middle school in 1995, 69% and 17% were attending state and municipal middle schools, respectively. In 2010, these figures changed to 50% and 38% attending state and municipal middle schools, respectively. Thus, the municipalities became the main responsible for the provision of education for the vast majority of the elementary education students, whereas municipalities and states became more evenly responsible for middle school students. For that reason, we focus our analyses on the elementary public school quality index.

School decentralization process was accompanied by instruments that enabled the federal government to monitor performance of municipal and state public schools. The first set of instruments for monitoring and evaluation that characterizes Brazilian accountability system was introduced with *Sistema Nacional de Avaliação da Educação Básica* (National Assessment of Basic Education or, simply, SAEB) in 1995. SAEB is run by the Ministry of Education and is characterized by an exam in Mathematics and Portuguese applied every two years in a sample of students from 5th and 9th grades of elementary school and from the 3rd grade of high school.

Other exams run by the Ministry of Education were implemented after SAEB. In 1998, *Exame Nacional do Ensino Médio* (National Examination of Secondary Education, or simply, ENEM) was created and in 2005 the *Prova Brasil* (Brazil Exam), a biannual exam with census coverage at urban public school level in Mathematics and reading for 5th and 9th graders. In the 2007 edition of *Prova Brasil*, all state schools adhered to the exam and there was broad support from municipal authorities, leading to a coverage of over 99% of the targeted population (Fernandes and Gremaud, 2009).[13]

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[11] Among the potential advantages of a decentralized school model, an important one is the fact that decisions impacting the quality of teaching would be brought closer to the local population by reducing information asymmetries, agency costs and problems of collective decision. Moreover, it is argued that decentralization might solve the problem of heterogeneity of preferences among populations of different localities and could reduce corruption (Galiani et al., 2008). For the effects of decentralization on schools, see also Ahlin and Mork (2008), Faguet and Sánchez (2008) and Gershberg et al. (2012).

[12] The bulk of remaining students were enrolled in private schools and very few in federal schools.

[13] Fernandes and Gremaud (2009) argue that although the coverage rate is high, there is some evidence of 'gaming the test' in small scale, especially by forced absenteeism of worst students.

After the first results of 2005 *Prova Brasil* were widely disseminated in 2006, one could say that Brazil had finally created its own national SAS. It was a 'weak' accountability system since, unlike in the US model, teachers and principals were not directly held accountable for the students results in the proficiency exam. In addition, the comparison between schools based on *Prova Brasil* did not take into account that they had different retention rates, allowing for important composition differences in student sample.

In order to correct for the differential retention rates, the Ministry of Education constructed an index that took into account both performance and retention rates. Thus, in 2007, IDEB was created, running a normalization of *Prova Brasil* times the school pass rate.

The IDEB became the instrument that informs population on school quality allowing pupils and parents to have a better informed school choice. Note that the IDEB is constructed for each public school and for the overall public school system (local and state separately). That has originated an informational channel that can be used to pressure teachers, principals, managers, and ultimately mayors responsible by improvements in the quality of education. The results of IDEB have been published by various media outlets and are available at the site of Ministry of Education.

As the mobility of students between schools is particularly limited within a given municipality as it may depend on the place of residence of the student, one of the most effective response channels from the population to IDEB results ends up being via political pressure, which we found in our paper to be empirically relevant and to occur through mayoral elections.

### 2.2. Decentralization and mayoral reelection

Most of the enrollments in public elementary schools are in schools run by municipal authorities. There are 5565 municipalities in Brazil taking care of more than a hundred thousand municipal elementary schools (first–fifth grades) with around 11.5 million students in 2010. Private schools and state and federal public schools respond for the remaining enrollments.

That is a relatively new pattern. Until the end of 1980's Brazilian municipalities had much less autonomy. The increase in municipal decentralization and autonomy was established in the 1988 Constitution. The new Constitution set up the responsibilities of municipalities, which include the organization and provision of public services of local interest such as transportation, preschool, primary education and health services.

Given that high level of decentralization of public provision through Brazilian municipalities, mayors typically have substantial authority over local resources. That makes running and rerunning for mayoral election politically attractive.

The reelection to executive positions in Brazil was established by Constitutional Amendment No. 16, July 4, 1997 and enforced for governors and the president in the 1998 election. Only one consecutive reelection is allowed. The executive mandate corresponds to four years at all federal, state, and municipal level. Mayors became eligible for a second term starting in the 2000 elections. Since then, it has been a tool often used by politicians. In the next section we describe the data set on electoral outcomes that help describing the profile of candidates.

## 3. Data set, sample selection and empirical strategy

### 3.1. Data

Our goal is to estimate the electoral impact of the information release on public school quality improvements. There were mayoral elections allowing for reelections in 2000, 2004, and 2008. There were two public releases of the quality of education index, IDEB. The 2005 IDEB was released in 2007, and the 2007 IDEB was released in 2008, three months before the 2008 mayoral elections. Our sample consists of all municipalities that: (i) incumbent mayors were eligible to run for reelections in 2004 or 2008; (ii) there were fewer than 200,000 voters; and (iii) there are elementary school IDEB indices for both 2005 and 2007 years. Thus, the sample includes both cases of municipalities that the incumbent mayor actually ran for reelection and those that they were allowed but decided not to do so. We chose to not restrict to municipalities where the incumbent actually ran for reelection because there could be a correlation between IDEB score and the mayor's decision of running on the election, a selection problem that would bias our estimators. Second, we restrict to municipalities with fewer than 200,000 voters in order to exclude those municipalities required by law to have run-off elections whenever there is no absolute majority winner in the first round election. The possibility of mayoral run-off elections changes the political competition at the municipal level, affecting incumbents' behavior

Table 1a
Summary statistics—incumbents' characteristics.

| | 2004 | | | 2008 | | |
|---|---|---|---|---|---|---|
| | N | Mean | Sd | N | Mean | Sd |
| Election variables | | | | | | |
| Reelected | 2505 | 0.4 | 0.49 | 3210 | 0.505 | 0.5 |
| Male | 2505 | 0.943 | 0.233 | 3210 | 0.908 | 0.289 |
| Married | 2489 | 0.827 | 0.378 | 3179 | 0.807 | 0.395 |
| Age | 2504 | 51.883 | 9.803 | 3206 | 50.813 | 9.904 |
| Governor's party | 2505 | 0.209 | 0.407 | 3210 | 0.165 | 0.372 |
| President's party | 2505 | 0.04 | 0.197 | 3210 | 0.08 | 0.271 |
| Politician's educational dummies | | | | | | |
| Incomplete middle school | 2484 | 0.109 | 0.312 | 3178 | 0.125 | 0.331 |
| Complete middle school or high school dropout | 2484 | 0.174 | 0.379 | 3178 | 0.112 | 0.316 |
| Complete high school or college dropout | 2484 | 0.315 | 0.465 | 3178 | 0.332 | 0.471 |
| Complete college | 2484 | 0.402 | 0.49 | 3178 | 0.43 | 0.495 |

Source: TSE (Supreme Electoral Court).

(Chamon et al., 2011). Of all 5565 municipalities, there are around only 40 municipalities with 200,000 or more voters in 2008. Under all these selection criteria there were 2505 and 3210 municipalities in 2004 and 2008, respectively.

Our measure of school quality is the municipal IDEB index. This index is calculated and publicly released by the Ministry of Education. It is a compounded index of proficiency and pass rates. Formally, it is a Cobb–Douglas type function $IDEB_{mc} = PB_{mc} \times PR_{mc}$, where $PB_{mc}$ is the fifth grader or ninth grader average test scores of municipality $m$ and cycle $c$ (elementary or middle school) from *Prova Brasil* standardized proficiency exam (Math and Portuguese); and $PR_{mc}$ is the average pass rate for the cycle evaluated. IDEB index is normalized to range from 0 to 10.[14]

The IDEB index is obtained for elementary school (first–fifth grades) and middle school (sixth–ninth grades) separately. Since most of the municipal education systems are concentrated in the elementary school, we use the municipal IDEB index of the elementary school and we refer to this index as 'fifth grade IDEB'. Indeed, of all elementary school students in the municipalities in our sample in 2008, 73.4% of them were enrolled in municipal schools. In contrast, of all middle school students in the municipalities in our sample, 57.3% of them were enrolled in municipal schools.

Summary statistics for each variable used in the regressions are displayed in Tables 1a–1c. Out of all municipalities whose mayor was able to run for reelection in 2004, 40.2% reelected the incumbent. In 2008, this figure increased to 50.5%. The great majority of them are male and married, and about 40% has completed college.

Tables 1a–1c also show that elementary school quality, measured by IDEB, has increased by 0.4 on average between 2005 and 2007, an increase greater than 10%, given the average 2005 IDEB was lower than 3.9. Municipal *per capita* education expenditure is divided into two variables: spending in the first two years and in the last two years in office. There are increases over time on the amount spent for both variables, but more accentuated in the final two years in office. Such pattern can also be seen in health and urbanism (mostly infrastructure) expenditures. Finally, we also present some demographic characteristics that are used either as control variables or to capture heterogeneous effects along the values of these variables.

Candidate and result variables for 2004 and 2008 mayoral elections are available from *Tribunal Superior Eleitoral* (TSE), the Brazilian Supreme Court for elections, on their website. IDEB indices and annual administrative data on individual schools are obtained from *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira* (INEP), the research institute of the Ministry of Education. Disaggregated expenditures by municipalities are collected from FINBRA, public expenditure database from the *National Treasure of the Ministry of Finance*. All demographic variables come from the 2000 Census data from *Instituto Brasileiro de Geografia e Estatística* (IBGE), the Brazilian Census bureau. Radio and daily newspaper existence are available at 2001 *Perfil dos Municípios Brasileiros: Gestão Pública* from IBGE as well.

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[14] For details on the construction of IDEB index, see Fernandes (2007).

Table 1b
Summary statistics—municipal IDEB and expenditures.

|  | 2004 | | | 2008 | | |
|---|---|---|---|---|---|---|
|  | N | Mean | Sd | N | Mean | Sd |
| Fifth grade change in IDEB (ΔIDEB) | 2505 | 0.403 | 0.523 | 3210 | 0.403 | 0.518 |
| Fifth grade 2007 IDEB | 2505 | 3.993 | 0.913 | 3210 | 3.891 | 0.904 |
| Fifth grade 2005 IDEB | 2505 | 3.59 | 0.929 | 3210 | 3.487 | 0.92 |
| Ninth grade change in IDEB (ΔIDEB) | 1184 | 0.248 | 0.455 | 1628 | 0.233 | 0.467 |
| Ninth grade 2007 IDEB | 1517 | 3.396 | 0.776 | 2036 | 3.282 | 0.746 |
| Ninth grade 2005 IDEB | 1199 | 3.106 | 0.742 | 1643 | 3.01 | 0.702 |
| Average per capita expenditure on education—first two years | 2451 | 312.84 | 909.28 | 3130 | 336.18 | 150.17 |
| Average per capita expenditure on education—last two years | 2466 | 270.82 | 126.52 | 3116 | 412.84 | 177.10 |
| Average per capita expenditure on health—first two years | 2451 | 178.61 | 250.50 | 3130 | 250.86 | 130.60 |
| Average per capita expenditure on health—last two years | 2466 | 188.44 | 98.02 | 3116 | 307.16 | 156.00 |
| Average per capita expenditure on urbanism—first two years | 2451 | 74.89 | 78.39 | 3130 | 105.28 | 127.18 |
| Average per capita expenditure on urbanism—last two years | 2466 | 85.61 | 89.03 | 3116 | 142.81 | 141.02 |

Source: Expenditure variables are from Brazilian National Treasury. All other variables are from INEP.

Table 1c
Summary statistics—municipalities' characteristics.

|  | 2004 | | | 2008 | | |
|---|---|---|---|---|---|---|
|  | N | Mean | Sd | N | Mean | Sd |
| Population (thousands) | 2505 | 22.961 | 32.388 | 3204 | 22.385 | 31.194 |
| GDP (millions of Reais) | 2505 | 224.00 | 579.00 | 3204 | 204.00 | 596.00 |
| Schooling years | 2505 | 4.458 | 1.179 | 3204 | 4.275 | 1.215 |
| HDI (Human Development Index) | 2505 | 0.706 | 0.08 | 3204 | 0.694 | 0.082 |
| Theil Index | 2505 | 0.526 | 0.108 | 3204 | 0.527 | 0.11 |
| Poor proportion | 2505 | 0.445 | 0.220 | 3204 | 0.477 | 0.225 |
| Radio station | 2505 | 0.462 | 0.499 | 3204 | 0.455 | 0.498 |
| Children population share (5–19 years old) | 2505 | 0.322 | 0.041 | 3203 | 0.327 | 0.042 |
| Dayly newspaper | 2505 | 0.769 | 0.422 | 3204 | 0.736 | 0.441 |

Source: Variables radio station and dayly newspaper are from 2001 Profile of Brazilian Municipalities (IBGE). All other variables are from 2000 IBGE Census.

### 3.2. Empirical strategy

Our goal is to test the hypothesis that there is a causal effect of changes in education quality (measured by ΔIDEB) during the incumbency term on the chances that mayors face of being reelected, once information on quality is available to voters. We focus on changes in quality as they are a good proxy for managerial efforts and commitment with the quality of public education, especially after we control for the initial level of school quality.

Ideally, we would like to have a scenario in which (i) changes in IDEB were randomly distributed among incumbent mayors; and (ii) publication of IDEB was randomly assigned across municipalities. Under such an experiment we could test whether changes in IDEB affect chances of being reelected and if that holds only when information on IDEB were public.

Obviously, such an experiment does not exist as changes in IDEB are functions of mayors' effort and their managerial ability, which are unobservable to us. Also publication of IDEB occurred simultaneously for all municipalities. In order to deal with the lack of a real experiment, we have to rely on some hypotheses on the behavior of the unobservable determinants of mayoral reelections. The nature of our data allows us to exploit some plausible identification restrictions to estimate the causal impact in this non-experimental environment. Consider the following model for $t = 2004$ and 2008:

$$Y_{mt} = \alpha_t + \beta_t \Delta\text{IDEB}_{mt} + \theta_t X_{mt} + \varepsilon_{mt} \tag{1}$$

where $Y_{mt}$ is the reelection dummy of an incumbent mayor in municipality $m$ and election $t$; $X_{mt}$ is a vector of observable covariates from mayors and municipalities; and $\varepsilon_{mt}$ is an unobserved component. The remaining Greek letters are the unknown coefficients.[15]

Identification of $\beta_{2004}$ and $\beta_{2008}$, the parameters that capture the marginal effect of $\Delta$IDEB on reelection chances for each election will require that $\text{Cov}(\Delta\text{IDEB}_{mt}, \varepsilon_{mt}|X_{mt}) = 0$, which stipulates that changes in IDEB are uncorrelated to the unobserved determinants of reelection, $\varepsilon_{mt}$.

Note that the covariance term may be non-zero even after controlling for observed covariates $X$. For example, the covariance will be non-zero if there are mayor's efforts, municipality characteristics or any other component that are correlated to school quality change and mayor's electoral potentiality and that were also observed by the voters but not by the econometrician.

Finally, our model for 2004 election is incomplete in the sense of presenting missing regressors, given that IDEB, the measure of school quality, was only introduced in between the elections. However, if we were able to create a measure of school quality for the period before the 2004 election, for example, by symmetry for 2001 and 2003, we would then expect that $\beta_{2004}$ would capture the impact of the information that already existed even before the publication of scores on reelection. If there were no systematic component of school quality that was used by voters before IDEB started being publicized, then $\beta_{2004}$ would be zero.

Given that there were no systematic measures of school quality before 2004 election, we cannot use a canonical differences-in-differences approach. Instead, for that first sub-period we use the IDEB waves of 2005 and 2007. By construction we expect that the correlation between 2004 election outcomes and IDEB results to be null. This is our 'placebo experiment' and therefore our results are also presented netted out of the placebo results.

In order to obtain results differenced out from the placebo ones, we proceed by pooling the placebo (2004) and the true (2008) experiments presented in Eq. (1) as:

$$Y_{mt} = \alpha + \beta\Delta\text{IDEB}_m + \gamma T_t + \delta T_t \times \Delta\text{IDEB}_{mt} + \theta X_{mt} + \lambda T_t \times X_{mt} + \xi_{mt}, \tag{2}$$

where $\xi_{mt} = (\varepsilon_{m2008} - \varepsilon_{m2004}) \times T_t + \varepsilon_{m2004}$, and $T_t$ is a dummy that equals one if $t = 2008$ and zero if $t = 2004$. Note that $\alpha_{2004}$, $\beta_{2004}$ and $\theta_{2004}$ from Eq. (1) are respectively equal to $\alpha$, $\beta$ and $\theta$.

A less stringent condition than assuming that $\text{Cov}(\Delta\text{IDEB}_{mt}, \varepsilon_{mt}|X_{mt}) = 0$ imposes a conditional (on $X$) mean independence between time changes in $\varepsilon_{mt}$ and IDEB changes. If

$$E\left[\varepsilon_{m2008}|\Delta\text{IDEB}, X\right] - E\left[\varepsilon_{m2004}|\Delta\text{IDEB}, X\right] = E\left[\varepsilon_{m2008}|X\right] - E\left[\varepsilon_{m2004}|X\right], \tag{3}$$

then we can identify the difference $\beta_{2008} - \beta_{2004}$ as the difference in derivatives:

$$\beta_{2008} - \beta_{2004} = \frac{\partial E\left(Y_{m2008}|\Delta\text{IDEB}, X\right)}{\partial\Delta\text{IDEB}} - \frac{\partial E\left(Y_{m2004}|\Delta\text{IDEB}, X\right)}{\partial\Delta\text{IDEB}}, \tag{4}$$

which can be consistently estimated as the parameter $\delta$ of Eq. (2).

In order to clarify the last identification result, consider the case of two different changes in school quality, $\Delta\text{IDEB}'$ and $\Delta\text{IDEB}$, and the two election races, 2008 and 2004. The differences in expected probabilities of reelections for a given year and level of covariates $X$ between $\Delta\text{IDEB}'$ and $\Delta\text{IDEB}$ are

$$E\left[Y_{m2008}|\Delta\text{IDEB}', X\right] - E\left[Y_{m2008}|\Delta\text{IDEB}, X\right] = \beta_{2008}\left(\Delta\text{IDEB}' - \Delta\text{IDEB}\right) + E\left[c_{m2008}|\Delta\text{IDEB}', X\right]$$
$$- E\left[c_{m2008}|\Delta\text{IDEB}, X\right] \tag{5}$$

and

$$E[Y_{m2004}|\Delta\text{IDEB}', X] - E\left[Y_{m2004}|\Delta\text{IDEB}, X\right] = \beta_{2004}(\Delta\text{IDEB}' - \Delta\text{IDEB}) + E[c_{m2004}|\Delta\text{IDEB}', X]$$
$$- E\left[c_{m2004}|\Delta\text{IDEB}, X\right] \tag{6}$$

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[15] Note that the data are such that there is a one-to-one mapping between an incumbent mayor and municipality. For that reason we do not use different subscripts for mayors and municipalities.

Applying the condition of Eq. (3), the difference-in-difference coefficient the of expected probability of reelection is

$$\left( E\left[Y_{m2008}|\Delta\text{IDEB}'\right] - E\left[Y_{m2008}|\Delta\text{IDEB}\right] \right) - \left( E\left[Y_{m2004}|\Delta\text{IDEB}'\right] - E\left[Y_{m2004}|\Delta\text{IDEB}\right] \right)$$

$$= (\beta_{2008} - \beta_{2004})\left( \Delta\text{IDEB}' - \Delta\text{IDEB} \right). \tag{7}$$

Dividing both sides by $\Delta\text{IDEB}' - \Delta\text{IDEB}$ and considering that $\Delta\text{IDEB}'$ is an infinitesimal departure from $\Delta\text{IDEB}$, we obtain Eq. (4). At the same time, the difference-in-difference representation helps understanding why the coefficient $\delta$ is the parameter of interest, since it captures exactly the differential impact of changes over time of $\Delta\text{IDEB}$ on $Y$, being precisely a 'difference in derivatives' parameter.

Intuitively, the identification restriction imposed by Eq. (4) is that expected differences in unobserved components between elections do not depend on changes in school quality. Given that we allow for unobservables to be arbitrarily correlated with changes in school quality and mayor reelection probabilities, and that these expected differences are conditioned on the level of school quality and other observables, we believe that this may not be an implausible restriction. Also, the coefficient of interest can be interpreted as the partial correlation between changes in school quality and probability of reelection in 2008 netted out by the partial correlation between changes in school quality and probability of reelection in 2004. In fact, the 2004 and 2008 experiments can be interpreted as the 'placebo' and the 'true experiment' respectively. Another way to interpret the parameter $\delta$ is by capturing the impact of increasing information on school quality, which in fact happened between 2004 and 2008 elections, on reelection chances. We present in the next section the results for the 2004 and 2008 regressions separately as well the 'difference in derivatives' regression described by Eq. (1).

## 4. Results

In this paper we are mainly concerned about capturing the impact of publication of improvements in education quality on election outcomes and therefore we need to net that effect out of the quantity effect induced by overall expenditures with education. Therefore, we use not only $\Delta\text{IDEB}$ and the vector of covariates and as independent variables in the regressions, but the logarithm of per capita spending on education as a way to separate the impacts of quantity and quality improvements. Note that we use two measures of spending: in the first two years and therefore, before the publication of IDEB during the 2005–2008 mandate, and the last two years. The reason we split expenditures this way has to do not only with political cycles of spending but also with the fact that we want a measure, such as expenditures in the first two years that were not influenced by changes in IDEB. The inclusion of expenditures in the final two years would give us partial effects of changes in IDEB.

We add controls for other types of expenditures as well, as all of them should satisfy the same budget restriction that education expenditures face. We also control for the baseline IDEB 2005, which is clearly (negatively) correlated to the change and, given the time frame it can be seen as a partial measure of quality of previous administration.[16] Finally, for all regressions presented in this section we included the control variables presented in Tables 1a–1c: population, GDP, municipal average schooling years, HDI, Theil index and variables of politicians, such as gender, education, if they are married, if they belong to the same party as governor's and if they belong to the same party of the president.

We first measure the impact of changes in IDEB for both elections controlling for the level of IDEB in 2005 as it can be seen from Table 2. The idea behind controlling for the 2005 IDEB level is to be able to obtain net impacts of effective actions toward improving school quality on electoral outcomes. Otherwise, if we did not control for the IDEB level, our estimates could have been mixing 'selection' (composition) effects with efforts made in response to 'incentive' electoral effects arising from the publication of IDEB (moral hazard).

We found no overall effects in 2004 elections. However, we do find a positive effect of IDEB increases on reelection chances, in the 2008 elections, when information on IDEB was actually available for voters.

We also control for educational expenditure on the model of probability of reelection. As expected, expenditures on education affected the probability of reelection for both elections and when expenditure variables of both first two years

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[16] See Table A1 in Appendix A.

Table 2
Reelection regressions.

| | Placebo experiment: 2004 | | | True experiment: 2008 | | | Diff | | |
|---|---|---|---|---|---|---|---|---|---|
| Fifth grade $\Delta$IDEB | −0.005 | −0.012 | −0.014 | 0.038** | 0.040** | 0.043** | 0.043 | 0.051* | 0.057** |
| | (0.021) | (0.021) | (0.021) | (0.018) | (0.019) | (0.019) | (0.028) | (0.029) | (0.029) |
| Baseline fifth grade IDEB | 0.022 | 0.012 | 0.015 | 0.032* | 0.032* | 0.032* | 0.010 | 0.020 | 0.017 |
| | (0.018) | (0.019) | (0.019) | (0.017) | (0.017) | (0.017) | (0.025) | (0.026) | (0.026) |
| Average per capita expenditure on education—first two years | | 0.053 | −0.066 | | −0.065** | −0.188*** | | −0.119** | −0.123 |
| | | (0.039) | (0.049) | | (0.032) | (0.058) | | (0.050) | (0.075) |
| Average per capita expenditure on health—first two years | | 0.011 | −0.041 | | 0.066** | 0.003 | | 0.056 | 0.044 |
| | | (0.028) | (0.036) | | (0.031) | (0.046) | | (0.042) | (0.058) |
| Average per capita expenditure on urbanism—first two years | | 0.026** | 0.010 | | 0.035*** | 0.010 | | 0.009 | −0.000 |
| | | (0.012) | (0.014) | | (0.010) | (0.014) | | (0.016) | (0.020) |
| Average per capita expenditure on education—last two years | | | 0.161*** | | | 0.128** | | | −0.033 |
| | | | (0.048) | | | (0.060) | | | (0.076) |
| Average per capita expenditure on health—last two years | | | 0.065 | | | 0.074 | | | 0.009 |
| | | | (0.040) | | | (0.050) | | | (0.064) |
| Average per capita expenditure on urbanism—last two years | | | 0.026** | | | 0.038** | | | 0.012 |
| | | | (0.012) | | | (0.015) | | | (0.020) |
| Observations | 2469 | 2400 | 2344 | 3160 | 3057 | 2973 | 5629 | 5457 | 5317 |
| R-squared | 0.073 | 0.076 | 0.090 | 0.054 | 0.061 | 0.067 | 0.073 | 0.079 | 0.089 |

For all regressions, dependent variable is reelection success dummy. Robust standard errors in parentheses for 2004 and 2008 regressions. For the difference estimator, cluster standard errors in parenthesis.

We included the following covariates in all regression specifications: (Incumbent's characteristics) Male, Married, Age, Governor's party and President's party; (Demographic variables) Log(per capita GDP), Log(population), Theil Index, HDI and Schooling years.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

and last two years are used, we found an interesting cyclical effect, as the impact of expenditure in the first two years is negative (non-significant for 2004) while the impact of expenditure in last two years is positive. Expenditures on urbanism (infrastructure), which are typically visible and attract electoral attention, had positive impact on reelections.

Interestingly, when we add expenditures in the regression, the coefficient on $\Delta$IDEB becomes even more positive. As Table 2 shows, an increase on IDEB during mayor's time in municipal office impacts the probability of reelection in 2008, but not in 2004. That is in accordance with the fact that voters did not have information about school quality on 2004 election, but they did have before 2008. For the difference estimator, we have that a one unit increase on $\Delta$IDEB raises about 5.7% points the probability of reelection of the mayor. It also can be seen that there is no difference in the coefficients associated with quantity effects on elections. They were visible in both elections and one should not expect that coefficients would change over time. Finally, the fact that the $\Delta$IDEB coefficient remained important after controlling for expenditures reveal that voters are sophisticated enough to reward mayors that are able to improve educational quality without rising spending significantly.

The results above strongly suggest that voters are concerned about school quality and the disclosure of IDEB added important information for the voter's decision. In order to obtain further evidences of this channel, we repeat the same exercise for different subpopulations to evaluate in which situations information about IDEB is more important for voters.

Tables 3a and 3b analyze the impact of changes in IDEB on reelection splitting the sample into two subsamples: municipalities with a proportion of poor people above the median value of the municipality distribution and those below the median.[17] The difference estimator results of Table 3a show that on municipalities below the median income a one unit increase in $\Delta$IDEB increases the probability of reelection in about 12 pp., which is much higher than the result in Table 2. Table 3b also evidences that on richer municipalities $\Delta$IDEB is not important on election, which can be justified by the fact that most public elementary schools are accessed by students from lower income families.

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[17] The proportion of poor people in each municipality is obtained from the 2000 census information. An individual is considered poor if her monthly per capita household income is below 2000 BRL$75.50. This value corresponds to half of the minimum wage in that year.

Table 3a
Reelection regressions by income per capita (poor municipalities).

| | Placebo experiment: 2004 | | | True experiment: 2008 | | | Diff | | |
|---|---|---|---|---|---|---|---|---|---|
| Fifth grade ΔIDEB | −0.041 | −0.047 | −0.045 | 0.069** | 0.070** | 0.074*** | 0.110*** | 0.118*** | 0.119*** |
| | (0.033) | (0.034) | (0.035) | (0.027) | (0.027) | (0.028) | (0.043) | (0.044) | (0.044) |
| Baseline fifth grade IDEB | 0.058** | 0.052* | 0.057* | 0.039 | 0.041 | 0.041 | −0.020 | −0.011 | −0.015 |
| | (0.029) | (0.029) | (0.030) | (0.025) | (0.025) | (0.026) | (0.037) | (0.038) | (0.038) |
| Average per capita expenditure on education—first two years | | −0.012 | −0.107* | | −0.038 | −0.212*** | | −0.026 | −0.105 |
| | | (0.060) | (0.064) | | (0.048) | (0.073) | | (0.075) | (0.095) |
| Average per capita expenditure on health—first two years | | 0.022 | −0.054 | | 0.146*** | 0.086 | | 0.124** | 0.140* |
| | | (0.042) | (0.046) | | (0.041) | (0.062) | | (0.059) | (0.077) |
| Average per capita expenditure on urbanism—first two years | | 0.026* | 0.005 | | 0.031** | 0.019 | | 0.005 | 0.015 |
| | | (0.015) | (0.019) | | (0.013) | (0.018) | | (0.020) | (0.026) |
| Average per capita expenditure on education—last two years | | | 0.155** | | | 0.241*** | | | 0.086 |
| | | | (0.073) | | | (0.078) | | | (0.108) |
| Average per capita expenditure on health—last two years | | | 0.116** | | | 0.083 | | | −0.033 |
| | | | (0.056) | | | (0.066) | | | (0.086) |
| Average per capita expenditure on urbanism—last two years | | | 0.036** | | | 0.013 | | | −0.023 |
| | | | (0.017) | | | (0.021) | | | (0.027) |
| Observations | 1146 | 1118 | 1087 | 1659 | 1608 | 1540 | 2805 | 2726 | 2627 |
| R-squared | 0.087 | 0.087 | 0.107 | 0.054 | 0.069 | 0.077 | 0.070 | 0.080 | 0.094 |

For all regressions, dependent variable is reelection success dummy. Robust standard errors in parentheses for 2004 and 2008 regressions. For the difference estimator, cluster standard errors in parenthesis.

We included the following covariates in all regression specifications: (Incumbent's characteristics) Male, Married, Age, Governor's party and President's party; (Demographic variables) Log(per capita GDP), Log(population), Theil Index, HDI and Schooling years.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table 3b
Reelection regressions by income per capita (rich municipalities).

| | Placebo experiment: 2004 | | | True experiment: 2008 | | | Diff | | |
|---|---|---|---|---|---|---|---|---|---|
| Fifth grade ΔIDEB | 0.011 | 0.005 | 0.003 | 0.014 | 0.010 | 0.010 | 0.002 | 0.005 | 0.008 |
| | (0.026) | (0.027) | (0.027) | (0.025) | (0.026) | (0.026) | (0.038) | (0.039) | (0.039) |
| Baseline fifth grade IDEB | −0.011 | −0.023 | −0.021 | 0.033 | 0.020 | 0.018 | 0.044 | 0.043 | 0.039 |
| | (0.025) | (0.026) | (0.026) | (0.024) | (0.025) | (0.025) | (0.036) | (0.037) | (0.037) |
| Average per capita expenditure on education—first two years | | 0.056 | −0.024 | | −0.089* | −0.105 | | −0.144** | −0.081 |
| | | (0.050) | (0.071) | | (0.047) | (0.102) | | (0.070) | (0.124) |
| Average per capita expenditure on health—first two years | | −0.002 | −0.029 | | −0.005 | −0.071 | | −0.003 | −0.042 |
| | | (0.039) | (0.056) | | (0.043) | (0.056) | | (0.059) | (0.079) |
| Average per capita expenditure on urbanism—first two years | | 0.030 | 0.019 | | 0.042** | −0.007 | | 0.012 | −0.025 |
| | | (0.019) | (0.023) | | (0.017) | (0.023) | | (0.026) | (0.032) |
| Average per capita expenditure on education—last two years | | | 0.096 | | | −0.017 | | | −0.113 |
| | | | (0.064) | | | (0.102) | | | (0.120) |
| Average per capita expenditure on health—last two years | | | 0.034 | | | 0.083 | | | 0.050 |
| | | | (0.059) | | | (0.067) | | | (0.089) |
| Average per capita expenditure on urbanism—last two years | | | 0.018 | | | 0.072*** | | | 0.053* |
| | | | (0.017) | | | (0.024) | | | (0.029) |
| Observations | 1323 | 1282 | 1257 | 1501 | 1449 | 1433 | 2824 | 2731 | 2690 |
| R-squared | 0.096 | 0.103 | 0.112 | 0.063 | 0.070 | 0.081 | 0.099 | 0.108 | 0.118 |

For all regressions, dependent variable is reelection success dummy. Robust standard errors in parentheses for 2004 and 2008 regressions. For the difference estimator, cluster standard errors in parenthesis.

We included the following covariates in all regression specifications: (Incumbent's characteristics) Male, Married, Age, Governor's party and President's party; (Demographic variables) Log(per capita GDP), Log(population), Theil Index, HDI and Schooling years.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table 4a
Reelection regressions by existence of local radio station (municipalities with radio).

| | Placebo experiment: 2004 | | | True experiment: 2008 | | | Diff | | |
|---|---|---|---|---|---|---|---|---|---|
| Fifth grade $\Delta$IDEB | 0.029 | 0.022 | 0.008 | 0.035 | 0.031 | 0.034 | 0.006 | 0.009 | 0.026 |
| | (0.031) | (0.031) | (0.031) | (0.029) | (0.029) | (0.029) | (0.042) | (0.043) | (0.043) |
| Baseline fifth grade IDEB | 0.041 | 0.028 | 0.030 | 0.009 | 0.003 | 0.003 | −0.032 | −0.024 | −0.028 |
| | (0.028) | (0.028) | (0.028) | (0.026) | (0.026) | (0.026) | (0.038) | (0.038) | (0.038) |
| Average per capita expenditure on education—first two years | | 0.087 | −0.040 | | −0.044 | −0.183[*] | | −0.131[*] | −0.144 |
| | | (0.055) | (0.080) | | (0.048) | (0.108) | | (0.074) | (0.134) |
| Average per capita expenditure on health—first two years | | 0.009 | −0.046 | | 0.034 | −0.021 | | 0.025 | 0.026 |
| | | (0.040) | (0.059) | | (0.041) | (0.059) | | (0.058) | (0.085) |
| Average per capita expenditure on urbanism—first two years | | 0.033[*] | 0.015 | | 0.056[***] | −0.000 | | 0.023 | −0.015 |
| | | (0.017) | (0.020) | | (0.018) | (0.023) | | (0.025) | (0.031) |
| Average per capita expenditure on education—last two years | | | 0.153[**] | | | 0.138 | | | −0.015 |
| | | | (0.071) | | | (0.106) | | | (0.126) |
| Average per capita expenditure on health—last two years | | | 0.081 | | | 0.049 | | | −0.033 |
| | | | (0.062) | | | (0.067) | | | (0.092) |
| Average per capita expenditure on urbanism—last two years | | | 0.026 | | | 0.079[***] | | | 0.053[*] |
| | | | (0.019) | | | (0.024) | | | (0.031) |
| Observations | 1146 | 1121 | 1103 | 1441 | 1414 | 1385 | 2587 | 2535 | 2488 |
| $R$-squared | 0.081 | 0.089 | 0.100 | 0.048 | 0.059 | 0.072 | 0.073 | 0.084 | 0.096 |

For all regressions, dependent variable is reelection success dummy. Robust standard errors in parentheses for 2004 and 2008 regressions. For the difference estimator, cluster standard errors in parenthesis.

We included the following covariates in all regression specifications: (Incumbent's characteristics) Male, Married, Age, Governor's party and President's party; (Demographic variables) Log(per capita GDP), Log(population), Theil Index, HDI and Schooling years.

[*] $p < 0.1$.
[**] $p < 0.05$.
[***] $p < 0.01$.

Tables 4a and 4b present the results from the samples split between municipalities with and without local radio stations. Tables 5a and 5b do the same between municipalities where there is circulation of local daily newspaper and where there is not. The idea of both tables is to distinguish situations based on easiness of access to information about IDEB. For both tables $\Delta$IDEB does not affect reelection, except for municipalities without radio. Thus, because we do not have precise information on how the media is influenced or controlled by local politicians, nor how voters access local media, these results are hardly conclusive. In fact, it may be the case that information on IDEB might have been accessed by population by other means than traditional media. This is supported by the fact that the correlation between having at most one elementary school in the municipality and having a radio station is highly negative. According to IBGE in 2009, the proportion of municipalities with at least one radio station among those that had at most one municipal elementary school was 17.8% whereas that proportion was 47.6% among those that had more than one municipal elementary school. Thus, in very small towns, information on school quality is more easily transmitted by mouth-to-mouth than by the media.

Tables 6a and 6b show the impact of changes in IDEB for two groups of municipalities: those municipalities with a fraction of children in the population above the median value of the municipality distribution in 2000 and those and below that cutoff point. We find that a one unit increase in $\Delta$IDEB raises the probability of reelection about 11 pp. in municipalities with a large share of children. For cities with relatively fewer children there is no impact. The idea here is that changes in IDEB must be more important in municipalities where there are more potential students.

## 5. Conclusions

This study examined whether there is demand for improvements in the quality of public education in Brazil using electoral accountability as the way to discipline educational system administrators. Our findings contributed to two otherwise unrelated bodies of the accountability literature: school and electoral accountability systems. We have linked these literatures by presenting evidence that retrospective voting in Brazilian localities provides incentives via rewards and punishments to school administrators that de facto strengthens the existing federal school accountability system.

Table 4b
Reelection regressions by existence of local radio station (municipalities without radio).

| | Placebo experiment: 2004 | | | True experiment: 2008 | | | Diff | | |
|---|---|---|---|---|---|---|---|---|---|
| Fifth grade ΔIDEB | −0.031 | −0.040 | −0.033 | 0.041* | 0.047* | 0.052** | 0.072* | 0.087** | 0.085** |
| | (0.027) | (0.028) | (0.029) | (0.024) | (0.024) | (0.025) | (0.037) | (0.039) | (0.039) |
| Baseline fifth grade IDEB | 0.006 | −0.003 | 0.001 | 0.051** | 0.051** | 0.054** | 0.045 | 0.055 | 0.053 |
| | (0.026) | (0.026) | (0.027) | (0.022) | (0.023) | (0.023) | (0.034) | (0.035) | (0.036) |
| Average per capita expenditure on education—first two years | | 0.026 | −0.088 | | −0.095** | −0.214*** | | −0.121* | −0.126 |
| | | (0.052) | (0.061) | | (0.044) | (0.070) | | (0.068) | (0.091) |
| Average per capita expenditure on health—first two years | | 0.013 | −0.038 | | 0.089* | 0.029 | | 0.076 | 0.067 |
| | | (0.042) | (0.047) | | (0.047) | (0.068) | | (0.064) | (0.082) |
| Average per capita expenditure on urbanism—first two years | | 0.020 | 0.006 | | 0.025* | 0.018 | | 0.005 | 0.012 |
| | | (0.016) | (0.021) | | (0.013) | (0.018) | | (0.021) | (0.027) |
| Average per capita expenditure on education—last two years | | | 0.178*** | | | 0.129* | | | −0.049 |
| | | | (0.067) | | | (0.075) | | | (0.101) |
| Average per capita expenditure on health—last two years | | | 0.050 | | | 0.083 | | | 0.032 |
| | | | (0.058) | | | (0.072) | | | (0.092) |
| Average per capita expenditure on urbanism—last two years | | | 0.024 | | | 0.010 | | | −0.014 |
| | | | (0.015) | | | (0.020) | | | (0.025) |
| Observations | 1323 | 1279 | 1241 | 1719 | 1643 | 1588 | 3042 | 2922 | 2829 |
| R-squared | 0.075 | 0.076 | 0.092 | 0.068 | 0.072 | 0.076 | 0.082 | 0.086 | 0.095 |

For all regressions, dependent variable is reelection success dummy. Robust standard errors in parentheses for 2004 and 2008 regressions. For the difference estimator, cluster standard errors in parenthesis.
We included the following covariates in all regression specifications: (Incumbent's characteristics) Male, Married, Age, Governor's party and President's party; (Demographic variables) Log(per capita GDP), Log(population), Theil Index, HDI and Schooling years.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table 5a
Reelection regressions by existence of local dayly newspapers (municipalities with newspaper).

| | Placebo experiment: 2004 | | | True experiment: 2008 | | | Diff | | |
|---|---|---|---|---|---|---|---|---|---|
| Fifth grade ΔIDEB | −0.021 | −0.019 | −0.023 | 0.003 | 0.006 | 0.011 | 0.024 | 0.024 | 0.034 |
| | (0.024) | (0.024) | (0.025) | (0.022) | (0.023) | (0.023) | (0.033) | (0.034) | (0.034) |
| Baseline fifth grade IDEB | 0.021 | 0.009 | 0.011 | 0.044** | 0.042** | 0.040** | 0.023 | 0.033 | 0.030 |
| | (0.021) | (0.021) | (0.021) | (0.019) | (0.020) | (0.020) | (0.029) | (0.029) | (0.029) |
| Average per capita expenditure on education—first two years | | 0.042 | −0.066 | | −0.059 | −0.157** | | −0.101* | −0.091 |
| | | (0.042) | (0.061) | | (0.038) | (0.080) | | (0.058) | (0.100) |
| Average per capita expenditure on health—first two years | | 0.039 | −0.012 | | 0.050 | −0.012 | | 0.010 | −0.000 |
| | | (0.033) | (0.046) | | (0.036) | (0.052) | | (0.049) | (0.070) |
| Average per capita expenditure on urbanism—first two years | | 0.028** | 0.015 | | 0.029** | −0.005 | | 0.001 | −0.020 |
| | | (0.014) | (0.016) | | (0.012) | (0.017) | | (0.018) | (0.024) |
| Average per capita expenditure on education—last two years | | | 0.138** | | | 0.091 | | | −0.047 |
| | | | (0.056) | | | (0.080) | | | (0.097) |
| Average per capita expenditure on health—last two years | | | 0.050 | | | 0.074 | | | 0.025 |
| | | | (0.049) | | | (0.059) | | | (0.076) |
| Average per capita expenditure on urbanism—last two years | | | 0.025* | | | 0.052*** | | | 0.027 |
| | | | (0.014) | | | (0.019) | | | (0.024) |
| Observations | 1899 | 1846 | 1810 | 2325 | 2259 | 2211 | 4224 | 4105 | 4021 |
| R-squared | 0.072 | 0.077 | 0.088 | 0.054 | 0.059 | 0.066 | 0.076 | 0.082 | 0.091 |

For all regressions, dependent variable is reelection success dummy. Robust standard errors in parentheses for 2004 and 2008 regressions. For the difference estimator, cluster standard errors in parenthesis.
We included the following covariates in all regression specifications: (Incumbent's characteristics) Male, Married, Age, Governor's party and President's party; (Demographic variables) Log(per capita GDP), Log(population), Theil Index, HDI and Schooling years.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table 5b
Reelection regressions by existence of local dayly newspapers (municipalities without newspaper).

| | Placebo experiment: 2004 | | | True experiment: 2008 | | | Diff | | |
|---|---|---|---|---|---|---|---|---|---|
| Fifth grade ΔIDEB | −0.038 | −0.028 | −0.037 | 0.016 | 0.014 | 0.010 | 0.054 | 0.043 | 0.047 |
| | (0.042) | (0.044) | (0.044) | (0.035) | (0.035) | (0.036) | (0.055) | (0.056) | (0.057) |
| Baseline fifth grade IDEB | 0.018 | 0.006 | 0.023 | 0.003 | 0.007 | 0.014 | −0.015 | 0.000 | −0.009 |
| | (0.042) | (0.044) | (0.045) | (0.033) | (0.035) | (0.036) | (0.053) | (0.056) | (0.056) |
| Average per capita expenditure on education—first two years | | 0.072 | −0.079 | | −0.082 | −0.248*** | | −0.154 | −0.170 |
| | | (0.081) | (0.077) | | (0.061) | (0.090) | | (0.098) | (0.117) |
| Average per capita expenditure on health—first two years | | −0.050 | −0.067 | | 0.145** | 0.048 | | 0.195** | 0.115 |
| | | (0.053) | (0.056) | | (0.059) | (0.092) | | (0.080) | (0.108) |
| Average per capita expenditure on urbanism—first two years | | 0.021 | −0.013 | | 0.051*** | 0.044* | | 0.030 | 0.057 |
| | | (0.023) | (0.031) | | (0.019) | (0.025) | | (0.030) | (0.040) |
| Average per capita expenditure on education—last two years | | | 0.255*** | | | 0.230** | | | −0.025 |
| | | | (0.097) | | | (0.102) | | | (0.144) |
| Average per capita expenditure on health—last two years | | | 0.058 | | | 0.100 | | | 0.043 |
| | | | (0.080) | | | (0.095) | | | (0.123) |
| Average per capita expenditure on urbanism—last two years | | | 0.032 | | | 0.009 | | | −0.023 |
| | | | (0.024) | | | (0.026) | | | (0.035) |
| Observations | 570 | 554 | 534 | 835 | 798 | 762 | 1405 | 1352 | 1296 |
| R-squared | 0.108 | 0.108 | 0.133 | 0.063 | 0.083 | 0.093 | 0.085 | 0.097 | 0.114 |

For all regressions, dependent variable is reelection success dummy. Robust standard errors in parentheses for 2004 and 2008 regressions. For the difference estimator, cluster standard errors in parenthesis.
We included the following covariates in all regression specifications: (Incumbent's characteristics) Male, Married, Age, Governor's party and President's party; (Demographic variables) Log(per capita GDP), Log(population), Theil Index, HDI and Schooling years.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table 6a
Reelection regressions by municipal proportion of children at school age (large share of children).

| | Placebo experiment: 2004 | | | True experiment: 2008 | | | Diff | | |
|---|---|---|---|---|---|---|---|---|---|
| Fifth grade ΔIDEB | −0.026 | −0.031 | −0.033 | 0.068** | 0.070** | 0.071** | 0.094** | 0.101** | 0.105** |
| | (0.033) | (0.033) | (0.034) | (0.027) | (0.028) | (0.028) | (0.042) | (0.043) | (0.044) |
| Baseline fifth grade IDEB | 0.058** | 0.052* | 0.061** | 0.039 | 0.040 | 0.042 | −0.019 | −0.012 | −0.019 |
| | (0.028) | (0.029) | (0.029) | (0.025) | (0.025) | (0.026) | (0.037) | (0.038) | (0.038) |
| Average per capita expenditure on education—first two years | | −0.036 | −0.116* | | −0.047 | −0.179** | | −0.011 | −0.063 |
| | | (0.055) | (0.062) | | (0.046) | (0.069) | | (0.070) | (0.092) |
| Average per capita expenditure on health—first two years | | 0.009 | −0.054 | | 0.148*** | 0.093 | | 0.139** | 0.147* |
| | | (0.039) | (0.045) | | (0.041) | (0.061) | | (0.057) | (0.076) |
| Average per capita expenditure on urbanism—first two years | | 0.021 | 0.000 | | 0.035*** | 0.023 | | 0.014 | 0.023 |
| | | (0.015) | (0.018) | | (0.013) | (0.017) | | (0.020) | (0.025) |
| Average per capita expenditure on education—last two years | | | 0.136* | | | 0.175** | | | 0.039 |
| | | | (0.071) | | | (0.077) | | | (0.106) |
| Average per capita expenditure on health—last two years | | | 0.119** | | | 0.077 | | | −0.042 |
| | | | (0.056) | | | (0.065) | | | (0.085) |
| Average per capita expenditure on urbanism—last two years | | | 0.029* | | | 0.015 | | | −0.015 |
| | | | (0.016) | | | (0.020) | | | (0.026) |
| Observations | 1171 | 1142 | 1111 | 1666 | 1614 | 1549 | 2837 | 2756 | 2660 |
| R-squared | 0.095 | 0.096 | 0.114 | 0.058 | 0.075 | 0.081 | 0.077 | 0.088 | 0.100 |

For all regressions, dependent variable is reelection success dummy. Robust standard errors in parentheses for 2004 and 2008 regressions. For the difference estimator, cluster standard errors in parenthesis.
We included the following covariates in all regression specifications: (Incumbent's characteristics) Male, Married, Age, Governor's party and President's party; (Demographic variables) Log(per capita GDP), Log(population), Theil Index, HDI and Schooling years.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table 6b
Reelection regressions by municipal proportion of children at school age (small share of children).

| | Placebo experiment: 2004 | | | True experiment: 2008 | | | Diff | | |
|---|---|---|---|---|---|---|---|---|---|
| Fifth grade ΔIDEB | 0.001 | −0.005 | −0.007 | 0.018 | 0.012 | 0.014 | 0.017 | 0.018 | 0.021 |
| | (0.026) | (0.027) | (0.027) | (0.025) | (0.026) | (0.026) | (0.038) | (0.039) | (0.039) |
| Baseline fifth grade IDEB | −0.006 | −0.021 | −0.025 | 0.035 | 0.024 | 0.021 | 0.041 | 0.044 | 0.046 |
| | (0.025) | (0.026) | (0.026) | (0.024) | (0.024) | (0.025) | (0.036) | (0.036) | (0.037) |
| Average per capita expenditure on education—first two years | | 0.105** | 0.013 | | −0.090* | −0.205** | | −0.195*** | −0.218* |
| | | (0.051) | (0.072) | | (0.048) | (0.104) | | (0.071) | (0.124) |
| Average per capita expenditure on health—first two years | | 0.003 | −0.034 | | −0.003 | −0.076 | | −0.006 | −0.042 |
| | | (0.041) | (0.060) | | (0.043) | (0.058) | | (0.060) | (0.084) |
| Average per capita expenditure on urbanism—first two years | | 0.037* | 0.027 | | 0.041** | −0.006 | | 0.004 | −0.033 |
| | | (0.021) | (0.024) | | (0.017) | (0.024) | | (0.027) | (0.034) |
| Average per capita expenditure on education—last two years | | | 0.100 | | | 0.097 | | | −0.003 |
| | | | (0.066) | | | (0.103) | | | (0.121) |
| Average per capita expenditure on health—last two years | | | 0.027 | | | 0.083 | | | 0.057 |
| | | | (0.060) | | | (0.068) | | | (0.091) |
| Average per capita expenditure on urbanism—last two years | | | 0.023 | | | 0.068*** | | | 0.045 |
| | | | (0.018) | | | (0.025) | | | (0.030) |
| Observations | 1298 | 1258 | 1233 | 1494 | 1443 | 1424 | 2792 | 2701 | 2657 |
| R-squared | 0.092 | 0.105 | 0.116 | 0.060 | 0.066 | 0.077 | 0.095 | 0.105 | 0.116 |

For all regressions, dependent variable is reelection success dummy. Robust standard errors in parentheses for 2004 and 2008 regressions. For the difference estimator, cluster standard errors in parenthesis.

We included the following covariates in all regression specifications: (Incumbent's characteristics) Male, Married, Age, Governor's party and President's party; (Demographic variables) Log(per capita GDP), Log(population), Theil Index, HDI and Schooling years.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Thus, we show that a 'weak' school accountability system may become 'strong' as long as there is a parallel system that punishes and rewards those responsible for school quality. A weak school accountability system may therefore dispense its 'rewards and punishments' arm as long as there are ways to discipline school administrators. We found evidence that local elections could be one of those ways.

The theoretical predictions from the political agency literature are ambiguous. Increases in the information on the existing quality of public goods could even decrease the quality being supplied by reducing the number of incumbent mayors who would be willing to pay larger reputational costs. We found that from 2005 to 2007 there was an important increase in quality, so mayors in general reacted to the informational shock positively. As anticipated by them (and by the theory), they were rewarded: those who were able to pay the reputational cost of increasing quality of education between 2005 and 2007 had their reelection chances increased.

We analyzed the impact of changes in IDEB from 2005 to 2007 on the probability of reelection in the elections of 2004 and 2008 overall and for several subpopulations. The results revealed that IDEB changes, on average, positively affected the chances of reelection of the mayor. In fact, a one unit increase in IDEB from 2005 to 2007 increases the chances of mayor reelection in about 5% points. An increase of one point in IDEB is indeed a feasible policy, as for municipalities in our sample the average change in IDEB from 2005 to 2007 was 0.5.

Other important results showed that the impact of IDEB is even higher in the poorest municipalities, and where there are more children. In these situations one unit increase in IDEB from 2005 to 2007 may increase the probability of reelection by more than 10% points. However, the impact was not the same when we split the sample using media access as a source of heterogeneity.

Our results point out that there seems to be, at least for some specific groups, demand for improvements in the quality of public education in Brazil. In fact, voters take into account the efficiency of public managers in using resources and not just the amount spent on education. A next step is to study the mechanisms adopted by mayors to increase IDEB. Do they respond by changing the allocation of resources, changing management tools or they simply ignore – and get punished by that – people's demand for increases in public education quality?

## Appendix A.

Table A1
Relation between IDEB changes and IDEB level.

| | Placebo experiment: 2004 | | | True experiment: 2008 | | |
|---|---|---|---|---|---|---|
| | Non reeligible | Reeligible | Difference | Not reeligible | Reeligible | Difference |
| 2005 fifth grade IDEB | −0.362[***] | −0.401[***] | −0.039 | −0.366[***] | −0.391[***] | −0.025 |
| | (0.019) | (0.016) | (0.033) | (0.025) | (0.014) | (0.034) |
| Log(per capita GDP) | 0.074[***] | 0.074[***] | −0.000 | 0.044 | 0.085[***] | 0.042 |
| | (0.026) | (0.023) | (0.033) | (0.033) | (0.020) | (0.037) |
| Log(population) | −0.070[***] | −0.072[***] | −0.003 | −0.060[***] | −0.074[***] | −0.015 |
| | (0.012) | (0.011) | (0.015) | (0.016) | (0.009) | (0.018) |
| Schooling years | 0.089[***] | 0.064[***] | −0.025 | 0.057 | 0.081[***] | 0.024 |
| | (0.027) | (0.024) | (0.035) | (0.035) | (0.021) | (0.040) |
| HDI | 0.873[**] | 1.954[***] | 1.082[**] | 2.001[***] | 1.305[***] | −0.696 |
| | (0.413) | (0.367) | (0.544) | (0.535) | (0.321) | (0.614) |
| Theil Index | −0.150 | −0.145 | 0.005 | −0.105 | −0.162[**] | −0.056 |
| | (0.102) | (0.090) | (0.125) | (0.140) | (0.078) | (0.144) |
| Observations | 1738 | 2505 | 4243 | 1031 | 3204 | 4235 |
| R-squared | 0.177 | 0.205 | 0.194 | 0.179 | 0.198 | 0.194 |
| F-stat[1] | | | 1.37 | | | 0.79 |

Standard errors in parentheses.
The F-stat is the test statistics used for testing that all coefficients are the same for the models in which the incumbent is eligible and ineligible for reelection.
[*] $p < 0.1$.
[**] $p < 0.05$.
[***] $p < 0.01$.

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