

Political Turnover, Bureaucratic Turnover and the Quality of Public Services

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We study how political turnover in mayoral elections in Brazil affects public service provision by local governments. Exploiting a regression discontinuity design for close elections, we find that municipalities with a new party in office experience upheavals in the municipal bureaucracy: new personnel are appointed across multiple service sectors, and at both managerial and non-managerial levels. In education, the increase in the replacement rate of personnel in schools controlled by the municipal government is accompanied by test scores that are .05-.08 standard deviations lower. In contrast, turnover of the mayor's party does not impact local (non-municipal) schools. These findings suggest that political turnover can adversely affect the quality of public services when the bureaucracy is not shielded from the political process.

Countries differ in the extent to which politicians control the appointment and turnover of public employees within the bureaucracy. One of the first cross-country datasets on bureaucratic structure (Rauch and Evans, 2000) documents that in many East Asian countries, as well as in India and Argentina, only the top chiefs and vice-chiefs in the core administrative agencies of the country are appointed by the president (or its equivalent). On the other end of the spectrum, in Israel, Haiti, Nigeria, and Brazil, almost all of the top 500 positions in the core government agencies are politically appointed by the president. A potential consequence of having civil service positions at the discretion of politicians is that bureaucratic turnover and political turnover become linked, leading to the politically motivated replacement of bureaucrats. In this paper, we investigate the scope and consequences of politically motivated replacement in local governments.

Accounts of such replacements in newly formed administrations are ubiquitous. In the U.S., senior staff turnover during President Trump's first year was

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a record-high 34%.¹ Political discretion over personnel appointments can also extend beyond the highest positions in the administration. In some Latin American countries, up to 26% of all government personnel worked under the threat of removal by the sitting president, who often exercises the discretionary power to remove personnel (Grindle, 2012). In the early 2000s in the national governments of Mexico and the Dominican Republic, 30,000 and 3,000 positions changed hands, respectively, when new administrations were elected.² High levels of bureaucratic replacement often lead to a public outcry over the adverse consequences it may have for government services.³ For example, these replacements may render services unstable, as policies are discontinued (Bostashvili and Ujhelyi, 2019). They may also lead to losses in personnel with position-specific knowledge (Wilson, 1989). However, an overhaul of the bureaucracy may ensure that the bureaucracy is serving the people rather than serving the interests of a few powerful groups, such as themselves and other organized groups (Olson, 1982; Grindle, 2004). In fact, Latin America's ability to pursue many policy reforms has been attributed to the widespread influence of politicians over bureaucratic appointments.⁴

Given that politically motivated replacements frequently occur when a new government comes to power, we ask: how does political turnover affect the bureaucracy and its performance? In Brazil, we find that political party turnover at the mayoral position level widely reshapes the local government's bureaucracy. Political turnover and the associated disruption in the bureaucracy harm the quality of public education, one of the primary responsibilities of local government in this context.

We focus on this particular context for several reasons. First, local politicians control, directly and indirectly, the appointment of personnel to the municipal bureaucracy. In particular, in Brazil, as in many Latin American countries, local politicians have considerable discretion over the public education system and the appointment of public school personnel, such as headmasters and teachers (Ferraz, Finan and Moreira (2012); Miranda and Pazello (2015); Munõz and Prem

¹President Trump's first-year staff turnover was more than triple the turnover during the Obama administration and higher than that of the five most recent U.S. presidents. See Brookings' report: [Why is Trump's staff turnover higher than the five most recent presidents](#) accessed May 18, 2020.

²These are raw counts of replacements that happened in the event of a political turnover (Iacoviello, 2006). These replacements could have happened in the absence of any political turnover. In contrast, our paper estimates personnel replacement that can be solely attributed to a change in the ruling party.

³According to *The New York Times* article: "Trump appears to be launching the biggest assault on the nation's civil service system since the 1883 Pendleton Act": ("[Trump's effort to remove the disloyal heightens unease across his administration](#)", *The New York Times* accessed May 22, 2020); *The Economist* describes personnel reassignments during Trump's administration that led to a complete mismatch between an individual's skills and responsibilities. It argues that such practices have raised concerns among Republicans and Democrats about whether the federal government can perform vital tasks. ("[Bureaucratic Blight](#)" *The Economist* accessed May 18, 2020)

⁴According to Grindle (2012), in the early 2000s in Colombia and Panama, 38% of career personnel and 26% of all government workers, respectively, worked under provisional appointments that could be terminated at the discretion of the sitting president. The author argues that political appointees played a role in the liberal reforms of the 1980s and 1990s and in the innovative cash transfer programs that were rapidly put in place in the 1990s and 2000s in Latin America.

(2019)). Second, education is an essential public service and is a significant contributing factor to macroeconomic growth and individual earnings (Barro (1991); Card (2001)). Local governments in Brazil are the leading providers of primary education and spend 30% of their budget on education provision. Additionally, our measure of public education output, test scores, is a welfare-relevant outcome and is tightly linked to the performance of the public employees responsible for public education provision. These factors allow us to analyze the research question of interest: In an environment where the mayoral office has considerable influence over the municipal bureaucracy, how does a change in the political party in power at the municipal level affect the provision of public services?

To estimate the causal effect of political turnover on service provision, we rely on a regression discontinuity design that uses close elections as an exogenous source of variation in political party turnover for the mayoral position. We use this identification strategy because a comparison of outcomes in municipalities that experience a change in the ruling party to those that do not may give biased estimates of the impact of political party turnover. For instance, in a municipality with an incompetent ruling party, quality of public services are likely trending down and, hence, the constituency is likely to vote for a change in the ruling party during elections. In this case, there would be a negative relationship between political party turnover and public service quality; however, such a relationship would not capture the causal effect of political turnover on public services. To identify the causal impact of political party turnover, we compare outcomes in municipalities where the incumbent party barely loses (and, hence, there is political party turnover) to outcomes in municipalities where the incumbent political party barely wins (and, hence, there is no political party turnover). In order for this regression discontinuity design to identify the causal effect of party turnover, we essentially need party turnover to be as good as random in municipalities with close elections. Indeed we find empirical evidence in support of this identification assumption.

We find that political party turnover leads to upheaval in the municipal bureaucracy. Party turnover increases the share of personnel that is new to the bureaucracy by 7 percentage points (23% of the mean value). The personnel movements occur soon after the new mayor takes office (within months) and affects personnel appointments at different levels of the hierarchy. Moreover, the new hires are observed across several different sectors: education, health, and construction. While this broad reshape of the bureaucracy can potentially affect many of the services the municipality provides, it is *a priori* unclear whether it is a blessing or a curse to the quality of such services. One possibility is that a new political party may decide to replace a bureaucrat who is entrenched: the bureaucrat produces low levels of public services and used to provide political services for the outgoing politician. Alternatively, the bureaucrat might produce a high level of public services, but may not help the newly-elected politician achieve his political goals. The net consequence for public service is an empirical question

that hinges on which motive is stronger. We study the output of the public education sector as measured by student achievement, the only service for which we can empirically quantify both personnel movements and service quality.

We find that political party turnover reduces the quality of public education in Brazilian municipalities. Party turnover lowers test scores, as measured one year after the election, by .05–.08 standard deviation units in terms of the individual-level national distribution of test scores. Some of the most successful education interventions, such as reducing classroom size (Krueger, 1999), or providing teacher incentives (Muralidharan and Sundararaman, 2011), impact test scores between .17 to .28 standard deviation units. Hence, the magnitude of the effect of political turnover on test scores is substantial, as it is approximately one-third of the impact of these successful interventions. We interpret the negative effect on test scores as a *permanently lower* quality of education for two reasons. First, because it persists: the effect of party turnover on test scores one year after the election is not statistically different from three or five years after the election. Hence, municipalities do not appear to experience a better longer-run trajectory after a short-term setback and lower test scores.⁵ Second, we investigate an alternative interpretation for lower test scores, that new parties often come to power on a platform to broaden access to education in a way that brings marginal students into the education system. We find that political party turnover does not affect the composition of students, the number of students or the dropout rate, hence ruling out compositional changes as an alternative explanation for lower test scores.

Does the disruption in the assignment of personnel cause the negative impact of political turnover on students' test scores, or does party turnover lead to other changes in the municipality that then drive the negative effect on test scores? To understand this better, we exploit the fact that the municipal government does not control all schools to conduct a “placebo” exercise. We find that for public schools in the same municipality not controlled by the municipal government, i.e. non-municipal schools, a change in the municipal government's political party does not impact the replacement rate of school personnel or student test scores. This contrasts with our results for municipal schools where political party turnover increases the replacement rate of headmasters and teachers by 28 and 11 percentage points, respectively, and as discussed, lowers test scores. This finding rules out an effect of political turnover on student achievement due to any shocks that are common to the entire municipality, such as municipal-level changes in income or crime. It also links together the disruption in personnel and lower test scores: when political party turnover is not accompanied by a disruption in the appointment of education personnel, there is no adverse effect of political turnover on student achievement.

⁵Note that the lower quality is relative to municipalities that did not experience political turnover. It does not imply that municipalities will experience lower personnel quality than their level *before* the election. In section V, we layout a model explaining how political turnover can be detrimental to public services and still compatible with long-run growth in public service quality.

The municipal government, however, controls other aspects of municipal education provision besides the appointment of personnel, such as allocating financial and political resources. One could argue that when new parties come to power, their candidate is less experienced, or they undergo a transition period in raising revenue or managing resources - and this, in turn, impacts the quality of public education. However, we do not find evidence that overall spending in municipalities that experience political turnover is lower. Municipalities that experience political turnover have a short-run increase in the share of the budget allocated to education and an increase in the share of personnel-related expenses. The increased education expenditures is likely a byproduct of the costs associated with the higher replacement rate in school personnel that happens soon after the election. Consistent with the fact that personnel replacement occurs within a year of the election, the increased education expenditures level off in the subsequent years. Beyond financial resources dedicated to education, we also do not find evidence that party turnover impacts students due to a change in policy priorities: political party turnover reduces test scores regardless of whether the winning party is ideological to the left or the right.⁶ Taken together, the placebo exercise and previous tests yield no evidence that the results are driven by broader economic shocks or shifts in financial resources or political ideology. While there could be other hard-to-measure channels, the replacement of personnel (at the school or higher up in the municipal bureaucracy) remains the main channel for which we find empirical supporting evidence. In the remainder of the paper, we derive and test empirically additional implications of this channel.

How does the politically caused disruption in personnel appointments translate into lower student achievement? First, school personnel in municipalities with a new political party have worse attributes: headmasters are less experienced as headmasters and teachers are less educated. Municipal personnel are also younger and have less seniority in municipalities with a party change. However, we find that the deterioration in personnel attributes does not entirely explain the magnitude of the decrease in test scores based on a cross-sectional correlation between these attributes and test scores. High personnel turnover rates are linked to lower test scores, possibly due to channels other than personnel quality (Ronfeldt, Loeb and Wyckoff, 2013). School personnel in municipalities with a new political party are more likely to answer negatively to a series of survey questions regarding the offering of school programs for students, the availability of and participation in teacher training and teacher council meetings, and the degree of collaboration between school personnel. Overall, the adverse consequences of both, lower per-

⁶If in the particular elections we study, 2008 and 2012, there were overwhelming shifts from the right to the left, for example, one could argue that our estimated effect of political party turnover on educational provision is picking up the effect of an ideological shift. Given that previous work has shown a link between party ideology and adoption of policies/economic outcomes (Pettersson-Lidbom, 2008), this would be a valid concern. However, by showing that the effect of political party turnover on outcomes is independent of the ideology of the winning political party, we can rule out such an argument and provide evidence that we are indeed estimating the effect of a change in *any* political party.

sonnel quality and disruption in school operation, can explain at least between 44%-71% of the reduction in test scores due to political turnover.

Why do newly elected politicians choose to replace personnel harming the quality of education? Our preferred explanation is that politicians trade-off bureaucrat's productivity and the bureaucrat's loyalty to deliver political gains. While we do not empirically observe loyalty nor the political gains obtained, through the lens of a simple model, we argue that the presented evidence thus far supports our preferred explanation (i.e., politicians replace personnel to obtain a political gain despite the cost for public services). Moreover, we find indirect evidence of politicians making such trade-offs. For instance, we explore the heterogeneity in our results with respect to municipal-level income, since prior work has found that low-income voters in Brazil do not prioritize investments in public education (Bursztyn, 2016). The effect of political turnover on the replacement rate of school personnel is approximately two to three times larger in low-income municipalities. Political parties appear to exercise considerably more discretion over school personnel in low-income areas, where the political cost of having worse schools is likely lower. This result suggests that politicians face a trade-off between exercising discretion over appointment of school personnel (for a political gain) and the political costs associated with disrupting schools and, potentially, having worse quality schools.

This paper contributes to a broad literature on the role of state personnel for the the internal workings and performance of governments (Ashraf and Bandiera, 2018; Finan, Olken and Pande, 2015, Pepinsky, Pierskalla and Sacks 2017). We relate to two strands of the literature that investigates the linkages between politicians and bureaucrats.⁷ First, a growing literature has shown empirically how control over personnel appointments facilitates some political gains. Several papers have provided micro-evidence of such political gains for mayors in Brazil.⁸ For instance, mayors appoint personnel to pay back past campaign favors from both elite donors (Colonnelli, Teso and Prem, 2020) and street-level supporters (Brollo, Forquesato and Gozzi, 2017, Barbosa and Ferreira, 2019). Politicians' use of discretion may also be forward-looking, aiming at achieving greater control over the nominee's responsibilities. For example, politically appointed headmasters time the enforcement of the eligibility for a social program in Brazil to election time (Brollo, Kaufmann and La Ferrara, 2020), and influence incumbent

⁷Much of the existing literature on state personnel does not focus on the linkages between politicians and bureaucrats, and instead asks which type of organizational practices (incentive structure, hiring system or organizational mission) is most desirable (Duflo, Hanna and Ryan, 2012; Banerjee et al., 2020; Dal Bó, Finan and Rossi, 2013). The adoption of such practices often hinges on a politician's will and oversight over the bureaucracy (Dhaliwal and Hanna, 2017). Our work focuses on a politician's choice with respect to one organizational practice: personnel replacements. There are other policy levers connecting politicians with bureaucrats' performance: the number of politicians in charge (Gulzar and Pasquale, 2017), the set of accountability rules in place (Raffler, 2016), and the electoral incentives politicians face (Ferraz and Finan, 2011)

⁸Folke, Hirano and Snyder (2011) was one of the first papers to document such political gains in the U.S. setting. Folke, Hirano and Snyder (2011) show how civil service reform in U.S. states hurts incumbent reelection chances.

vote shares when the headmasters' schools are polling stations in mayoral elections (Menezes, Rocha and Schuabb, 2018). This body of work suggests that the political gains of the politically motivated replacements that we document are abundant and widespread. In contrast, we take the perspective of citizens and study how politically motivated replacements affect bureaucratic performance.

A second strand of the literature investigates the net consequences of political control over bureaucratic appointments for the performance of governments.⁹ Since Rauch's (1995) seminal work, an emerging literature has studied how the removal of such control through civil service reforms affects the operation of governments. Civil service reforms often improve bureaucratic performance (Xu 2018, Ornaghi 2016), presumably because they reduce personnel replacements (Moreira and Pérez, 2020).¹⁰ However, the removal of political control over appointments may impact bureaucratic performance through other channels, some of which are unrelated to bureaucrats: for instance, changing the selection of politicians (Ujhelyi, 2014a) or the policy choices politicians make (Ujhelyi 2014b, Bostashvili and Ujhelyi 2019).¹¹ Hence, the underlying trade-off that results from politically motivated replacements is a subset of this broader trade-off involved in delegating political control over personnel appointments. While politically motivated replacements may reduce bureaucratic entrenchment, they may also lead to losses in human capital. To study the net effect of such a trade-off, we compare the performance of two bureaucracies under the same institutional rules, but where the politician in one of these bureaucracies derives a greater benefit from replacing personnel. Iyer and Mani (2012) is the closest paper to ours, as the authors perform a similar comparison: they study how turnover of the chief minister of Indian states, a politician, affected reassignments of high-level bureaucrats and the bureaucracy's performance.

Iyer and Mani (2012) was the first paper to employ micro empirical analysis to study how politicians use reassignments of bureaucrats to control their output. The paper's main findings concern the implications of such practices for bureaucrats' career and related inefficiencies: lack of human capital investment

⁹Our paper also relates to literature that studies the production function of education and the consequences of personnel movements. See, for example, Fagnäs and Pelkonen (2020) and Ronfeldt, Loeb and Wyckoff (2013) on teacher reassignments in India and the U.S., respectively, as well as Miranda and Pazello (2015) studying the reassignment of headmasters in Brazil.

¹⁰Xu (2018) investigates the "incentive effect" of a politically appointed (vs. meritocratically appointed) head of a colony in the British Empire on tax revenue and other fiscal outcomes. His novel empirical strategy estimates the effect on performance that is due only to changes in the bureaucrat's effort (i.e., the incentive effect) rather than due to changes in the bureaucrats' selection. Ornaghi (2016) exploits population-based merit system mandates for U.S. municipal police department in a regression discontinuity design and shows that crime rates are lower in departments operating under the merit system. Moreira and Pérez (2020) show that custom houses in the U.S. operating under the merit system after *The Pendleton Act (1883)* improved personnel practices (increased personnel quality and lowered personnel replacements) relative to custom houses operating under the patronage system.

¹¹Ujhelyi (2014a) presents a theoretical discussion of civil service reform and how it affects the selection and performance of elected politicians. There is empirical evidence that civil service reform in U.S. states led to the reallocation of spending to lower levels of governments for which merit systems were non-existent (Ujhelyi, 2014b) and also limited the politicians' ability to engage in voter-friendly spending around election times (Bostashvili and Ujhelyi, 2019).

and mismatches between positions and the bureaucrats' skills. The paper also finds that a higher rate of change in the ruling politician is associated with higher poverty rate levels.¹² Our work differs from theirs in three ways. First, they compare bureaucracies with and without political leadership changes, irrespective of the underlying cause of turnover. Presumably, a bureaucracy that experiences turnover might have experienced poor public service delivery leading up to the turnover, when it was decided that the poor public services justified the leadership removal. In contrast, we use a regression discontinuity design to compare similar bureaucracies, where political turnover ends up happening by chance. Employing both methods using our data yields different results. The effect size of political turnover on public service quality using the regression discontinuity strategy is twice the OLS effect size estimate. Second, we investigate the scope of politically motivated replacements comprehensively: at the top of the bureaucracy, as Iyer and Mani do, but also the spillovers to the lower levels of the hierarchy. Lastly, we analyze how politically motivated replacement affects the exact inputs in the production of the service for which we measure service quality.

Finally, a few other papers have highlighted particular channels through which bureaucratic replacements *can* be used to improve performance. For example, to provide incentives for bureaucrats' to exert greater effort (Khan, Khwaja and Olken, 2019), to limit informal ties between staff and clients (Stovel and Savage, 2006) and to facilitate monitoring since reassignments help rulers filter out noise in performance measures that is due to the challenging characteristics of the area (Kiser and Kane, 2001). We contribute to this body of work by investigating how politicians' *actual* use of bureaucratic replacements affects public services.

I. Context

We use party changes in mayoral elections in Brazil to study the effect of political party turnover on the municipal bureaucracy and the service they provide. This section provides relevant details about municipal elections and municipal governments in Brazil. It also describes the education system and the link between municipal governments and the education system.

A. Brazilian Municipalities

There are 5,565 Brazilian municipalities (as of 2008). Municipalities are highly decentralized, autonomous, and responsible for key public services such as education, health, transportation, and sanitation. Municipalities rely mostly on transfers from the higher (state and federal) levels of government (Gardner, 2013) to fund public services expenditures. Mayors are elected in municipal elections that

¹²The authors use the frequency of change in the ruling politician as an instrument for the replacement rate of IAS officers. Poverty rates increased by 0.9 percentage points in districts with a 10 percentage point higher probability of bureaucratic replacement. They also investigate consequences for immunization completion and road completion (both are found to be statistically insignificant).

are held every four years on the same day across the country. While political parties are not term-limited, mayors are term-limited: they can hold office for two consecutive terms.

Municipal employment is a large part of public sector employment and has been growing in recent years. Municipal employment was 47% of public employment in 2002 and 52.6% of public employment in 2010 (Cardoso, 2011). The appointment of personnel to municipal employment takes two forms. Approximately 68% of municipal employees are civil servants (Relação Anual de Informações Sociais, 2010). They have passed a civil service exam (*concurso público*) and have tenure. The remainder of municipal employees are hired on contract. The use of contract workers is meant to allow municipalities more flexibility and control so that personnel can be hired faster or with particular qualifications that are missing from the pool of those who have passed the civil service exam. However, the mayor must be able to provide justification for hiring contract workers and may be investigated if misconduct is detected.¹³

There are several reasons local politicians may care about appointing loyalists to positions throughout the administration. Public managers can use their control over public programs and resources politically. For instance, headmasters play a key role in enforcing the conditionality of the *Bolsa Família* conditional cash transfer program. School-aged children must be in attendance for 85% of school days for their family to receive this transfer, and headmasters make political use of their latitude to determine whether particular school absences count toward non-compliance (Brollo, Kaufmann and La Ferrara, 2020). Also, because school management in Brazil involves managing an abundance of resources for food, transportation, and textbook programs, there is some anecdotal evidence that the headmaster position is used as a way to provide contracts to political supporters in the process of acquiring school supplies.¹⁴ Public employment across all hierarchical levels and sectors is also used as a reward for street-level supporters and donors who have previously helped in the political campaigns (Colonnelli, Teso and Prem (2020), Barbosa and Ferreira (2019), Brollo, Forquesato and Gozzi (2017)).

B. Brazilian Education

One of the main responsibilities of municipal governments is the provision of public education. Under Brazil's Educational Guidelines Law (Law 9394), municipalities are responsible for basic education (early childhood and elementary education), while states and the federal government are responsible for providing higher levels of education. Depending on the population size, municipalities

¹³For instance, mayors in 86 cities in the state of Paraíba had criminal and civil complaints filed against them for hiring 20,000 contract workers under the guise of exceptional public interest in 2012 [<http://www.diariosertao.com.br/noticias/paraiba/79267>, accessed March 2014].

¹⁴See, for example, the following interview with the outgoing secretary of education for the state of Rio de Janeiro: <http://oglobo.globo.com/sociedade/educacao/o-pais-nao-tem-mais-tempo-perder-discutindo-obvio-diz-wilson-risolia-14892991>, accessed October 2016.

can also provide middle school education. We focus on primary education (elementary and middle schools) due to the availability of test score data. Overall, 12.5% of primary schools are private schools, fewer than 1% are controlled by the federal government, 19.5% are controlled by states, and 68% are controlled by municipalities.¹⁵ For municipal schools, the municipal government serves as the school district. However, the funding of education comes primarily from higher levels of government. Most of the funds for education, especially those funds that ensure the daily operations of schools, come from a federal fund called FUNDEF/FUNDEB, a non-discretionary fund that pays a fixed rate per enrolled student. Thus, the funding of the daily operations of schools is unlikely to be affected by political cycles or political alliances.¹⁶

The municipality is responsible for all decisions regarding the daily operations of the school: distributing school lunches, providing school transportation, and hiring, paying, and training of school personnel (teachers, headmasters, and administrators). Similar to the municipal bureaucracy more generally, 66% of teachers have passed an exam and have job security (although they can be transferred across schools). The remainder of teachers are hired on contract, at the discretion of the municipal government, and do not have job security. The mayor's office is allowed to hire teachers on contract to fill vacancies or find people with the appropriate qualifications. Furthermore, approximately 60% of headmasters in municipal schools are politically appointed, as opposed to being selected through a competitive process or being elected by the school community. In Brazil, the position of headmaster is considered a "position of trust" (*cargo de confiança*), which means that politicians can and do appoint someone they trust to this position and hold considerable discretion over it.

C. Political Discretion in Brazil: A Comparative Perspective

The degree of discretion that Brazilian politicians hold in replacing personnel is not unique. In an assessment of rules and norms in hiring practices in the public sector across Latin America, the IDB ranked Brazil as the country with the least political discretion in hiring (Iacoviello, 2006). The IDB index scale varied from complete discretion of public sector appointments (0) to extensive coverage of career civil service (5). Only Brazil ranked high (score 4-5) on the chart, although Chile and Costa Rica were also acknowledged to have made significant progress (score 3). This rank was meant to capture *de jure* and *de facto* norms that prevail in the region, as in this setting the formal allocation of discretion is just the tip of the iceberg. As Grindle (2012) puts it when describing civil service reforms that have been passed in most Latin America countries: "The *de facto* practices trump *de jure* theory(...) only three of the eighteen countries actually recruited

¹⁵The vast majority of students in Brazil, 76.8%, are enrolled in public schools (Brazilian National Household Survey, 2011).

¹⁶This is important in our setting given that we are studying the effect of political party turnover on education. Nonetheless, we investigate the effect of party turnover on education resources in Section V.

a significant number of public sector workers through a structured career system. In fact, the growth of the public sector in many countries in the 1960s and 1970s generally meant rapid and partisan or personnel hiring.” In Ecuador, for example, less than 3 percent of the hired personnel in a given year had taken the “mandatory” examination. Concerns over high bureaucratic turnover have been raised even in developed countries. High personnel turnover was one of the two elements concerning proponents of civil service reforms in the UK government under Prime Minister Boris Johnson ([Civil service: What changes does the government want to make?](#), *BBC* accessed July 28, 2020). According to the Institute for Government: “High staff turnover remains a major problem —and has hampered Brexit preparations”. In 2019, staff turnover was 40% among employees working in the Department for Exiting the EU, and was also high in the Treasury and other policy departments; rates of 18-20% ([Whitehall Monitor 2020: Managing People](#), *Institute for Government* accessed July 28, 2020).

Regarding education workers, in particular, there are other countries in which politicians influence the appointment of school personnel. In Latin America the origins of political appointment of headmasters is often traced to the dictatorship period. [DonosoDíaz, Fernández-Negrete and Reyes Araya](#) argue that “immobility” was awarded to school headmasters by the dictatorship as a reward for loyalty, rather than performance on the job. According to Jaime Saavedra, World Bank Global Director of Education, political appointment in schools seems problematic even in modern times ([The political decision most relevant to education: leave politics outside of the classroom](#) accessed in June 6, 2020). In Chile, it was not until 2011 that a civil servant commission was established to limit the extent of patronage and corruption around the appointment of public school headmasters ([Munõz and Prem, 2019](#)). In India and in Mexico, the discretionary appointment of teachers has been documented to be highly politicized and corrupt, despite politicians’ lack of de jure control over teachers’ appointment ([Fagernäs and Pelkonen \(2020\)](#) and [Estrada \(2019\)](#)).

II. Data

We combine electoral outcomes for local governments with data on several aspects of public education. We first provide a brief timeline of when elections take place and when data is collected and then describe each of the data sources used in more detail.

Timeline. We focus on the 2008 and 2012 elections because some of our key outcome variables (student test scores and teacher assignments) become available starting in 2007. As the timeline shows in [Figure 2](#), municipal elections are held in October (every four years) and the mayor takes office in January of the following year.¹⁷ The academic year begins in March and ends in December. The

¹⁷Federal and state elections also take place every four years, but they are staggered to occur two years apart from municipal elections.

main source for personnel movements across the entire municipal bureaucracy is the Annual Registry of Social Information (*RAIS*). We use two main sources to measure the quality of education provision and school personnel movements: the School Census (*Censo Escolar*), which is conducted annually in May, and the nationwide, standardized exam *Prova Brasil*, which is administered every two years in November.

Electoral Data. The electoral data comes from the Brazilian Superior Electoral Court (*Tribunal Superior Eleitoral, TSE*), which oversees all local, state, and federal elections in Brazil (TSE, 2004, 2008 and 2012). We use electoral data from 2004, 2008, and 2012 to determine the incumbent party, the winning party, and each party's vote share in the 2008 and 2012 municipal elections. This allows us to compute the running variable in our regression discontinuity design: the incumbent political party's vote margin, defined as the vote share of the incumbent political party minus the vote share of the incumbent party's strongest opponent. In Appendix Table A3, we show that our results are similar if our running variable is defined as the incumbent candidate's vote margin instead of the incumbent party's vote margin. We chose to use the incumbent party's vote margin due to two statistical reasons. First, individual candidates are term-limited while political parties are not, resulting in a larger sample; Second, incumbent candidate turnover is less precisely measured than political party turnover. While there are unique identifiers for political parties across all elections, candidate turnover relies on an algorithm matching politicians' names and characteristics rather than unique candidate ID. We believe that both personal-based and party-based patronage occurs as in this setting the political parties are weak (De Magalhaes, 2015).¹⁸

Municipal Personnel Data. The *RAIS* data is made available by the Special Secretary of Labor and Retirement (*Secretaria Especial da Previdência e Trabalho, RAIS (2006-2014)*). This is an annual survey that reports any changes in the labor contracts of any employer in Brazil on a monthly basis. This is used for administrative purposes for various social insurance programs in Brazil, and misreporting has consequences for employers and employees. We use the *RAIS* from 2007-2015 to build a panel of municipal governments (the employer) with the following characteristics: total number of labor contracts, new and terminated labor contracts, and the number of contracts per occupation code and type of contract (Contract workers vs Civil Servant). With this information, we build our main outcome variables: New Municipal Personnel (share) is the ratio between the number of new labor contracts that had been added 12 months after the election divided by the total number of contracts that existed the month prior to the election. We also investigate this measure on a quarterly basis (instead of on a 12-months

¹⁸We find evidence that both candidate turnover and party turnover are both associated with the outcome of interest. We regress test scores as a function of both measures of turnover unconditional on vote margin (Appendix Table A8). We find that each measure of turnover is negatively associated with test scores. This result suggests that both party connections and individual connections can explain the adverse consequences for public services.

horizon). We construct the analogous variable for Municipal Personnel Who Left (share) using the number of terminated contracts. We also construct variables of labor movements for different subgroups. We look at Contract workers and Civil servant workers, and we use the occupation code that is made available for each labor contract to classify workers by hierarchical level and sector. Each contract is classified at one of three hierarchical levels —High Manager, Low Manager and Not Manager (e.g., finance director, police captain, nurse, respectively). At baseline high managers represented 6.6% of labor contracts, low managers 1.4% and not managers 92%. Each of the contracts that were service-specific we classified in one of four service sectors —Health, Education, Construction, Other (e.g., doctor, primary school teacher, architect, police officer, respectively). Besides these service-specific workers, a large share of workers had occupations that could be mapped into multiple service sectors (e.g., assistant). At baseline, multiple service workers represented 36.5% of labor contracts; while Education-specific workers 26.3%, Health-specific workers 11.9%, Construction-specific workers 3.3% and 22% were specific to sectors other than education, health, and construction. Combining the respective service-specific workers and the multiple-services workers, we study personnel movements in a particular service sector. We use this classification to construct measures of new and terminated contracts within each service sector.¹⁹

Education Data. The data on education comes from two sources made available by the National Institute for Research on Education (*Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, INEP*). The first is the School Census (*Censo Escolar*), an annual survey of every school in Brazil, private and public (INEP (2007a), INEP (2009a), INEP (2011a) INEP (2013b) and INEP (2007-2013a)). A large share of the educational budget is determined based on the enrollment figures in this census. Hence, the federal government frequently checks and audits the information in this census and misreporting has serious consequences. Therefore, this survey is a reliable source of information. We use the School Census from 2007, 2009, 2011, and 2013 to build a panel of schools with the following information: characteristics of the school (such as the quality

¹⁹Note that the RAIS data, while reliable for measuring total labor contracts by municipal governments, it is not as reliable for a precise measure of a worker's responsibilities/occupations. Workers are often associated with a broad occupation code and they can be reassigned to a new position within the municipality (e.g. an assistant becomes a pedagogical coordinator). As long as the contracting arrangement does not change, there will be no update in their occupation code reported in RAIS. The teacher data (from the School Census, as explained below) is more reliable, as it reports the exact responsibility of a school staff (4th grade teacher in classroom X, Y, Z) in a particular *year* as reported by the particular school where they teach. For example, in our sample the average municipality in the RAIS data has only 82 workers reported as teaching staff and 8 education administrators (which includes headmasters and pedagogical coordinators). According to the School Census, the average municipality has 15 schools and about 8 teaching staff per school. Considering that each school has at least one headmaster, the RAIS data is missing a total of 45 school personnel, which is about a third of the total. The total number of school personnel in the School Census is also more consistent with the total number of labor contracts as reported by RAIS. School personnel (according to Census) represents roughly 20% of all workers (reported in RAIS). This share is consistent with the fact that the educational budget represents 30% of the municipality's expenses.

of its infrastructure and whether the school is located in an urban or rural area), school-level dropout rates, school-level enrollment figures, school-level student characteristics (such as gender and whether the location of birth and residency are urban or rural), school-level teacher characteristics (such as gender, age, and education), and the movement of individual teachers. This last measure is one of our main outcome variables and is computed by comparing teacher rolls from the year before the election and the year after the election. More precisely, we compute the share of teachers that are new to the school by taking the pool of teachers in a given school the year after the election and checking to see if those teachers were present in the same school the year before the election. We also compute the share of teachers that have left a school by taking the pool of teachers in a given school the year before the election and checking to see if those teachers are present in the same school the year after the election. We cannot say whether teachers who left the school did so voluntarily or were fired/transferred. The School Census is conducted in May, and therefore any outcome measure from the Census should be thought of as an assessment of the education system five months after the new party assumed power.

Our second source of education data is *Prova Brasil*, a nationwide, standardized exam administered every two years since 2007 to all 4th and 8th graders in public schools that have at least 20 students enrolled in that particular grade level (INEP (2007b), INEP (2009b), INEP (2011b), INEP (2013c)). This assessment is a low-stakes assessment conducted by the federal government to evaluate the progress of students' cognitive ability nationwide. It has no direct implications for students' progress in school, students' grades, teacher promotion or removal. In fact, students are not informed about their individual performance in this assessment. We use *Prova Brasil* data from 2007, 2009, 2011, and 2013 to measure student achievement and the movement of headmasters. For each student, we average her math and Portuguese language test scores. To ease interpretation, we then standardize student test scores according to the individual-level distribution of test scores for students in municipalities that did not experience political party turnover in the most recent election cycle. When students take the exam, all students, the proctoring teachers, and the headmaster of the school complete a survey. We use the student surveys to obtain the demographic characteristics of students (race, gender, and family background), which we use as controls in some specifications. We use the headmaster survey to construct our measure of headmaster replacement. The survey asks headmasters, "How many years have you been a headmaster in this school?" We consider new headmasters to be those who report being the headmaster of their current school for less than two years. The exam is administered in mid-November, and therefore any outcome measure from *Prova Brasil* should be thought of as an assessment of the education system eleven months after the new party assumed power.

Municipal Characteristics and Political Ideology Data. We supplement our core election and education data with municipal characteristics from *Instituto*

Brasileiro de Geografia e Estatística, IBGE and *Instituto de Pesquisa Economica Aplicada*, IPEA (IPEA (1980-2015), IPEA (2007 and 2010)). We use this source to gather information on municipal population and municipal median income. We also use municipal-level public finance data, drawn from the Ministry of Finance (*Ministerio da Fazenda*, FINBRA (2009-2011), FINBRA (2013-2015)) to obtain data on municipal-level educational resources. Finally, we use data from *Base dos Dados* and *Atlas Político – Mapa do Congresso* respectively to connect municipalities identifiers across data sources and to categorize party ideology as belonging to the left, center, or right (Basedosdados, 2006-2013).

A. Sample Selection and Summary Statistics

We take a number of steps to select municipalities into our sample. We start with 5,553 municipalities. We consider only municipalities where political parties compete in *regular* elections. This means we drop 147 and 111 municipalities in 2008 and 2012, respectively, that had irregular elections due to, for instance, the death of a candidate or possible detection of fraud ahead of election day. We also drop municipalities that can potentially go to second-round elections. Second-round elections can only occur if the municipality is above the population threshold of 200,000 *and* no candidate wins the majority of the votes. Given that the average municipal population in Brazil is 33,000, this restriction drops a small number of municipalities: 124 and 132 municipalities in 2008 and 2012, respectively.²⁰

Since the incumbent party's vote margin is the running variable in our regression discontinuity design, the incumbent political party must run for re-election to be included in our estimation sample. This is the case in approximately half of the municipalities. There are 35 political parties in Brazil, and it is not uncommon for a political party to support the candidate of another party in a particular election instead of running its own candidate.²¹ One could argue that the exclusion of such municipalities makes the estimated Local Average Treatment Effect (i.e., LATE) parameter to be an upper bound for the effect of political turnover. For example, if the incumbent-party-supported candidate is disproportionately likely to win, then our sample excludes cases in which incumbent parties retain de

²⁰We exclude municipalities with irregular elections or ones that can potentially go to second-round in order to simplify the presentation of the empirical results. Keeping such municipalities in the sample would require a fuzzy RD with an IV where the incumbent party's vote margin from the first-round of elections is used as an instrument for whether the municipality ultimately experiences political turnover. By focusing on municipalities with regular elections, the incumbent party's vote margin is the sole determinant of political party turnover (i.e. the first stage coefficient from a regression of party turnover on incumbent party's vote margin is equal to 1) and, therefore, we can present our empirical results using a (sharp) regression discontinuity framework. In Appendix Tables A1 and A2, we show that our results do not change if we include *all* municipalities and use a fuzzy RD with the incumbent party's vote margin from the first-round of elections as an instrument for political party turnover.

²¹According to the *Tribunal Superior Eleitoral - TSE* there were 33 political parties in 2021, and at least two were extinct in 2019 after our 2008 reference year, Partido Republicano Progressista - PRP and Partido Humanista da Solidariedade - PHS (<https://www.tse.jus.br/partidos/partidos-politicos/registrados-no-tse>, assessed in 2021)

facto power (via their influence on the winning candidate). Thus, the difference between incumbent wins and incumbent losses may be exaggerated by excluding these in-between cases. More generally, the RD strategy estimates a LATE that is representative for the 41% municipalities that experience close elections. We discuss the external validity of our LATE estimates in section III. Overall, we are left with 2,852 municipalities in 2008 and 3,114 municipalities in 2012. These municipalities constitute our sample.

Appendix Table A5 shows some descriptive statistics of the data. The unit of observation in this table is a municipality-election cycle. Column 1 shows municipal and school characteristics for all municipalities, and Column 2 shows these same characteristics for municipalities in our sample. Our sample of municipalities is similar to Brazilian municipalities overall, with the exception that municipalities in our sample are smaller in terms of population and therefore have fewer and smaller schools. Column 3 of Appendix Table A5 shows descriptive statistics for municipalities in our sample that have at least one school that participates in the *Prova Brasil* (PB) exam. A school must have at least 20 students enrolled in the 4th or 8th grade to participate in the national exam for that particular grade level. This means that schools with *Prova Brasil* data are large schools and are more likely to be located in urban areas. The variables measured from the School Census (for instance, teacher replacement and dropout rates) are available for all schools in our sample (Column 2). Any measures that come from the *Prova Brasil* exam (student test scores and headmaster replacement) are available only for larger, more urban schools (Column 3).

III. Empirical Strategy

To estimate the effect of political party turnover on the bureaucracy and its performance, we rely on a regression discontinuity design (RDD) using close municipal elections in Brazil. This section describes the details of our RDD identification strategy and provides evidence in support of the identification assumption.

A. Identification Strategy

To identify the effect of a change in the political party, we compare outcomes in municipalities where the incumbent party barely loses (thus there is political party turnover) to outcomes in municipalities where the incumbent political party barely wins (and there is no political party turnover). That is, we use a sharp regression discontinuity design for close elections.

Our main specification is a linear regression for close elections, where “close” is defined according to the optimal bandwidth selection of Calonico et al. (2016). We estimate the effect of political party turnover on outcomes of interest by estimating the following equation at the individual-level or the school-level, depending on the outcome, for municipalities with close elections:

$$(1) \quad Y_{jmt+1} = \alpha + \beta \mathbb{1}\{IncumbVoteMargin_{mt} < 0\} + \gamma IncumbVoteMargin_{mt} + \delta \mathbb{1}\{IncumbVoteMargin_{mt} < 0\} \times IncumbVoteMargin_{mt} + X'_{jmt} \Lambda + \epsilon_{jmt}$$

where Y_{jmt+1} is the outcome variable of interest (individual-level test scores or school-level headmaster/teacher replacements) in municipality m , measured one year after the election (election time t is either 2008 or 2012). The running variable of the RD is the incumbent vote margin, $IncumbVoteMargin_{mt}$, and it is computed as the vote share of the incumbent political party minus the vote share of the incumbent party's strongest opponent. The treatment variable is $\mathbb{1}\{IncumbVoteMargin_{mt} < 0\}$, which is an indicator variable equal to one if the incumbent political party lost the election and, hence, the municipality experienced political party turnover. X_{jmt} is a set of controls that includes school-level baseline test scores and individual-level demographics (when the outcome variable is test scores), school-level characteristics, and an election-cycle dummy to control for a general time trend between the two election cycles.²² Standard errors are clustered at the municipality level.

We use the following specification to estimate heterogeneous treatment effects:

$$(2) \quad Y_{jmt+1} = (\alpha + \beta \mathbb{1}\{IVM_{mt} < 0\} + \delta \mathbb{1}\{IVM_{mt} < 0\} \times IVM_{mt} + \gamma IVM_{mt}) \otimes Charact_{jm} + X'_{jmt} \Lambda + \epsilon_{jmt}$$

$IncumbVoteMargin$ has been abbreviated to IVM . $Charact_{jm}$ represents a baseline covariate (i.e., school or municipality characteristic). This specification mainly interacts all right-hand-side variables in equation 1 (except the control variables and the error term) with a baseline covariate ($Charact_{jm}$).

External Validity. The regression discontinuity strategy estimates a Local Average Treatment Effect (i.e., LATE) that is representative for the 41% of municipalities that experience close elections. Note that in our setting, close elections are not a permanent characteristic of municipalities. Out of all municipalities that experience a close election in one election cycle, only 27% experience close elections again in the subsequent election cycle. This suggests that the effect of political turnover we document is not due to a time-invariant characteristic of those municipalities that experience close election. We present a couple of tests to determine whether the effect of political turnover is different for the broader

²²We do not have a panel of students. We observe 4th and 8th graders every two years. We have a panel of schools and, therefore, control for the baseline, school-level average test score of the school we observe a particular student in.

set of municipalities. First, our close election sample ultimately excludes municipalities where either the incumbent party does not seek reelection, or the incumbent party runs but the election is not close. These cases account for 46% and 31% of all municipalities, respectively. In Appendix Figure A5 we show that our results are not sensitive to the widening (or narrowing) of the definition of close election, nor are they sensitive to the inclusion of municipalities where the incumbent party chose not to run. Second, relative to all municipalities, close election municipalities are substantially more likely to have a leftist ruling party and are substantially smaller.²³ The effect of political turnover on outcomes does not vary by the ideology of the political party nor by the municipality’s size (Appendix Table A4). Lastly, political parties are not term-limited, only candidates. Our empirical strategy compares outcomes in municipalities where the incumbent political party barely wins to outcomes in municipalities where a new party barely wins. Hence, the municipalities where the incumbent party continues in power are more likely to have a term-limited candidate. To the extent that term-limited candidates are less accountable to voters and more corrupt (Ferraz and Finan (2011)), this biases the estimated effect size downward (toward finding a null/positive effect). Overall, we find limited empirical evidence that the results are systematically smaller for the broader set of municipalities. However, our findings are representative only for municipalities that experience close elections, and any extrapolation beyond this sample should be interpreted cautiously.

B. Identification Assumption

For Equation (1) to estimate the causal effect of political party turnover, the key identification assumption is that potential outcomes are continuous around the cutoff $IncumbVoteMargin = 0$ and, thus, any discontinuity in outcomes at the cutoff is the result of political party turnover. Essentially, the identification assumption is that in competitive elections, whether the incumbent political party wins or loses is “as good as” randomly assigned. To provide support for this identification assumption, we show that there is no evidence of sorting of the running variable, $IncumbVoteMargin$, around the zero threshold and there is no evidence of discontinuity in covariates at the zero threshold.

Appendix Figure A2 shows the distribution of the running variable in our RDD, $IncumbVoteMargin$, for municipalities in our sample in both election cycles. Municipalities with $IncumbVoteMargin < 0$ are those where the incumbent party lost its re-election bid and, hence, the municipality experienced political party turnover in the respective election cycle. Municipalities with $IncumbVoteMargin > 0$ are those where the incumbent party won re-election and, hence, the municipality did not experience political party turnover in the

²³Several characteristics differ to a statistically significant degree between the RD sample and full universe of municipalities (Appendix Table A6). Municipality size and ideology are the only cases where the magnitude of the difference between the two samples is larger than 10%. Hence, we test for heterogeneous treatment effects with respect to these two dimensions.

respective election cycle. The distribution of *IncumbVoteMargin* seems fairly smooth around the $IncumbVoteMargin = 0$ threshold. In fact, a formal test for manipulation of the running variable fails to reject the null hypothesis that *IncumbVoteMargin* is continuous at the zero threshold. Appendix Figure A1 shows this formal test, the McCrary Test (McCrary, 2008). The estimated discontinuity at the zero threshold is $-.0019$ (log difference in height) with a standard error of $.0607$.²⁴

Further supporting our identification assumption, we find no evidence of discontinuity in covariates at the $IncumbVoteMargin = 0$ threshold. Columns 1 and 2 in Table 1 and Appendix Table A7 show the mean value of 61 variables at baseline (one year prior to the election) for municipalities that did not have party turnover and municipalities that did have party turnover the year of the election in a close election. “Close” is defined as $|IncumbVoteMargin| < .09$ in this table.²⁵ The balance of covariates is not sensitive to the chosen bandwidth. Column 3 shows the p-value corresponding to the coefficient on $\mathbb{1}\{IncumbVoteMargin < 0\}$ in Equation (1) with the corresponding variable at baseline used as the outcome variable. As the p-values in Column 3 suggest, among 61 covariates, there is only one that displays a discontinuity at the $IncumbVoteMargin = 0$ threshold. Importantly, there is no statistically significant discontinuity at a 5% level in our main outcomes of interest (test scores and replacement of personnel) at baseline. We present the corresponding graphs of test scores and replacement of personnel at baseline as a function of the incumbent vote margin (Appendix Figure A3 and Appendix Figure A4 respectively). Importantly, the replacement of personnel is smooth around the cutoff regardless if measured 1 month before the election or 12 months before the election (Appendix Table A9, Panel A and B). The absence of a discontinuity at the relevant threshold for baseline characteristics across all these tests lends credibility to our identification assumption that political party turnover is “as good as randomly assigned.”²⁶

²⁴Further confirming our finding of no manipulation in the running variable is a study done by Eggers et al. (2015). They analyze data from 40,000 close races in many different electoral settings, including Brazilian mayors in 2000-2008. They find no systematic evidence of sorting or imbalance around electoral thresholds and confirm that the relevant actors do not have precise control over election results in these settings (with the exception of U.S. House of Representative in the second half of the 20th century).

²⁵Approximately 40% of the municipalities in our sample fall within this bandwidth. Local elections in Brazil are quite competitive. There were between 2-15 candidates/parties running in the mayoral elections we study with an average of 2.99 and a median of 3 candidates.

²⁶An additional threat to the validity of our empirical strategy is the possibility of manipulation of vote shares in close elections in a way that correlates with our outcomes of interest *but* does not result in sorting of the running variable around the threshold or a jump of covariates at the threshold. For instance, incompetent incumbent parties may be the least successful at manipulating close elections in their favor *and* the least effective at provision of public services. Therefore, municipalities where incumbent parties barely lose may have particularly bad public education. To address this concern, we check whether mean baseline characteristics shown in Tables 1 and A7 are systematically different in municipalities with and without party turnover in close elections – essentially a comparison of means instead of checking for a discontinuity in the *IncumbVoteMargin* at the zero threshold (what Tables 1 and A7 show). Among 61 covariates, there are 7 variables with a significant mean difference across control and treated municipalities (results not shown).

IV. Results

We show the RD plots using the optimal bandwidth for each outcome. Since we have several outcomes of interest and the optimal bandwidth is different for each of these outcomes, we also show the corresponding regression tables using the optimal bandwidth for the particular outcome under study and two other bandwidths (0.07 and 0.11) in an effort to keep the estimation sample fixed, and also to show that our point estimates are not sensitive to bandwidth choice.²⁷

A. Political Turnover and Government Personnel Movements

We show that political party turnover leads to upheaval in the municipal bureaucracy. Political party turnover increases the share of personnel that are new to the bureaucracy. These new appointments occur soon after the mayor takes office (within months) and affect personnel appointments at different levels of the hierarchy. Moreover, the new hires are observed across different sectors, not concentrated in education, health or construction sectors.

Municipal Government Personnel Movements. Figure 3 shows the share of municipal personnel contracts that are new (i.e., were initiated starting the month of the election and up to one year after the election) in municipalities with close elections. The share of municipal personnel contracts that are new are higher in municipalities where a new political party has barely won (right side of the figure) compared to municipalities where the incumbent political party has barely stayed in power (left side of the figure). Table 2, Panel A, Columns 1-3 show the corresponding regression results: political party turnover leads to an increase of 7 percentage points in the share of municipal personnel contracts that are new (23% of the mean replacement rate in the control group). Table 2, Panel B, Columns 1-3 show the increase in new personnel contracts is short-lived, occurs within a year after the new political party takes office in January. One could argue that the defeated incumbent might be responsible for the personnel changes. Accordingly, we estimate the effect of political turnover on the share of municipal personnel contracts that were initiated immediately after the election and before the new government takes office. Appendix Table A10 shows that 92% of the new labor contracts appear after the elected candidate takes office (Columns 2-4). More precisely 61% occurs in the 3 months that follow the day the new political party takes office (Column 2). Table 2, Panel A, Columns 4-6 show that there is no corresponding increase in the share of municipal contracts that are terminated, leading to a net increase in the size of the bureaucracy. The estimated increase of the bureaucracy is consistent with calculations made by *IPEA (Applied Economics Research Institute)*, which report a 2.3% annual growth in municipal employment between 1995 and 2016 (Lopez and Guedes,

²⁷The rationale behind the fixed bandwidth choice (.07 and .11) is the following: they are approximately the minimum (0.07) and the mean (.11) of the various individual optimal bandwidths for the main outcomes of interest.

2018).²⁸

Replacement vs. New Positions Are newly hired personnel replacing personnel in existing positions (as opposed to being designated to new positions)? Appendix Table A11, columns 1-2, show personnel movements separately for temporary contract workers and civil servants. Political turnover increases the share of temporary contracts that are new by 10.7 percentage points (Panel A), and also increases the share of temporary contracts that are terminated by 7.4 percentage points (Panel B). Political turnover does not affect civil servant contracts (Panel A and B, column 2). One interpretation of these results is that politicians are indeed replacing personnel into existing positions and firing/terminating the contracts when feasible (i.e., for contract workers). For civil servants, politicians may downgrade the bureaucrat's responsibilities but cannot terminate/fire the individual. In this context it is common practice to keep an employee on the municipal government payroll but remove his responsibilities entirely, reassigning the real position to a newly hired worker.²⁹ In fact, in the Teacher data set, where we observe responsibility assignment, for every new teacher assigned to a given school, there is a teacher that leaves the same school. We discuss teacher movements in detail in Section IV.B.

Scope of movements within the organization The *Annual Registry of Social Information (RAIS)* contains information about the occupation associated with a given labor contract. We use this information to assess the horizontal and vertical reach of the municipal personnel movements. Appendix Table A11 (Panel A) shows the number of new contracts in each category one year after the election, divided by the total number of contracts in that category at election time. Panel B shows the corresponding results for contracts that were terminated. Political party turnover increases the share of high manager contracts that are new by 7.9 percentage points (Panel A, Column 3). This effect is slightly higher than the effect on non-managerial workers: the share of non-managerial contracts that are new increases by 5.4 percentage points (Panel A, Columns 5). The effect size is similar for low-level manager contracts (5.7 percentage point) and statistically insignificant at the 10% level (Panel A, Column 4). Only a small fraction of contracts are low-level manager contracts (1.6%), affecting the precision of the estimate for low-level managers. In Appendix Table A11 columns 6-10, we present personnel movements by service sector. There is an increase in the share of contracts that are new in all sectors, including for "Other sectors". In each of the service sectors (e.g., Education), there are service-specific workers (e.g., primary school teachers) and other workers that can work in different sectors (e.g., assistants). The increase is observed primarily in "multiple sectors" type

²⁸Barbosa and Ferreira (2019) also document that expenditures with personnel almost doubled in this period, increasing from 35% of local budgets in 1995 to almost 50% in 2013

²⁹See <https://www.gazetadonorte.com/deixar-o-funcionario-publico-na-geladeira>, accessed March 2020. This article describes the practice that is informally called "putting the worker in the refrigerator". It is a way to sideline inconvenient personnel who cannot be fired.

of contracts, suggesting personnel movements does not target a particular service sector or a particular class of organized workers, such as teachers or doctors (Appendix Table A12).

Thus far, we have documented a comprehensive reshaping of the bureaucracy, a reshaping that has *a priori* an ambiguous effect on service delivery. One possibility is that a new political party may decide to replace a bureaucrat who is entrenched: the bureaucrat produces low levels of public services and used to provide political services for the outgoing politician. His replacement can improve public services. Alternatively, the bureaucrat might produce a high level of public services, but may be non-loyal to the politician and may not help the politician achieve his political goals. His replacement can harm public services. The net consequence for public service is an empirical question that hinges on which motive drives the replacement. Next, we investigate the consequences of political turnover for public education, which is one of the primary responsibilities of the municipal government and a sector in which we can quantify both personnel movements and service quality as measured by students' test scores. We then provide evidence that personnel replacement is an important mechanism through which political turnover affects the quality of education. After establishing this link empirically, we formally discuss using a simple model the two motives for politically motivated replacement outlined above, loyalty and entrenchment. Lastly, we derive predictions and present empirical evidence consistent with the model's narrative.

B. Political Turnover and Public Education

We show that political party turnover reduces students' test scores. The negative effect of political party turnover on student achievement is not driven by selection or shifts in party ideology and persists up to three years after the election, at which point there is another election. We find that the prompt increase in new hires observed in the bureaucracy as a whole is replicated for the school personnel, namely headmasters and teachers. Moreover, the school personnel replacements seem to have a political component: political turnover induces replacement of headmasters primarily among politically appointed headmasters and the replacement rate is higher when the political cost of the replacements is lower. Finally, we discuss additional consequences of political party turnover and use a placebo exercise to shed light on the mechanisms through which political party turnover impacts student achievement.

STUDENT ACHIEVEMENT

We estimate Equation (1) separately for 4th and 8th graders because all municipalities offer elementary schools but not all municipalities offer middle schools. (usually larger municipalities offer both elementary and middle schools.)

Effect on 4th Graders. Figure 4 shows 4th grade test scores one year after

the election (in 2008 or 2012) in municipalities with close elections.³⁰ Test scores for 4th graders are lower in municipalities where a new political party has barely won (right side of the figure) compared to municipalities where the incumbent political party has barely stayed in power (left side of the figure). As Table 3 shows, municipalities with a new party in office have test scores that are 0.08 standard deviations lower than comparable municipalities with no change in the political party. The estimated effect of political party turnover is robust to the inclusion of individual-level demographic controls, school-level controls, a dummy for the 2012 election cycle, and varying the estimation bandwidth.

Effect on 8th Graders. The same pattern holds for 8th grade test scores one year after the election, as shown in Figure 4. Eighth graders' test scores are lower in municipalities where a new political party has barely won compared to municipalities where the incumbent political party has barely stayed in office. Table 3 is the corresponding table and shows that test scores are 0.05 standard deviation units lower in municipalities with a new party in office. Again, the effect of political party turnover on test scores for students in 8th grade is robust to the inclusion of controls and varying the estimation bandwidth. One potential issue with test scores for 8th graders as the outcome variable is that the optimal bandwidth is very large: 0.151. This is presumably the case because there are fewer municipal middle schools. Nonetheless, municipalities with $|IncumbVoteMargin| < 0.151$ constitute 60% of the municipalities in our sample. Reassuringly, even when we restrict the estimation bandwidth to smaller bandwidths (Columns 3-6 in Table 3), which are closer to the optimal bandwidth for 4th grade test scores, we still find a negative effect of political party turnover on 8th grade test scores.

Ruling out Selection. A particular explanation for the relationship between political party turnover and test scores observed so far may be that new parties often come to power on a platform of broadening access to education. Hence, when new parties come to power, they systematically increase access to education *or* manage to reduce the dropout rate in a way that brings marginal students into the education system and therefore lowers test scores. Appendix Table A13 shows the effect of political party turnover on the composition of students one year after the election. In terms of observable characteristics, students are similar in municipalities where the incumbent party (barely) lost and those where the incumbent party (barely) won. Furthermore, we estimate the effect of political party turnover on school-level dropout rates. One benefit of this measure is that it is available for all schools (as compared to information from *Prova Brasil*, which is available only for larger schools). Appendix Figure A6 and Appendix Table A15 show these results. Municipalities with political party turnover have 12% higher dropout rates compared to municipalities without political party turnover. However, this estimate is not statistically significant. Importantly, we do not find

³⁰Test scores are standardized based on the distribution of test scores in municipalities that did not experience political turnover. Municipal schools are, on average, of lower quality compared to other public (state and federal) schools. Hence, the mean standardized test score for 4th graders in municipal schools is less than zero.

evidence that political party turnover *decreases* the dropout rate and hence gives rise to a relationship between political turnover and test scores that is due to selection. If anything, our estimate of the effect of political party turnover on test scores is an underestimate, given that party turnover has a slight positive effect on dropout rates (assuming that students at the bottom of the distribution are the most likely to drop out).

Heterogeneity with Respect to Party Ideology. Appendix Figures A7 and A8 show the effect of party turnover on test scores separately for municipalities where a left-leaning political party (barely) wins and those where a right-leaning political party (barely) wins. Political party turnover reduces test scores regardless of the ideology of the winning party. Thus, the effect of political party turnover on test scores cannot be explained by general shifts in ideology that have been shown to impact the adoption of policies and economic outcomes in previous work (Pettersson-Lidbom, 2008).³¹

Persistence. Does the effect of political party turnover on test scores persist? This is an important question not only from a welfare perspective, but also for understanding potential mechanisms. If political party turnover reduces student achievement initially but puts students on a better trajectory, then we would expect test scores to decrease the year after the election but begin to improve over time. Using the 2008 election, we trace the effect of political party turnover on test scores one, three, and five years after the election. We do not have a panel of students. Instead, we estimate the effect of party turnover in 2008 on 4th graders in 2009, 4th graders in 2011 (who were in the 2nd grade when the 2008 election took place), and 4th graders in 2013 (who were in kindergarten when the 2008 election took place). Appendix Table A16 shows how a change in the political party in 2008 affects 4th graders' test scores over time. The effect of political party turnover is most precisely estimated one year after the election. Yet, as time passes, there is still a lingering negative effect of political party turnover on test scores.³² Although the estimated effect is not significantly different from zero in later years, we cannot reject that the effect of party turnover on test scores in 2009 is different from the effect in 2011 or 2013.³³

Interpreting the Magnitude. The cost of political party turnover for students in municipal primary schools is large. The magnitude of the effect of political turnover on test scores is approximately one third of the impact of most successful interventions in other contexts, such as reducing classroom size (Krueger,

³¹There are municipalities that go from a left-leaning party to a right-leaning party and municipalities that move in the other direction in both election cycles. Thus it is not the case that there is persistence in the ideology of governing parties for a given municipality over time. This lack of persistence in ideology allows us to talk about "shifts" in ideology.

³²For example, the effect after 3 years represented in column 1 is: $-.113 + .019 = -.094$

³³Appendix Table A17 shows the same results for 8th graders. Because there are fewer municipal middle schools, we have significantly fewer observations (both in terms of individual students and in terms of clusters) when we limit our analysis to the 2008 election cycle. The negative effect of political party turnover on 8th grade test scores is negative and persistent; however, the standard errors are large and the estimates are noisy.

1999) or providing teacher incentives (Muralidharan and Sundararaman, 2011). Below we offer a few benchmark exercises that are more appropriate to the context we study.

Institutional gap. The test score performance of students in non-municipal schools is much higher than the performance of municipal school students. On average, for the year after the election, municipal school 4th grade and 8th grade students perform, respectively, .18 standard deviations lower and .20 standard deviation lower than students in non-municipal schools. The effect of political turnover in the mayoral position represents between 26% and 45% of the test score gap between municipal and non-municipal schools. Assuming that political turnover in other levels of government does not result in the same disruption in state and federal schools, then the effect of political turnover can explain about 35% of this gap.

Financial resources wasted. The effect of political turnover on test scores represents roughly 24% of the learning gain students experience in 4th grade in close-election municipalities.³⁴ Assuming cognitive skill as measured by Prova Brasil is the only objective of education, we make a back-of-the-envelope calculation of the total public resources wasted. The annual cost of public education per 4th grade student in Brazil in this time period was 21.2% of the GDP per capita.³⁵ Hence, political turnover represents a waste of 5.1% of GDP per capita per enrolled student. Per capita GDP in Brazil is around \$8831 (World Bank, 2008). There is a total of 173,113 4th grade students in municipalities that experienced a change in the political party in a close election in 2008 and 2012 from our main regression: Table 3, Column 1 (Panel A). Considering only these students, the total waste in public funds is \$78 million U.S. dollars. This calculation underestimates the cost of political party turnover, as it does not take into account the much larger number of students in those municipalities who do not participate in the 4th grade Prova Brasil exam. If we take into account all students enrolled in municipal schools and assume a similar effect of political turnover on their achievement, the total waste is 13 times larger, representing roughly 6.8% of the municipal government total spending in a year.³⁶

³⁴The learning gain in this context is obtained by comparing 4th grade and 8th grade performance among all students in all schools in those municipalities. To compare performance across grades, we use the raw Prova Brasil exam (before any standardization). Prova Brasil is designed using Item Response Theory to allow comparison across years and grades. The average performance of students in 8th grade is about 36.8 (Math) - 53.5 (Language) raw points higher than in 4th grade students. Political turnover decreases raw test scores by 3.61 points (Math) and 2.19 (Language). Assuming that the learning gain is equal across these grades and that the composition of students does not change between grades, we estimate that on average the effect of political turnover represents 27.5% of the learning gain obtained in one school year.

³⁵The estimate of public investment in education is from INEP <http://portal.inep.gov.br/indicadores-financeiros-educacionais> assessed in 04/28/2020.

³⁶This calculation uses the following assumptions. The 173,113 students reside in 927 municipalities. There are approximately 2.3 million students enrolled in municipal schools in all grades in those 927 municipalities. The total government spending per municipality is on average 29.32 million Reais, which is 15.94 U.S. dollars. Hence, 6.8% of Total Government spending = $\frac{78 \times 13}{15.94 \times 927}$.

Monetary value of a compensatory policy. Previous literature has shown that the conditional cash transfer program in Brazil, *Bolsa Familia*, which covers about one fourth of Brazil's population, has increased enrollment, lowered dropout rates, and raised grade promotion, but has had *no* effect on student test scores – potentially due to the increases in enrollment rates (Glewwe and Kassouf, 2012; De Brauw et al., 2015). Quantifying the monetary value of a compensatory intervention in the same context is difficult given the lack of impact of that *Bolsa Familia*, the largest education policy in Brazil, has had on test scores.³⁷ Hence, we look to another (similar) setting to understand the monetary value of a compensatory policy. Angrist et al. (2002) find that providing vouchers for private schools increases test scores by .2 standard deviation units at a total cost of \$244 (in 2008 US\$) per student. Performance of 4th grade and 8th grade students are likely more visible to voters due to the Prova Brasil that focuses on those grades. If the municipal governments in our sample tried to offset the effect of political party turnover for these students by carrying out an intervention similar to that of Angrist et al. (2002), they would need to spend \$31.7 million U.S. dollars.³⁸

SCHOOL PERSONNEL MOVEMENTS

Headmaster Replacements. Appendix Figure A9 shows how political party turnover affects headmaster replacements in all municipalities (not just those with close elections). This figure plots the share of headmasters who are new to their current school for schools in four different kinds of municipalities: municipalities that did not experience a change in the political party either in 2008 or in 2012, municipalities that experienced a change only in 2008, municipalities that experienced a change only in 2012, and municipalities that experienced a change in both election cycles. When a new party takes office, there is a sharp increase in the share of schools with a new headmaster the following year. This event-study analysis is striking, yet it may be that when an incumbent party gets voted out of office with a large margin, the new party comes to power on a mandate to change the education system and, therefore, there is a sharp increase in the replacement rate of headmasters. Accordingly, we estimate the effect of political party turnover on headmaster replacements for municipalities with close elections. Figure 5 shows the share of schools with a new headmaster one year after the election in municipalities where a new political party (barely) wins compared to municipalities

³⁷Mexico's conditional cash transfer program, *Progresa*, which was implemented as a randomized control trial unlike *Bolsa Familia* and, therefore, offers the opportunity for a more systematic analysis, has also been shown to have increased enrollment, with no significant impacts on test scores (Behrman, Sengupta and Todd, 2000).

³⁸This calculation is made using the following assumptions. We assume that raising one student's test scores in our setting would cost \$244 multiplied by how our point estimate compares to that of Angrist et al. (2002): $0.08/0.2=4$. We then count the number of students in treated municipalities from our main regression: Table 3, Column 1 (Panels A and B). In total, there are 297,118 students who experienced a change in the political party in a close election in 2008 and 2012. We arrive at \$29 million by making the following calculation: $(.08/.2) \times 244 \times 297,118 = 28,998,717$.

where the incumbent political party (barely) stays in power. Table 4 shows the corresponding regression results: political party turnover leads to an increase of 28 percentage points in the replacement rate of headmasters (64% of the mean headmaster replacement rate).³⁹

The *Prova Brasil* data only register one headmaster per school. The data does not make it possible to measure whether the increase in the number of personnel contracts documented in the municipality as a whole also happens at the school level. In contrast, the teachers' data (*School Census*) allow us to study to what extent these replacements lead to an inflation in the number of personnel in schools. The comparison between teacher and headmaster replacement also sheds light on the extent of replacements among managerial and non-managerial positions within the same government organization.

Teacher Replacements. Figure 5 shows that schools in municipalities with a (barely) new political party have a higher share of teachers who are new to the school one year after the election. Appendix Figure A11 shows that schools in municipalities with a (barely) new political party also have a higher share of teachers who have left the school one year after the election. The corresponding regressions are shown in Table 5. Political party turnover increases the share of teachers who are new to a school by approximately 11 percentage points (Panel A, column 1) and increases the share of teachers who have left the school by approximately the same amount (Panel C, column 1). Thus, it is not the case that new teachers enter the school once a new political party takes office as part of an inflation in the size of the teaching staff. Rather, it seems that there is a “reshuffling” of teachers across schools. In other words, for every new teacher who is hired in a school there is a corresponding teacher who leaves that school. In fact, the number of teachers per school is not different in municipalities with and without political turnover (Appendix Table A32, Column 1). Note that the baseline replacement rate is similar (and high) for teachers and headmasters. It implies an annualized rate of 21% of teachers (and headmasters) who will leave the school in the next year.⁴⁰ Despite similar baseline replacement rates, political

³⁹The event-study analysis shows that political turnover increases headmaster replacements the year after the election. To illustrate the timing of headmaster replacements with causal estimates, Appendix Figure A10 and Appendix Table A18 show how political party turnover in 2008 affects headmaster replacements one, three, and five years after the election for municipalities that had close elections in 2008. In municipalities with a (barely) new political party, there is a sharp increase in the share of schools with a new headmaster only the year after the election. It seems that the replacement of headmasters occurs soon after the new political party takes office in January.

⁴⁰This high-level of school personnel replacement is found in other settings. The corresponding share of teachers who leave a given school in the Boston Public Schools over a one-year period is 24% (Cohodes and Walters, 2019) and between 21.2-18.2% for all schools in Peru (Alvas et al., 2019). Moreover, the institutional arrangement governing teacher positions in Brazil can explain the high replacement rate. Once teachers pass the civil service exam, they are called to work at any school with a vacancy. This school is often not in the teacher's preferred location. Every year, there is an “internal selection process” (*concurso remoção*) that allows teachers to choose a different school from the one they were initially assigned to. Thus, a 21% annual teacher turnover rate (or 46% teacher turnover rate every two years) is not uncommon in Brazil. In fact, we found several newspaper articles that document similarly high turnover rates throughout Brazil. For instance, “Secretary of Education of São Paulo, Maria Helena Guimarães de Castro stated [teacher] turnover of 40% in the state system:”

turnover has a larger effect on the replacement of headmasters than on teachers (28 percentage points vs 11.7 percentage points). Assuming teachers are considered non-managerial workers and headmasters perform a managerial type of work, we can contrast with the findings for the bureaucracy as a whole. The difference is qualitatively similar to the fact we document in Section IV.A: political turnover increases the replacement of high-managers more than the replacement of non-managerial workers. Although, in the case of school personnel, the difference between the effect on headmasters replacement and teacher replacement is substantially larger.

Unfortunately, we cannot repeat the event-study analysis that we did for headmasters (Appendix Figure A9) with teachers because the School Census did not track teachers in 2005; hence, we cannot compute the share of teachers who are new to a school/have left a school in 2007. Instead, Appendix Figure A12 shows how political party turnover in 2008 affects teacher replacements one, three, and five years after the election to produce a better sense of how the effect of political party turnover propagates.⁴¹ The corresponding table, Appendix Table A19, shows that one year after a new party (barely) enters office, there is a sharp increase in the replacement rate of teachers. Three years after the election, the replacement rate of teachers is still higher in treated municipalities, so there is some persistence in the effect of party turnover on teacher assignments. However, the estimated coefficient is not statistically significant, and the magnitude is half of the estimated coefficient for the effect immediately after the election. By 2013, at which time there has been another election, there is no effect of political party turnover in 2008 on teacher replacements.

Heterogeneity with Respect to Politically Appointed Headmasters.

In this context, one important headmaster characteristic is the headmaster's type of appointment. Headmasters in Brazil are chosen mainly by selection through a competitive process (such as taking a civil service exam), election by the school community (i.e., parents and teachers), political appointment, or a combination of these (for instance, in Rio, the school community can vote among a few candidates who have passed the civil service exam).⁴² The headmaster questionnaire asks the headmasters "How did you get to the headmaster position in this school?" Based on this question, we categorize the manner by which the headmaster was chosen as: selection, election, or political appointment.⁴³ In municipal schools, the most

<http://gestaoescolar.org.br/formacao/rotatividade-professores-483054.shtml>, accessed October 2016.

⁴¹This figure shows teacher replacements in terms of the share of teachers that are new to a school and Appendix Figure A13 shows teacher turnover in terms of the share of teachers that have left a school. Both figures show similar patterns.

⁴²There is heterogeneity within municipalities in terms of the mechanism by which the headmaster is chosen. We have not been able to fully understand where this heterogeneity comes from – although we suspect there is some historical dependence. Understanding this heterogeneity and its impact on the quality of public service provision would certainly make for interesting future research.

⁴³More precisely, the survey responses are: selection (8%), election only (18%), selection and election (7.5%), technical appointment (15%), political appointment (31%), other kinds of appointment (15%), and other means (6%). Based on our analysis of school characteristics and conversations with the Former Secretary of Education in Rio, we categorize *any* kind of appointment (technical appointment, political

common method for choosing the headmaster is political appointment: 65% of headmasters (that we can categorize) respond that they are political appointees. We divide headmasters into two types: those who are political appointees at baseline and those who are not political appointees at baseline (i.e., they were selected or elected). Note that we use the reported selection method at baseline because the appointment method can be influenced by the politician, and hence so can outcomes themselves. Then, we study the heterogeneity of headmaster replacement according to whether the school had a headmaster politically appointed by the previous administration. Appendix Table A20 shows that in schools where the headmaster was politically appointed, political turnover increases headmaster replacement by 35 percentage points (Panel A), while it increases replacements only by 3 percentage points (statistically insignificant) in schools where the headmaster was not politically appointed (Panel B). Political party turnover induces headmaster replacement mostly among politically appointed headmasters.⁴⁴ While we do not observe whether teachers are political appointees, we study how teacher movements differ in schools where the headmaster was politically appointed by the previous administration. Appendix Table A20 shows that in schools where the headmaster was politically appointed by the previous administration, political turnover increases the teacher replacement rate by 9.6 percentage points (vs. 5 percentage points in schools where headmaster is not politically appointed). The difference in the replacement rate for teachers between the two types of schools, where headmasters were politically appointed and where they were not, is statistically insignificant at 10%. Overall, political turnover leads to substantial school personnel replacement when the school has a headmaster who was politically appointed by the previous administration.

Heterogeneity with Respect to Municipal Income. Anecdotal evidence suggests that parents object to the politically motivated replacement of headmasters.⁴⁵ Prior work (Bursztyn, 2016) has shown that low-income voters in the same context prefer direct transfers to investments in public education spending. Hence, it is possible that parental resistance occurs more in high-income areas and dampens politicians' discretion over the assignment of school personnel. We use the median of monthly household income within a municipality in the *Census* before the two electoral-cycles as our measure of income. We divide our sample of municipalities into the subset of municipalities with below-median income and the subset of municipalities with above-median income and estimate the effect of political turnover on the replacement of school personnel separately

appointment, and other appointment) as political appointment. However, our results are similar if we consider political appointees strictly as those headmasters who choose political appointment on the survey.

⁴⁴Anecdotaly, such headmasters are often teachers within a school who are promoted to the headmaster position. Since they do not reach the headmaster position via the civil service examination, they do not have job tenure as headmasters. Thus, when the political party that appointed them leaves office, they often return to teaching.

⁴⁵See for example: <http://www.saocarlosagora.com.br/cidade/noticia/2013/04/30/41314/vereadores-afirmam-que-cargo-de-diretor-de-escola-e-de-livre-escolha-do-prefeito>, accessed October 2016.

for low- and high-income municipalities. Appendix Figure A14 and Appendix Table A21 show that political party turnover increases the rate of headmaster replacement by 39 percentage points in low-income areas and by 13 percentage points in high-income areas. This difference is statistically significant. The effect of political party turnover on teacher replacements is also higher in low-income municipalities compared to high-income ones (Appendix Figures A15 and A16, Appendix Table A22). The heterogeneity in the effect of political party turnover on the assignment of school personnel suggests that political discretion over school personnel is higher in low-income municipalities.

Taken together, the heterogeneity findings suggest a political component in the replacement of school personnel. In particular, it appears that politicians exert a trade-off: politicians exert greater discretion—for the purpose of political gain elsewhere—when the cost of doing so is lower. The cost might be lower, for example, when it is easier to disrupt a particular service (i.e., because headmasters are politically appointed) or when the political costs associated with disrupting that service is lower (i.e., because voters don't care about that service).⁴⁶ Before discussing the politically motivated replacement and the related trade-off that politicians face in greater detail in section V, we next investigate whether there are other consequences of political turnover that can explain the decrease in the quality of education.

C. Political Turnover & Other Mechanisms

In this section we investigate whether there are channels other than the discretion over personnel appointment that lead political turnover to affect the quality of education. First, we do not find evidence that political turnover negatively impacts allocation of education resources or political resources. Second, we use local schools that are not controlled by the municipal government to perform a placebo exercise. We show that changes in the party of the mayor do not impact the rate of replacement of school personnel or student test scores in these *non-municipal* schools.

Financial Resources. Education funding in Brazil is mostly non-discretionary and comes from a federal program (FUNDEF/FUNDEB) that pays a fixed rate per student (see [Menezes-Filho and Pazello \(2007\)](#) for a detailed description of FUNDEF/FUNDEB). Municipalities are mandated to spend 25% of their total

⁴⁶We do not find the similar heterogeneity, with respect to income and also with respect to politically appointed headmasters, in the effect on test scores. Appendix Table A23 show that political party turnover reduces test scores in both low- (Panel A) and high- (Panel B) income areas. Although the estimated coefficients are more precisely estimated in low-income areas, we cannot reject that the effect of political party turnover is the same in low- and high- income municipalities. Political party turnover reduces test scores both in schools where headmaster was politically appointed (Appendix Table A20, Panel A) and in schools where the headmaster was not (Appendix Table A20, Panel B). One could argue that the negative impact of political party turnover on test scores should be larger in areas where the relevant mechanism (personnel replacement) is higher. However, test scores in those schools (both in low-income areas and in politically appointed schools) are substantially lower and, presumably, more difficult to reduce even further. Additionally, the cost of personnel disruptions in terms of student achievement may not be linear.

revenue on education. If the combination of the federal transfers and the amount spent by municipalities does not amount to a minimum (pre-established) amount per pupil, the federal government complements the educational resources to reach the set minimum.

We find that political party turnover does not affect the number of students enrolled (Appendix Table A14). Therefore, the non-discretionary component of municipal-level educational funding is likely not affected by political party turnover (or at least should not be affected in theory). Yet if new parties are less experienced at raising revenue or managing the disbursement of funds or if political turnover systematically changes the alignments between municipal and higher levels of government, then political turnover may impact education because of access to or allocation of educational funds. Table 7 shows that municipalities with and without political party turnover in close elections have similar total municipal expenditures one to two years after the election. However, as Panel A shows, the share of expenditures spent of education and on municipal personnel are higher in municipalities where a new political party (barely) wins the year after the election. This is consistent with a transitory increase in such expenditures due to the increase in the replacement of personnel, which levels off in the second year after the election. Appendix Table A.44 shows that the effect of political turnover on educational expenditure is of the same magnitude as the effect on personnel expenditure⁴⁷ Given that we observe a temporary increase in educational-related expenditures in municipalities with a new party in power, it is unlikely that a deterioration in financial resources drives the negative impact of political turnover on student achievement. The analysis of municipal expenditures thus far establishes that financial resources do not change *at the municipality level* in a way that would result in lower test scores in municipalities with party turnover. However, the municipal government itself could re-allocate funds across its schools within a municipality in a way that would result in lower average test scores for the municipality. The *Prova Brasil* headmaster survey asks headmasters whether their schools have experienced financial difficulties. Table 7, Panel C shows that political party turnover does not seem to impact school-level financial resources (as reported by the headmaster). Therefore, we do not find evidence that political turnover impacts the access to and allocation of resources at the municipality or school-level.

Political Resources. Another explanation is that challengers systematically do not run on a pro-education platform and decide to spend their political capital elsewhere. If that was the underlying reason, we should observe a differential effect of political turnover depending on the party ideology. Similar to the heterogeneity analysis for test scores (discussed in Section IV.B), political party turnover

⁴⁷This data is from the Federal Treasury FINBRA database. This database presents expenditures by sector (education, health, etc.) and by type of expense (personnel, interest payments, and investments). The share of expenditures on personnel refers to expenditures related to all municipal personnel, not only education personnel. Unfortunately, we are not able to measure expenditures on education personnel alone, and therefore use expenditures on all municipal personnel as a proxy.

increases the replacement rate of headmasters and municipal personnel regardless of the ideology of the winning party (Appendix Table A25). The corresponding results for teachers are mixed. Appendix Figures A18 and A19 suggests that political turnover leads to a greater teacher replacement rate when a leftist party wins. Appendix Table A26 presents the formal test for this hypothesis. While the findings are sensitive to the close election bandwidth, for some definitions of close elections, we find heterogeneous effects for new teachers that are statistically significant at 10% level (Appendix Table A26, Columns 1-6). Since leftist parties in this context are often more likely to run on an education platform or to derive political support from education workers, leftist parties may expand the number of teaching positions more than rightists parties. However, political turnover increases the share of teachers that are new, even when a rightist party wins. Also, political turnover leads to teachers leaving municipal schools irrespective of the ideology of the winning party (Appendix Table A26, Column 7-12). Overall, The heterogeneity with respect to party ideology suggests that both leftists and rightists newly formed governments replace more personnel as a result of political turnover. Consistent with this finding, political turnover affects test scores irrespective of the ideology of the winning party.

We consider the effect of changes in the mayor's party on headmaster replacement and student test scores in non-municipal schools. The set of non-municipal schools is comprised of state and federal schools (since only public schools participate in the *Prova Brasil* exam). When we consider teacher replacements as an outcome, the set of non-municipal schools is comprised of state, federal, and private schools (since all schools participate in the School Census). Note that state and federal elections are held every four years as well, but with a 2-year gap from municipal elections. Thus we do not have political turnover in higher levels of government that coincide with our treatment of local political party turnover.

School Personnel in Non-municipal Schools. Figure 6 and Table 6 (Panel A) show that when a new mayoral political party (barely) comes to power, there is no change in the share of non-municipal schools with a new headmaster. Figure 6 and Table 5 (Panel B) show the same results for the share of teachers that are new to non-municipal schools.⁴⁸ The share of teachers who are new to non-municipal schools is slightly higher, 1.1 percentage points, in municipalities with a new political party in power. However, this increase is noisily estimated and is one-tenth of the increase in the same measure for municipal schools. The fact that we observe a small effect, although not statistically significant, on teacher replacements in non-municipal schools is likely due to the fact that the teacher market for municipal and non-municipal schools is somewhat integrated and the disruption to the teacher market for municipal schools spills over into the market for teachers in non-municipal schools.⁴⁹ Overall, we see that changes in the

⁴⁸Appendix Figure A20 show the results graphically for the share of teachers who have left non-municipal school.

⁴⁹In fact, 22% of teachers in non-municipal schools also teach in municipal schools. In Brazil, teachers

mayor's political party have little to no effect on teacher and headmaster replacements in non-municipal schools. Importantly, political party turnover does not affect the characteristics of school personnel in non-municipal schools (Appendix Table A30).

Student Achievement in Non-municipal Schools. Figure 7 and Table 6 (Panel B) show the effect of political party turnover in mayoral elections on 4th grade test scores in non-municipal schools.⁵⁰ When a new mayoral political party (barely) comes to power, there is no statistically significant decrease in test scores for students in non-municipal schools. Importantly, we can formally reject that the effect of mayoral political party turnover on 4th grade test scores in municipal and non-municipal schools is the same with an estimated difference in coefficients of 0.080 and a p-value of .027.

One important issue is that municipal schools are worse quality schools than non-municipal schools: in 2007, for example, the average test score in municipal schools was .09 standard deviation units lower than in non-municipal schools. It may be the case, then, that political party turnover reduces student achievement only in low-quality schools. Appendix Figure A22 and Appendix Table A28 show the effect of political party turnover on test scores in low-quality municipal schools (Panel A of the table) and high-quality municipal schools (Panel B of the table). We see that the effect of political party turnover is negative in both low- and high-quality municipal schools. Although the coefficients are more noisily estimated in high-quality schools, we cannot reject that the effect of political turnover is the same in low- and high-quality schools. Therefore, the fact that we do not see an effect of political party turnover on student achievement in non-municipal schools cannot be explained by differences in school quality.⁵¹

What the Placebo Shows. Political party turnover in mayoral elections does not translate into disruptions in the assignment of school personnel or deterioration in student achievement in non-municipal schools. The absence of an effect of mayoral party changes on test scores in non-municipal schools is not due to the fact that non-municipal schools are of better quality. These findings rule out an effect of political party turnover on education provision due to any changes caused by party turnover that affect the entire municipality (such as municipal-level changes in crime or income).⁵² The findings of this section also provide

may teach in more than one school since the school-day is only half of a day. In our sample, teachers teach in 1.3 schools on average.

⁵⁰We show the corresponding analysis for middle schools (i.e. 8th graders) in Appendix Figure A21 and Appendix Table A27. The results are similar: political party turnover in mayoral elections does not significantly reduce 8th grade test scores. However we cannot formally reject that the effect of party turnover for 8th grade test scores is the same in municipal and non-municipal schools.

⁵¹We show the result of the heterogeneity analysis with respect to baseline test scores for 8th graders in municipal schools in Appendix Figure A23 and Appendix Table A29. Since there are fewer municipal middle schools to begin with, we lose power when we divide the sample of 8th graders based on baseline test scores. However, there is no evidence that the negative effect of political party turnover on 8th grade test scores is driven by low-quality schools.

⁵²Note that the the placebo exercise is imperfect: even if we had found an effect on non-municipal schools, it would not be evidence against the personnel mechanism we claim, as there are indirect ways

suggestive evidence that political party turnover impacts student achievement through the replacement of educational personnel (at schools or higher up in the bureaucracy): when political party turnover is not accompanied by a disruption in the appointment of personnel, there is no negative effect of political turnover on student achievement.

The municipal government controls aspects of municipal education provision besides the replacement of personnel and the allocation of educational funds. For instance, the municipal government also directly or indirectly controls educational policies: it often sets the curriculum, prioritizes school programs and determines teachers' incentives. While the replacement of personnel may also contribute to changes in educational policy, we cannot know what would have been the counterfactual set of educational policies if politicians had no control over personnel appointments. Yet, as explained previously, the effect of political turnover on test scores occurs irrespective of the ideology of the winning party and irrespective of changes in resources devoted to education. Thus, if the result is explained by changes in educational policy that would have happened regardless of the change in personnel, then it must be a policy change that does not vary by party ideology and does not lead to a decrease in educational expenditures. One hard-to-measure possibility is that the new administration and its loyalists harass any political appointee that happens to keep his job. While there are other possible consequences of political turnover that are hard to measure, the politically motivated replacement of personnel (at the school or higher up in the municipal bureaucracy) remains the main channel for which we find empirical supporting evidence. In the next section, we assume that the "politically motivated replacement" is the only channel driving test scores, and we derive and test empirically some additional implications of this channel.

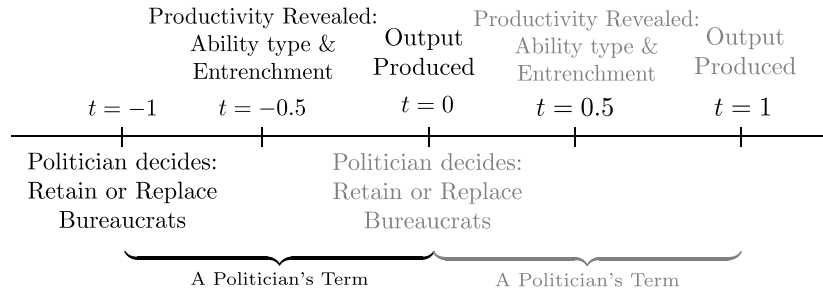
V. Politically Motivated Replacements & The Politician's Tradeoff

How does politically motivated replacement translate into lower student achievement? Are there political gains to replacing personnel, or situations in which they refrain from doing so? We discuss a model that provides a narrative for the empirical findings: a politician is about to take office and has to decide whether to replace or retain bureaucrats. The model accomplishes three main goals. First, it provides a precise definition for what we refer to as "politically motivated replacements": the additional bureaucratic replacements that occur in municipalities that experience political turnover that would not have occurred if the incumbent party had continued in office. Second, the model offers two opposing mechanisms - loyalty and bureaucratic entrenchment - that cause "politically mo-

this mechanism can produce an effect on non-municipal schools (e.g., through the labor market for teachers). Nonetheless, the fact that we found no effect on non-municipal schools helps to narrow down the set of alternative mechanisms. For instance, if we had found an effect on non-municipal schools, it would be consistent with an indirect effect of the personnel channel we emphasize. However, it would also be consistent with various other channels unrelated to personnel, such as changes in income or crime, leading to lower test scores.

tivated replacements” to be either harmful or beneficial to public services. These forces lead to additional predictions about the replacement patterns that we empirically test in the data. Lastly, in reality, politicians replace personnel even in the absence of political turnover. The model explains how such replacements are different from politically motivated replacements, helping interpret our empirical findings. In what follows, we lay out the basic features of our model, and refer readers to the online appendix for technical details.

Figure 1. : Model Timeline



The Model A period represents a politician’s term. Every period the politician in office, a *challenger* or an *incumbent*, decides to retain or replace bureaucrats. By the end of the politician’s term, a bureaucrat with ability a_i and loyalty j produces a public good (a_i) and a political service (s_j). Figure 1 summarizes the timing. The politician values both outputs, while society only values the public good. A bureaucrat can be either loyal to the challenger or the incumbent. A loyalist bureaucrat produces a higher political service than a non-loyalist (i.e., $s_{loyalist} > s_{non-loyalist}$). For each bureaucrat who is not retained, the politician can choose the loyalty of the newly-hired replacement but cannot choose his ability. Any newly-hired bureaucrat in period $t = 0$ will have ability $a_i \in \{a_1, a_2, a_3\}$ randomly drawn from a distribution with mean $E[a]$, where $a_1 < E[a] < a_2 < a_3$, and the ability is revealed only after hiring (in period $t = 0.5$). We assume that the expected total output produced by a newly hired loyalist is higher than the total output produced by a mid-ability non-loyalist (i.e., Assumption 1: $s_{loyalist} + E[a] > s_{non-loyalist} + a_2$), but the opposite holds for the high-ability bureaucrat (i.e., Assumption 2: $s_{non-loyalist} + a_3 > s_{loyalist} + E[a]$). Moreover, bureaucrats in office get entrenched with probability π . We assume for simplicity that only a_2 type can get entrenched. Relative to a non-entrenched bureaucrat, an entrenched bureaucrat produces lower public good output (i.e., $a_2^{entr} = a_2 - \delta$, where $\delta > 0$), and produces a larger political service output only

when he is a loyalist (i.e., $s_{loyalist}^{entr} = s_{loyalist} + \delta$, where $\delta > 0$). We assume that an entrenched bureaucrat produces lower public good than the expected public good from a newly-hired bureaucrat (i.e., Assumption 3: $a_2^{entr} < E[a]$).

Let $\gamma_t(a_i, j)$ be the share of bureaucrats in period t with attributes (a_i, j) . Given a distribution of bureaucrats in $t = 0$, the politician chooses to retain or replace them to maximize bureaucrats' total output in period $t = 1$:

Politician's Objective function:

$$\underbrace{\sum_{i=1,2,3} \sum_{j=non-loyalist}^{loyalist} (s_j + a_i) \times \gamma_1(a_i; j)}_{\text{Loyalty term}} + \underbrace{\sum_{j=non-loyalist}^{loyalist} ((s_j^{entr} + a_2^{entr}) - (s_j + a_2)) \times \gamma_1(a_2; j) \times \pi}_{\text{Entrenchment term}}$$

The *Loyalty term* shows that the politician cares about the total output a bureaucrat produces, the sum of public good and political service. The total output a loyalist produces is larger than what a non-loyalist produces. Because of *Assumption 1*, the politician chooses to replace a mid-ability non-loyalist and hire a loyalist with lower expected ability but higher expected total output. This mechanism explains how politically motivated replacement (of non-loyalists) can be detrimental to public good output. We call this mechanism “adverse politically motivated replacement”.

The *Entrenchment term* represents an opposing force that makes politically motivated replacements to improve public good output. At the time of the politician's decision some mid-ability bureaucrats have become entrenched. Note that the politician will choose to retain a mid-ability *loyalist* regardless of whether he is entrenched, as the loyalist's total output does not change with entrenchment (i.e., $s_{loyalist}^{entr} + a_2^{entr} = s_{loyalist} + a_2$). In contrast, because of *Assumption 3*, the politician chooses to replace an entrenched *non-loyalist* by a newly hired loyalist (since $s_{loyalist} + E[a] > s_{non-loyalist} + a_2^{entr}$), leading to higher public good output (since $E[a] > a_2^{entr}$). This mechanism explains how politically motivated replacement (of non-loyalists) can improve public good output. We call this mechanism “quality-enhancing politically motivated replacement”.

To match our empirical setting, we investigate the case where there was an incumbent in charge in period $t = -1$, and we contrast the decision of a challenger in charge in period $t = 0$ against the decision that would have occurred if the incumbent party had continued in office. Note that the continuing incumbent will not have any mid-ability non-loyalist to replace, since they would have been replaced in his previous term in office (recall *Assumption 1*). When a challenger takes office, the replacement of mid-ability non-loyalists produces both mechanisms outlined above: “adverse politically motivated replacement” and “quality-enhancing politically motivated replacement”. These politically motivated replacements will be the only difference between the challenger's decision and the continuing incumbent's decision. Our empirical estimate of the effect of

political turnover can be interpreted as the net effect of these two forces.

Embedded in the *Loyalty term* is another mechanism: “natural replacement”. Note that the challenger and the continuing incumbent will always remove low-ability bureaucrats even when they are loyalists. The newly hired loyalist will produce the same political service output and have a larger expected ability than the low-ability loyalist, leading to a higher expected public good output (i.e., $E[a] > a_1$). Hence, the “natural replacement” channel (replacement of loyalists by a new set of loyalists) leads to an improvement in personnel quality over time, with or without political turnover. This mechanism is not necessary to produce the politically motivated replacements we study, but it has implications for how we interpret the replacement patterns under the continuing incumbent administration.

Prediction 1. A challenger replaces an additional share of bureaucrats (i.e., “politically motivated replacements”) relative to the continued incumbent. Depending on which force (entrenchment vs loyalty) dominates, public good output might be smaller or larger.

Empirical findings. We find that the share of municipal personnel that are new is 7 percentage points higher in municipalities with political turnover relative to municipalities with a continuing incumbent (in Section IV.A, Table 2). The corresponding numbers for teachers and headmasters are 11 and 28 percentage points, respectively (in Section IV.B, Table 5 and Table 4). These changes represent an increase of between 23% and 63% relative to the “natural replacement” rate observed under the continuing incumbents. The public good output, as measured by test scores, is lower in municipalities where the challenger took office (in Section IV.B, Table 3). This result suggests that between the two forces outlined by the model that can potentially explain politically motivated replacements, loyalty seems to be a stronger force than entrenchment, as political turnover led to lower bureaucratic output.

Prediction 2. Assuming no entrenchment (i.e., $\pi = 0$), bureaucrats’ output under the challenger will be lower than under the continued incumbent. This difference can be attributed to the “adverse politically motivated replacements” lowering the average quality of bureaucrats.

Empirical findings. Below, we discuss evidence consistent with a change in bureaucrats’ quality, explaining the lower challenger’s output relative to the continuing incumbent. The model presents a parsimonious representation of the “adverse politically motivated replacement” channel where the unique source of inefficiency is the difference in bureaucrats’ quality. In reality, however, a bureaucrat replacement can lead to lower public good even when the newly hired bureaucrat has the same ability as the outgoing one, due to a “disrupted operations” channel. For example, the replacement may lead to losses in position-specific

human capital that the bureaucrat had acquired over his tenure. We investigate this “disrupted operations” channel empirically and gauge its importance relative to the personnel quality channel. Overall, changes in personnel quality explain a larger share of the reduced test scores that results from political turnover.

Personnel Quality. We investigate how political turnover affects the quality of teachers, headmasters, and overall municipal personnel. The *School Census* contains demographic information on teachers: their age, gender, education level, and type of contract (starting in 2011). Using this information, we test whether the composition of the pool of teachers in municipalities with and without political party change is different. Appendix Table A32 shows that the share of teachers with a B.A. is 7.7 percentage points (or 16% of the mean value) lower in municipalities that (barely) experience political party turnover. A decrease of 7.7 percentage points in the share of teachers with a B.A. within a school is correlated with a .017 standard deviation decrease in test scores.⁵³ Using the *Prova Brasil* headmaster questionnaire, we explore the consequences for headmasters’ characteristics. Appendix Table A31 shows that headmasters in municipalities that (barely) experience political party turnover are less experienced as headmasters (by 1.8 years or 35% of the mean years of headmaster experience) and slightly less likely to have graduate training (the equivalent of a master’s degree). One additional unit of each of these characteristics is correlated with .001 and .23 standard deviation units of improvement in test scores, respectively. Lastly, using the *RAIS* data, we show that the pool of municipal personnel are younger and have less seniority in municipalities with a party change, although they have similar education (Appendix Table A33). Assuming that this estimate is entirely due to the composition of individuals for a given occupation, we can estimate how these attributes relate to tests scores.⁵⁴ The lower age of personnel and lesser seniority are also negatively correlated to students’ test scores. Overall, the attributes of teachers, headmasters, and municipal personnel combined explain a share (0.024 standard deviation units if we assume the attributes impact test scores additively) of the (0.05–0.08 standard deviation unit) reduction in test scores due to political turnover.

It is important to note that the “adverse politically motivated replacement” force predicts lower personnel quality *relative* to the continuing incumbent administration. It does not predict that municipalities will experience lower personnel quality relative to their level *before* the election. According to the model, the “natural replacement” increases the quality of personnel, as politicians (incumbents and challengers) are always retaining the high-ability loyalists and removing

⁵³The correlations in this subsection are estimated using the municipalities in our sample with close elections that did not have political turnover in order to avoid including the causal effect of political party turnover in the correlations.

⁵⁴The changes in municipal personnel characteristics have a different interpretation from the changes in school personnel characteristics. For municipal personnel, we cannot determine whether the composition of positions changed or whether the composition of individuals for a given position changed.

those of low ability. As discussed, teachers' and headmasters' education and headmasters' experience seem to be the attributes that politicians screen for among school personnel. Hence, the "natural replacement" implies such attributes will increase over time in the absence of political turnover. Appendix Figure A24 shows that the continuing incumbent increases the quality of school personnel over time, consistent with a positive selection effect from "natural replacements". The corresponding municipal personnel attributes also increase over time (Appendix Figure A25). The pattern observed in the headmaster experience illustrates how these forces interact. In municipalities that experience political turnover, the headmaster's experience decreases one year after the election, suggesting that the negative selection effect from "adverse politically motivated replacement" is in absolute terms larger than the positive selection effect from "natural replacement" (Appendix Figure A24). The "natural replacement" channel offers a potential explanation of how the model is consistent with long-run growth in public service quality despite the prediction of political turnover lowering personnel quality: the level of personnel quality might increase over time in all municipalities.⁵⁵

Disrupted Operations. Ronfeldt, Loeb and Wyckoff (2013) associate high teacher turnover with lower test scores for elementary school students in New York City.⁵⁶ They suggest that there are disruptive effects of teacher turnover (beyond changing the distribution of teacher quality), such as reduced school-specific human capital, disrupted school programs, and lessened teacher collaboration. Presumably, there might be disruptive consequences for education from replacing teachers and replacing other personnel involved with the provision of education. Using the *Prova Brasil* surveys completed in municipal schools, we find that political party turnover increases the share of headmasters who report negatively on a series of questions about how their school operates. Appendix Table A34 shows these results. Headmasters in municipalities with political turnover report holding fewer teacher council meetings and are less likely to report having a coordinated curriculum within the school, having a curriculum that was developed jointly by the teachers and headmaster, receiving textbooks on time, receiving the correct textbooks, offering programs for dropouts and failing students, and holding teacher

⁵⁵Observe that the "natural replacement" might be stronger than the "adverse politically motivated replacement", leading to a higher level of the attribute after the election (if compared to before the election), and still lower than under the continuing incumbent. This description fits the pattern observed in the evolution of teacher and headmaster education over time. The possibility of a "natural replacement" channel (relative to "adverse politically motivated replacement" channel) suggests that the wholesale removal of political influence over personnel appears to have nuanced consequences for personnel's quality. This emphasizes the challenges of enacting policy to attenuate the negative impacts of political turnover.

⁵⁶As a benchmark, Ronfeldt, Loeb and Wyckoff (2013) show that student test scores are on average 13.9 percent of a standard deviation lower in years when there was 100 percent turnover as compared to when there was no turnover. Because, in our setting, political turnover increases teacher turnover by 11 percentage points, we can make a back-of-the-envelope calculation of the predicted effect of teacher turnover alone on students achievement. According to their estimates, when teacher replacement increases by 11 percentage points this corresponds to a decrease in students' achievement by .0153 standard deviations. This can be interpreted as one component of the broader effect of political turnover. Political turnover, for instance, affects education personnel beyond the 4th grade teachers.

training. They also report that fewer teachers participate in training conditional on holding teacher training. Appendix Table A36 reports the same results for questions regarding the operation of the school that were asked of teachers. The results are similar. Moreover, teachers in municipalities with party turnover report negatively about their relationship with the headmaster and other teachers, but these point estimates are statistically insignificant. The correlation between the school operations index and test scores is .13. Hence, a .09 standard deviation decrease in the school operations index is associated with a .012 standard deviation decrease in test scores.⁵⁷

The detrimental consequence of lower attributes combined with the disruption in school operations explains 0.035 standard deviation units, and hence roughly between 44 percent and 71 percent of the lower level of test scores. However, the “disrupted operations” mechanism combined with the “natural replacement” cautions against interpreting the cross-sectional correlations as the contribution of each mechanism for the lower test scores. Note that the “natural replacements” improve personnel quality. The schools that have higher quality personnel might be those that replaced personnel the most. Considering that the “disrupted operations” is a byproduct of the “natural replacements”, correlations would reflect both forces jointly. The positive correlation between personnel quality and test scores would be attenuated by the negative consequences of “disrupted operations”. The same bias would apply to the correlation between the school operations index and test scores.⁵⁸ According to the model, we should interpret the cross-sectional correlation exercises as a lower bound of the contribution of politically motivated replacements to the lower test scores.

Disrupted operations vs worse personnel quality. Politically motivated replacements can harm school operations due to the higher replacement rate level (lead-

⁵⁷One may ask the relative importance of the replacement of different personnel. For instance, 4th grade teachers relative to other personnel (in the school or higher up in the bureaucracy). Unfortunately, political turnover affects personnel replacements broadly, and we cannot separately identify the impact of replacing particular personnel. Nonetheless, two exercises suggest that 4th grade teachers are not the only type of personnel that matters. First, we study whether a politically appointed headmaster affects the composition of teachers that are brought in during political turnover. Appendix Table A38 shows that the negative effect on teachers’ education that results from political turnover happens primarily in schools where the headmaster is politically appointed. This result suggests that a politically appointed headmaster facilitates politically motivated replacements in schools. Second, we study the association between political turnover and a measure of school operations when we control in the regression for the different types of replacements (Appendix Table A39). These replacement measures are outcomes themselves, and therefore are endogenous to political turnover. Hence, the results should be taken with a grain of salt and interpreted as correlations only. Controlling for the share of 4th grade teachers that are new to the school has little effect on the political turnover estimated coefficient. One could argue that this might be because 4th grade teachers are not actually replaced. However, political turnover increases the replacement of teachers broadly in the school, for 4th grade teachers and also for teachers in other grades (Appendix Table A40). Moreover, controlling for the replacement of personnel other than 4th grade teachers lowers the point estimate of political turnover more than controlling only for 4th grade teacher replacement. This result suggests that personnel beyond 4th grade teachers is also relevant for the disruption in the school operation that we document.

⁵⁸This exercise depends on the underlying assumptions that we assume regarding how attributes lead to test score improvements (e.g., additive separability function)

ing to “disrupted operations”) or because of such replacements screen for worse quality personnel. The evidence, that we explain below, suggests a greater importance of the “worse quality of personnel” channel. First, the correlation between the various personnel replacements and test scores is 20 times larger (-.0011 vs -.021) when estimated for municipalities that experience political turnover (i.e., municipalities that experience more politically motivated replacements).⁵⁹ According to the model, in the absence of political turnover a replacement of a bureaucrat is accompanied by an *improvement* in personnel quality, while when there is political turnover a replacement is accompanied by an *deterioration* in personnel quality. The 20 times larger correlation suggests the personnel quality differential is quite important for the test scores. Second, the “disrupted operations” channel leads to losses in position-specific knowledge due to the differences between the outgoing employee who had acquired knowledge while working and the newly hired employee who lacks such knowledge. This difference is likely to vanish as time passes and the newly hired gets experienced. If the “disrupted operations” channel was the only underlying reason behind the increase in school problems reported by headmasters and teachers, the gap in school operations between municipalities with and without political turnover should disappear over time. Indeed, while one year after the election, there was a difference in whether textbooks arrive on time between municipalities with and without political turnover, three years after the election, there is no longer a difference (Appendix Table A35). However, the effect of political turnover on the overall school operations index is only 42 percent smaller three years after the election as compared to one year after the election (Appendix Table A35 and Appendix Table A37). This result suggests that a substantial share of the effect of political turnover on school problems can be attributed to more permanent changes, such as the lower personnel quality.⁶⁰

Prediction 3. Assuming no entrenchment (i.e., $\pi = 0$), in choosing to replace a bureaucrat, the challenger trades off a bureaucrat who produces a larger public good output and little political services against another bureaucrat who produces a smaller expected public good output but also produces a higher political service. Replacement patterns should reflect this trade-off.

Empirical findings. In Section IV.B, we have already discussed patterns consistent with a political service - public good trade-off. For instance, Appendix

⁵⁹This exercise uses the same steps as the set of correlations presented for the quality of personnel. To be precise, we first estimate the correlation between each type of personnel replacement - teacher, headmaster, and municipal personnel - and test scores. Next, we use the political turnover effect on each of these replacements. We sum the cross-product of the three effect sizes and the three correlations to reach the number reported.

⁶⁰Alternatively, the 58 percent of the effect of political turnover on the index of school operations could be due to temporary changes (i.e., the disruptive effect of replacement for which the loss in position-specific human capital takes longer than three years to accumulate). However, a higher relative importance of permanent changes (i.e., lower personnel quality) is also consistent with the fact that the effect of political turnover on test scores persists up to at least five years after the election (Appendix Table A16, discussed in Section IV.B)

Figures A15, A16 and A14 show that politicians appear to exercise considerably more discretion over school personnel in low-income municipalities, where low-income voters do not prioritize investments in public education (Bursztyn, 2016). We now discuss additional exercises that are consistent with our model and have been empirically tested elsewhere. Iyer and Mani (2012) study how political leadership changes lead to transfers of high-level bureaucrats (IAS officers) in India. Two patterns they document can be tested in our setting. First, they find that leadership changes increase the transfer rate among low-ability bureaucrats more than it increases among high-ability bureaucrats (Iyer and Mani (2012)'s hypothesis 2). Second, they find that leadership changes within the same political ideology lead to fewer transfers than leadership changes that cross political ideology lines (Iyer and Mani (2012)'s hypothesis 6). Our findings below are consistent with these two empirical patterns.

Personnel quality and Replacement. The challenger and the incumbent will always retain the highest ability bureaucrat. While performing “adverse politically motivated replacements”, the challenger will replace bureaucrats of lower ability at a higher rate than the continuing incumbent will. Therefore, political turnover will lead to a smaller increase in the replacement of the highest-ability bureaucrat than the replacement of lower ability bureaucrats will increase.⁶¹ We use teachers’ and headmasters’ characteristics to create a teacher quality index and a headmaster quality index, respectively. We analyze how the effect of political turnover on replacements varies according to each of these measures. Political turnover increases the exit rate of less qualified headmasters more than it does the exit rate of highly qualified headmasters (Appendix Table A41). The corresponding difference in teachers exit rate between high-skill and low-skill teachers is also negative but is statistically not different from zero.⁶²

Ideology Transition and Replacement. While the direction of the ideology shift (to the left or right) does not explain most personnel replacements (discussed in Section IV.B), the presence (or absence) of an ideology shift may still influence the extent of replacement. When party ideology changes completely between administrations (from left to right or right to left) the ruling political party might share a smaller subset of loyalists with the former administration, leading to

⁶¹The comparative static that the likelihood of replacement that results from political turnover decreases with ability holds for the comparison between the highest ability bureaucrat (i.e., a_3) and the bureaucrats with the lower ability levels combined (i.e., $a_1 + a_2$). This comparison parallels Iyer and Mani (2012)'s hypothesis 2. Their model assumes that any politically motivated replacement only occurs for the lowest ability bureaucrat. Since the lowest ability is the only type in their model that can be loyal or non-loyal to a politician. Our model allows for mid-ability bureaucrats to be fired for political reasons, while still existing a lower type for which the replacement probability will be unaffected by political turnover.

⁶²Unfortunately, we cannot repeat the same exercise for municipal personnel as the results would confound differences in the replacement likelihood for positions at different levels of the hierarchy. The corresponding teachers’ and headmasters’ exercises allow the comparison of the replacement likelihood of a high-ability individual vs. low ability individual for a given position.

a higher replacement rate.⁶³ In Appendix Table A42, the effects of candidate turnover on municipal personnel replacement and teacher replacement are larger when accompanied by an ideology transition (from left to right, or right to left).⁶⁴

Overall the patterns are consistent with the “adverse politically motivated replacement” channel outlined in the model. One can interpret the effect of political turnover as the *net effect* of the two forces: “adverse politically motivated replacement” and “*quality-enhancing politically motivated replacement*”. While our results suggest that the “adverse” force is stronger, some of the politically motivated replacements can be “quality-enhancing”. We do not observe measures of entrenchment to test for this mechanism directly. We find suggestive evidence that the importance of “quality-enhancing” motives leading to politically motivated replacement is in practice limited. For instance, we find that municipal schools that were ranked among the worst-performing schools within the municipality did not experience higher levels of replacement as a result of political turnover (Appendix Table A43).

VI. Conclusion

Using a regression discontinuity on close mayoral elections in Brazil, we identify the impact of political party turnover on the internal workings of the municipal bureaucracy. We document a widespread disruption in the municipal bureaucracy. New personnel is hired across sectors and in both managerial and non-managerial positions when the mayor’s political party changes. In education, political turnover lowers student achievement and leads to a sharp increase in school personnel replacements. Changes in the party of the mayor do not impact student achievement or school personnel assignments in local schools not managed by the municipal government. Moreover, the politically motivated replacement of personnel (at schools or higher up in the bureaucracy) remains the main mechanism for which we find empirical supporting evidence. Guided by a conceptual framework for the politician’s decision to replace bureaucrats, we study empirically how such replacements translate into lower student achievement: by disrupting the school operations and lowering personnel quality.

We study a phenomenon —politically motivated replacements —that is common in governments around the world, but that has been overlooked in empirical studies. We document the extent and scope of personnel replacements in local government in Brazil. We show the degree to which such replacements can be

⁶³One can argue that greater ideological misalignment between the politician and the bureaucracy may be a quality-enhancing reason to replace a bureaucrat. Loyalty-matching can increase public good output (in addition to political service output), for example, by allowing politicians to develop cohesion between the executive branch and the administration. However, this benefit is often mentioned in relation to high-ranking bureaucrats (Gulzar and Pasquale, 2017). Ideological misalignment is less likely to justify replacement of teachers.

⁶⁴We use candidate turnover instead of party turnover because ideology transition is perfectly collinear with the interaction term: ideology transition X Political party turnover. Hence, the parameter associated with such interaction cannot be estimated.

solely attributed to a change in the ruling party, as opposed to "natural replacements" that would have happened if the incumbent had continued in office. We find that this "excess replacement" is substantial and detrimental to the quality of public education. Our findings are important for understanding how the benefits of electoral accountability institutions depend on the rules governing the bureaucracy. Past work has shown that political discretion over personnel appointments undermines the screening role of elections in improving the quality of political leaders (Folke, Hirano and Snyder, 2011). A politicized bureaucracy can still undermine the benefits of elections even when the incumbent is as good as the strongest opponent. Our work shows that in elections where two competing candidates have similar vote shares and a coin-flip determines the winner, political turnover disrupts the bureaucracy, adversely affecting public education quality. Politically motivated replacement can be a costly byproduct of contested elections in environments where politicians control bureaucratic appointments.

Nonetheless, politically motivated replacements carry a few potential benefits. For instance, the replacement process allows politicians to remove low-performing or entrenched bureaucrats. In our current study, we find that the net effect of the various costs and benefits of politically motivated replacements is harmful to education. A natural next step for research in this area would be to examine the determinants of these opposing forces. For instance, how does the frequency of political turnover or the nature of a particular public service mediate which forces prevail? Are there settings where the benefits outweigh the costs? We hope that future work will shed light on these questions.

REFERENCES

- Alvas, Camila, Matteo Bobba, Gianmarco Leon, Christopher Neilson, and Marco Nieddu.** 2019. "Teacher Wages, Student Achievement, and the Recruitment of Talent in Rural Peru." *Mimeo*.
- Angrist, Joshua, Eric Bettinger, Erik Bloom, Elizabeth King, and Michael Kremer.** 2002. "Vouchers for private schooling in Colombia: Evidence from a randomized natural experiment." *The American Economic Review*, 92(5): 1535–1558.
- Ashraf, Nava, and Oriana Bandiera.** 2018. "Social incentives in organizations." *Annual Review of Economics*, 10: 439–463.
- Banerjee, Abhijit, Raghavendra Chattopadhyay, Keniston Daniel Duflo, Esther, and Nina Singh.** 2020. "Improving Police Performance in Rajasthan, India: Experimental Evidence on Incentives, Managerial Autonomy and Training." *American Economic Journal: Economic Policy*.
- Barbosa, Klenio, and Fernando V Ferreira.** 2019. "Occupy government: democracy and the dynamics of personnel decisions and public finances." National Bureau of Economic Research.

- Barro, Robert J.** 1991. "Economic growth in a cross section of countries." *The Quarterly Journal Of Economics*, 106(2): 407–443.
- Basedosdados.** 2006-2013. "Correspondência entre os códigos institucionais de entidades brasileiras." *Base dos Dados*. <https://www.basedosdados.org/dataset/br-bd-diretorios-brasil/resource/c1deb363-ffba-4b1e-95dc-c5e08311852e>, [Online; accessed March-2021].
- Behrman, Jere R, Piyali Sengupta, and Petra Todd.** 2000. "The impact of *Progresá* on achievement test scores in the first year." *International Food Policy Research Institute, Washington, DC*.
- Bostashvili, David, and Gergely Ujhelyi.** 2019. "Political budget cycles and the civil service: Evidence from highway spending in U.S. states." *Journal of public economics*, 175: 17–28.
- Brollo, Fernanda, Katja Kaufmann, and Eliana La Ferrara.** 2020. "The political economy of program enforcement: Evidence from Brazil." *Journal of the European Economic Association*, 18(2): 750–791.
- Brollo, Fernanda, Pedro Forquesato, and Juan Carlos Gozzi.** 2017. "To the victor belongs the spoils? Party Membership and Public Sector Employment in Brazil." *Mimeo*. Warwick Economics Research Papers.
- Burszty, Leonardo.** 2016. "Poverty and the political economy of public education spending: Evidence from Brazil." *Journal of the European Economic Association*, 14(5): 1101–1128.
- Calonico, Sebastian, Matias D Cattaneo, Max H Farrell, and Rocio Titiunik.** 2016. "Regression Discontinuity Designs Using Covariates." Working paper, University of Michigan.
- Card, David.** 2001. "Estimating the return to schooling: Progress on some persistent econometric problems." *Econometrica*, 69(5): 1127–1160.
- Cardoso, Jose Celso.** 2011. "Burocracia e Ocupação no Setor Público Brasileiro." Instituto de Pesquisa Econômica Aplicada (IPEA).
- Cohodes, Sarah, Setren Elizabeth, and Christopher R. Walters.** 2019. "Can Successful Schools Replicate? Scaling Up Boston's Charter School Sector." *Mimeo*.
- Colonnelli, Emanuele, Edoardo Teso, and Mouno Prem.** 2020. "Patronage in the Allocation of Public Sector Jobs." *The American Economic Review*, 110(10): 3071–99.
- Dal Bó, Ernesto, Frederico Finan, and Martín A Rossi.** 2013. "Strengthening state capabilities: The role of financial incentives in the call to public service." *The Quarterly Journal of Economics*, 128(3): 1169–1218.

- De Brauw, Alan, Daniel O Gilligan, John Hoddinott, and Shalini Roy.** 2015. "The Impact of *Bolsa Familia* on Schooling." *World Development*, 70: 303–316.
- De Magalhaes, Leandro.** 2015. "Incumbency Effects in a Comparative Perspective: Evidence from Brazilian Mayoral Elections." *Political Analysis*, 23(1): 113–126.
- Dhaliwal, Iqbal, and Rema Hanna.** 2017. "The devil is in the details: The successes and limitations of bureaucratic reform in India." *Journal of Development Economics*, 124: 1–21.
- DonosoDíaz, S., J. P. Fernández-Negrete, and D. Reyes Araya.** 2019. "Directores de escuelas públicas chilenas seleccionados por alta dirección removidos de su cargo antes de finalizar su período de gestión: Lecciones para América Latina." *Archivos Analíticos de Políticas Educativa*, 27(43).
- Duflo, Esther, Rema Hanna, and Stephen P Ryan.** 2012. "Incentives work: Getting teachers to come to school." *American Economic Review*, 102(4): 1241–78.
- Eggers, Andrew C, Anthony Fowler, Jens Hainmueller, Andrew B Hall, and James M Snyder.** 2015. "On the validity of the regression discontinuity design for estimating electoral effects: New evidence from over 40,000 close races." *American Journal of Political Science*, 59(1): 259–274.
- Estrada, Ricardo.** 2019. "Rules versus Discretion in Public Service: Teacher Hiring in Mexico." *Journal of Labor Economics*, 37(2): 545–579.
- Fagernäs, Sonja, and Panu Pelkonen.** 2020. "Teachers, Electoral Cycles, and Learning in India." *Journal of Human Resources*, 55(2): 699–732.
- Ferraz, Claudio, and Frederico Finan.** 2011. "Electoral accountability and corruption: Evidence from the audits of local governments." *American Economic Review*, 101(4): 1274–1311.
- Ferraz, Claudio, Frederico Finan, and Diana B Moreira.** 2012. "Corrupting learning: Evidence from missing federal education funds in Brazil." *Journal of Public Economics*, 96(9): 712–726.
- Finan, Frederico, Benjamin A Olken, and Rohini Pande.** 2015. "The personnel economics of the state." *Handbook of Economic Field Experiments*.
- FINBRA.** 2009-2011. "Dados contábeis dos Municípios." *Tesouro Nacional*. <https://www.tesourotransparente.gov.br/publicacoes/finbra-dados-contabeis-dos-municipios-1989-a-2012/2012/26>, [Online; accessed March-2021].

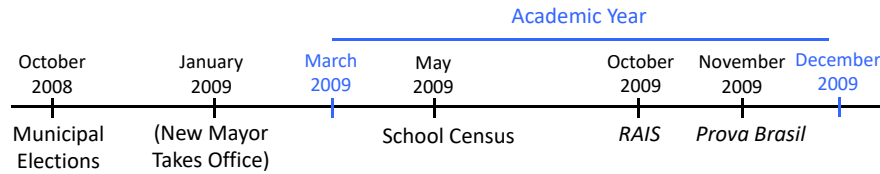
- FINBRA.** 2013-2015. “Dados contábeis dos Municípios.” *Tesouro Nacional*. https://siconfi.tesouro.gov.br/siconfi/pages/public/consulta_finbra/finbra_list.jsf, [Online; accessed March-2021].
- Folke, Olle, Shigeo Hirano, and James M Snyder.** 2011. “Patronage and elections in U.S. states.” *American Political Science Review*, 105(3): 567–585.
- Gardner, Rachel Elizabeth.** 2013. “Essays on Municipal Public Finance in Brazil.” PhD diss. University of California, Berkeley.
- Glewwe, Paul, and Ana Lucia Kassouf.** 2012. “The impact of the *Bolsa Escola/Familia* conditional cash transfer program on enrollment, dropout rates and grade promotion in Brazil.” *Journal of development Economics*, 97(2): 505–517.
- Grindle, Merilee.** 2004. “Good Enough Governance: Poverty Reduction and Reform in Developing Countries.” *Governance*, 17(4): 525–548.
- Grindle, Merilee S.** 2012. *Jobs for the Boys*. Harvard University Press.
- Gulzar, Saad, and Benjamin J Pasquale.** 2017. “Politicians, bureaucrats, and development: Evidence from India.” *American Political Science Review*, 111(1): 162–183.
- Iacoviello, Mercedes.** 2006. “Analysis Comparativo por Subsistemas.” *Informe sobre la situacion del servicio civil en América Latina*.
- INEP.** 2007-2013a. “Indicadores Educacionais - Taxas de Rendimento.” *Instituto Nacional de Estudos e Pesquisa Educacionais Anisio Teixeira*. <http://portal.inep.gov.br/web/guest/indicadores-educacionais>, [Online; accessed March-2021].
- INEP.** 2007a. “Microdados Censo Escolar.” *Instituto Nacional de Estudos e Pesquisa Educacionais Anisio Teixeira*. http://download.inep.gov.br/microdados/micro_censo_escolar_2007.zip, [Online; accessed March-2021].
- INEP.** 2007b. “Microdados Prova Brasil.” *Instituto Nacional de Estudos e Pesquisa Educacionais Anisio Teixeira*. https://download.inep.gov.br/microdados/microdados_prova_brasil_2007.zip, [Online; accessed March-2021].
- INEP.** 2009a. “Microdados Censo Escolar.” *Instituto Nacional de Estudos e Pesquisa Educacionais Anisio Teixeira*. http://download.inep.gov.br/microdados/micro_censo_escolar_2009.zip, [Online; accessed March-2021].

- INEP.** 2009b. “Microdados Prova Brasil.” *Instituto Nacional de Estudos e Pesquisa Educacionais Anísio Teixeira*. https://download.inep.gov.br/microdados/microdados_prova_brasil_2009.zip, [Online; accessed March-2021].
- INEP.** 2011a. “Microdados Censo Escolar.” *Instituto Nacional de Estudos e Pesquisa Educacionais Anísio Teixeira*. http://download.inep.gov.br/microdados/micro_censo_escolar_2011.zip, [Online; accessed March-2021].
- INEP.** 2011b. “Microdados Prova Brasil.” *Instituto Nacional de Estudos e Pesquisa Educacionais Anísio Teixeira*. https://download.inep.gov.br/microdados/microdados_prova_brasil_2011.zip, [Online; accessed March-2021].
- INEP.** 2013b. “Microdados Censo Escolar.” *Instituto Nacional de Estudos e Pesquisa Educacionais Anísio Teixeira*. http://download.inep.gov.br/microdados/micro_censo_escolar_2013.zip, [Online; accessed March-2021].
- INEP.** 2013c. “Microdados Prova Brasil.” *Instituto Nacional de Estudos e Pesquisa Educacionais Anísio Teixeira*. https://download.inep.gov.br/microdados/microdados_aneb_prova_brasil_2013.zip, [Online; accessed March-2021].
- IPEA.** 1980-2015. “Índice de Preços ao Consumidor (IPCA).” *Instituto de Pesquisa Econômica Aplicada*. www.ipeadata.gov.br, [Online; accessed March-2021].
- IPEA.** 2007 and 2010. “População Municipal.” *Instituto de Pesquisa Econômica Aplicada*. www.ipeadata.gov.br, [Online; accessed March-2021].
- Iyer, Lakshmi, and Anandi Mani.** 2012. “Traveling Agents: Political Change and Bureaucratic Turnover in India.” *Review of Economics and Statistics*, 94(3): 723–739.
- Khan, Adnan Q, Asim Ijaz Khwaja, and Benjamin A Olken.** 2019. “Making moves matter: Experimental evidence on incentivizing bureaucrats through performance-based postings.” *American Economic Review*, 109(1): 237–70.
- Kiser, Edgar, and Joshua Kane.** 2001. “Revolution and State Structure: The Bureaucratization of Tax Administration in Early Modern England and France.” *American Journal of Sociology*, 107(1): 183–223.
- Krueger, Alan B.** 1999. “Experimental estimates of education production functions.” *The Quarterly Journal of Economics*, 114(2): 497–532.

- Lopez, Felix, and Erivelton Guedes.** 2018. “Uma Análise Multidimensional da Burocracia Pública Brasileira em Duas Décadas 1995-2016.” *Atlas do Estado Brasileiro - IPEA*.
- McCrary, Justin.** 2008. “Manipulation of the running variable in the regression discontinuity design: A density test.” *Journal of Econometrics*, 142(2): 698–714.
- Menezes, Aline, Rudi Rocha, and Vinicius Schuabb.** 2018. “Incumbency Advantage: the bureaucracy Mechanism.” *mimeo*.
- Menezes-Filho, Naercio, and Elaine Pazello.** 2007. “Do teachers’ wages matter for proficiency? Evidence from a funding reform in Brazil.” *Economics of Education Review*, 26(6): 660–672.
- Miranda, Jéssica, and Elaine Pazello.** 2015. “Rotatividade de Diretores e Desempenho da Escola.” Masters Thesis, Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto.
- Moreira, Diana, and Santiago Pérez.** 2020. “Civil Service Reform and Organizational Practices: Evidence from the Pendleton Act.” *mimeo*.
- Munõz, Pablo, and Mounu Prem.** 2019. “Managers’ Productivity and Labor Market: Evidence from School Principals.” *mimeo*.
- Muralidharan, Karthik, and Venkatesh Sundararaman.** 2011. “Teacher performance pay: Experimental evidence from India.” *Journal of Political Economy*, 119(1): 39–77.
- Olson, Mancur.** 1982. *Rise and Decline of Nations: Economic Growth*.
- Ornaghi, Arianna.** 2016. “Civil Service Reforms: Evidence from U.S. Police Departments.” Working paper, Massachusetts Institute of Technology.
- Pepinsky, Thomas B, Jan H Pierskalla, and Audrey Sacks.** 2017. “Bureaucracy and service delivery.” *Annual Review of Political Science*, 20: 249–268.
- Pettersson-Lidbom, Per.** 2008. “Do parties matter for economics outcomes? A regression-discontinuity approach.” *Journal of the European Economic Association*, 6(5): 1037–1056.
- Raffler, Pia.** 2016. “Does Political Oversight of the Bureaucracy Increase Accountability? Field Experimental Evidence from an Electoral Autocracy.” Working paper, Yale University.
- RAIS.** 2006-2014. “Microdados RAIS.” *Ministério da Economia*. <ftp://ftp.mtps.gov.br/pdet/microdados/RAIS/>, [Online; accessed March-2021].

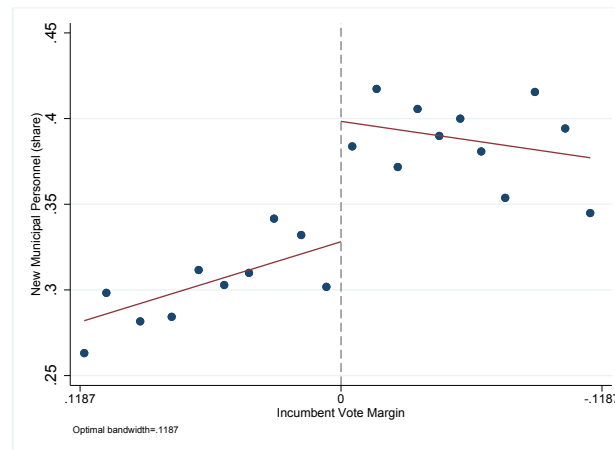
- Rauch, James E, and Peter B Evans.** 2000. "Bureaucratic Structure and Bureaucratic Performance in Less Developed Countries." *Journal of Public Economics*, 75(1): 49–71.
- Ronfeldt, Matthew, Susanna Loeb, and James Wyckoff.** 2013. "How teacher turnover harms student achievement." *American Educational Research Journal*, 50(1): 4–36.
- Stovel, Katherine, and Mike Savage.** 2006. "Mergers and mobility: organizational growth and the origins of career migration at Lloyds Bank." *American Journal of Sociology*, 101(4): 1080–1121.
- TSE.** 2004, 2008 and 2012. "Repositório de Dados Eleitorais." *Tribunal Superior Eleitoral*. <https://www.tse.jus.br/eleicoes/estatisticas/repositorio-de-dados-eleitorais-1/repositorio-de-dados-eleitorais>, [Online; accessed March-2021].
- Ujhelyi, Gergely.** 2014a. "Civil service reform." *Journal of Public Economics*, 118: 15–25.
- Ujhelyi, Gergely.** 2014b. "Civil service rules and policy choices: evidence from U.S. state governments." *American Economic Journal: Economic Policy*, 6(2): 338–80.
- Wilson, James.** 1989. *Bureaucracy What Government Agencies Do and Why They Do It*. New York: Basic Books.
- Xu, Guo.** 2018. "The costs of patronage: Evidence from the british empire." *American Economic Review*, 108(11): 3170–98.

Figure 2. : Timeline of Election and Data Collection

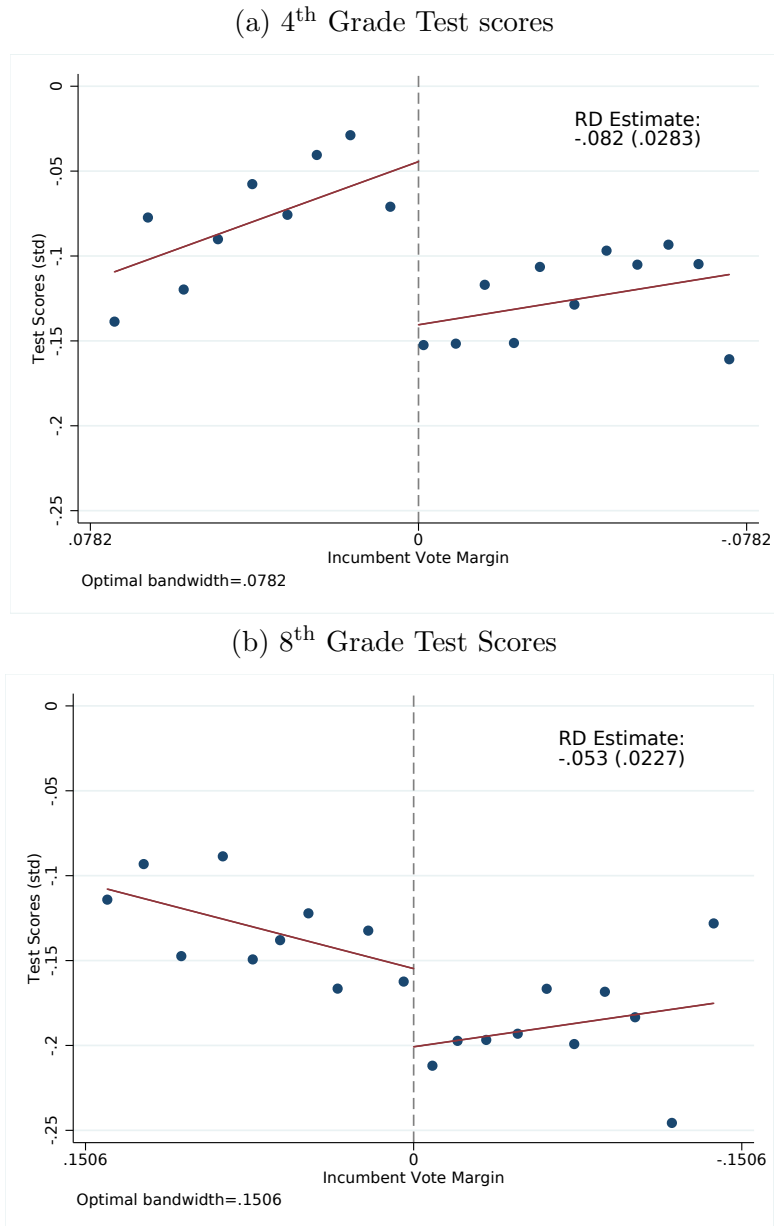


Notes: This timeline shows the timing of local elections and data collection. Municipal elections in Brazil are held in October every four years on the same day in all municipalities. The mayor takes office in January of the following year. The academic year runs from March to December. The *RAIS* data is collected annually and allows to identify municipal personnel movements on a monthly-basis. The School Census is collected annually in May and allows us to identify schools and measure the replacement rate of teachers. The *Prova Brasil* exam is a nation-wide, standardized exam and occurs every two years in November. We use *Prova Brasil* to measure student achievement, as well as the replacement rate of headmasters. Therefore, the measure of teacher replacement should be thought of as an evaluation of the education system 5 months after a new party has come to power and the measures of student achievement and headmaster replacement should be thought of as evaluations of the education system 11 months after a new party has come to power.

Figure 3. : Political Turnover and New Municipal Personnel (Share)



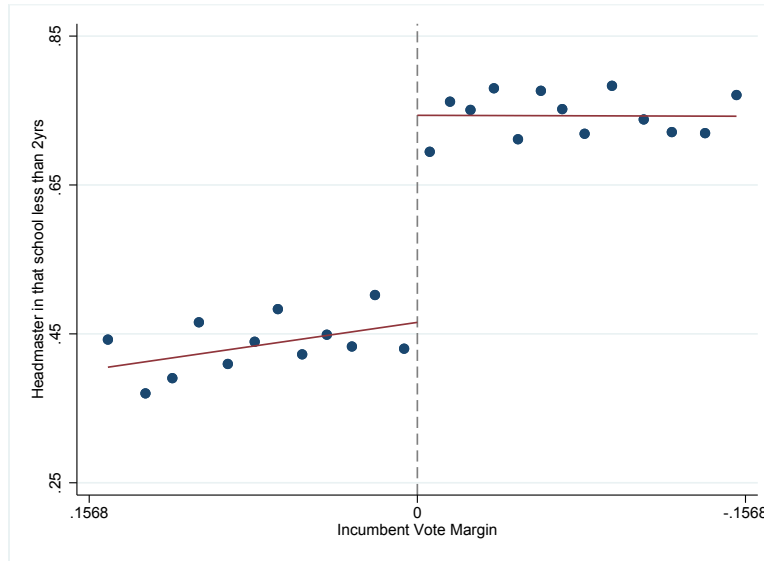
Note: This figure shows the mean of municipal-level share of new municipal personnel in 2009 and 2013 by bins of *IncumbVoteMargin*. Municipalities with *IncumbVoteMargin* < 0 experienced change in the political party of the mayor in 2008 or 2012 elections. Municipalities with *IncumbVoteMargin* > 0 did not experience change in the political party of the mayor in 2008 or 2012 elections. Note that values to the right side of the zero are negative (political turnover), while values on the left side are positive (no political turnover). New Municipal Personnel (share) is the ratio between the number of new labor contracts that had been added 12 months after the election divided by the total number of contracts that existed the month prior to the election.

Figure 4. : Political Turnover and 4th and 8th Grade Test Scores

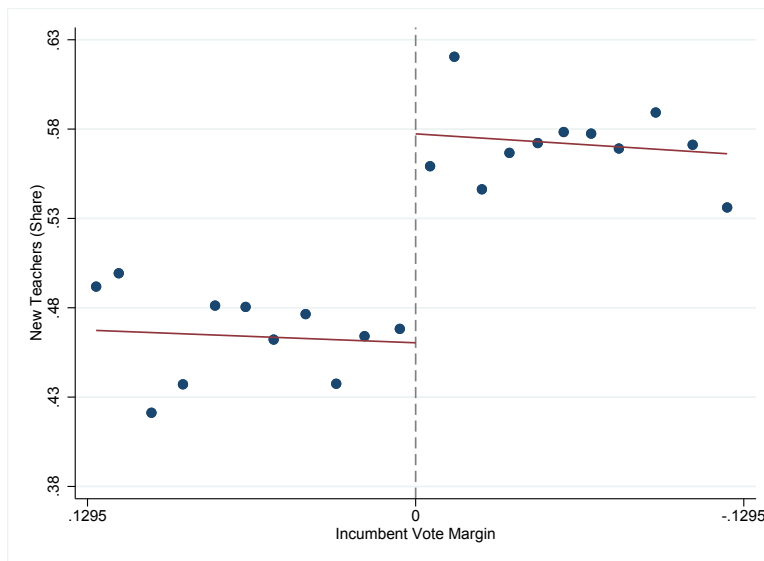
Notes: This figure shows the mean of individual-level 4th grade test scores (Panel A) and 8th grade test scores (Panel B) by bins of *IncumbVoteMargin*. Municipalities with *IncumbVoteMargin* < 0 experienced a change in the political party of the mayor. Municipalities with *IncumbVoteMargin* > 0 did not experience a change in the political party of the mayor. Note that values to the right side of the zero are negative (political turnover), while values on the left side are positive (no political turnover). Test scores are from the *Prova Brasil* exam and are standardized based on the distribution of individual-level test scores in municipalities with no change in the ruling party. Average, school-level test scores for the respective grade at baseline (the year before the respective election) is included as a control.

Figure 5. : Political Turnover and School Personnel Changes

(a) Headmaster Replacement



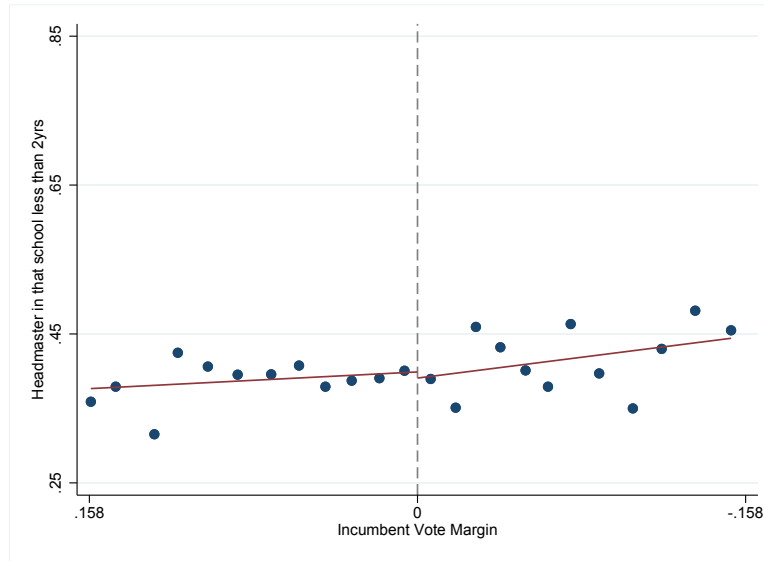
(b) New Teachers



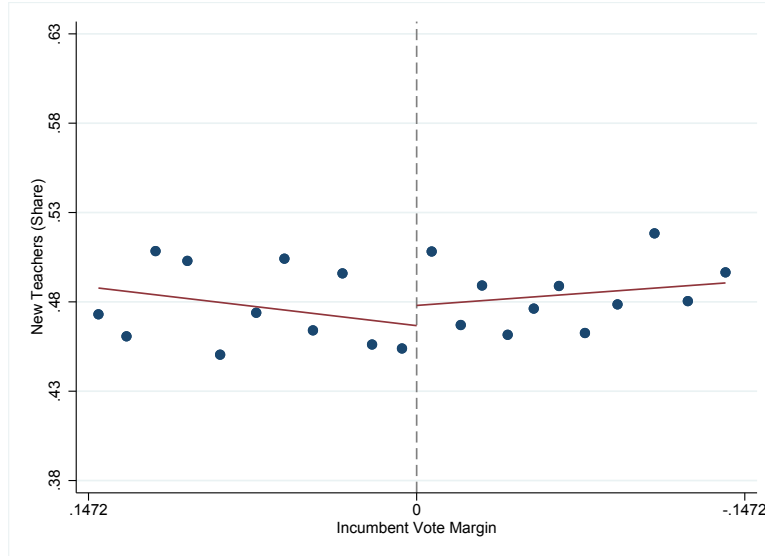
Notes: Panel A shows the share of schools with a new headmaster and Panel B shows the share of teachers that are new to the school by bins of *IncumbVoteMargin*. Municipalities with *IncumbVoteMargin* < 0 experienced a change in the political party of the mayor. Municipalities with *IncumbVoteMargin* > 0 did not experience a change in the political party of the mayor. Note that values to the right side of the zero are negative (political turnover), while values on the left side are positive (no political turnover). New headmasters are those that report being the headmaster of their current school for less than two years on the *Prova Brasil* headmaster questionnaire. The share of teachers that are new to a school is computed using the School Census and corresponds to the share of teachers in a school who are in that school at time t (one year after the respective election) but were not in that same school at time $t - 2$ (the year before the respective election).

Figure 6. : Political Turnover and School Personnel Changes in Non-municipal Schools

(a) Headmaster Replacement

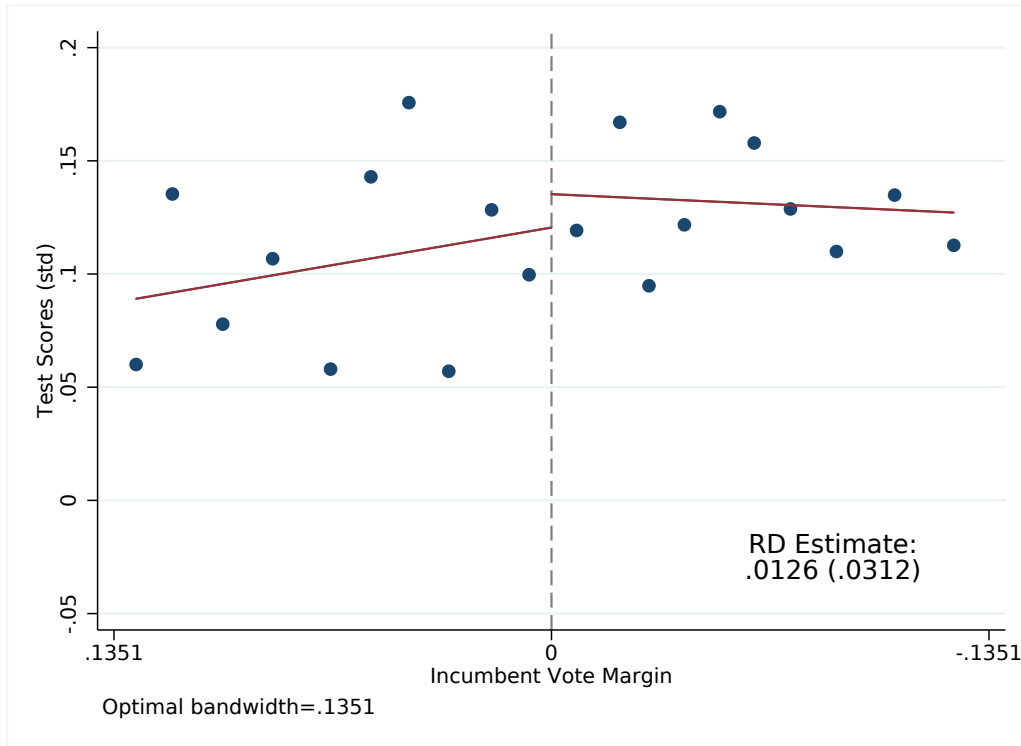


(b) New Teachers



Notes: This figure shows a similar analysis to that of Figure 5 with the key difference that the sample for this figure is *non-municipal* schools. Note that values to the right side of the zero are negative (political turnover), while values on the left side are positive (no political turnover). The set of *non-municipal* schools is comprised of state and federal schools in Panel A (only public schools participate in the *Prova Brasil* exam) and state, federal, and private schools in Panel B (all schools participate in the School Census).

Figure 7. : Political Turnover and 4th Grade Test Scores in Non-municipal Schools



Notes: This figure shows a similar analysis to that of Figure 4 with the key difference that the sample for this figure is *non-municipal* schools. Note that values to the right side of the zero are negative (political turnover), while values on the left side are positive (no political turnover). The set of *non-municipal* schools for this outcome is comprised of state and federal schools, since only public schools participate in the *Prova Brasil* exam.

Table 1—: Descriptive Statistics and Test for Discontinuity in Baseline Characteristics, $|IncumbVoteMargin| < .09$

	(1) No Party Turnover	(2) Party Turnover	(3) P-value
Number of Municipalities	1,233	1,195	.
Municipal Characteristics			
Population	18,299.92	20,095.88	0.72
Ruling party from left	0.25	0.23	0.78
Winning party from left	0.25	0.30	0.04
Ruling party from right	0.57	0.57	0.36
Winning party from right	0.57	0.52	0.57
Number of Municipal Personnel	642.43	707.36	0.80
New Personnel High Manager (% of category)	0.28	0.28	0.55
New Personnel Low Manager (% of category)	0.23	0.22	0.36
New Personnel Not Manager (% of category)	0.25	0.24	0.67
New Personnel Education (% of category)	0.27	0.27	0.73
New Personnel Health (% of category)	0.29	0.28	0.96
New Personnel Construction (% of category)	0.20	0.20	0.37
New Personnel Multiple (% of category)	0.22	0.21	0.77
New Personnel Other (% of category)	0.26	0.26	0.86
Personnel that Left High Manager (% of category)	0.24	0.25	0.84
Personnel that Left Low Manager (% of category)	0.19	0.18	0.84
Personnel that Left Not Manager (% of category)	0.16	0.16	0.26
Personnel that Left Education (% of category)	0.19	0.20	0.33
Personnel that Left Health (% of category)	0.18	0.18	0.48
Personnel that Left Construction (% of category)	0.14	0.14	0.87
Personnel that Left Multiple (% of category)	0.14	0.14	0.47
Personnel that Left Other (% of category)	0.18	0.19	0.21
School Characteristics			
Share urban	0.26	0.28	0.50
Share connected to water network	0.39	0.41	0.84
Share connected to sewage system	0.15	0.16	0.79
Share with Internet	0.17	0.20	0.21
Number of school staff	15.13	16.24	0.78
Number of teachers per school	7.58	8.05	0.95
Teacher age	36.57	36.60	0.44
Share of female teachers	0.82	0.82	0.17
Share of teachers born in same municipality	0.69	0.69	0.41
Share of teachers with B.A.	0.43	0.44	0.48
Share of teachers who took <i>Concurso</i>	0.66	0.68	0.20
Share of teachers who are temporary	0.33	0.31	0.20
Number of classrooms taught per teacher	1.87	1.90	0.25
Number of schools taught per teacher	1.29	1.29	0.50
Share of teachers who teach only in municipal schools	0.93	0.92	0.99
Outcomes of Interest at Baseline			
4th grade test scores (only in PB)	-0.16	-0.12	0.10
8th grade test scores (only in PB)	-0.18	-0.16	0.22
Dropout rate	0.04	0.04	0.85
New headmaster (only in PB)	0.36	0.33	0.80
Share of teachers who are new to the school	0.51	0.52	0.68
Share of teachers who have left the school	0.50	0.51	0.48
New Municipal Personnel (share)	0.25	0.24	0.92
Municipal Personnel that Left (share)	0.17	0.17	0.45

This table shows descriptive statistics for municipalities that did not have political party turnover and municipalities that did have political party turnover in close elections, $|IncumbVoteMargin| < .09$, in Columns 1-2. Column 3 tests for a discontinuity in baseline characteristics at the $IncumbVoteMargin=0$ threshold: This column reports the p-value corresponding to the coefficient on $\mathbb{1}\{IncumbVoteMargin < 0\}$ in our main specification, Equation 1, with the corresponding variable at baseline used as the dependent variable. Appendix Table A7 includes additional statistics for School Characteristics.

Table 2—: Political Turnover and Municipal Personnel Replacement

Panel A: Municipal Personnel 1 year after the Election						
Outcome:	New Municipal Personnel (Share)		Municipal Personnel Who Left (Share)			
	(1)	(2)	(3)	(4)	(5)	
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.0693 (0.0188)	0.0715 (0.0242)	0.0621 (0.0196)	0.0233 (0.0168)	0.0326 (0.0220)	0.0204 (0.0176)
Observations	2,533	1,656	2,381	2,589	1,656	2,381
R-squared	0.0315	0.0264	0.0318	0.0159	0.0116	0.0159
Clusters	2157	1507	2052	2205	1507	2052
Mean Dep Variable	0.306	0.317	0.308	0.226	0.235	0.227
Using Bandwidth	0.119	0.0700	0.110	0.122	0.0700	0.110
Optimal Bandwidth	0.119	0.119	0.119	0.122	0.122	0.122
Panel B: Municipal Personnel from 1 to 2 years after the Election						
Outcome:	New Municipal Personnel (Share)		Municipal Personnel Who Left (Share)			
	(1)	(2)	(3)	(4)	(5)	
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.0169 (0.0150)	0.0290 (0.0208)	0.0147 (0.0166)	0.0051 (0.0136)	0.0165 (0.0187)	0.0043 (0.0150)
Observations	2,826	1,650	2,373	2,780	1,650	2,373
R-squared	0.0019	0.0031	0.0030	0.0065	0.0045	0.0060
Clusters	2357	1503	2047	2326	1503	2047
Mean Dep Variable	0.235	0.238	0.235	0.177	0.183	0.179
Using Bandwidth	0.137	0.0700	0.110	0.135	0.0700	0.110
Optimal Bandwidth	0.137	0.137	0.137	0.135	0.135	0.135

This table reports the coefficient on political party turnover estimating 1. Outcome variables: in columns 1-3, Panel A, New municipal personnel (share) is the ratio between the number of new labor contracts that had been added 12 months after the election divided by the total number of contracts that existed the month prior to the election, in Columns 4-6, Panel A, Municipal Personnel Who Left (share) is analogous and uses number of terminated contracts. Panel B uses the corresponding outcome variables where new and terminated contracts were measured between the first and second year after the election.

Table 3—: Political Turnover and 4th Grade and 8th Grade Test Scores

Panel A	Outcome: Individual 4 th Grade Test Scores (standardized)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.082 (0.028)	-0.064 (0.026)	-0.091 (0.029)	-0.075 (0.027)	-0.067 (0.024)	-0.055 (0.022)
School-level baseline scores	0.869 (0.014)	0.739 (0.014)	0.864 (0.015)	0.737 (0.015)	0.861 (0.012)	0.732 (0.012)
N	325,554	325,554	295,170	295,170	429,979	429,979
R-squared	0.218	0.252	0.213	0.248	0.218	0.252
Controls	No	Yes	No	Yes	No	Yes
Clusters	1669	1669	1538	1538	2101	2101
Using Bandwidth	0.0782	0.0782	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.0782	0.0782	0.0782	0.0782	0.0782	0.0782

Panel B	Outcome: Individual 8 th Grade Test Scores (standardized)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.054 (0.023)	-0.042 (0.023)	-0.050 (0.030)	-0.046 (0.029)	-0.059 (0.025)	-0.049 (0.025)
School-level baseline scores	0.789 (0.012)	0.729 (0.013)	0.783 (0.016)	0.725 (0.017)	0.783 (0.013)	0.722 (0.014)
N	245,302	245,302	126,855	126,855	191,169	191,169
R-squared	0.162	0.174	0.158	0.170	0.157	0.169
Controls	No	Yes	No	Yes	No	Yes
Clusters	1602	1602	965	965	1335	1335
Using Bandwidth	0.151	0.151	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.151	0.151	0.151	0.151	0.151	0.151

Notes: This table reports the coefficient on political party turnover from regressing individual-level 4th grade test scores (Panel A) and 8th grade test scores (Panel B) on the running variable of the RDD ($IncumbVoteMargin$), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin| < Using\ Bandwidth$. Test scores are from the *Prova Brasil* exam and are standardized based on the distribution of individual-level test scores in municipalities with no change in the ruling party. All specifications control for school-level, average test scores for the respective grader at baseline (one year before the respective election). Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet), individual-level controls (an indicator variable for gender, whether the student is white, and whether the student sees their mother reading), and a 2012 election-cycle indicator.

Table 4—: Political Turnover and Headmaster Replacements

Outcome:	Headmaster is new to the school (as Headmaster)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.278 (0.027)	0.277 (0.026)	0.273 (0.040)	0.272 (0.039)	0.271 (0.032)	0.270 (0.032)
N	15,011	15,011	7,517	7,517	11,196	11,196
R-squared	0.099	0.103	0.090	0.096	0.096	0.100
Controls	No	Yes	No	Yes	No	Yes
Clusters	2648	2648	1562	1562	2139	2139
Mean Dep Var	0.435	0.435	0.454	0.454	0.446	0.446
Using Bandwidth	0.157	0.157	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.157	0.157	0.157	0.157	0.157	0.157

This table reports the coefficient on political party turnover from regressing an indicator variable for whether the school has a new headmaster on the running variable of the RDD ($IncumbVoteMargin$), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin| < \text{Using Bandwidth}$. New headmasters are those that report being the headmaster of their current school for less than two years on the *Prova Brasil* headmaster questionnaire. Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator.

Table 5—: Political Turnover and New Teachers in Municipal and Non-municipal Schools

Panel A: Municipal Schools						
Outcome	Share of Teachers New to the School					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.117 (0.018)	0.119 (0.018)	0.112 (0.022)	0.113 (0.022)	0.101 (0.019)	0.103 (0.019)
Observations	38,065	38,065	21,885	21,885	32,883	32,883
R-squared	0.026	0.029	0.027	0.029	0.030	0.032
Controls	No	Yes	No	Yes	No	Yes
Clusters	2297	2297	1509	1509	2056	2056
Mean LHS	0.464	0.464	0.464	0.464	0.459	0.459
Using Bandwidth	0.130	0.130	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.130	0.130	0.130	0.130	0.130	0.130
Panel B: Non-municipal Schools						
Outcome	Share of Teachers New to the School					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.011 (0.013)	0.016 (0.013)	0.037 (0.019)	0.037 (0.018)	0.021 (0.015)	0.025 (0.015)
Observations	13,819	13,819	7,449	7,449	10,774	10,774
R-squared	0.001	0.017	0.003	0.013	0.001	0.015
Controls	No	Yes	No	Yes	No	Yes
Clusters	2466	2466	1521	1521	2064	2064
Mean LHS	0.477	0.477	0.475	0.475	0.475	0.475
Using Bandwidth	0.147	0.147	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.147	0.147	0.147	0.147	0.147	0.147

This table reports the coefficient on political party turnover from regressing the share of teachers that are new to the school or the share of teachers that have left a school on the running variable of the RDD ($IncumbVoteMargin$), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin|$; Using Bandwidth separately for municipal (Panel A) and *non-municipal* (Panel B) schools. The share of teachers that are new to a school is computed using the School Census and corresponds to the share of teachers in a school who are in that school at time t (one year after the respective election) but were not in that same school at time $t - 2$ (the year before the respective election). Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator. The set of *non-municipal* schools for these outcomes is comprised of state, federal, and private schools (since all schools participate in School Census).

(Continued from previous page)

Panel C: Municipal Schools						
Outcome	Share of Teachers that have Left the School					
	(1)	(2)	(3)	(4)	(5)	(6)
$1\{IncumbVoteMargin < 0\}$	0.114 (0.018)	0.115 (0.018)	0.106 (0.022)	0.107 (0.022)	0.098 (0.019)	0.099 (0.019)
Observations	38,808	38,808	21,885	21,885	32,883	32,883
R-squared	0.024	0.026	0.025	0.026	0.027	0.029
Controls	No	Yes	No	Yes	No	Yes
Clusters	2327	2327	1509	1509	2056	2056
Mean LHS	0.448	0.448	0.449	0.449	0.444	0.444
Using Bandwidth	0.133	0.133	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.133	0.133	0.133	0.133	0.133	0.133
Panel D: Non-municipal Schools						
Outcome	Share of Teachers that have Left the School					
	(1)	(2)	(3)	(4)	(5)	(6)
$1\{IncumbVoteMargin < 0\}$	0.015 (0.012)	0.017 (0.012)	0.039 (0.018)	0.038 (0.018)	0.023 (0.014)	0.025 (0.014)
Observations	14,427	14,427	7,449	7,449	10,774	10,774
R-squared	0.001	0.021	0.003	0.018	0.002	0.020
Controls	No	Yes	No	Yes	No	Yes
Clusters	2551	2551	1521	1521	2064	2064
Mean LHS	0.460	0.460	0.455	0.455	0.458	0.458
Using Bandwidth	0.156	0.156	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.156	0.156	0.156	0.156	0.156	0.156

This table reports the coefficient on political party turnover from regressing the share of teachers that are new to the school or the share of teachers that have left a school on the running variable of the RDD ($IncumbVoteMargin$), political party turnover ($1\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin|$; Using Bandwidth separately for municipal (Panel C) and *non-municipal* (Panel D) schools. The share of teachers that have left a school is computed using the School Census and corresponds to the share of teachers in a school who were in that school at time $t - 2$ (the year before the respective election) but are no longer in that same school at time t (one year after the respective election). Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator. The set of *non-municipal* schools for these outcomes is comprised of state, federal, and private schools (since all schools participate in School Census).

Table 6—: Political Turnover and Non-municipal Schools

Panel A	Outcome: Headmaster is new to the school (as Headmaster)					
	(1)	(2)	(3)	(4)	(5)	(6)
$1\{IncumbVoteMargin < 0\}$	-0.008 (0.027)	-0.016 (0.025)	0.002 (0.039)	-0.019 (0.036)	0.027 (0.032)	0.008 (0.030)
N	7,762	7,762	4,050	4,050	5,780	5,780
R-squared	0.001	0.023	0.001	0.029	0.000	0.025
Controls	No	Yes	No	Yes	No	Yes
Clusters	2321	2321	1374	1374	1858	1858
Mean Dep Var	0.389	0.389	0.387	0.387	0.395	0.395
Using Bandwidth	0.158	0.158	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.158	0.158	0.158	0.158	0.158	0.158
Panel B	Outcome: Individual 4 th Grade Test Scores (standardized)					
	(1)	(2)	(3)	(4)	(5)	(6)
$1\{IncumbVoteMargin < 0\}$	0.013 (0.031)	0.024 (0.029)	-0.005 (0.044)	0.024 (0.040)	0.007 (0.035)	0.025 (0.033)
School-level baseline scores	0.805 (0.016)	0.707 (0.016)	0.806 (0.020)	0.707 (0.020)	0.816 (0.018)	0.716 (0.018)
N	152,086	152,086	89,753	89,753	126,439	126,439
R-squared	0.157	0.191	0.154	0.188	0.158	0.192
Controls	No	Yes	No	Yes	No	Yes
Clusters	1161	1161	755	755	1015	1015
Using Bandwidth	0.135	0.135	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.135	0.135	0.135	0.135	0.135	0.135

This table shows a similar analysis to that of Tables 3 and 4 with the key difference that the estimation sample for this table is *non-municipal* schools. The set of *non-municipal* schools for these outcomes is comprised of state and federal schools, since only public schools participate in the *Prova Brasil* exam.

Table 7—: Political Turnover and Financial Resources

Panel A		Municipal level Financial Resources: 1 year after the election					
Outcome:	Total Expenditures			Expenditures on Education (Share)			
	(1)	(2)	(3)	(4)	(5)	(6)	
$\mathbb{1}\{IncumbVoteMargin < 0\}$	1.5333 (2.4263)	1.3636 (2.6085)	2.4858 (2.1865)	0.0174 (0.0067)	0.0184 (0.0080)	0.0146 (0.0064)	
Observations	2,491	1,943	2,794	2,565	1,943	2,794	
R-squared	0.0097	0.0063	0.0087	0.0239	0.0254	0.0236	
Mean Dep Variable	23.99	23.55	23.98	0.299	0.297	0.299	
Using Bandwidth	0.0956	0.0700	0.110	0.0983	0.0700	0.110	
Optimal Bandwidth	0.0956	0.0956	0.0956	0.0983	0.0983	0.0983	

Panel B		Municipal level Financial Resources: 2 years after the election					
Outcome:	Total Expenditures			Expenditures on Education (Share)			
	(1)	(2)	(3)	(4)	(5)	(6)	
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.7139 (2.6542)	1.1100 (2.8334)	1.3727 (2.4474)	0.0020 (0.0067)	0.0021 (0.0083)	0.0017 (0.0067)	
Observations	2,463	1,885	2,716	2,731	1,885	2,716	
R-squared	0.0069	0.0046	0.0074	0.0130	0.0125	0.0128	
Mean Dep Variable	25.85	25.68	25.72	0.298	0.297	0.298	
Using Bandwidth	0.0972	0.0700	0.110	0.111	0.0700	0.110	
Optimal Bandwidth	0.0972	0.0972	0.0972	0.111	0.111	0.111	

Panel C		School Level Financial Resources		
Outcome:	"Does your school experience financial problems?"			
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.023 (0.024)	0.037 (0.028)		0.027 (0.023)
N	10,813	7,389		11,011
R-squared	0.013	0.014		0.013
Controls	Yes	Yes		Yes
Clusters	2105	1563		2139
Mean Dep Variable	0.601	0.608		0.601
Using Bandwidth	0.108	0.0700		0.110
Optimal Bandwidth	0.108	0.108		0.108

This table reports the coefficient on political party turnover from regressing each of the variables on the running variable of the RDD ($IncumbVoteMargin$), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin| < Using Bandwidth$. It shows municipal-level regressions, using data from the Brazilian Federal Treasury for both election cycles 2008 and 2012 in Panels A-B. Panel A refers to different categories of municipal financial resources assessed one year after the election, Panel B refers to resources assessed two years after the election. Total Expenditures refer to a municipality's total budget, at 2008 Brazilian Reais price-levels scaled by a factor of 1,000,000. Expenditures on Education (share) is the share of the municipality's total budget spent on education. Panel C shows school-level regressions, using data from the *Prova Brasil* headmaster questionnaire (for both election-cycles). Controls in Panel C include school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator.

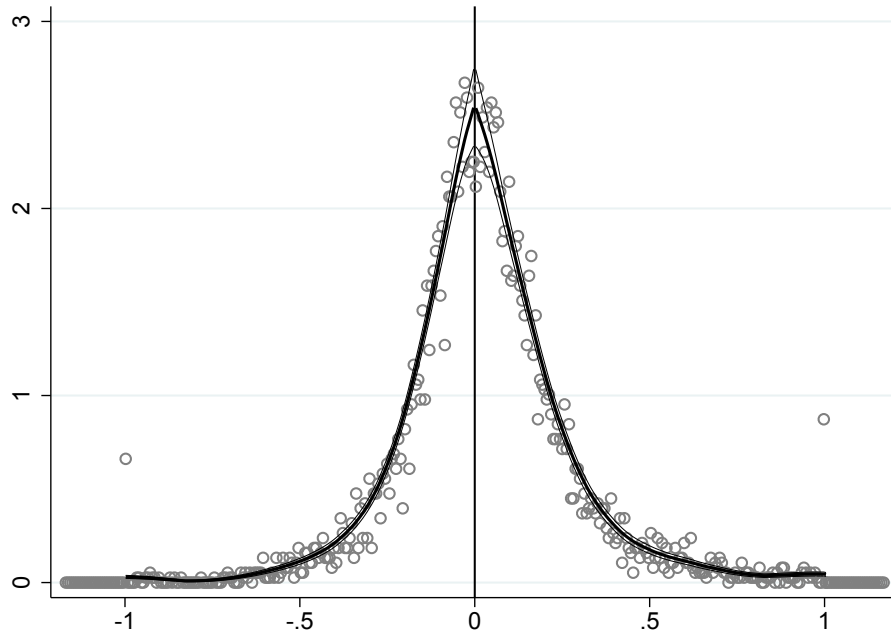
Online Appendix A. Figures and Tables
Political Turnover, Bureaucratic Turnover and the Quality of
Public Services

Mitra Akhtari
Airbnb

Diana Moreira
U.C. Davis

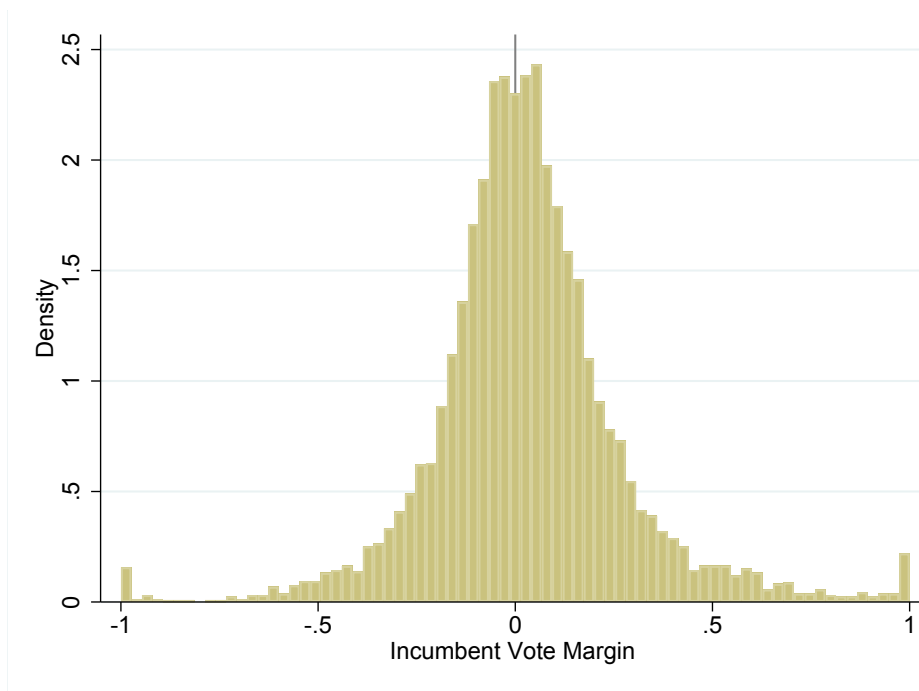
Laura Trucco
Amazon

FIGURE A.1: MCCRARY TEST FOR MANIPULATION OF INCUMBENT VOTE MARGIN



NOTES: THIS FIGURE SHOWS THE MCCRARY TEST FOR MANIPULATION OF THE RUNNING VARIABLE IN THE RDD, *IncumbVoteMargin*. THE TEST FAILS TO REJECT THE NULL HYPOTHESIS THAT *IncumbVoteMargin* IS CONTINUOUS AT THE ZERO THRESHOLD. THE ESTIMATED DISCONTINUITY IS $-.0019$ (LOG DIFFERENCE IN HEIGHT) WITH A STANDARD ERROR OF $.0607$.

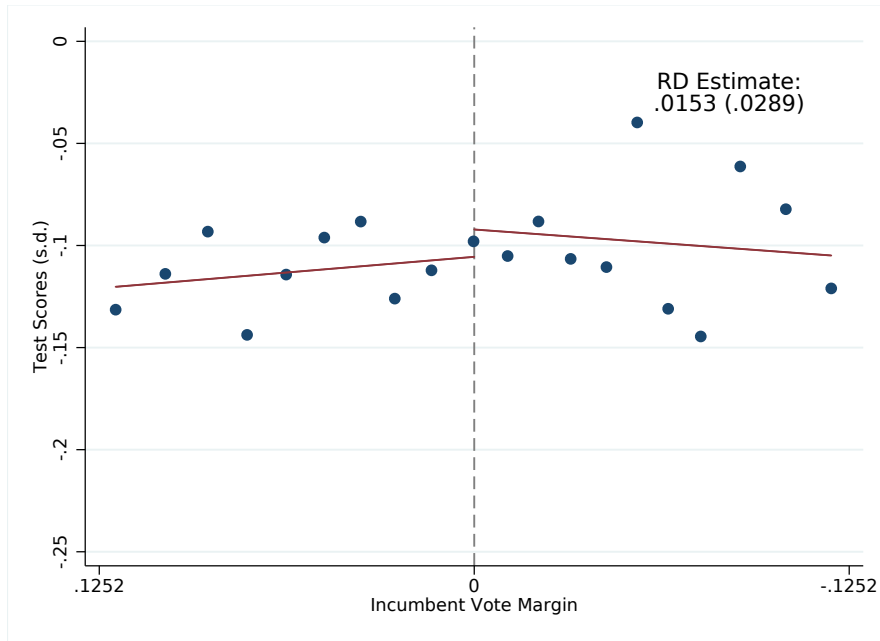
FIGURE A.2: DISTRIBUTION OF INCUMBENT VOTE MARGIN



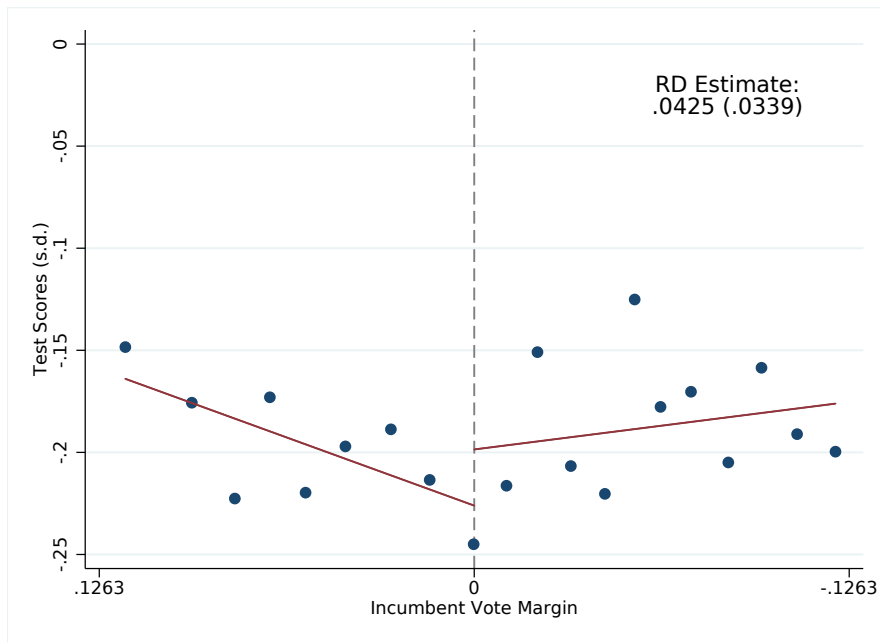
NOTES: THIS HISTOGRAM SHOWS THE DISTRIBUTION OF THE RUNNING VARIABLE IN THE RDD, *IncumbVoteMargin*, IN OUR SAMPLE OF MUNICIPALITIES IN THE 2008 AND 2012 ELECTION CYCLE. *IncumbVoteMargin* IS COMPUTED AS THE VOTE SHARE OF THE INCUMBENT POLITICAL PARTY MINUS THE VOTE SHARE OF THE INCUMBENT PARTY'S STRONGEST OPPONENT.

FIGURE A.3: POLITICAL TURNOVER AND TEST SCORES AT BASELINE

(a) 4th Grade Test Score

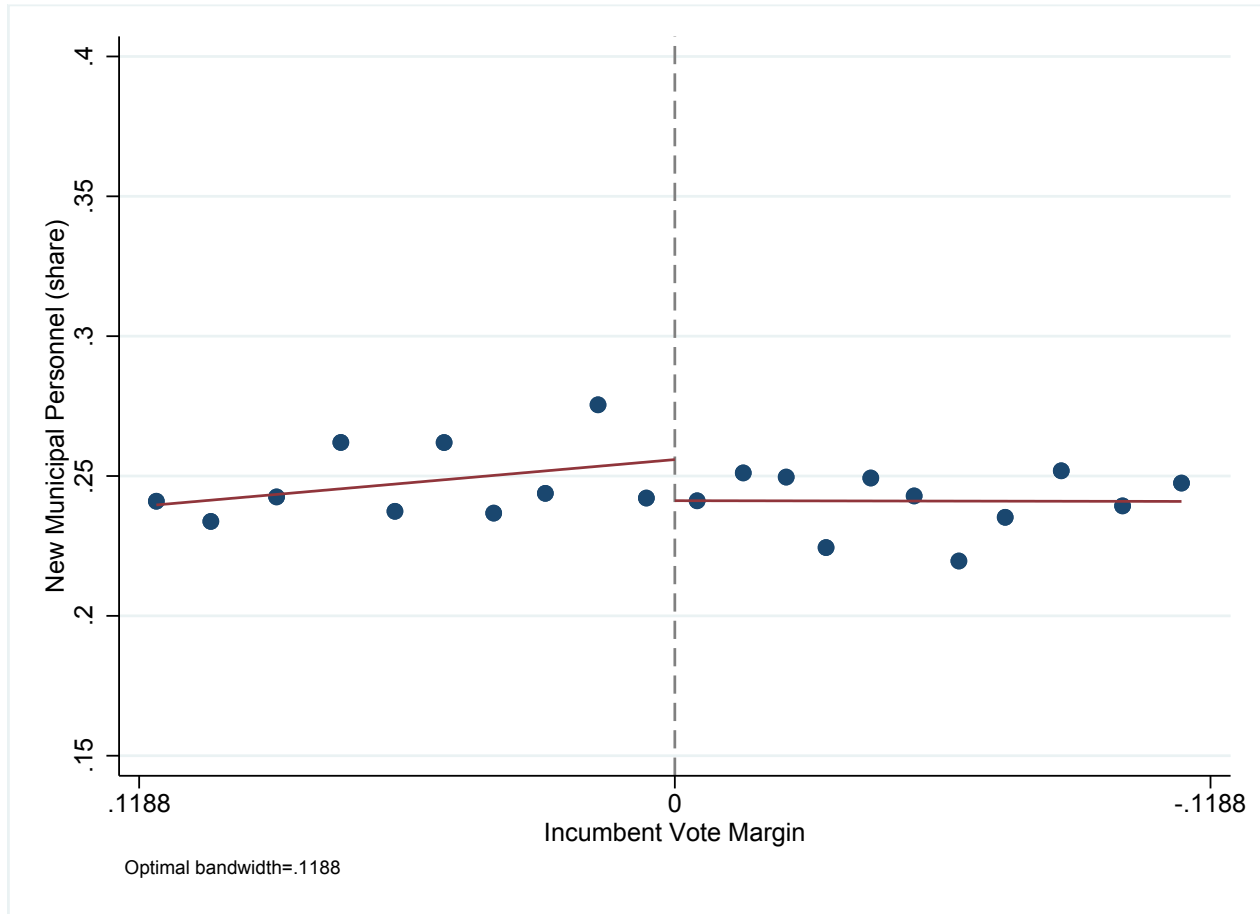


(b) 8th Grade Test Score



NOTES: THESE GRAPHS SHOW THE (LACK OF A) DISCONTINUITY IN TEST SCORES ONE YEAR PRIOR TO THE ELECTION AS A FUNCTION OF INCUMBENT VOTE MARGIN DURING THE ELECTION FOR INDIVIDUAL-LEVEL 4TH (PANEL A) AND 8TH (PANEL B) GRADE TEST SCORES. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. TEST SCORES ARE FROM THE *Prova Brasil* EXAM AT BASELINE (THE YEAR BEFORE THE ELECTION) AND ARE STANDARDIZED BASED ON THE DISTRIBUTION OF INDIVIDUAL-LEVEL TEST SCORES IN MUNICIPALITIES WITH NO CHANGE IN THE RULING PARTY. THE SCHOOL-LEVEL AVERAGE TEST SCORES FOR THE RESPECTIVE GRADE PRIOR TO THE BASELINE YEAR IS INCLUDED AS A CONTROL.

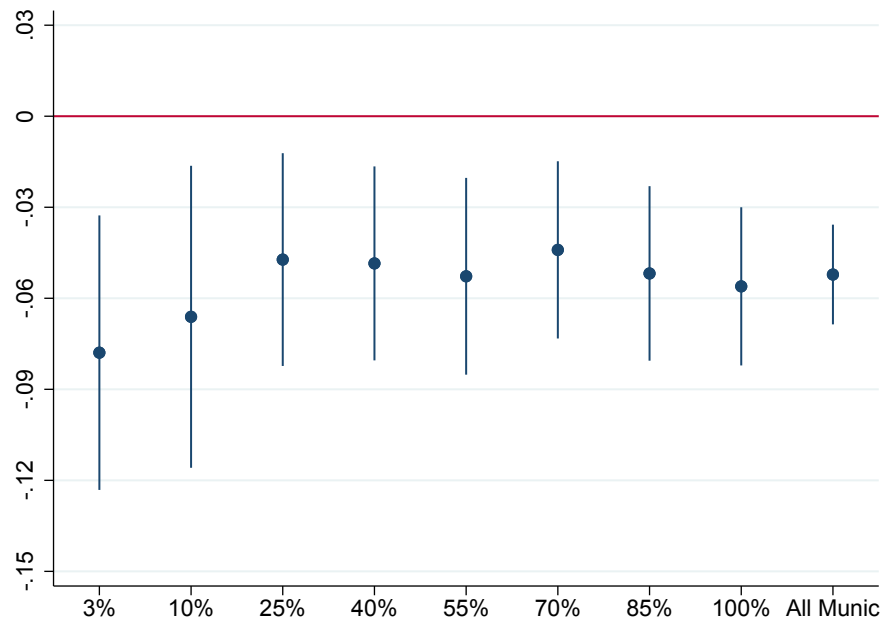
FIGURE A.4: POLITICAL TURNOVER AND NEW MUNICIPAL PERSONNEL CHANGES AT BASELINE



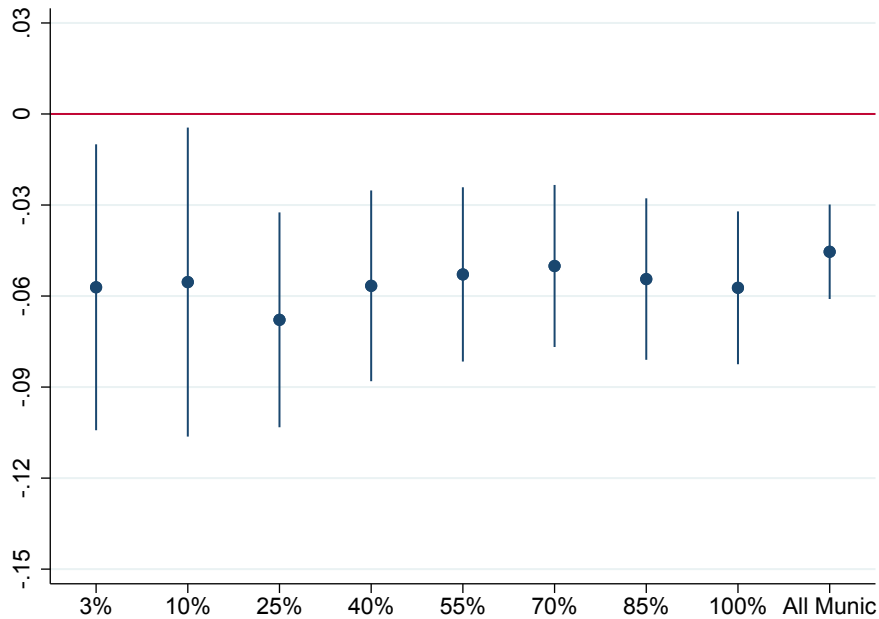
NOTES: THIS FIGURE SHOWS THE MEAN OF MUNICIPAL-LEVEL SHARE OF NEW MUNICIPAL PERSONNEL IN 2008 AND 2012 BY BINS OF *IncumbVoteMargin*. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED CHANGE IN THE POLITICAL PARTY OF THE MAYOR IN 2008 OR 2012 ELECTIONS. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE CHANGE IN THE POLITICAL PARTY OF THE MAYOR IN 2008 OR 2012 ELECTIONS. NOTE THAT VALUES TO THE RIGHT SIDE OF THE ZERO ARE NEGATIVE (POLITICAL TURNOVER), WHILE VALUES ON THE LEFT SIDE ARE POSITIVE (NO POLITICAL TURNOVER). NEW MUNICIPAL PERSONNEL (SHARE) AT BASELINE IS THE RATIO BETWEEN THE NUMBER OF NEW LABOR CONTRACTS THAT HAD BEEN ADDED IN THE 12 MONTHS BEFORE THE ELECTION DIVIDED BY THE TOTAL NUMBER OF CONTRACTS THAT EXISTED ONE YEAR BEFORE THE ELECTION.

FIGURE A.5: EXTERNAL VALIDITY TEST SCORES

(a) 4th Grade Test Score

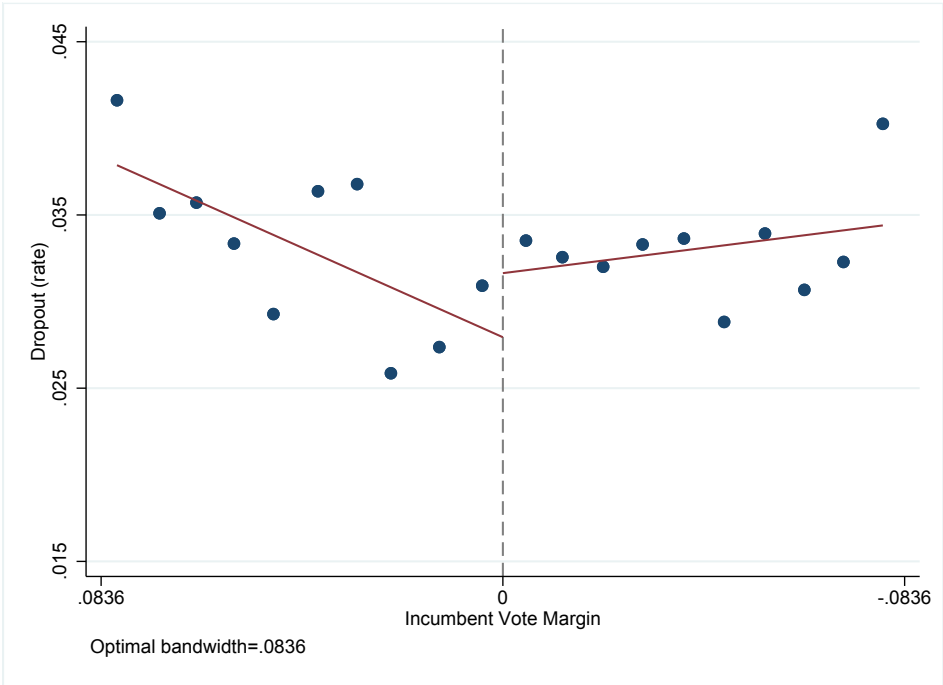


(b) 8th Grade Test Score



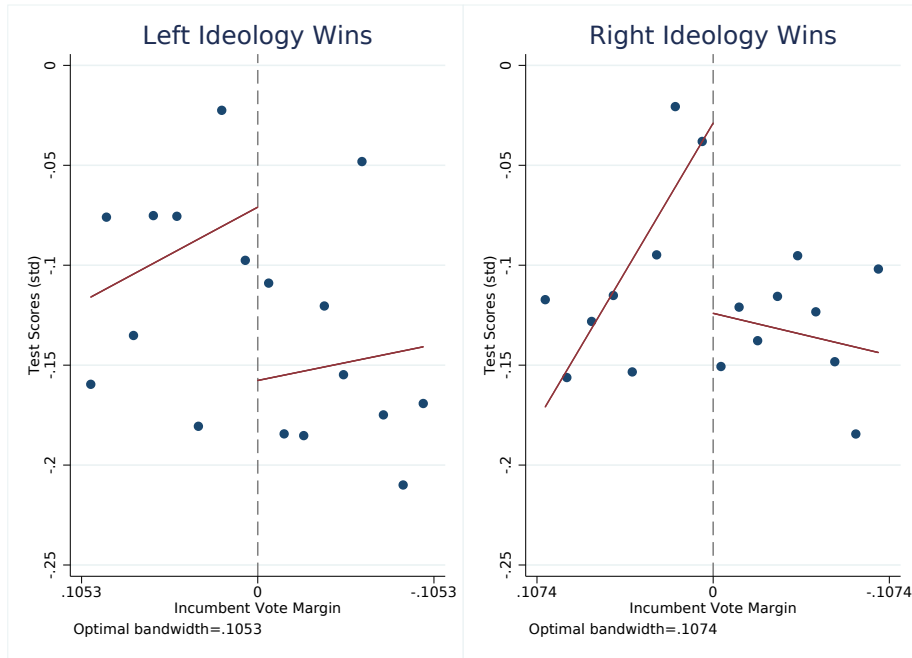
NOTES: THIS FIGURE SHOWS COEFFICIENTS ON POLITICAL TURNOVER FROM REGRESSING 1 WITHIN DIFFERENT BANDWIDTHS OF *IncumbVoteMargin* (X-AXIS). OUTCOME: INDIVIDUAL-LEVEL 4TH GRADE TEST SCORES (PANEL A) AND 8TH GRADE TEST SCORES (PANEL B). TEST SCORES ARE FROM THE PROVA BRASIL EXAM AND ARE STANDARDIZED BASED ON THE DISTRIBUTION OF INDIVIDUAL-LEVEL TEST SCORES IN MUNICIPALITIES WITH NO CHANGE IN THE RULING PARTY. ALL SPECIFICATIONS CONTROL FOR SCHOOL-LEVEL, AVERAGE TEST SCORES AT BASELINE (ONE YEAR BEFORE THE RESPECTIVE ELECTION). "ALL MUNIC" CATEGORY INCLUDES MUNICIPALITIES WHERE PARTY DID NOT RUN FOR REELECTION AND THEREFORE *IncumbVoteMargin* IS NOT DEFINED (OUT OF THE BANDWIDTH SAMPLE).

FIGURE A.6: POLITICAL TURNOVER AND SCHOOL-LEVEL DROPOUT RATES



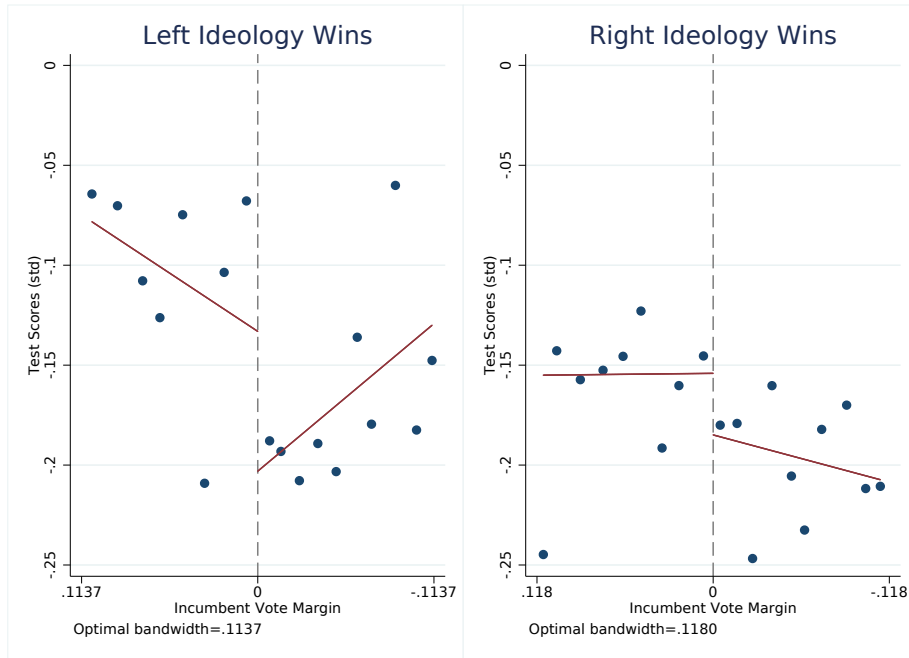
NOTES: THIS FIGURE SHOWS THE MEAN OF SCHOOL-LEVEL DROPOUT RATES BY BINS OF *IncumbVoteMargin*. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. THE SCHOOL-LEVEL DROPOUT RATE IS MEASURED BY THE SCHOOL CENSUS AND REFERS TO THE DROPOUT RATE FOR ALL STUDENTS WITHIN A SCHOOL (IN ALL GRADE LEVELS). THE SCHOOL-LEVEL DROPOUT RATE AT BASELINE (THE YEAR BEFORE THE RESPECTIVE ELECTION) IS INCLUDED AS A CONTROL.

FIGURE A.7: POLITICAL TURNOVER AND 4TH GRADE TEST SCORES IN MUNICIPALITIES WHERE THE WINNING PARTY WAS FROM THE LEFT VS. THE RIGHT



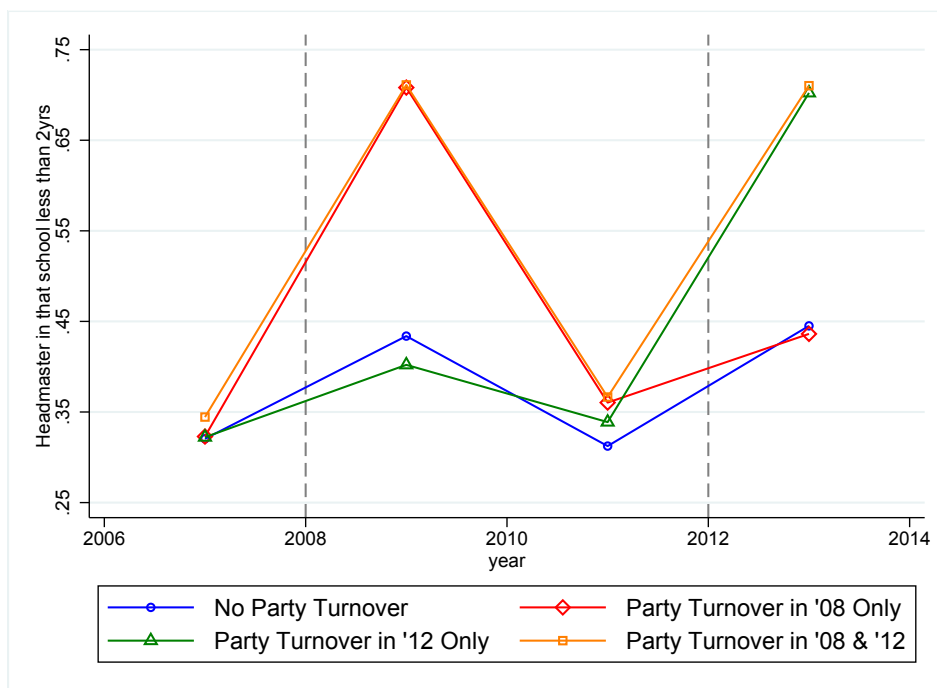
NOTES: THIS FIGURE SHOWS THE MEAN OF INDIVIDUAL-LEVEL 4TH GRADE TEST SCORES BY BINS OF *IncumbVoteMargin* SEPARATELY FOR MUNICIPALITIES WHERE THE WINNING PARTY WAS FROM THE LEFT AND THOSE WHERE THE WINNING PARTY WAS FROM THE RIGHT. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. TEST SCORES ARE FROM THE *Prova Brasil* EXAM AND ARE STANDARDIZED BASED ON THE DISTRIBUTION OF INDIVIDUAL-LEVEL TEST SCORES IN MUNICIPALITIES WITH NO CHANGE IN THE RULING PARTY. AVERAGE, SCHOOL-LEVEL 4TH GRADE TEST SCORES AT BASELINE (THE YEAR BEFORE THE RESPECTIVE ELECTION) IS INCLUDED AS A CONTROL. PARTY IDEOLOGY IS CLASSIFIED AS BELONGING TO THE LEFT VS. THE RIGHT ACCORDING TO *Atlas Político – Mapa do Congresso*.

FIGURE A.8: POLITICAL TURNOVER AND 8TH GRADE TEST SCORES IN MUNICIPALITIES WHERE THE WINNING PARTY WAS FROM THE LEFT VS. THE RIGHT



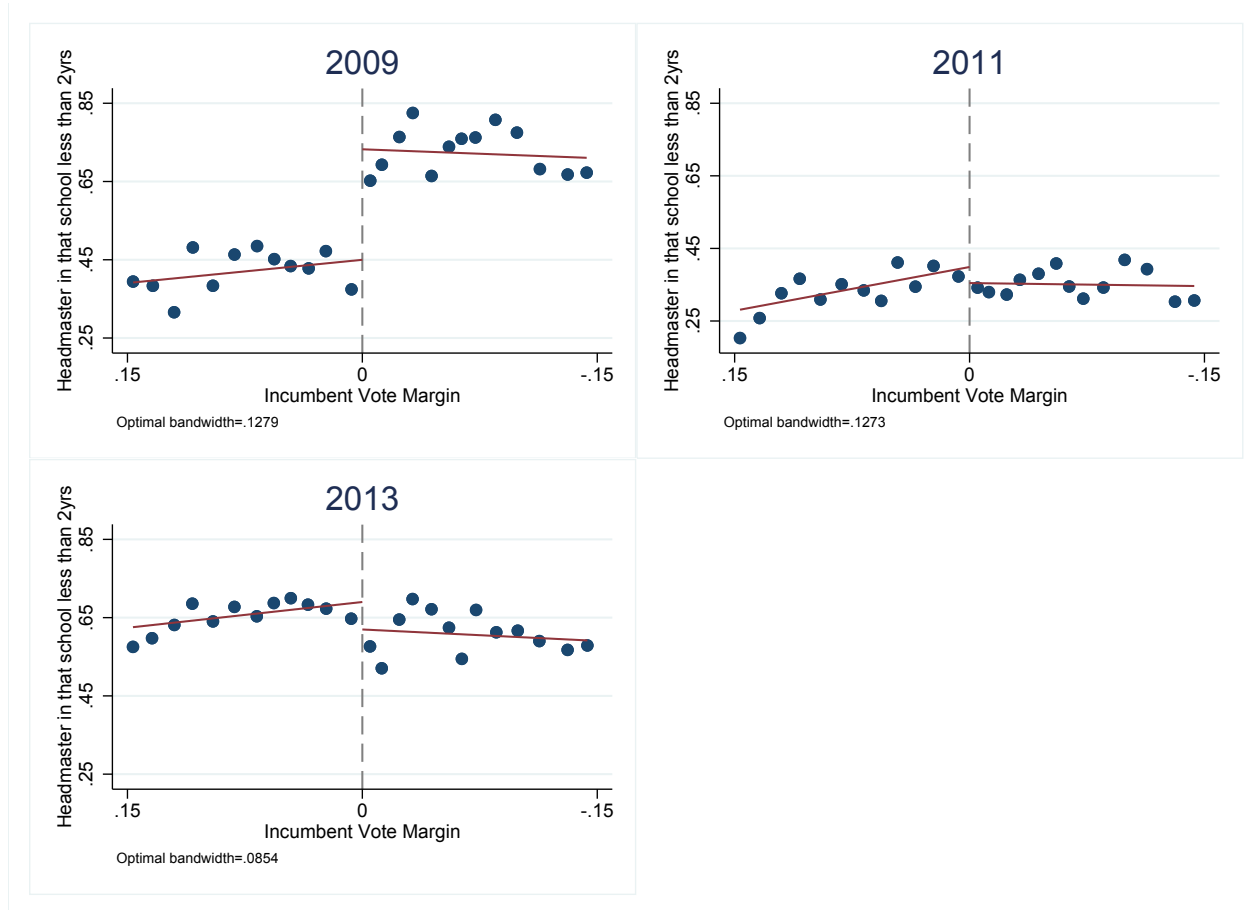
NOTES: THIS FIGURE SHOWS THE MEAN OF INDIVIDUAL-LEVEL 8TH GRADE TEST SCORES BY BINS OF *IncumbVoteMargin* SEPARATELY FOR MUNICIPALITIES WHERE THE WINNING PARTY WAS FROM THE LEFT AND THOSE WHERE THE WINNING PARTY WAS FROM THE RIGHT. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. TEST SCORES ARE FROM THE *Prova Brasil* EXAM AND ARE STANDARDIZED BASED ON THE DISTRIBUTION OF INDIVIDUAL-LEVEL TEST SCORES IN MUNICIPALITIES WITH NO CHANGE IN THE RULING PARTY. AVERAGE, SCHOOL-LEVEL 8TH GRADE TEST SCORES AT BASELINE (THE YEAR BEFORE THE RESPECTIVE ELECTION) IS INCLUDED AS A CONTROL. PARTY IDEOLOGY IS CLASSIFIED AS BELONGING TO THE LEFT VS. THE RIGHT ACCORDING TO *Atlas Político – Mapa do Congresso*.

FIGURE A.9: POLITICAL TURNOVER AND HEADMASTER REPLACEMENT - EVENT STUDY



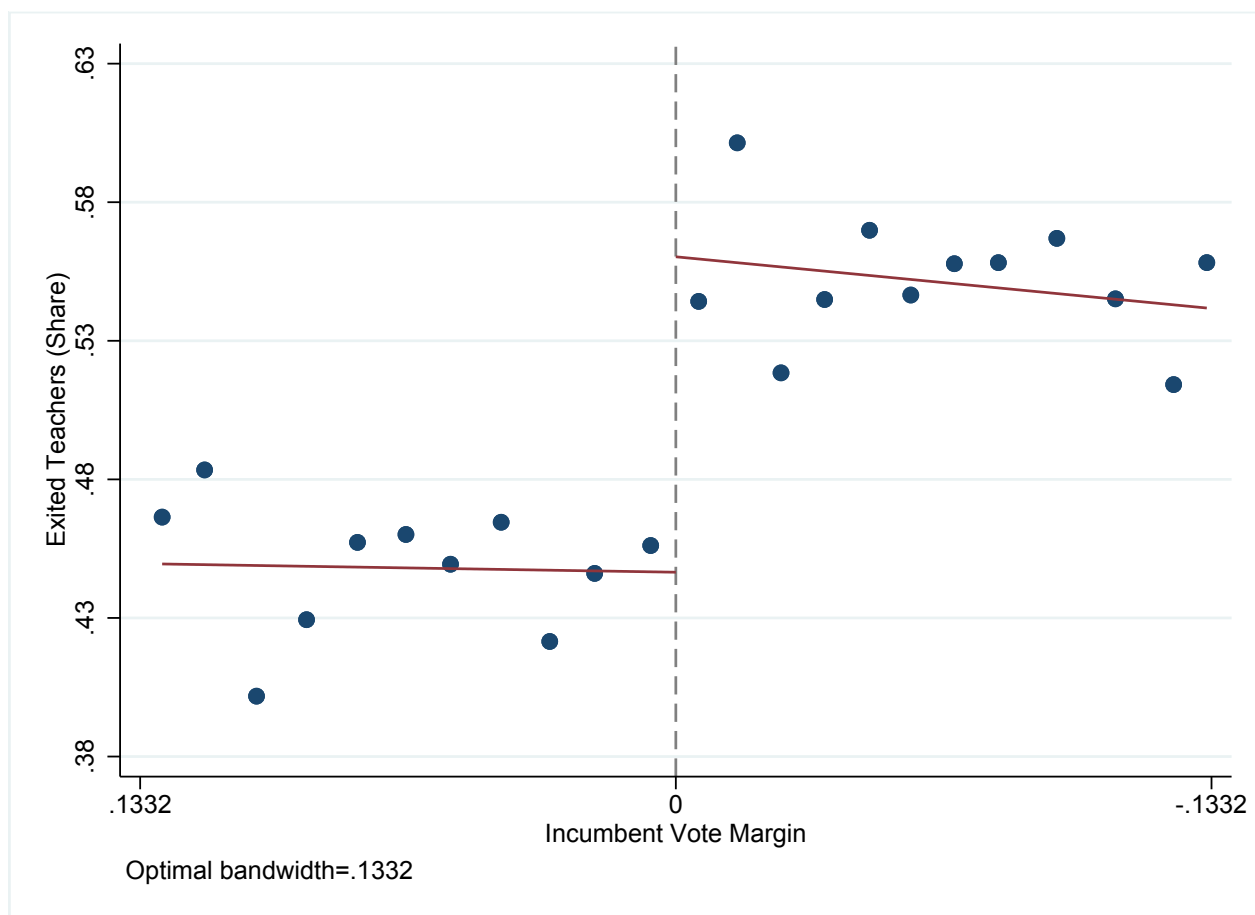
NOTES: THIS FIGURE SHOWS THE SHARE OF SCHOOLS WITH A NEW HEADMASTER IN MUNICIPALITIES THAT: DID NOT EXPERIENCE PARTY TURNOVER IN EITHER ELECTION CYCLE, EXPERIENCED PARTY TURNOVER ONLY IN 2008, EXPERIENCED PARTY TURNOVER ONLY IN 2012, OR EXPERIENCED PARTY TURNOVER IN BOTH ELECTION CYCLES. NEW HEADMASTERS ARE THOSE THAT REPORT BEING THE HEADMASTER OF THEIR CURRENT SCHOOL FOR LESS THAN TWO YEARS ON THE *Prova Brasil* HEADMASTER QUESTIONNAIRE.

FIGURE A.10: POLITICAL TURNOVER IN 2008 AND HEADMASTER REPLACEMENT 1, 3, AND 5 YEARS AFTER THE ELECTION



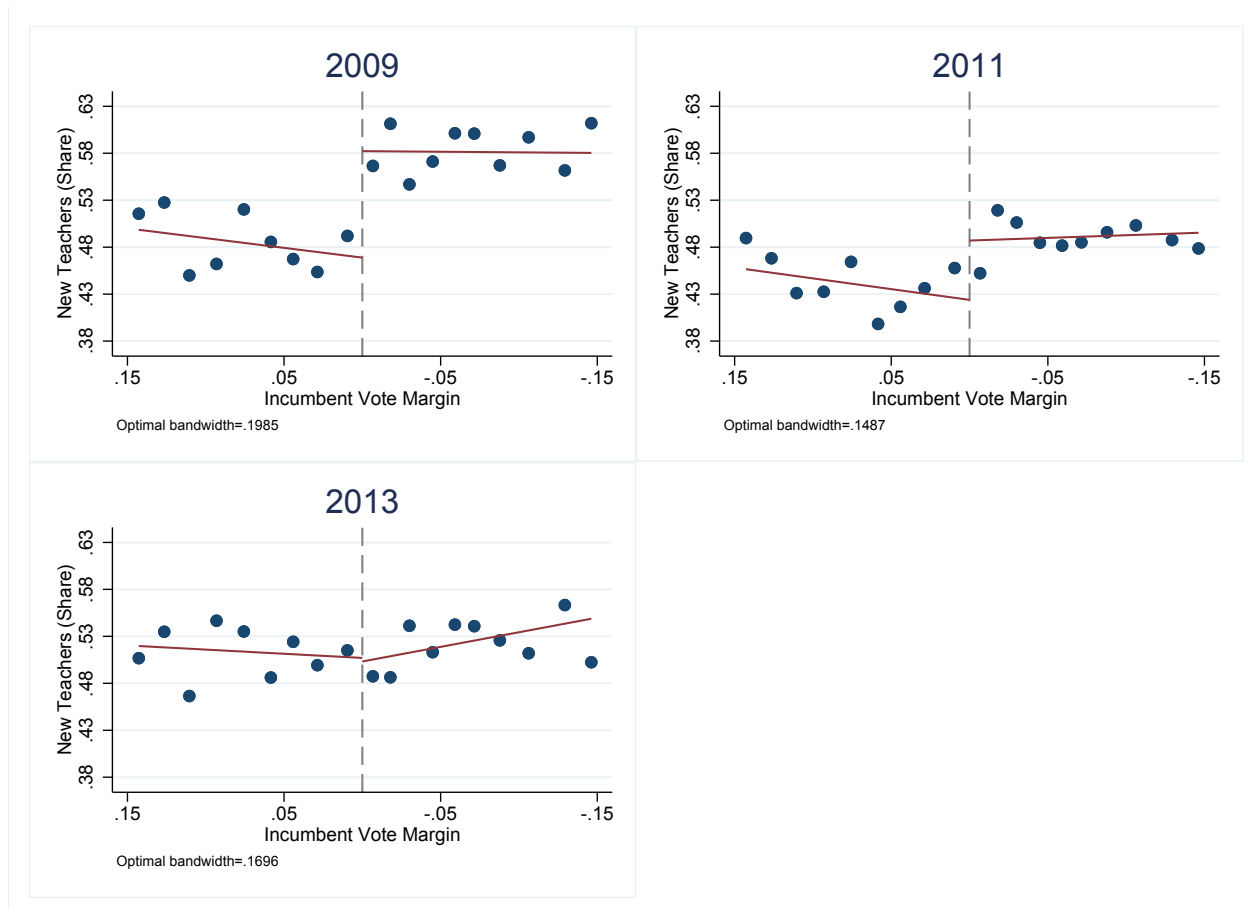
NOTES: THIS FIGURE SHOWS THE SHARE OF SCHOOLS WITH A NEW HEADMASTER BY BINS OF $IncumbVoteMargin_{2008}$ SEPARATELY FOR EACH YEAR t , WHERE t IS ONE YEAR, THREE YEARS, AND FIVE YEARS AFTER THE 2008 ELECTION. MUNICIPALITIES WITH $IncumbVoteMargin_{2008} < 0$ EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH $IncumbVoteMargin_{2008} > 0$ DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. NEW HEADMASTERS ARE THOSE THAT REPORT BEING THE HEADMASTER OF THEIR CURRENT SCHOOL FOR LESS THAN TWO YEARS ON THE *Prova Brasil* HEADMASTER QUESTIONNAIRE.

FIGURE A.11: POLITICAL TURNOVER AND TEACHERS WHO HAVE LEFT



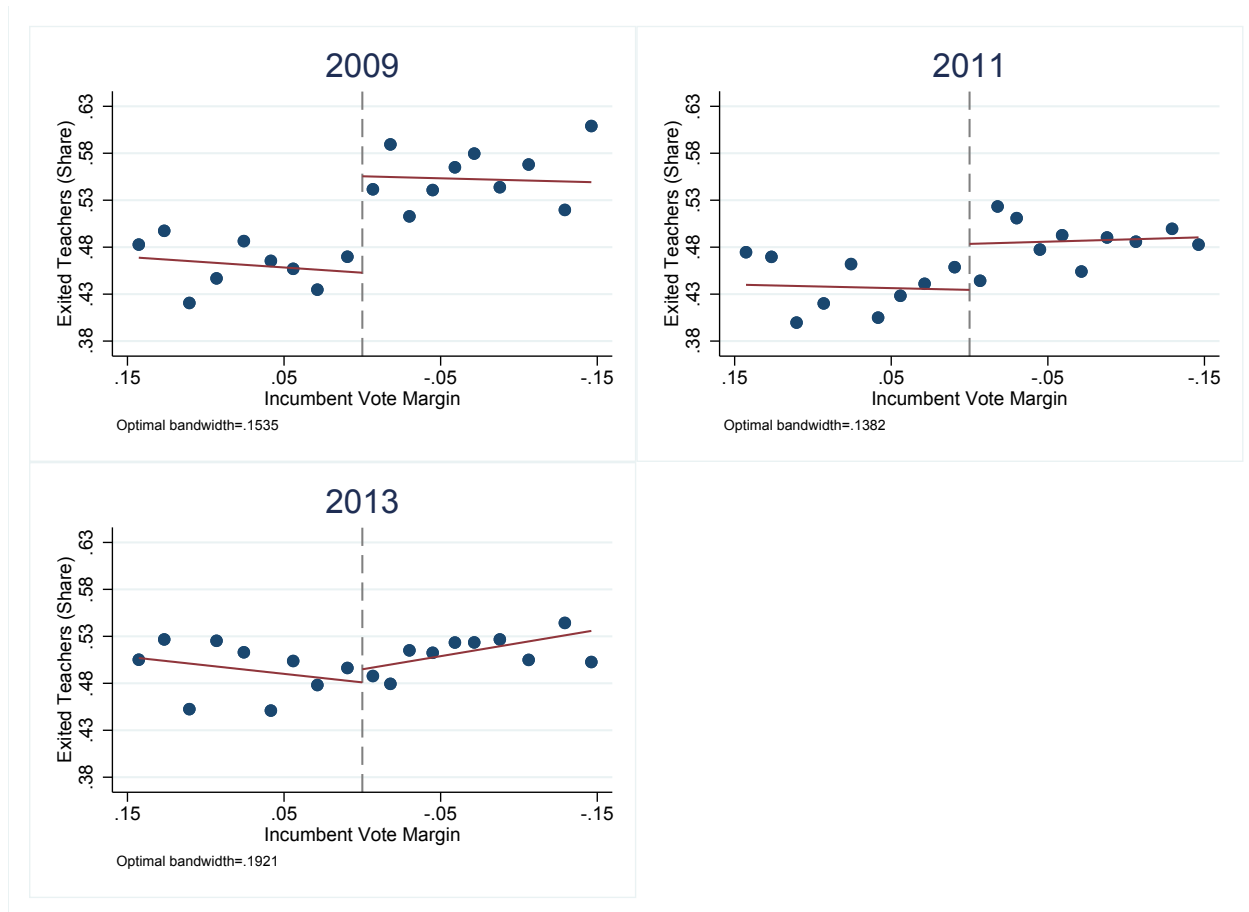
NOTES: THIS FIGURE SHOWS THE SHARE OF TEACHERS WHO HAVE LEFT THE SCHOOL BY BINS OF *IncumbVoteMargin*. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. THE SHARE OF TEACHERS WHO HAVE LEFT A SCHOOL IS COMPUTED USING THE SCHOOL CENSUS AND CORRESPONDS TO THE SHARE OF TEACHERS IN A SCHOOL WHO WERE IN THAT SCHOOL AT TIME $t - 2$ (THE YEAR BEFORE THE RESPECTIVE ELECTION) BUT ARE NO LONGER IN THAT SAME SCHOOL AT TIME t (ONE YEAR AFTER THE RESPECTIVE ELECTION).

FIGURE A.12: POLITICAL TURNOVER IN 2008 AND NEW TEACHERS 1, 3, AND 5 YEARS AFTER THE ELECTION



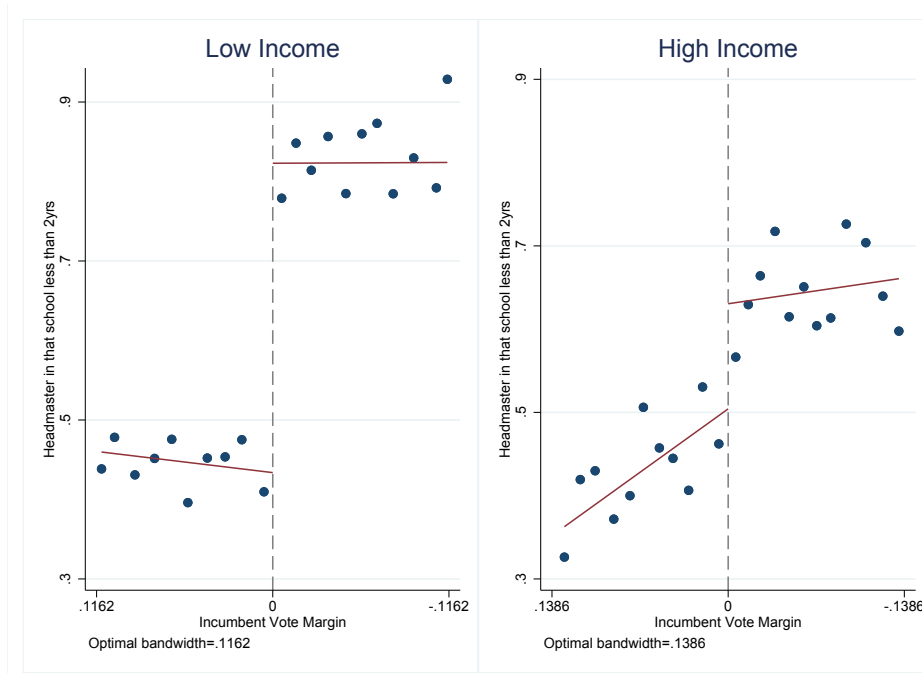
NOTES: THIS FIGURE SHOWS THE SHARE OF TEACHERS THAT ARE NEW TO A SCHOOL BY BINS OF $IncumbVoteMargin_{2008}$ SEPARATELY FOR EACH YEAR t , WHERE t IS ONE YEAR, THREE YEARS, AND FIVE YEARS AFTER THE 2008 ELECTION. MUNICIPALITIES WITH $IncumbVoteMargin_{2008} < 0$ EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH $IncumbVoteMargin_{2008} > 0$ DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. THE SHARE OF TEACHERS THAT ARE NEW TO A SCHOOL IS COMPUTED USING THE SCHOOL CENSUS AND CORRESPONDS TO THE SHARE OF TEACHERS IN A SCHOOL WHO ARE IN THAT SCHOOL AT TIME t BUT WERE NOT IN THAT SAME SCHOOL AT TIME $t - 2$.

FIGURE A.13: POLITICAL TURNOVER IN 2008 AND TEACHERS THAT HAVE LEFT 1, 3, AND 5 YEARS AFTER THE ELECTION



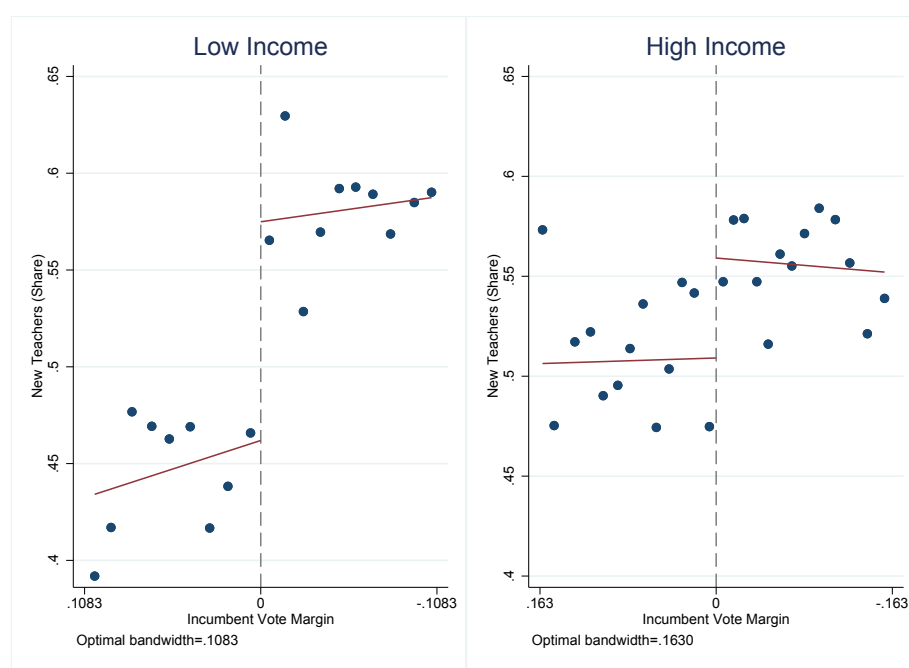
NOTES: THIS FIGURE SHOWS THE SHARE OF TEACHERS THAT HAVE LEFT A SCHOOL BY BINS OF $IncumbVoteMargin_{2008}$ SEPARATELY FOR EACH YEAR t , WHERE t IS ONE YEAR, THREE YEARS, AND FIVE YEARS AFTER THE 2008 ELECTION. MUNICIPALITIES WITH $IncumbVoteMargin_{2008} < 0$ EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR IN 2008. MUNICIPALITIES WITH $IncumbVoteMargin_{2008} > 0$ DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR IN 2008. THE SHARE OF TEACHERS THAT HAVE LEFT A SCHOOL IS COMPUTED USING THE SCHOOL CENSUS AND CORRESPONDS TO THE SHARE OF TEACHERS IN A SCHOOL WHO WERE IN THAT SCHOOL AT TIME $t - 2$ BUT ARE NO LONGER IN THAT SAME SCHOOL AT TIME t .

FIGURE A.14: POLITICAL TURNOVER AND HEADMASTER REPLACEMENT IN LOW- AND HIGH-INCOME MUNICIPALITIES



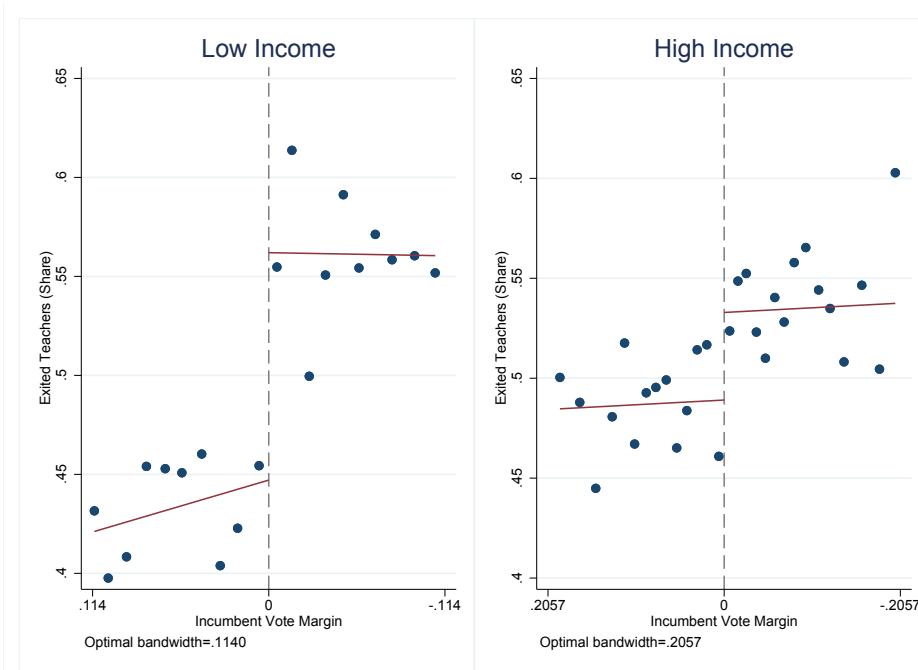
NOTES: THIS FIGURE SHOWS THE SHARE OF SCHOOLS WITH A NEW HEADMASTER BY BINS OF *IncumbVoteMargin* SEPARATELY FOR MUNICIPALITIES WITH HIGH AND LOW INCOME. MUNICIPALITIES WITH $IncumbVoteMargin < 0$ EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH $IncumbVoteMargin > 0$ DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. NEW HEADMASTERS ARE THOSE THAT REPORT BEING THE HEADMASTER OF THEIR CURRENT SCHOOL FOR LESS THAN TWO YEARS ON THE *Prova Brasil* HEADMASTER QUESTIONNAIRE. LOW-INCOME MUNICIPALITIES ARE THOSE BELOW THE MEDIAN IN THE MUNICIPAL-LEVEL DISTRIBUTION OF MEDIAN MONTHLY HOUSEHOLD INCOME AS MEASURED IN THE 2000 CENSUS. HIGH INCOME MUNICIPALITIES ARE THOSE ABOVE THE MEDIAN IN THIS DISTRIBUTION.

FIGURE A.15: POLITICAL TURNOVER AND NEW TEACHERS IN LOW- AND HIGH-INCOME MUNICIPALITIES



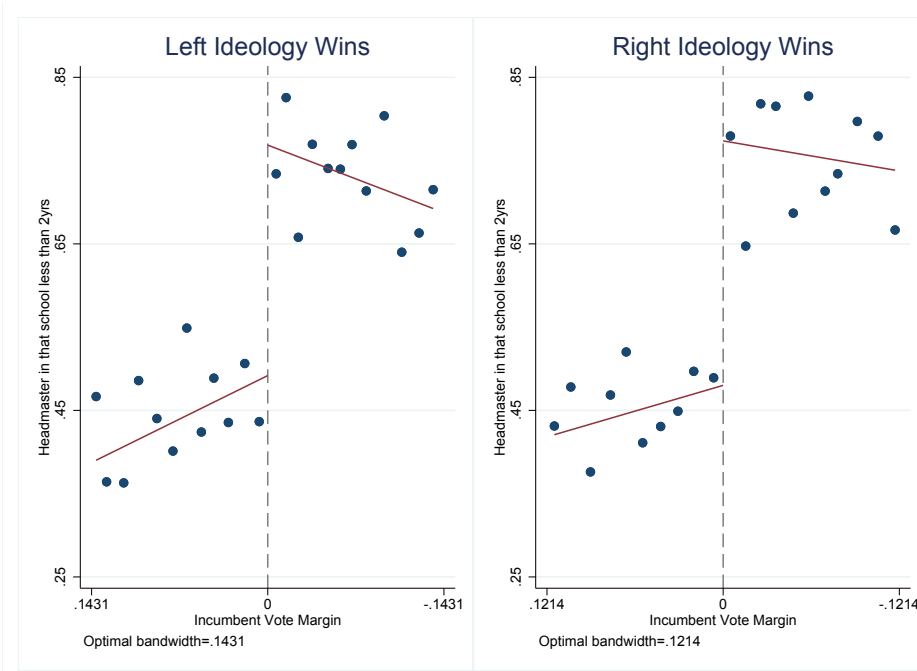
NOTES: THIS FIGURE SHOWS THE SHARE OF TEACHERS THAT ARE NEW TO A SCHOOL BY BINS OF *IncumbVoteMargin* SEPARATELY FOR MUNICIPALITIES WITH HIGH AND LOW INCOME. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. THE SHARE OF TEACHERS THAT ARE NEW TO A SCHOOL IS COMPUTED USING THE SCHOOL CENSUS AND CORRESPONDS TO THE SHARE OF TEACHERS IN A SCHOOL WHO ARE IN THAT SCHOOL AT TIME t (ONE YEAR AFTER THE RESPECTIVE ELECTION) BUT WERE NOT IN THAT SAME SCHOOL AT TIME $t - 2$ (THE YEAR BEFORE THE RESPECTIVE ELECTION). LOW-INCOME MUNICIPALITIES ARE THOSE BELOW THE MEDIAN IN THE MUNICIPAL-LEVEL DISTRIBUTION OF MEDIAN MONTHLY HOUSEHOLD INCOME AS MEASURED IN THE 2000 CENSUS. HIGH INCOME MUNICIPALITIES ARE THOSE ABOVE THE MEDIAN IN THIS DISTRIBUTION.

FIGURE A.16: POLITICAL TURNOVER AND TEACHERS THAT HAVE LEFT IN LOW- AND HIGH-INCOME MUNICIPALITIES



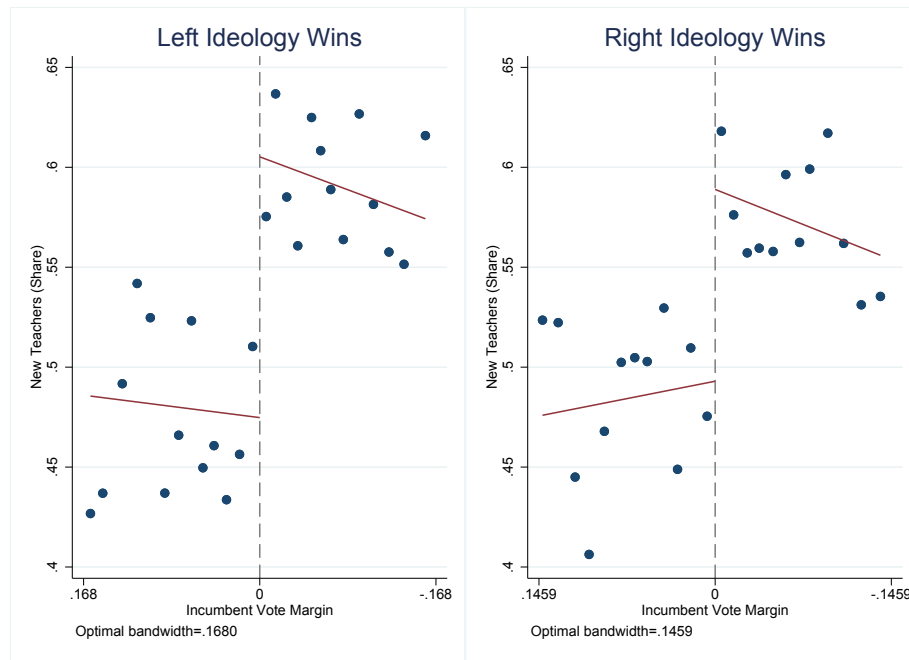
NOTES: THIS FIGURE SHOWS THE SHARE OF TEACHERS THAT HAVE LEFT A SCHOOL BY BINS OF *IncumbVoteMargin* SEPARATELY FOR MUNICIPALITIES WITH HIGH AND LOW INCOME. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. THE SHARE OF TEACHERS THAT HAVE LEFT A SCHOOL IS COMPUTED USING THE SCHOOL CENSUS AND CORRESPONDS TO THE SHARE OF TEACHERS IN A SCHOOL WHO WERE IN THAT SCHOOL AT TIME $t - 2$ (THE YEAR BEFORE THE RESPECTIVE ELECTION) BUT ARE NO LONGER IN THAT SAME SCHOOL AT TIME t (ONE YEAR AFTER THE RESPECTIVE ELECTION). LOW-INCOME MUNICIPALITIES ARE THOSE BELOW THE MEDIAN IN THE MUNICIPAL-LEVEL DISTRIBUTION OF MEDIAN MONTHLY HOUSEHOLD INCOME AS MEASURED IN THE 2000 CENSUS. HIGH INCOME MUNICIPALITIES ARE THOSE ABOVE THE MEDIAN IN THIS DISTRIBUTION.

FIGURE A.17: POLITICAL TURNOVER AND HEADMASTER REPLACEMENT IN MUNICIPALITIES WHERE THE WINNING PARTY WAS FROM THE LEFT VS. THE RIGHT



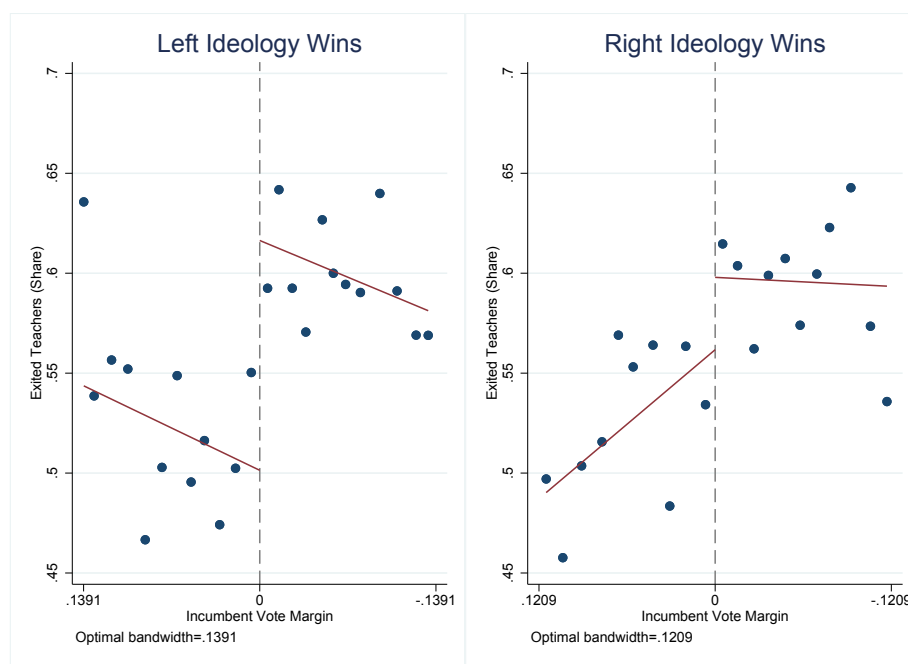
NOTES: THIS FIGURE SHOWS THE SHARE OF SCHOOLS WITH A NEW HEADMASTER BY BINS OF *IncumbVoteMargin* SEPARATELY FOR MUNICIPALITIES WHERE THE WINNING PARTY WAS FROM THE LEFT AND THOSE WHERE THE WINNING PARTY WAS FROM THE RIGHT. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. NEW HEADMASTERS ARE THOSE THAT REPORT BEING THE HEADMASTER OF THEIR CURRENT SCHOOL FOR LESS THAN TWO YEARS ON THE *Prova Brasil* HEADMASTER QUESTIONNAIRE. PARTY IDEOLOGY IS CLASSIFIED AS BELONGING TO THE LEFT VS. THE RIGHT ACCORDING TO *Atlas Político – Mapa do Congresso*.

FIGURE A.18: POLITICAL TURNOVER AND NEW TEACHERS IN MUNICIPALITIES WHERE THE WINNING PARTY WAS FROM THE LEFT VS. THE RIGHT



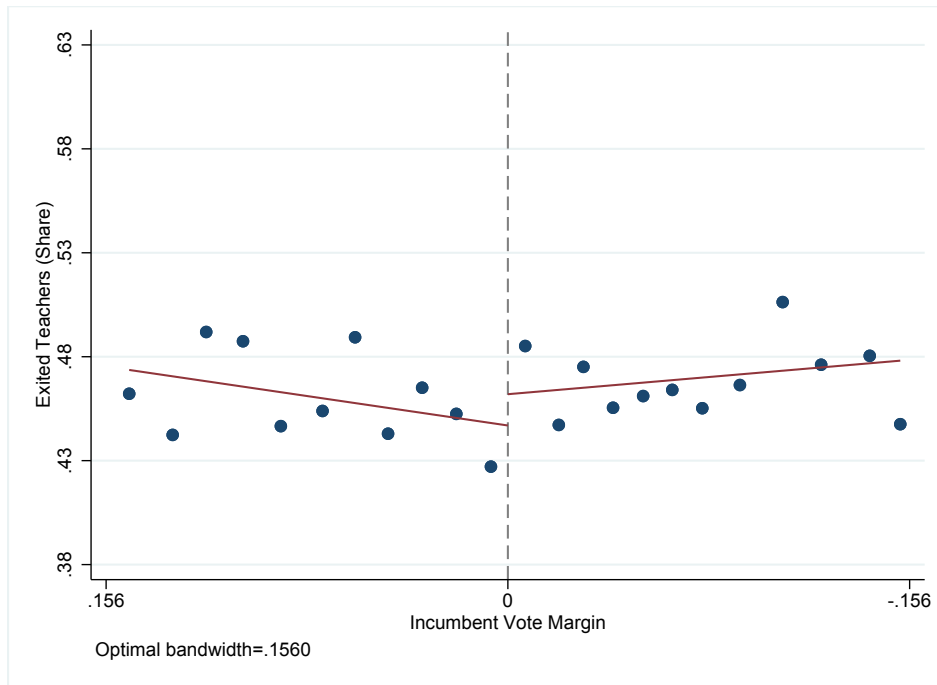
NOTES: THIS FIGURE SHOWS THE SHARE OF TEACHERS THAT ARE NEW TO A SCHOOL BY BINS OF *IncumbVoteMargin* SEPARATELY FOR MUNICIPALITIES WHERE THE WINNING PARTY WAS FROM THE LEFT AND THOSE WHERE THE WINNING PARTY WAS FROM THE RIGHT. MUNICIPALITIES WITH $IncumbVoteMargin < 0$ EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH $IncumbVoteMargin > 0$ DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. THE SHARE OF TEACHERS THAT ARE NEW TO A SCHOOL IS COMPUTED USING THE SCHOOL CENSUS AND CORRESPONDS TO THE SHARE OF TEACHERS IN A SCHOOL WHO ARE IN THAT SCHOOL AT TIME t (ONE YEAR AFTER THE RESPECTIVE ELECTION) BUT WERE NOT IN THAT SAME SCHOOL AT TIME $t - 2$ (THE YEAR BEFORE THE RESPECTIVE ELECTION). PARTY IDEOLOGY IS CLASSIFIED AS BELONGING TO THE LEFT VS. THE RIGHT ACCORDING TO *Atlas Político – Mapa do Congresso*.

FIGURE A.19: POLITICAL TURNOVER AND TEACHERS THAT HAVE LEFT IN MUNICIPALITIES WHERE THE WINNING PARTY WAS FROM THE LEFT VS. THE RIGHT



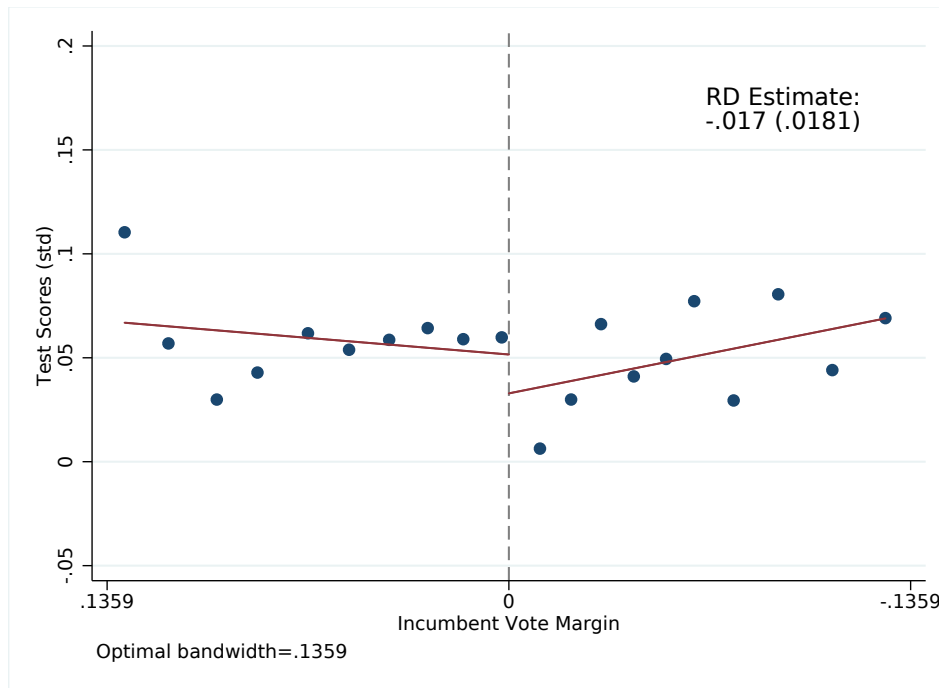
NOTES: THIS FIGURE SHOWS THE SHARE OF TEACHERS THAT HAVE LEFT A SCHOOL BY BINS OF *IncumbVoteMargin* SEPARATELY FOR MUNICIPALITIES WHERE THE WINNING PARTY WAS FROM THE LEFT AND THOSE WHERE THE WINNING PARTY WAS FROM THE RIGHT. MUNICIPALITIES WITH $IncumbVoteMargin < 0$ EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH $IncumbVoteMargin > 0$ DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. THE SHARE OF TEACHERS THAT HAVE LEFT A SCHOOL IS COMPUTED USING THE SCHOOL CENSUS AND CORRESPONDS TO THE SHARE OF TEACHERS IN A SCHOOL WHO WERE IN THAT SCHOOL AT TIME $t - 2$ (THE YEAR BEFORE THE RESPECTIVE ELECTION) BUT ARE NO LONGER IN THAT SAME SCHOOL AT TIME t (ONE YEAR AFTER THE RESPECTIVE ELECTION). PARTY IDEOLOGY IS CLASSIFIED AS BELONGING TO THE LEFT VS. THE RIGHT ACCORDING TO *Atlas Político – Mapa do Congresso*.

FIGURE A.20: POLITICAL TURNOVER AND TEACHERS THAT HAVE LEFT IN NON-MUNICIPAL SCHOOLS



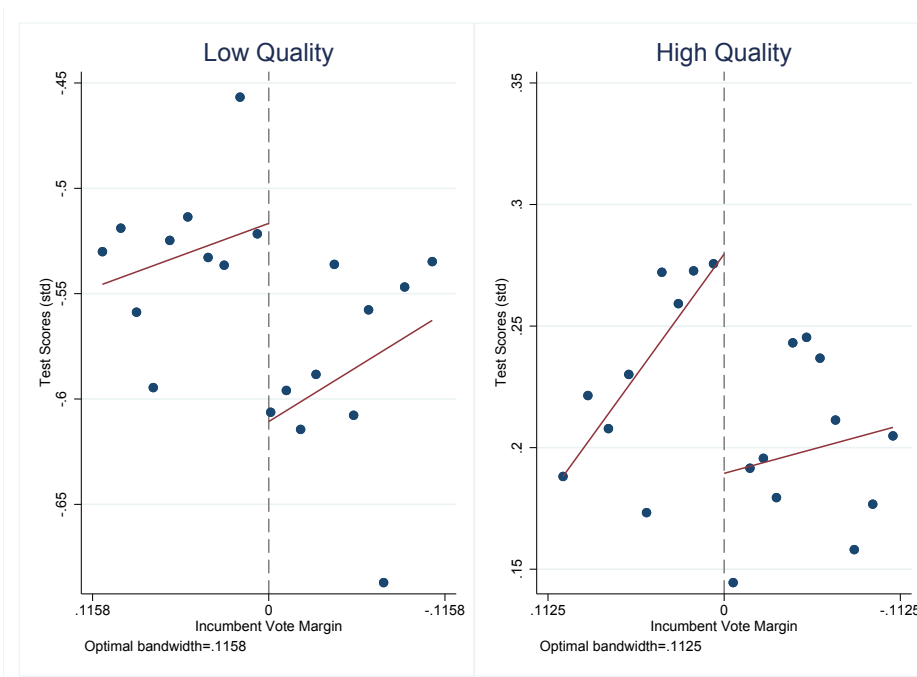
NOTES: THIS FIGURE SHOWS THE SHARE OF TEACHERS THAT HAVE LEFT *non-municipal* SCHOOLS BY BINS OF *IncumbVoteMargin*. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. THE SHARE OF TEACHERS THAT HAVE LEFT A SCHOOL IS COMPUTED USING THE SCHOOL CENSUS AND CORRESPONDS TO THE SHARE OF TEACHERS IN A SCHOOL WHO WERE IN THAT SCHOOL AT TIME $t - 2$ (THE YEAR BEFORE THE RESPECTIVE ELECTION) BUT ARE NO LONGER IN THAT SAME SCHOOL AT TIME t (ONE YEAR AFTER THE RESPECTIVE ELECTION). THE SET OF *non-municipal* SCHOOLS FOR THIS OUTCOME IS COMPRISED OF STATE, FEDERAL, AND PRIVATE SCHOOLS.

FIGURE A.21: POLITICAL TURNOVER AND 8TH GRADE TEST SCORES IN NON-MUNICIPAL SCHOOLS



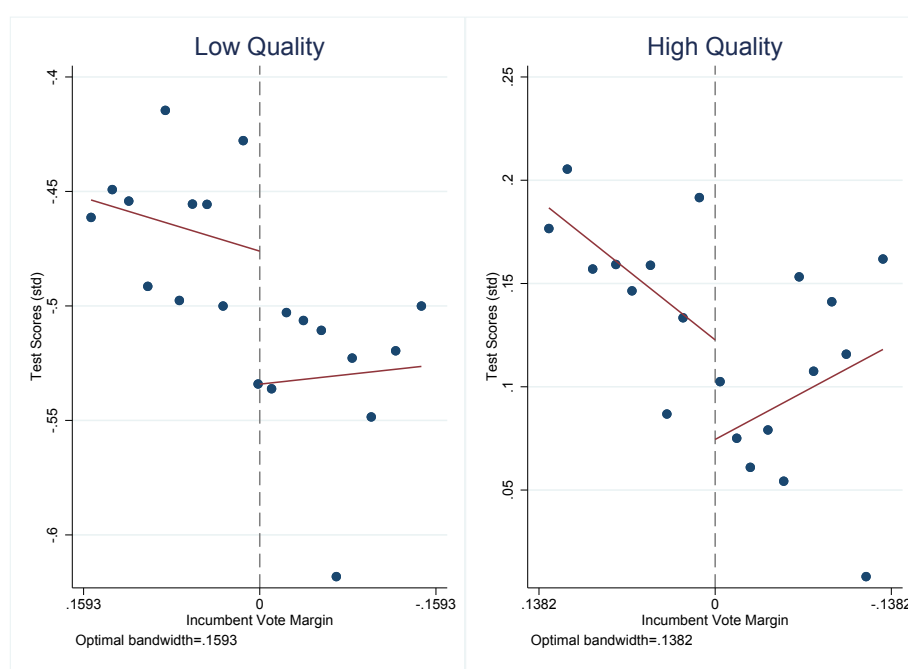
NOTES: THIS FIGURE SHOWS THE MEAN OF INDIVIDUAL-LEVEL 8TH GRADE TEST SCORES FOR STUDENTS IN *non-municipal* SCHOOLS BY BINS OF *IncumbVoteMargin*. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. TEST SCORES ARE FROM THE *Prova Brasil* EXAM AND ARE STANDARDIZED BASED ON THE DISTRIBUTION OF INDIVIDUAL-LEVEL TEST SCORES IN MUNICIPALITIES WITH NO CHANGE IN THE RULING PARTY. AVERAGE, SCHOOL-LEVEL 8TH GRADE TEST SCORES AT BASELINE (THE YEAR BEFORE THE RESPECTIVE ELECTION) IS INCLUDED AS A CONTROL. THE SET OF *non-municipal* SCHOOLS FOR THIS OUTCOME IS COMPRISED OF STATE AND FEDERAL SCHOOLS, SINCE ONLY PUBLIC SCHOOLS PARTICIPATE IN THE *Prova Brasil* EXAM.

FIGURE A.22: POLITICAL TURNOVER AND 4TH GRADE TEST SCORES IN LOW- AND HIGH-QUALITY SCHOOLS



NOTES: THIS FIGURE SHOWS THE MEAN OF INDIVIDUAL-LEVEL 4TH GRADE TEST SCORES BY BINS OF *IncumbVoteMargin* SEPARATELY FOR LOW- AND HIGH-QUALITY *municipal* SCHOOLS. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. TEST SCORES ARE FROM THE *Prova Brasil* EXAM AND ARE STANDARDIZED BASED ON THE DISTRIBUTION OF INDIVIDUAL-LEVEL TEST SCORES IN MUNICIPALITIES WITH NO CHANGE IN THE RULING PARTY. AVERAGE, SCHOOL-LEVEL 4TH GRADE TEST SCORES AT BASELINE (THE YEAR BEFORE THE RESPECTIVE ELECTION) IS INCLUDED AS A CONTROL. LOW-QUALITY SCHOOLS ARE THOSE BELOW THE MEDIAN IN THE SCHOOL-LEVEL DISTRIBUTION OF TEST SCORES AT BASELINE (THE YEAR BEFORE THE RESPECTIVE ELECTION). HIGH-QUALITY SCHOOLS ARE THOSE ABOVE THE MEDIAN IN THIS DISTRIBUTION.

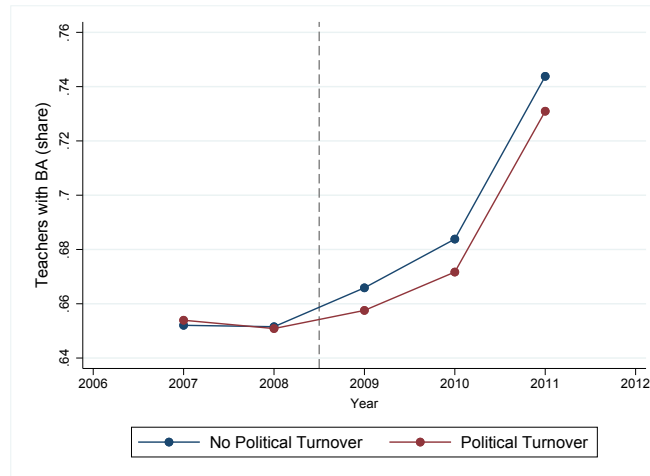
FIGURE A.23: POLITICAL TURNOVER AND 8TH GRADE TEST SCORES IN LOW- AND HIGH-QUALITY SCHOOLS



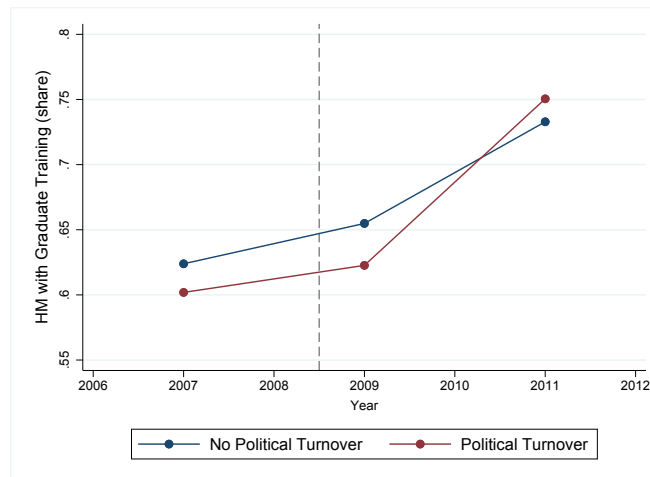
NOTES: THIS FIGURE SHOWS THE MEAN OF INDIVIDUAL-LEVEL 8TH GRADE TEST SCORES BY BINS OF *IncumbVoteMargin* SEPARATELY FOR LOW- AND HIGH-QUALITY *municipal* SCHOOLS. MUNICIPALITIES WITH *IncumbVoteMargin*<0 EXPERIENCED A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. MUNICIPALITIES WITH *IncumbVoteMargin*>0 DID NOT EXPERIENCE A CHANGE IN THE POLITICAL PARTY OF THE MAYOR. TEST SCORES ARE FROM THE *Prova Brasil* EXAM AND ARE STANDARDIZED BASED ON THE DISTRIBUTION OF INDIVIDUAL-LEVEL TEST SCORES IN MUNICIPALITIES WITH NO CHANGE IN THE RULING PARTY. AVERAGE, SCHOOL-LEVEL 8TH GRADE TEST SCORES AT BASELINE (THE YEAR BEFORE THE RESPECTIVE ELECTION) IS INCLUDED AS A CONTROL. LOW-QUALITY SCHOOLS ARE THOSE BELOW THE MEDIAN IN THE SCHOOL-LEVEL DISTRIBUTION OF TEST SCORES AT BASELINE (THE YEAR BEFORE THE RESPECTIVE ELECTION). HIGH-QUALITY SCHOOLS ARE THOSE ABOVE THE MEDIAN IN THIS DISTRIBUTION.

FIGURE A.24: SCHOOL PERSONNEL CHARACTERISTICS 2007-2011

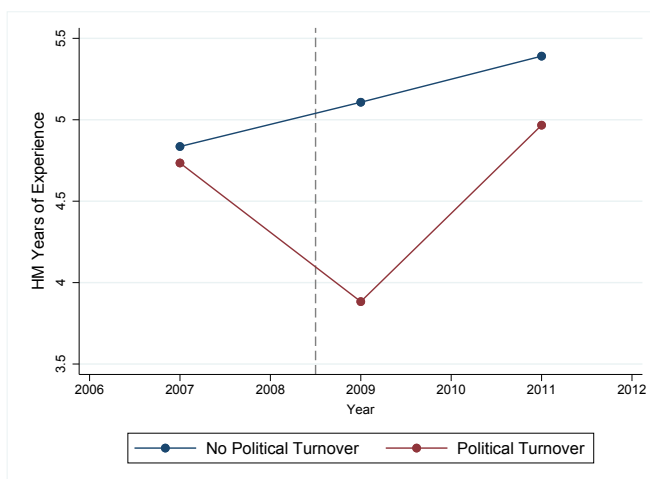
(a) Teacher with B.A.



(b) Headmasters with Graduate Training



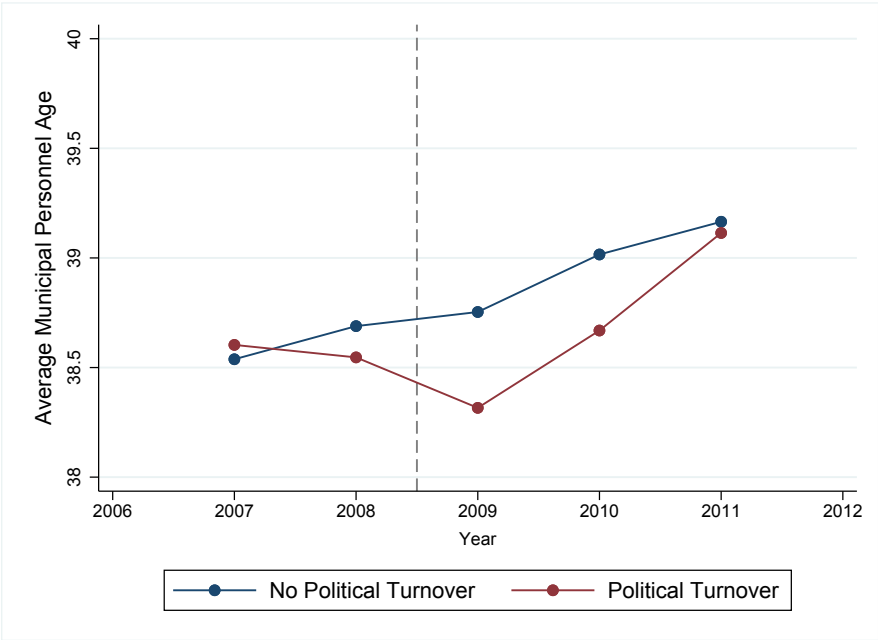
(c) Headmasters Experience (as Headmaster)



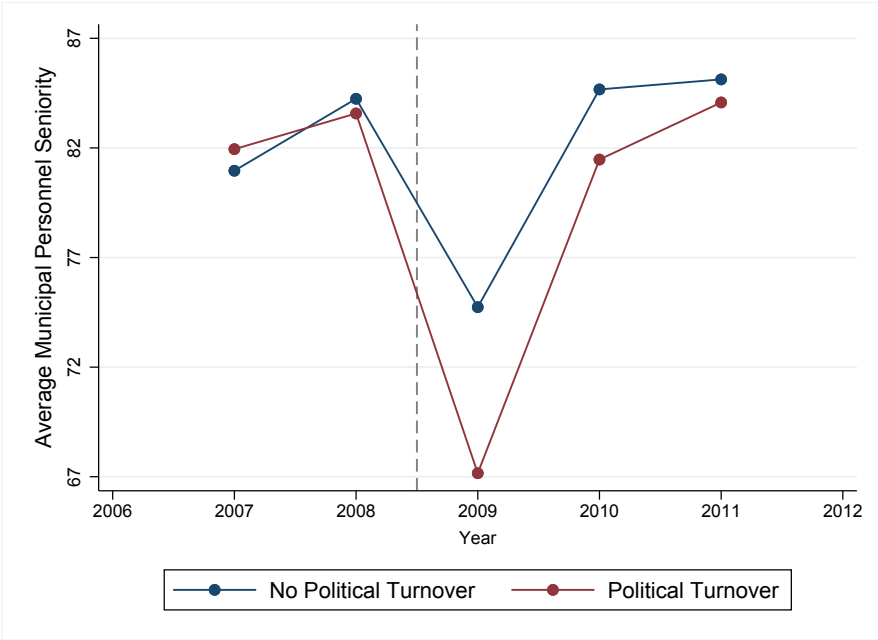
NOTES: THIS FIGURE SHOWS SCHOOL PERSONNEL CHARACTERISTICS IN MUNICIPALITIES THAT EXPERIENCED POLITICAL TURNOVER IN 2008 AND MUNICIPALITIES THAT DID NOT EXPERIENCE. SAMPLE RESTRICTED TO MUNICIPALITIES WITH CLOSE ELECTIONS ($|IncumbVoteMargin_{2008}| < 0.09$). DASHED VERTICAL LINE REPRESENTS END OF MAYOR'S TERM. THE SHARE OF TEACHERS WITH B.A. (PANEL A) IS FROM THE SCHOOL CENSUS, AVERAGED AT THE MUNICIPAL-LEVEL. HEADMASTER CHARACTERISTICS ARE SHARE OF HEADMASTERS WITH GRADUATE TRAINING (PANEL B) AND NUMBER OF YEARS OF EXPERIENCE AS HEADMASTER (PANEL C), EXTRACTED FROM THE PROVA BRASIL HEADMASTER QUESTIONNAIRE AND AVERAGED AT THE MUNICIPAL-LEVEL.

FIGURE A.25: MUNICIPAL PERSONNEL CHARACTERISTICS 2007-2011

(a) Average Municipal Personnel Age



(b) Average Municipal Personnel Seniority



NOTES: THIS FIGURE SHOWS SCHOOL PERSONNEL CHARACTERISTICS IN MUNICIPALITIES THAT EXPERIENCED POLITICAL TURNOVER IN 2008 AND MUNICIPALITIES THAT DID NOT EXPERIENCE. SAMPLE RESTRICTED TO MUNICIPALITIES WITH CLOSE ELECTIONS ($|IncumbVoteMargin_{2008}| < 0.09$). DASHED VERTICAL LINE REPRESENTS END OF MAYOR'S TERM. THE MUNICIPAL PERSONNEL CHARACTERISTICS ARE FROM RAIS. THE VARIABLES AGE AND SENIORITY WERE CALCULATED AS THE AVERAGE ATTRIBUTE AMONG WORKERS EMPLOYED IN THE MUNICIPALITY ONE YEAR AFTER THE ELECTION.

TABLE A.1: POLITICAL TURNOVER AND 4TH GRADE TEST SCORES FOR ALL MUNICIPALITIES

	Outcome: Individual 4 th Grade Test Scores (standardized)					
	(1)	(2)	(3)	(4)	(5)	(6)
Party Turnover	-0.065 (0.031)	-0.066 (0.029)	-0.070 (0.036)	-0.066 (0.033)	-0.070 (0.031)	-0.070 (0.028)
School-level baseline scores	0.841 (0.018)	0.713 (0.019)	0.827 (0.024)	0.701 (0.026)	0.838 (0.017)	0.711 (0.018)
N	582,788	582,788	405,856	405,856	601,125	601,125
R-squared	0.199	0.235	0.189	0.225	0.197	0.233
Controls	No	Yes	No	Yes	No	Yes
Clusters	2153	2153	1606	1606	2193	2193
Using Bandwidth	0.107	0.107	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.107	0.107	0.107	0.107	0.107	0.107

This table includes the sample of **all** municipalities, including those with irregular elections and those that could potentially go to a second round of elections (population $\geq 200,000$). The endogenous variable, Party Turnover, is instrumented for using the incumbent political party's vote margin from the first round of regular elections. The first-stage coefficients for the instrument range from .80-.81 across bandwidths (not reported). All specifications control for school-level, average test scores for 4th graders at baseline (one year before the respective election). Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet), individual-level controls (an indicator variable for gender, whether the student is white, and whether the student sees their mother reading), and a 2012 election-cycle indicator.

TABLE A.2: POLITICAL TURNOVER AND 8TH GRADE TEST SCORES FOR ALL MUNICIPALITIES

	Outcome: Individual 8 th Grade Test Scores (standardized)					
	(1)	(2)	(3)	(4)	(5)	(6)
Party Turnover	-0.080 (0.029)	-0.068 (0.030)	-0.086 (0.038)	-0.087 (0.038)	-0.086 (0.034)	-0.084 (0.034)
School-level baseline scores	0.763 (0.014)	0.706 (0.015)	0.757 (0.015)	0.701 (0.016)	0.772 (0.014)	0.711 (0.014)
N	335,824	335,824	169,556	169,556	255,509	255,509
R-squared	0.137	0.151	0.140	0.153	0.148	0.161
Controls	No	Yes	No	Yes	No	Yes
Clusters	1536	1536	1010	1010	1401	1401
Using Bandwidth	0.124	0.124	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.124	0.124	0.124	0.124	0.124	0.124

This table includes the sample of **all** municipalities, including those with irregular elections and those that could potentially go to a second round of elections (population $\geq 200,000$). The endogenous variable, Party Turnover, is instrumented for using the incumbent political party's vote margin from the first round of regular elections. The first-stage coefficients for the instrument range from .80-.81 across bandwidths (not reported). All specifications control for school-level, average test scores for 8th graders at baseline (one year before the respective election). Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet), individual-level controls (an indicator variable for gender, whether the student is white, and whether the student sees their mother reading), and a 2012 election-cycle indicator.

TABLE A.3: CANDIDATE TURNOVER AND 4TH GRADE AND 8TH GRADE TEST SCORES

Panel A	Outcome: Individual 4 th Grade Test Scores (standardized)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbCandidateVoteMargin < 0\}$	-0.078 (0.028)	-0.094 (0.025)	-0.090 (0.032)	-0.102 (0.029)	-0.078 (0.028)	-0.094 (0.024)
School-level baseline scores	0.868 (0.014)	0.734 (0.014)	0.874 (0.013)	0.745 (0.013)	0.870 (0.013)	0.735 (0.013)
Observations	338,152	338,152	246,872	246,872	366,391	366,391
Schl Controls	No	Yes	No	Yes	No	Yes
Indiv Controls	No	Yes	No	Yes	No	Yes
Clusters	1723	1723	1309	1309	1867	1867
Using Bandwidth	0.0980	0.0980	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.0980	0.0980	0.0980	0.0980	0.0980	0.0980

Panel B	Outcome: Individual 8 th Grade Test Scores (standardized)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbCandidateVoteMargin < 0\}$	-0.071 (0.026)	-0.070 (0.026)	-0.063 (0.034)	-0.068 (0.034)	-0.079 (0.028)	-0.078 (0.028)
School-level baseline scores	0.792 (0.014)	0.736 (0.014)	0.772 (0.017)	0.723 (0.017)	0.781 (0.015)	0.725 (0.015)
Observations	181,865	181,865	106,072	106,072	161,483	161,483
Schl Controls	No	Yes	No	Yes	No	Yes
Indiv Controls	No	Yes	No	Yes	No	Yes
Clusters	1344	1344	833	833	1191	1191
Using Bandwidth	0.128	0.128	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.128	0.128	0.128	0.128	0.128	0.128

This table reports the coefficient on candidate turnover from regressing individual-level 4th grade test scores (Panel A) and 8th grade test scores (Panel B) on the running variable of the RDD ($IncumbCandidateVoteMargin$), candidate turnover ($\mathbb{1}\{IncumbCandidateVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbCandidateVoteMargin| < Using Bandwidth$. Test scores are from the *Prova Brasil* exam and are standardized based on the distribution of individual-level test scores in municipalities with no change in the ruling party. All specifications control for school-level, average test scores for the respective grader at baseline (one year before the respective election). Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet), individual-level controls (an indicator variable for gender, whether the student is white, and whether the student sees their mother reading), and a 2012 election-cycle indicator.

TABLE A.4: 4TH GRADE TEST SCORES BY MUNICIPALITIES' CHARACTERISTICS

Outcome Characteristic	Individual 4th grade Test Score (standardized)					
	Above Median Population (1)	Above Median Population (2)	Above Median N. schools (3)	Above Median N. schools (4)	Left Ideology Wins (5)	Left Ideology Wins (6)
$1\{IncumbVoteMargin < 0\}$	-0.052 (0.051)	-0.065 (0.040)	-0.066 (0.041)	-0.072 (0.038)	-0.081 (0.042)	-0.089 (0.038)
$1\{Characteristic\}$	-0.020 (0.044)	-0.045 (0.036)	-0.101 (0.041)	-0.116 (0.036)	-0.035 (0.049)	-0.035 (0.045)
$1\{IncumbVoteMargin < 0\} \times 1\{Characteristic\}$	-0.035 (0.061)	-0.000 (0.049)	-0.013 (0.056)	0.013 (0.049)	0.019 (0.064)	0.038 (0.057)
Observations	325,554	429,979	325,554	429,979	279,744	327,168
R-squared	0.218	0.218	0.220	0.220	0.208	0.208
Controls	No	No	No	No	No	No
Clusters	1669	2101	1669	2101	1487	1703
Mean LHS	-0.105	-0.117	-0.105	-0.117	-0.112	-0.127
Using Bandwidth	0.0782	0.110	0.0782	0.110	0.0910	0.110
Optimal Bandwidth	0.0782	0.0782	0.0782	0.0782	0.0910	0.0910

This table reports the coefficient on Political turnover from regressing the individual 4th grade test score estimating Equation 2. Test scores are from the *Prova Brasil* exam and are standardized based on the distribution of individual-level test scores in municipalities with no change in the ruling party. All specifications control for school-level, average test scores for 4th graders at baseline (one year before the 2008 election). Above Median Population is an indicator variable equal to 1 if municipality's population is above median of population distribution at baseline (one year before the election). Above Median N. schools is an indicator variable equal to 1 if municipality's count of schools is above median of school count distribution according to School Census at baseline (one year before the election). Left Ideology Wins is an indicator variable equal to 1 if a left-wing party won the election and 0 if a right-wing party won. Party ideology is classified as belonging to the left vs. the right according to *Atlas Político - Mapa do Congresso*.

TABLE A.5: SELECTION OF MUNICIPALITIES AND SCHOOLS INTO THE SAMPLE

	(1) All Municipalities		(2) Sample Municipalities		(3) Sample Municipalities & School takes PB	
	Mean	SD	Mean	SD	Mean	SD
Municipal Characteristics						
Municipality population	33,290.76	197,908.57	20,201.30	27,236.13	21,180.96	27,771.40
Ruling party from left	0.26	0.44	0.26	0.44	0.26	0.44
Winning party from left	0.30	0.46	0.28	0.45	0.28	0.45
Ruling party from right	0.56	0.50	0.55	0.50	0.55	0.50
Winning party from right	0.53	0.50	0.53	0.50	0.53	0.50
School Characteristics						
Number of schools per municipality	17.85	29.62	14.88	20.54	4.96	6.51
Share urban	0.34	0.47	0.31	0.46	0.73	0.45
Share connected to grid	0.85	0.36	0.86	0.35	0.99	0.11
Share connected to water network	0.45	0.50	0.43	0.50	0.80	0.40
Share connected to sewage system	0.21	0.41	0.18	0.39	0.41	0.49
Share with regular trash collection	0.45	0.50	0.44	0.50	0.85	0.35
Share with Internet	0.29	0.45	0.27	0.45	0.64	0.48
Number of teachers per school	9.67	11.42	8.79	10.17	18.83	11.27
Teacher age	37.26	6.64	37.13	6.56	38.27	3.97
Share of female teachers	0.81	0.28	0.82	0.27	0.85	0.15
Share of teachers with B.A.	0.50	0.41	0.51	0.40	0.70	0.29
Share of teachers who took <i>Concurso</i>	0.64	0.38	0.63	0.38	0.76	0.26
Number of students per school	190.37	252.30	163.43	214.72	378.56	245.30
Share of female students	0.47	0.09	0.47	0.09	0.48	0.04
Share of student with urban residence	0.32	0.42	0.29	0.40	0.64	0.39
Number classrooms per school	8.42	8.92	7.66	7.96	15.69	8.44
Students/class per school	18.51	7.38	17.72	7.15	23.41	4.91
Number of 4th graders per school	23.33	35.78	20.34	30.72	49.84	38.31
Number of 8th graders per school	10.66	30.96	8.83	26.65	24.07	41.44
N (municipality-election cycle)	11,106		5,966		5,608	

This table shows descriptive statistics for: all municipalities, municipalities in our sample, and municipalities in our sample with at least one school that participates in the *Prova Brasil* exam. Our sample is selected by dropping: municipalities with irregular elections, municipalities that could potentially go to second-round elections, and municipalities where the incumbent political party did not run for re-election. Furthermore, schools that participate in the *Prova Brasil* exam are schools with at least 20 students enrolled in the relevant grade-level. Hence the sample of schools for which we have *Prova Brasil* data for is also "selected." The unit of observations is a municipality-election cycle.

TABLE A.6: SELECTION OF MUNICIPALITIES: RD VS NON-RD SAMPLE ($|IncumbVoteMargin| < .09$)

	Non-RD Sample	RD Sample	P-value
Municipal Characteristics			
Population	35753.87	24944.40	0.02
Ruling party from left	0.26	0.24	0.14
Winning party from left	0.30	0.28	0.01
Ruling party from right	0.56	0.57	0.34
Winning party from right	0.52	0.54	0.15
Number of Candidates Running	3.04	3.04	0.99
School Characteristics			
Number of schools	18.63	15.21	0.00
Share urban	0.34	0.32	0.00
Share connected to water network	0.45	0.44	0.00
Share connected to sewage system	0.22	0.20	0.00
Share with Internet	0.29	0.29	0.08
Number of school staff	20.41	19.29	0.00
Number of teachers per school	9.75	9.37	0.00
Teacher age	37.23	37.38	0.00
Share of female teachers	0.81	0.82	0.00
% teachers born same munic	0.63	0.64	0.00
Share of teachers with B.A.	0.49	0.53	0.00
Share of temporary teachers	0.35	0.33	0.00
Classrooms taught per teacher	1.97	1.94	0.00
Schools taught per teacher	1.32	1.32	0.43
% teach only municipal school	0.92	0.92	0.21
Number of students per school	193.98	175.40	0.00
% students with schl transport	0.26	0.29	0.00
Number classrooms per school	8.49	8.10	0.00
Students/class per school	18.68	17.81	0.00

This table shows descriptive statistics for municipalities that did not experience close elections (column 1) and close election municipalities (column 2). Column 3 represents p-value of t-test of difference in means between the two samples. Close elections defined by ($|IncumbVoteMargin| < .09$)

TABLE A.7: DESCRIPTIVE STATISTICS AND TEST FOR DISCONTINUITY IN BASELINE CHARACTERISTICS, $|IncumbVoteMargin| < .09$

	(1) No Party Turnover	(2) Party Turnover	(3) P-value
Number of Municipalities	1,233	1,195	.
School Characteristics			
Teacher experience (only in PB)	12.46	12.40	0.88
Share of female headmasters (only in PB)	0.85	0.85	0.27
Headmaster age (only in PB)	40.91	41.44	0.70
Headmaster education experience (only in PB)	14.23	14.59	0.28
Headmaster experience (only in PB)	4.99	5.39	0.69
Number of students per school	152.24	160.96	0.74
Share of students who use school transportation	0.26	0.27	0.11
Number classrooms per school	7.02	7.41	0.73
Students/class per school	17.97	18.08	0.53
Number of 4th graders per school	18.55	20.16	0.93
Number of 8th graders per school	7.62	8.23	0.65
Share connected to grid	0.83	0.84	0.30
Share with regular trash collection	0.37	0.40	0.70
Share of female students	0.46	0.47	0.82
Share of students born in same municipality	0.62	0.63	0.72
Share of student with urban residence	0.25	0.27	0.64

This table shows additional descriptive statistics for school-level characteristics in municipalities that did not have political party turnover and municipalities that did have political party turnover in close elections, $|IncumbVoteMargin| < .09$, in Columns 1-2. Column 3 tests for a discontinuity in baseline characteristics at the $IncumbVoteMargin=0$ threshold: This column reports the p-value corresponding to the coefficient on $\mathbb{1}\{IncumbVoteMargin < 0\}$ in our main specification, Equation 1, with the corresponding variable at baseline used as the dependent variable. The remaining set of characteristics are shown in Table 1.

TABLE A.8: TEST SCORES AND (UNCONDITIONAL) POLITICAL TURNOVER

Outcome	Individual 4th Grade Test Scores (standardized)	
	(1)	(2)
Unconditional Party Turnover	-0.033 (0.011)	-0.016 (0.011)
Unconditional Candidate Turnover	-0.027 (0.011)	-0.017 (0.009)
School-level Test Scores at Baseline	0.851 (0.007)	0.430 (0.009)
Observations	1,848,228	1,848,228
R-squared	0.216	0.292
Controls and FE	No	Yes
Clusters	4988	4988
Mean LHS	-0.0948	-0.0948

This table reports the coefficient on unconditional party and candidate turnover estimating OLS regressions. Outcome: the individual-level 4th grade test scores. Test scores are from the *Prova Brasil* exam and are standardized based on the distribution of individual-level test scores in municipalities with no change in the ruling party. Controls include school-level, average test scores for 4th graders at baseline (one year before the 2008 election), school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet), individual-level controls (an indicator variable for gender, whether the student is white, and whether the student sees their mother reading), a 2012 election-cycle indicator and municipal fixed effects. Unconditional party turnover equals one if the incoming party is different than incumbent party and zero otherwise. It is well defined even if the incumbent party did not participate in the election. Unconditional candidate turnover is equal to one if newly elected candidate is different than incumbent candidate and zero otherwise. Likewise the variable is well defined even if the candidate chose not to participate in the election.

TABLE A.9: POLITICAL TURNOVER AND MUNICIPAL PERSONNEL REPLACEMENT AT BASELINE

Panel A: Municipal Personnel up to 1 month before the Election

Outcome	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	New Municipal Personnel (Share)		Municipal Personnel Who Left (Share)		Municipal Personnel (Share)		Net New Municipal Personnel (Share)		
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.0138 (0.0152)	0.0007 (0.0203)	-0.0159 (0.0164)	-0.0016 (0.0133)	0.0237 (0.0181)	-0.0019 (0.0142)	-0.0083 (0.0080)	-0.0158 (0.0118)	-0.0054 (0.0099)
Observations	2,745	1,655	2,380	2,650	1,655	2,380	3,519	1,655	2,380
R-squared	0.0015	0.0040	0.0017	0.0006	0.0033	0.0004	0.0054	0.0094	0.0054
Clusters	2306	1506	2051	2244	1506	2051	2800	1506	2051
Mean Dep Variable	0.245	0.251	0.246	0.163	0.169	0.163	0.0886	0.0841	0.0874
Using Bandwidth	0.132	0.0700	0.110	0.125	0.0700	0.110	0.194	0.0700	0.110
Optimal Bandwidth	0.132	0.132	0.132	0.125	0.125	0.125	0.194	0.194	0.194

Panel B: Municipal Personnel up to 1 year before the Election

Outcome	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	New Municipal Personnel (Share)		Municipal Personnel Who Left (Share)		Municipal Personnel (Share)		Net New Municipal Personnel (Share)		
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.0120 (0.0166)	-0.0230 (0.0229)	-0.0162 (0.0185)	-0.0126 (0.0159)	0.0026 (0.0207)	-0.0112 (0.0164)	-0.0106 (0.0116)	-0.0284 (0.0182)	-0.0097 (0.0147)
Observations	2,814	1,654	2,376	2,498	1,654	2,376	3,227	1,654	2,376
R-squared	0.0545	0.0594	0.0578	0.0017	0.0007	0.0012	0.0954	0.0929	0.1029
Clusters	2346	1505	2047	2136	1505	2047	2609	1505	2047
Mean Dep Variable	0.291	0.299	0.292	0.172	0.179	0.173	0.126	0.129	0.126
Using Bandwidth	0.137	0.0700	0.110	0.117	0.0700	0.110	0.166	0.0700	0.110
Optimal Bandwidth	0.137	0.137	0.137	0.117	0.117	0.117	0.166	0.166	0.166

This table reports the coefficient on political party turnover estimating Equation 1. Outcome variables: in columns 1-3, Panel A, New municipal personnel (share) is the ratio between the number of new labor contracts that had been added on an annual basis up to 1 month before the election divided by the total number of contracts that existed 12 month prior to the election, in Columns 4-6, Panel A, Municipal Personnel Who Left (share) is analogous and uses number of terminated contracts; in Columns 7-9, Panel A Net Municipal Personnel (Share) is the difference between New municipal personnel (share) and Municipal Personnel Who Left (share). Panel B uses the corresponding outcome variables where new and terminated contracts were measured 12 months before the election.

TABLE A.10: MUNICIPAL PERSONNEL BY THREE MONTHS INTERVALS

Panel A: New Municipal Personnel (Share)				
Outcome	Oct-Dec (1)	Jan-Mar (2)	Apr-Jun (3)	Jul-Sep (4)
$1\{IncumbVoteMargin < 0\}$	0.0048 (0.0026)	0.0410 (0.0158)	0.0135 (0.0084)	0.0080 (0.0077)
Observations	2,381	2,381	2,381	2,381
R-squared	0.0168	0.0207	0.0126	0.0046
Clusters	2052	2052	2052	2052
Mean Dep Variable	0.0103	0.209	0.0581	0.0461
Using Bandwidth	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.140	0.112	0.168	0.140
Panel B: Municipal Personnel Who have Left (Share)				
Outcome	Oct-Dec (1)	Jan-Mar (2)	Apr-Jun (3)	Jul-Sep (4)
$1\{IncumbVoteMargin < 0\}$	0.0174 (0.0122)	0.0013 (0.0058)	-0.0009 (0.0056)	-0.0029 (0.0062)
Observations	2,381	2,381	2,381	2,381
R-squared	0.0106	0.0034	0.0050	0.0032
Clusters	2052	2052	2052	2052
Mean Dep Variable	0.129	0.0377	0.0317	0.0375
Using Bandwidth	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.122	0.182	0.175	0.126

This table reports the coefficient on political party turnover estimating Equation 1. Outcome variables: New municipal personnel (share) is the ratio between the number of new labor contracts that had been added every quarter after the election divided by the total number of contracts that existed the month prior to the election (Panel A). Column 1 (Oct-Dec) uses contracts added on the quarter following the election, on the same year and under same mayor term. Column 2-4 use contracts added on each one of the first three quarters over the year after the election in chronological order and are thus under a new term for the elected mayor. Municipal Personnel Who Left (share) is analogous and uses number of terminated contracts (Panel B).

TABLE A.11: POLITICAL TURNOVER AND TYPE OF ACTIVE CONTRACT

Panel A: New Municipal Personnel by Contract Type (% of personnel with that contract type)

Outcome	Type of Contract			Hierarchical Level			Sector			
	Civil Servant (1)	Contract (2)	High Manager (3)	Low Manager (4)	Not Manager (5)	All Sectors (6)	Education (7)	Health (8)	Construction (9)	Other (10)
$\mathbb{I}\{IncumbVoteMargin < 0\}$	-0.0365 (0.0198)	0.1068 (0.0298)	0.0789 (0.0305)	0.0566 (0.0391)	0.0541 (0.0202)	0.0744 (0.0314)	0.0637 (0.0210)	0.0663 (0.0220)	0.0717 (0.0223)	0.0672 (0.0203)
Observations	2,277	2,276	2,166	1,744	2,372	2,381	2,370	2,369	2,368	2,381
R-squared	0.0067	0.0262	0.0315	0.0269	0.0219	0.0140	0.0279	0.0329	0.0383	0.0428
Cluster	1966	1976	1884	1543	2045	2052	2043	2043	2042	2052
Mean Dep Variable	0.159	0.618	0.590	0.432	0.280	0.330	0.302	0.305	0.292	0.316
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110

Panel B: Municipal Personnel Who have Left by Contract Type (% of personnel with that contract type)

Outcome	Type of Contract			Hierarchical Level			Sector			
	Civil Servant (1)	Contract (2)	High Manager (3)	Low Manager (4)	Not Manager (5)	All Sectors (6)	Education (7)	Health (8)	Construction (9)	Other (10)
$\mathbb{I}\{IncumbVoteMargin < 0\}$	-0.0135 (0.0155)	0.0739 (0.0322)	0.1267 (0.0337)	0.1036 (0.0389)	0.0240 (0.0177)	0.0268 (0.0217)	0.0241 (0.0189)	0.0239 (0.0192)	0.0302 (0.0187)	0.0283 (0.0175)
Observations	2,277	2,276	2,166	1,744	2,372	2,381	2,370	2,369	2,368	2,381
R-squared	0.0010	0.0347	0.0507	0.0344	0.0124	0.0103	0.0160	0.0205	0.0245	0.0265
Cluster	1966	1976	1884	1543	2045	2052	2043	2043	2042	2052
Mean Dep Variable	0.121	0.493	0.417	0.334	0.211	0.234	0.225	0.222	0.215	0.227
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110

This table reports the coefficient on political party turnover estimating Equation 1. Outcome variables: New Municipal Personnel by contract type (as % of total personnel in that contract type) is the ratio between the number of new labor contracts (of a given type) that had been added 12 months after the election divided by the total number of contracts (of a given type) in the month prior to the election; in Panel B, Municipal Personnel Who have Left by contract type (as % of total personnel in that contract type) is analogous and uses number of terminated contracts. Attributes come from RAIS and are type of contract, hierarchical level and sector employed.

TABLE A.12: MUNICIPAL PERSONNEL REPLACEMENT BY SECTOR-SPECIFIC CONTRACTS

Panel A: New Municipal Personnel by contract type (as % of total personnel in that contract type)

Outcomes	Multiple (1)	Education-specific (2)	Health-specific (3)	Construction-specific (4)	Specific to other sectors (5)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.0708 (0.0224)	0.0207 (0.0240)	0.0414 (0.0269)	-0.0019 (0.0288)	0.0360 (0.0261)
Observations	2,367	2,266	2,217	1,831	2,331
R-squared	0.0384	0.0058	0.0090	0.0034	0.0115
Cluster	2041	1968	1929	1604	2016
Mean Dep Variable	0.303	0.295	0.296	0.189	0.364
Using Bandwidth	0.110	0.110	0.110	0.110	0.110

Panel B: Municipal Personnel that have Left by contract type (as % of total personnel in that contract type)

Outcomes	Multiple (1)	Education-specific (2)	Health-specific (3)	Construction-specific (4)	Specific to other sectors (5)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.0338 (0.0189)	0.0033 (0.0223)	0.0093 (0.0245)	0.0613 (0.0252)	0.0391 (0.0224)
Observations	2,367	2,266	2,217	1,831	2,331
R-squared	0.0271	0.0029	0.0100	0.0101	0.0163
Cluster	2041	1968	1929	1604	2016
Mean Dep Variable	0.219	0.226	0.222	0.167	0.255
Using Bandwidth	0.110	0.110	0.110	0.110	0.110

This table reports the coefficient on political party turnover estimating Equation 1. Outcome variables: New Municipal Personnel by contract type (as % of total personnel in that contract type) is the ratio between the number of new labor contracts (of a given type) that had been added 12 months after the election divided by the total number of contracts (of a given type) in the month prior to the election; in Panel B, Municipal Personnel Who have Left by contract type (as % of total personnel in that contract type) is analogous and uses number of terminated contracts.

TABLE A.13: POLITICAL TURNOVER AND STUDENT COMPOSITION

Outcome:	Female (1)	White (2)	Asset Index (3)	Mother's Education (4)	Mother Reads (5)	Parental Support Index (6)	Works Outside (7)	Previously Failed (8)	Previously Dropped Out (9)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.007 (0.006)	-0.011 (0.013)	0.059 (0.215)	0.085 (0.097)	-0.000 (0.011)	-0.002 (0.038)	-0.006 (0.004)	-0.005 (0.012)	-0.002 (0.004)
Observations	933,305	933,305	933,143	933,305	933,305	933,143	933,305	691,559	700,956
R-squared	0.001	0.015	0.055	0.010	0.008	0.003	0.002	0.016	0.005
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	2294	2294	2294	2294	2294	2294	2294	2287	2287
Mean LHS	0.381	0.231	-1.358	4.091	0.628	-0.0834	0.134	0.369	0.0818
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.133	0.103	0.117	0.137	0.133	0.112	0.134	0.0972	0.114

This table reports the coefficient on political party turnover from regressing each of the student characteristic variables on the running variable of the RDD ($IncumbVoteMargin$), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin| < UsingBandwidth$. The Asset Index is constructed as follows. We standardize the responses to a series of questions – regarding the number of household items (colored TV, radio, fridge, bathroom), whether or not the student has other items (a VCR/DVD player, a freezer, a vacuum cleaner, a computer, Internet), and how often a domestic worker comes to the student's house – by subtracting the overall mean and dividing by the standard deviation of all student responses for each question. We then add all these standardized question responses to arrive at the "Asset Index." The Parental Involvement Index is constructed as follows. We standardize responses to a series of questions – regarding how often the students' parents attend Parent-Teacher Council meetings, whether parents talk to the student about what happens in school, and whether parents incentivize the student to do homework, read, and attend school – by subtracting the overall mean and dividing by the standard deviation of all student responses for each question. We then add all these standardized question responses to arrive at the "Parental Involvement Index." Student characteristics are from the *Prova Brasil* questionnaire filled out by students. Controls include school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator.

TABLE A.14: POLITICAL TURNOVER AND NUMBER OF STUDENTS ENROLLED

Outcome	Students Enrolled per school					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.445 (10.308)	3.132 (6.047)	2.058 (11.773)	5.090 (7.239)	1.104 (9.855)	2.202 (5.872)
Observations	38,512	38,512	27,553	27,553	41,191	41,191
R-squared	0.000	0.473	0.000	0.471	0.000	0.471
Controls	No	Yes	No	Yes	No	Yes
Clusters	2286	2286	1789	1789	2419	2419
Mean LHS	147	147	149.3	149.3	146.9	146.9
Using Bandwidth	0.101	0.101	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.101	0.101	0.101	0.101	0.101	0.101

This table reports the coefficient on political party turnover estimating Equation 1. Outcome variables: Students Enrolled per School comes from School Census and is defined as the number of all students enrolled across all grades in given school. Controls include a 2012 election-cycle indicator and school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet).

TABLE A.15: POLITICAL TURNOVER AND DROPOUT RATES

Outcome:	School-level Dropout Rates					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.0039 (0.0036)	0.0042 (0.0035)	0.0049 (0.0034)	0.0052 (0.0034)	0.0031 (0.0033)	0.0036 (0.0032)
Baseline Dropout rate	0.3423 (0.0248)	0.3280 (0.0246)	0.3399 (0.0284)	0.3272 (0.0281)	0.3380 (0.0207)	0.3225 (0.0206)
Observations	31,742	31,742	26,492	26,492	39,661	39,661
R-squared	0.1446	0.1524	0.1502	0.1566	0.1391	0.1473
Controls	No	Yes	No	Yes	No	Yes
Clusters	2029	2029	1783	1783	2412	2412
Mean LHS	0.0337	0.0337	0.0323	0.0323	0.0335	0.0335
Using Bandwidth	0.0836	0.0836	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.0836	0.0836	0.0836	0.0836	0.0836	0.0836

This table reports the coefficient on political party turnover from regressing school-level dropout rates on the running variable of the RDD ($IncumbVoteMargin$), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin| < Using$ Bandwidth. The school-level dropout rate is measured by the School Census and refers to the dropout rate for all students within a school (in all grade levels). All specifications control for the school-level, dropout rate at baseline (the year before the respective election). Controls include school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator.

TABLE A.16: POLITICAL TURNOVER IN 2008 AND 4TH GRADE TEST SCORES 1, 3, AND 5 YEARS AFTER THE ELECTION

Outcome:	Individual 4th Grade Test Scores (standardized)			
	(1)	(2)	(3)	(4)
$\mathbb{1}\{IncumbVoteMargin_{2008} < 0\}$	-0.113 (0.046)	-0.106 (0.041)	-0.063 (0.039)	-0.060 (0.035)
$\mathbb{1}\{IncumbVoteMargin_{2008} < 0\} \times 2011$	0.019 (0.049)	0.013 (0.046)	0.016 (0.042)	0.011 (0.040)
$\mathbb{1}\{IncumbVoteMargin_{2008} < 0\} \times 2013$	0.033 (0.056)	0.038 (0.051)	-0.013 (0.046)	-0.013 (0.042)
Observations	384,233	384,233	535,315	535,315
R-squared	0.165	0.203	0.163	0.200
Controls	No	Yes	No	Yes
Clusters	728	728	1013	1013
Using Bandwidth	0.0700	0.0700	0.110	0.110

This table reports the coefficient on political party turnover from regressing individual-level 4th grade test scores on the running variable of the RDD ($IncumbVoteMargin_{2008}$), political party turnover ($\mathbb{1}\{IncumbVoteMargin_{2008} < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin_{2008}| < \text{Using Bandwidth}$, as well as the interaction for each year t , where t is one year, three years, and five years after the 2008 election. Test scores are from the *Prova Brasil* exam and are standardized based on the distribution of individual-level test scores in municipalities with no change in the ruling party. All specifications control for school-level, average test scores for 4th graders at baseline (one year before the 2008 election). Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and individual-level controls (an indicator variable for gender, whether the student is white, and whether the student sees their mother reading). Test scores are from the *Prova Brasil* exam and are standardized based on the distribution of individual-level test scores in municipalities with no change in the ruling party.

TABLE A.17: POLITICAL TURNOVER IN 2008 AND 8TH GRADE TEST SCORES 1, 3, AND 5 YEARS AFTER THE ELECTION

Outcome:	Individual 8th Grade Test Scores (standardized)			
	(1)	(2)	(3)	(4)
$\mathbb{1}\{IncumbVoteMargin_{2008} < 0\}$	-0.043 (0.049)	-0.059 (0.049)	-0.037 (0.040)	-0.043 (0.040)
$\mathbb{1}\{IncumbVoteMargin_{2008} < 0\} \times 2011$	-0.010 (0.061)	-0.007 (0.059)	0.004 (0.048)	0.003 (0.046)
$\mathbb{1}\{IncumbVoteMargin_{2008} < 0\} \times 2013$	-0.068 (0.075)	-0.074 (0.071)	-0.047 (0.065)	-0.056 (0.061)
Observations	148,709	148,709	216,249	216,249
R-squared	0.138	0.154	0.131	0.148
Controls	No	Yes	No	Yes
Clusters	432	432	607	607
Using Bandwidth	0.0700	0.0700	0.110	0.110

This table reports the coefficient on political party turnover from regressions of individual-level 8th grade test scores on the running variable of the RDD ($IncumbVoteMargin_{2008}$), political party turnover ($\mathbb{1}\{IncumbVoteMargin_{2008} < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin_{2008}| < \text{Using Bandwidth}$, as well as the interaction for each year t , where t is one year, three years, and five years after the 2008 election. All specifications control for school-level, average test scores for 8th graders at baseline (one year before the 2008 election). Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and individual-level controls (an indicator variable for gender, whether the student is white, and whether the student sees their mother reading). Test scores are from the *Prova Brasil* exam and are standardized based on the distribution of individual-level test scores in municipalities with no change in the ruling party.

TABLE A.18: POLITICAL TURNOVER IN 2008 AND HEADMASTER REPLACEMENT 1, 3, AND 5 YEARS AFTER THE ELECTION

Outcome:	Headmaster is new to the school (as Headmaster)					
	2009		2011		2013	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.274 (0.050)	0.271 (0.051)	-0.056 (0.042)	-0.054 (0.042)	-0.056 (0.056)	-0.064 (0.055)
N	4,882	4,882	3,966	3,966	3,794	3,794
R-squared	0.090	0.091	0.002	0.005	0.005	0.014
Controls	No	Yes	No	Yes	No	Yes
Clusters	1082	1082	995	995	969	969
Mean Dep Variable	0.438	0.438	0.348	0.348	0.665	0.665
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.128	0.128	0.152	0.152	0.0785	0.0785

This table shows the coefficient on political party turnover in 2008 from regressing an indicator variable for whether the school has a new headmaster on the running variable of the RDD ($IncumbVoteMargin_{2008}$), political party turnover ($\mathbb{1}\{IncumbVoteMargin_{2008} < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin_{2008}| < \text{Using Bandwidth}$, separately for each year t , where t is one year, three years, and five years after the 2008 election. New headmasters are those that report being the headmaster of their current school for less than two years on the *Prova Brasil* headmaster questionnaire. Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet).

TABLE A.19: POLITICAL TURNOVER IN 2008 AND TEACHER REPLACEMENTS 1, 3, AND 5 YEARS AFTER THE ELECTION

Outcome:	Share of Teachers New to the School					Share of Teachers that have Left the School						
	2009	2011	2013	2009	2011	2009	2011	2013	2011	2013		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.093 (0.030)	0.093 (0.030)	0.047 (0.035)	0.046 (0.035)	-0.001 (0.036)	-0.002 (0.036)	0.080 (0.031)	0.079 (0.031)	0.035 (0.035)	0.034 (0.035)	0.007 (0.033)	0.006 (0.033)
Observations	15,172	15,172	15,172	15,172	15,172	15,172	15,172	15,172	15,172	15,172	15,172	15,172
R-squared	0.024	0.025	0.007	0.010	0.000	0.004	0.022	0.022	0.007	0.009	0.001	0.004
Schl Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Clusters	1109	1109	1109	1109	1109	1109	1109	1109	1109	1109	1109	1109
Mean LHS	0.476	0.476	0.433	0.433	0.512	0.512	0.455	0.455	0.431	0.431	0.489	0.489
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.199	0.199	0.149	0.149	0.170	0.170	0.154	0.154	0.138	0.138	0.192	0.192

This table shows the coefficient on political party turnover in 2008 from regressing the share of teachers that are new to the school or the share of teachers that have left a school on the running variable of the RDD ($IncumbVoteMargin_{2008}$), political party turnover ($\mathbb{1}\{IncumbVoteMargin_{2008} < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin_{2008}| < UsingBandwidth$, separately for each year t , where t is one year, three years, and five years after the 2008 election. The share of teachers that are new to a school is computed using the School Census and corresponds to the share of teachers in a school who are in that school at time t but were not in that same school at time $t - 2$. The share of teachers that have left a school is also computed using the School Census and corresponds to the share of teachers in a school who were in that school at time $t - 2$ but are no longer in that same school at time t . Controls include school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet).

TABLE A.20: HETEROGENEITY BY TYPE OF HEADMASTER APPOINTMENT AT BASELINE

Outcome:	Test Scores		Headmaster Turnover		New Teachers		Teachers that have left	
Panel A								
	Politically Appointed at Baseline							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.055 (0.024)	-0.048 (0.023)	0.354 (0.032)	0.350 (0.032)	0.096 (0.016)	0.098 (0.016)	0.100 (0.016)	0.101 (0.016)
School-level baseline scores	0.849 (0.014)	0.728 (0.015)						
Observations	284,998	284,998	5,916	5,916	6,669	6,669	6,669	6,669
R-squared	0.216	0.250	0.159	0.162	0.088	0.095	0.079	0.086
Controls	No	Yes	No	No	No	No	No	No
Clusters	1818	1818	1736	1736	1725	1725	1725	1725
Mean Dep. Variable	-0.196	-0.196	0.459	0.459	0.452	0.452	0.435	0.435
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.0860	0.0860	0.113	0.113	0.156	0.156	0.152	0.152
Panel B								
	Not Politically Appointed at Baseline							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.112 (0.052)	-0.092 (0.045)	0.036 (0.067)	0.038 (0.065)	0.050 (0.029)	0.054 (0.028)	0.054 (0.027)	0.057 (0.026)
School-level baseline scores	0.855 (0.022)	0.731 (0.023)						
Observations	112,413	112,413	2,061	2,061	2,017	2,017	2,017	2,017
R-squared	0.188	0.223	0.009	0.020	0.015	0.027	0.013	0.021
Controls	No	Yes	No	No	No	No	No	No
Clusters	554	554	560	560	532	532	532	532
Mean Dep. Variable	0.0419	0.0419	0.415	0.415	0.468	0.468	0.456	0.456
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.103	0.103	0.149	0.149	0.145	0.145	0.155	0.155

This table reports the coefficient on political party turnover estimating Equation 1. The outcomes are the individual-level 4th grade test scores (columns 1 and 2), an indicator variable for whether the school has a new headmaster (columns 3 and 4), share of teachers that are new to the school (columns 5 and 6) and share of teachers that have left a school (columns 7 and 8). Test scores are from the *Prova Brasil* exam and are standardized based on the distribution of individual-level test scores in municipalities with no change in the ruling party. Headmaster Turnover is an indicator variable for whether the school has a new headmaster, those that report being the headmaster of their current school for less than two years on the *Prova Brasil* headmaster questionnaire. The share of teachers that are new to a school is computed using the School Census and corresponds to the share of teachers in a school who are in that school at time t (one year after the respective election) but were not in that same school at time $t - 2$ (the year before the respective election). The share of teachers that have left a school is also computed using the School Census and corresponds to the share of teachers in a school who were in that school at time $t - 2$ (the year before the respective election) but are no longer in that same school at time t (one year after the respective election). Controls include a 2012 election-cycle indicator and school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school’s trash is regularly collected, and the school has Internet). In Columns 1 and 2 only, there are also for school-level, average test scores for 4th graders at baseline (one year before the 2008 election) and, in Column 2, individual-level controls (an indicator variable for gender, whether the student is white, and whether the student sees their mother reading). The analysis is made separately for schools that had a politically appointed headmaster at baseline (Panel A) and those that did not (Panel B). Politically appointed headmasters are those who report being some type of “appointee” on the *Prova Brasil* headmaster questionnaire.

TABLE A.21: POLITICAL TURNOVER AND HEADMASTER REPLACEMENT IN LOW- AND HIGH-INCOME MUNICIPALITIES

Outcome:	Headmaster is new to the school (as Headmaster)					
Panel A	Low Income Municipalities (Below Median Income)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.389 (0.038)	0.389 (0.037)	0.371 (0.047)	0.370 (0.045)	0.379 (0.039)	0.379 (0.038)
Observations	6,703	6,703	4,294	4,294	6,447	6,447
R-squared	0.151	0.154	0.160	0.167	0.156	0.159
Controls	No	Yes	No	Yes	No	Yes
Clusters	1073	1073	754	754	1030	1030
Mean Dep. Variable	0.447	0.447	0.447	0.447	0.445	0.445
Using Bandwidth	0.116	0.116	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.116	0.116	0.116	0.116	0.116	0.116
Panel B	High Income Municipalities (Above Median Income)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.126 (0.044)	0.125 (0.043)	0.136 (0.065)	0.138 (0.064)	0.107 (0.049)	0.112 (0.049)
Observations	5,809	5,809	3,114	3,114	4,560	4,560
R-squared	0.050	0.051	0.030	0.032	0.045	0.046
Controls	No	Yes	No	Yes	No	Yes
Clusters	1220	1220	764	764	1048	1048
Mean Dep. Variable	0.430	0.430	0.467	0.467	0.448	0.448
Using Bandwidth	0.139	0.139	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.139	0.139	0.139	0.139	0.139	0.139

This table shows the same analysis as in Table 4 separately for low-income (Panel A) and high-income (Panel B) municipalities. Low-income municipalities are those below the median in the municipal-level distribution of median monthly household income as measured in the 2000 Census. High income municipalities are those above the median in this distribution.

TABLE A.22: POLITICAL TURNOVER AND TEACHER REPLACEMENTS IN LOW- AND HIGH-INCOME MUNICIPALITIES

Outcome:	Share of Teachers New to the School					Share of Teachers that have Left the School						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A	Low Income Municipalities (Below Median Income)											
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.113 (0.024)	0.114 (0.024)	0.130 (0.028)	0.130 (0.028)	0.117 (0.024)	0.118 (0.024)	0.115 (0.024)	0.116 (0.024)	0.127 (0.028)	0.127 (0.028)	0.114 (0.025)	0.114 (0.024)
Observations	24,003	24,003	16,008	16,008	24,337	24,337	25,052	25,052	16,008	16,008	24,337	24,337
R-squared	0.036	0.038	0.032	0.034	0.035	0.037	0.032	0.034	0.029	0.031	0.032	0.034
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Clusters	965	965	707	707	975	975	1001	1001	707	707	975	975
Mean Dep. Variable	0.447	0.447	0.453	0.453	0.447	0.447	0.434	0.434	0.439	0.439	0.433	0.433
Using Bandwidth	0.108	0.108	0.0700	0.0700	0.110	0.110	0.114	0.114	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.108	0.108	0.108	0.108	0.108	0.108	0.114	0.114	0.114	0.114	0.114	0.114
Panel B	High Income Municipalities (Above Median Income)											
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.050 (0.022)	0.055 (0.022)	0.049 (0.032)	0.050 (0.032)	0.041 (0.026)	0.046 (0.026)	0.044 (0.019)	0.049 (0.019)	0.039 (0.031)	0.040 (0.030)	0.040 (0.025)	0.045 (0.024)
Observations	10,983	10,983	5,458	5,458	7,881	7,881	12,640	12,640	5,458	5,458	7,881	7,881
R-squared	0.008	0.018	0.008	0.018	0.009	0.018	0.008	0.018	0.008	0.020	0.008	0.019
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Clusters	1286	1286	762	762	1028	1028	1425	1425	762	762	1028	1028
Mean Dep. Variable	0.508	0.508	0.507	0.507	0.506	0.506	0.487	0.487	0.487	0.487	0.487	0.487
Using Bandwidth	0.163	0.163	0.0700	0.0700	0.110	0.110	0.206	0.206	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.163	0.163	0.163	0.163	0.163	0.163	0.206	0.206	0.206	0.206	0.206	0.206

This table shows the same analysis as in Table 5 (Panel A) separately for low-income (Panel A) and high-income (Panel B) municipalities. Low-income municipalities are those below the median in the municipal-level distribution of median monthly household income as measured in the 2000 Census. High income municipalities are those above the median in this distribution.

TABLE A.23: POLITICAL TURNOVER AND 4TH GRADE TEST SCORES IN LOW- AND HIGH-INCOME MUNICIPALITIES

Outcome:	Individual 4 th Grade Test Scores (standardized)					
Panel A	Low Income Municipalities (Below Median Income)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.060 (0.037)	-0.038 (0.035)	-0.069 (0.039)	-0.053 (0.037)	-0.061 (0.032)	-0.047 (0.031)
School-level baseline scores	0.737 (0.025)	0.667 (0.024)	0.738 (0.024)	0.669 (0.023)	0.726 (0.022)	0.654 (0.022)
Observations	148,635	148,635	127,443	127,443	188,065	188,065
R-squared	0.111	0.152	0.112	0.152	0.109	0.151
Controls	No	Yes	No	Yes	No	Yes
Clusters	802	802	718	718	987	987
Using Bandwidth	0.0812	0.0812	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812
Panel B	High Income Municipalities (Above Median Income)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.035 (0.034)	-0.023 (0.031)	-0.101 (0.043)	-0.085 (0.037)	-0.068 (0.035)	-0.059 (0.032)
School-level baseline scores	0.717 (0.020)	0.635 (0.019)	0.726 (0.027)	0.638 (0.026)	0.736 (0.022)	0.650 (0.020)
Observations	267,939	267,939	162,548	162,548	234,096	234,096
R-squared	0.100	0.135	0.099	0.135	0.106	0.141
Controls	No	Yes	No	Yes	No	Yes
Clusters	1148	1148	776	776	1054	1054
Using Bandwidth	0.125	0.125	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.125	0.125	0.125	0.125	0.125	0.125

This table shows the same analysis as in Table 3 (Panel A) separately for low-income (Panel A) and high-income (Panel B) municipalities. Low-income municipalities are those below the median in the municipal-level distribution of median monthly household income as measured in the 2000 Census. High income municipalities are those above the median in this distribution.

TABLE A.24: POLITICAL TURNOVER AND 8TH GRADE TEST SCORES IN LOW- AND HIGH-INCOME MUNICIPALITIES

Outcome:	Individual 8 th Grade Test Scores (standardized)					
Panel A	Low Income Municipalities (Below Median Income)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.032 (0.028)	-0.027 (0.028)	-0.034 (0.037)	-0.027 (0.037)	-0.015 (0.031)	-0.007 (0.031)
School-level baseline scores	0.687 (0.020)	0.659 (0.021)	0.663 (0.032)	0.633 (0.031)	0.687 (0.024)	0.655 (0.024)
Observations	143,725	143,725	74,190	74,190	113,464	113,464
R-squared	0.081	0.092	0.072	0.084	0.082	0.093
Controls	No	Yes	No	Yes	No	Yes
Clusters	936	936	549	549	770	770
Using Bandwidth	0.154	0.154	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.154	0.154	0.154	0.154	0.154	0.154
Panel B	High Income Municipalities (Above Median Income)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.078 (0.040)	-0.050 (0.038)	-0.086 (0.051)	-0.075 (0.050)	-0.123 (0.044)	-0.099 (0.042)
School-level baseline scores	0.763 (0.031)	0.721 (0.027)	0.755 (0.033)	0.712 (0.032)	0.749 (0.033)	0.703 (0.029)
Observations	95,630	95,630	50,338	50,338	73,955	73,955
R-squared	0.098	0.119	0.092	0.111	0.093	0.113
Controls	No	Yes	No	Yes	No	Yes
Clusters	615	615	390	390	527	527
Using Bandwidth	0.141	0.141	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.141	0.141	0.141	0.141	0.141	0.141

This table shows the same analysis as in Table 3 (Panel B) separately for low-income (Panel A) and high-income (Panel B) municipalities. Low-income municipalities are those below the median in the municipal-level distribution of median monthly household income as measured in the 2000 Census. High income municipalities are those above the median in this distribution.

TABLE A.25: PERSONNEL REPLACEMENTS: BY WINNING PARTY IDEOLOGY

Outcome:	Headmaster	Teachers (Share)		Municipal Personnel (Share)	
	Replacement	New	Who Left	New	Who Left
	(1)	(2)	(3)	(4)	(5)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.271 (0.040)	0.061 (0.027)	0.046 (0.028)	0.069 (0.023)	0.023 (0.022)
Left Ideology Wins	-0.019 (0.044)	-0.049 (0.036)	-0.048 (0.037)	0.004 (0.027)	-0.000 (0.027)
$\mathbb{1}\{IncumbVoteMargin < 0\}$ × Left Ideology Wins	0.018 (0.069)	0.082 (0.048)	0.059 (0.049)	-0.002 (0.041)	0.003 (0.037)
Observations	8,654	31,044	31,717	2,265	2,265
R-squared	0.097	0.026	0.019	0.026	0.005
Controls	No	No	No	No	No
Clusters	1729	1867	1978	1979	1979
Mean LHS	0.453	0.478	0.478	0.309	0.236
Using Bandwidth	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.104	0.126	0.116	0.123	0.124

This table reports the coefficient on political party turnover estimating Equation 2. Outcomes: Headmaster Replacement (Column 1) is an indicator variable for whether the school has a new headmaster, those that report being the headmaster of their current school for less than two years on the *Prova Brasil* headmaster questionnaire. The share of teachers that are new to a school (Column 2) is computed using the School Census and corresponds to the share of teachers in a school who are in that school at time t (one year after the respective election) but were not in that same school at time $t - 2$ (the year before the respective election). The share of teachers that have left a school (Column 3) is also computed using the School Census and corresponds to the share of teachers in a school who were in that school at time $t - 2$ (the year before the respective election) but are no longer in that same school at time t (one year after the respective election). New municipal personnel (share) is the ratio between the number of new labor contracts that had been added 12 months after the election divided by the total number of contracts that existed the month prior to the election (Column 4) and Municipal Personnel Who Left (share) is analogous and uses number of terminated contracts (Column 5). Left Ideology Wins is an indicator variable equal to 1 if a left-wing party won the election and 0 if a right-wing party won. Party ideology is classified as belonging to the left vs. the right according to *Atlas Político - Mapa do Congresso*.

TABLE A.26: POLITICAL TURNOVER AND TEACHER REPLACEMENTS BY WINNING PARTY IDEOLOGY

Outcome	Share of Teachers New to the School			Share of Teachers that have Left the School								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.074 (0.026)	0.076 (0.026)	0.099 (0.031)	0.100 (0.031)	0.061 (0.027)	0.062 (0.027)	0.045 (0.027)	0.048 (0.027)	0.074 (0.031)	0.075 (0.031)	0.046 (0.028)	0.049 (0.028)
Left Ideology Wins	-0.060 (0.034)	-0.037 (0.037)	-0.027 (0.042)	-0.001 (0.046)	-0.049 (0.036)	-0.032 (0.040)	-0.053 (0.036)	-0.039 (0.039)	-0.024 (0.042)	-0.014 (0.047)	-0.048 (0.037)	-0.040 (0.041)
$\mathbb{1}\{IncumbVoteMargin < 0\}$ × Left Ideology Wins	0.091 (0.045)	0.086 (0.045)	0.041 (0.057)	0.039 (0.056)	0.082 (0.048)	0.080 (0.048)	0.063 (0.047)	0.061 (0.047)	0.025 (0.057)	0.027 (0.056)	0.059 (0.049)	0.058 (0.049)
Observations	35,347	35,347	21,016	21,016	31,044	31,044	33,249	33,249	21,444	21,444	31,717	31,717
R-squared	0.023	0.028	0.023	0.027	0.026	0.030	0.020	0.034	0.015	0.028	0.019	0.033
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Clusters	2060	2060	1354	1354	1867	1867	2049	2049	1447	1447	1978	1978
Mean LHS	0.480	0.480	0.485	0.485	0.478	0.478	0.476	0.476	0.486	0.486	0.478	0.478
Using Bandwidth	0.126	0.126	0.0700	0.0700	0.110	0.110	0.116	0.116	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.126	0.126	0.126	0.126	0.126	0.126	0.116	0.116	0.116	0.116	0.116	0.116

This table reports the coefficient on political party turnover estimating Equation 2. Outcomes: The share of teachers that are new to a school (Columns 1-6) is computed using the School Census and corresponds to the share of teachers in a school who are in that school at time t (one year after the respective election) but were not in that same school at time $t - 2$ (the year before the respective election). The share of teachers that have left a school (Columns 7-12) is also computed using the School Census and corresponds to the share of teachers in a school who were in that school at time $t - 2$ (the year before the respective election) but are no longer in that same school at time t (one year after the respective election). Controls include a 2012 election-cycle indicator and school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet). Left Ideology Wins is an indicator variable equal to 1 if a left-wing party won the election and 0 if a right-wing party won. Party ideology is classified as belonging to the left vs. the right according to *Atlas Político - Mapa do Congresso*.

TABLE A.27: POLITICAL TURNOVER AND 8TH GRADE TEST SCORES IN NON-MUNICIPAL SCHOOLS

Outcome:	Individual 8 th Grade Test Scores (standardized)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.017 (0.018)	-0.011 (0.018)	-0.030 (0.026)	-0.013 (0.025)	-0.031 (0.021)	-0.023 (0.020)
Baseline Scores	0.760 (0.010)	0.697 (0.010)	0.753 (0.013)	0.688 (0.013)	0.762 (0.011)	0.699 (0.011)
N	381,972	381,972	222,724	222,724	316,167	316,167
R-squared	0.106	0.125	0.106	0.125	0.107	0.126
Controls	No	Yes	No	Yes	No	Yes
Clusters	2155	2155	1409	1409	1888	1888
Using Bandwidth	0.136	0.136	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.136	0.136	0.136	0.136	0.136	0.136

This table shows a similar analysis to that of Table 3 (Panel B) with the key difference that the estimation sample for this table is *non-municipal* schools. The set of *non-municipal* schools for this outcome is comprised of state and federal schools, since only public schools participate in the *Prova Brasil* exam.

TABLE A.28: POLITICAL TURNOVER AND 4TH GRADE TEST SCORES IN LOW- AND HIGH-QUALITY MUNICIPAL SCHOOLS

Outcome:	Individual 4 th Grade Test Scores (standardized)					
Panel A	Low Quality Schools (Below Median Baseline Test Scores)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.084 (0.033)	-0.060 (0.031)	-0.075 (0.040)	-0.050 (0.038)	-0.076 (0.034)	-0.052 (0.032)
School-level baseline scores	0.836 (0.028)	0.674 (0.027)	0.840 (0.035)	0.675 (0.033)	0.832 (0.028)	0.668 (0.028)
Observations	187,043	187,043	119,327	119,327	178,087	178,087
R-squared	0.065	0.114	0.067	0.115	0.066	0.115
Controls	No	Yes	No	Yes	No	Yes
Clusters	1219	1219	820	820	1159	1159
Using Bandwidth	0.117	0.117	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.117	0.117	0.117	0.117	0.117	0.117
Panel B	High Quality Schools (Above Median Baseline Test Scores)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.064 (0.030)	-0.061 (0.028)	-0.107 (0.038)	-0.096 (0.034)	-0.064 (0.031)	-0.062 (0.028)
School-level baseline scores	0.791 (0.023)	0.682 (0.022)	0.801 (0.029)	0.690 (0.028)	0.796 (0.023)	0.686 (0.023)
Observations	256,887	256,437	176,174	175,843	252,342	251,892
R-squared	0.088	0.127	0.089	0.127	0.089	0.128
Controls	No	Yes	No	Yes	No	Yes
Clusters	1469	1469	1062	1062	1450	1450
Using Bandwidth	0.112	0.112	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.112	0.112	0.112	0.112	0.112	0.112

This table shows the same analysis as in Table 3 (Panel A) separately for low-income (Panel A) and high-income (Panel B) municipalities. Low-income municipalities are those below the median in the municipal-level distribution of median monthly household income as measured in the 2000 Census. High income municipalities are those above the median in this distribution.

TABLE A.29: POLITICAL TURNOVER AND 8TH GRADE TEST SCORES IN LOW- AND HIGH-QUALITY MUNICIPAL SCHOOLS

Outcome:	Individual 8 th Grade Test Scores (standardized)					
Panel A	Low Quality Schools (Below Median Baseline Test Scores)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.057 (0.029)	-0.048 (0.028)	-0.019 (0.040)	-0.007 (0.039)	-0.033 (0.035)	-0.019 (0.035)
School-level baseline scores	0.676 (0.030)	0.613 (0.032)	0.654 (0.043)	0.596 (0.043)	0.666 (0.036)	0.603 (0.037)
Observations	119,600	119,600	57,177	57,177	88,390	88,390
R-squared	0.038	0.052	0.034	0.048	0.038	0.052
Controls	No	Yes	No	Yes	No	Yes
Clusters	960	960	527	527	742	742
Using Bandwidth	0.163	0.163	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.163	0.163	0.163	0.163	0.163	0.163
Panel B	High Quality Schools (Above Median Baseline Test Scores)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.040 (0.033)	-0.026 (0.032)	-0.078 (0.041)	-0.077 (0.041)	-0.078 (0.034)	-0.070 (0.034)
School-level baseline scores	0.846 (0.025)	0.773 (0.026)	0.864 (0.033)	0.791 (0.034)	0.839 (0.027)	0.762 (0.028)
Observations	123,518	122,616	70,089	69,678	103,681	102,779
R-squared	0.087	0.102	0.091	0.107	0.083	0.098
Controls	No	Yes	No	Yes	No	Yes
Clusters	965	962	612	608	864	859
Using Bandwidth	0.131	0.131	0.0700	0.0700	0.110	0.110
Optimal Bandwidth	0.131	0.131	0.131	0.131	0.131	0.131

This table shows the same analysis as in Table 3 (Panel B) separately for low-quality (Panel A) and high-quality (Panel B) *municipal* schools. Low-quality schools are those below the median in the school-level distribution of test scores at baseline (the year before the respective election). High-quality schools are those above the median in this distribution.

TABLE A.30: POLITICAL TURNOVER AND SCHOOL PERSONNEL CHARACTERISTICS IN NON-MUNICIPAL SCHOOLS

Panel A: Headmaster Characteristics

Outcome:	Female	Age	B.A.	Graduate Training	Salary	Hours Worked	Experience in Education	Experience as Headmaster
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.013 (0.024)	0.051 (0.422)	0.001 (0.008)	0.018 (0.017)	57.170 (101.458)	0.075 (0.304)	0.156 (0.199)	0.421 (0.309)
Observations	5,782	5,726	5,632	5,726	5,736	5,791	5,785	5,774
R-squared	0.006	0.021	0.015	0.092	0.240	0.322	0.208	0.020
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	1863	1853	1843	1858	1858	1862	1862	1861
Mean LHS	0.766	45	0.973	0.871	2960	39.04	15.67	5.771
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.175	0.171	0.128	0.151	0.142	0.192	0.155	0.106

Panel B: Teacher Characteristics

Outcome:	N Teachers	Age	Female	B.A.	Graduate Training	Temporary Contract	Contract Type Missing
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.844 (0.688)	0.011 (0.309)	-0.002 (0.015)	0.010 (0.023)	-0.014 (0.021)	-0.037 (0.032)	0.095 (0.030)
Observations	14,251	14,251	14,251	14,251	14,251	5,415	8,060
R-squared	0.179	0.011	0.051	0.188	0.111	0.152	0.110
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	2299	2299	2299	2299	2299	1523	1523
Mean LHS	20.38	37.84	0.753	0.744	0.288	0.434	0.292
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.109	0.114	0.173	0.117	0.114	0.138	0.139

This table reports the coefficient on political party turnover estimating Equation 1. Outcomes: Headmaster characteristics (Panel A) are from the *Prova Brasil* headmaster questionnaire. The teacher characteristics (Panel B) are from the School Census and are averaged at the school-level. Controls include a 2012 election-cycle indicator and school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet). The set of non-municipal schools in Panel A is comprised of state and federal schools, since only public schools participate in the *Prova Brasil* exam. The set of *non-municipal* schools in Panel B is comprised of state, federal, and private schools (since all schools participate in School Census).

TABLE A.31: POLITICAL TURNOVER AND HEADMASTER CHARACTERISTICS

Outcome:	Female	Age	B.A.	Graduate Training	Salary	Hours Worked	Experience in Education	Experience as Headmaster
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.019 (0.019)	-0.231 (0.405)	-0.004 (0.014)	-0.043 (0.022)	9.492 (77.119)	-0.096 (0.274)	-0.134 (0.222)	-1.758 (0.258)
Observations	11,112	10,989	10,853	10,773	11,019	11,170	11,161	11,176
R-squared	0.032	0.055	0.050	0.252	0.275	0.323	0.148	0.046
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	2142	2141	2132	2130	2141	2144	2136	2142
Mean LHS	0.820	41.62	0.901	0.767	2056	38.69	14.14	5.047
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.137	0.139	0.142	0.113	0.117	0.145	0.166	0.134

This table reports the coefficient on political party turnover from regressing each of the headmaster characteristic variables on the running variable of the RDD (*IncumbVoteMargin*), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin| < \text{Using Bandwidth}$. Headmaster characteristics are from the *Prova Brasil* headmaster questionnaire. Controls include school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator.

TABLE A.32: POLITICAL TURNOVER AND TEACHER CHARACTERISTICS

Outcome:	N Teachers	Age	Female	B.A.	Graduate Training	Temporary Contract	Contract Type Missing
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.176 (0.274)	-0.443 (0.382)	-0.018 (0.017)	-0.077 (0.025)	-0.025 (0.014)	0.034 (0.037)	0.010 (0.006)
Observations	39,642	39,642	39,642	39,642	39,642	20,945	20,945
R-squared	0.505	0.047	0.032	0.269	0.193	0.093	0.023
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	2304	2304	2304	2304	2304	1523	1523
Mean LHS	7.859	37.31	0.815	0.485	0.155	0.344	0.0184
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.0922	0.144	0.0995	0.0917	0.0884	0.0915	0.169

This table reports the coefficient on political party turnover from regressing each of the teacher characteristic variables on the running variable of the RDD (*IncumbVoteMargin*), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin| < \text{Using Bandwidth}$. The teacher characteristics are from the School Census and are averaged at the school-level. Controls include school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator.

TABLE A.33: POLITICAL TURNOVER AND MUNICIPAL PERSONNEL CHARACTERISTICS

Outcomes	Age (1)	College (2)	High School (3)	Middle Edu (4)	Mean Wage (5)	Seniority (6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.422 (0.213)	-0.001 (0.011)	0.016 (0.014)	-0.015 (0.011)	17.387 (24.423)	-6.595 (2.739)
Observations	2,373	2,373	2,373	2,373	2,373	2,373
R-squared	0.031	0.028	0.001	0.047	0.332	0.029
Clusters	2047	2047	2047	2047	2047	2047
Mean Dep. Variable	39.16	0.272	0.389	0.273	1167	78.93
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.120	0.121	0.131	0.145	0.105	0.136

This table reports the coefficient on Political turnover from regressing municipal personnel characteristics estimating Equation 1. The municipal personnel characteristics are from *RAIS*. The variables Age, Mean Wage and Seniority were calculated as the average attribute among workers employed in the municipality one year after the election. The variables College, High School and Middle School are each the share of the workers with the respective attribute among the employed in the municipality one year after the election.

TABLE A.34: POLITICAL TURNOVER AND SCHOOL PROBLEMS (AS REPORTED BY HEADMASTER)

Outcome:	Teacher Council Meetings (1)	Coordinated Curriculum (2)	Curriculum Together (3)	Textbooks On-time (4)	Textbooks Correct (5)	Program for Dropouts (6)	Program for Tutoring (7)	Program for Failing Students (8)	Teacher Training Held (9)	Teacher Training Participation (10)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.130 (0.066)	-0.027 (0.011)	-0.047 (0.021)	-0.090 (0.026)	-0.059 (0.025)	-0.052 (0.027)	-0.076 (0.025)	-0.035 (0.019)	-0.150 (0.031)	-0.026 (0.013)
N	7,058	7,058	7,058	7,058	7,058	7,058	7,058	7,058	7,058	4,228
R-squared	0.035	0.036	0.155	0.029	0.023	0.086	0.055	0.123	0.024	0.488
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	1819	1819	1819	1819	1819	1819	1819	1819	1819	1521
Mean Dep Var	2.557	0.963	0.776	0.776	0.794	0.621	0.835	0.845	0.607	0.639
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.160	0.119	0.142	0.115	0.138	0.113	0.132	0.139	0.120	0.117

This table reports the coefficient on political party turnover from regressing each of the outcome variables (survey responses) on the running variable of the RDD ($IncumbVoteMargin$), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin| < Using\ Bandwidth$. The survey responses are from the *Proza Brasil* headmaster questionnaire. Teacher Council Meetings refers to the number of teacher council meetings that have been held in the school this year (ranges from 0-3). Coordinated Curriculum refers to whether the school has a teaching plan (*Projeto Pedagógico*). Curriculum Together refers to whether the headmasters and teachers developed the teaching plan together. Textbooks On-time refers to whether the school received its textbooks at the beginning of the school-year and Textbooks Correct refers to whether the appropriate textbooks were (eventually) received. Each of the Program variables refers to whether the school offers that particular program for students. Teacher Training Held refers to whether the school held any teacher training sessions. Finally, Teacher Training Participation refers to the share of teachers who participated in the teacher training sessions (conditional on the school holding at least one such session). Controls include school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator.

TABLE A.35: POLITICAL TURNOVER IN 2008 AND SCHOOL PROBLEMS 1 AND 3 YEARS AFTER ELECTION (AS REPORTED BY HEAD-MASTER)

Outcome:	Teacher Council Meetings (1)	Coordinated Curriculum (2)	Curriculum Together (3)	Textbooks On-time (4)	Textbooks Correct (5)	Program for Dropouts (6)	Program for Tutoring (7)	Program for Failing Students (8)	Teacher Training Held (9)	Teacher Training Participation (10)	Problems Index (11)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.244 (0.097)	-0.048 (0.021)	-0.057 (0.040)	-0.131 (0.036)	-0.089 (0.041)	-0.103 (0.039)	-0.147 (0.044)	-0.070 (0.036)	-0.145 (0.049)	-0.037 (0.012)	-0.246 (0.046)
2011	-0.089 (0.049)	-0.001 (0.012)	0.101 (0.035)	-0.047 (0.031)	0.093 (0.028)	-0.003 (0.027)	-0.034 (0.024)	-0.034 (0.026)	0.018 (0.039)	-0.006 (0.008)	0.004 (0.026)
$\mathbb{1}\{IncumbVoteMargin < 0\} \times 2011$	0.116 (0.078)	0.021 (0.022)	0.068 (0.048)	0.158 (0.043)	0.048 (0.040)	-0.005 (0.045)	0.066 (0.036)	-0.002 (0.040)	0.083 (0.053)	0.034 (0.013)	0.142 (0.039)
Observations	6,623	6,623	6,623	6,623	6,623	6,623	6,623	6,623	6,623	3,876	6,623
R-squared	0.043	0.034	0.043	0.028	0.030	0.024	0.074	0.044	0.035	0.036	0.145
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	1138	1138	1138	1138	1138	1138	1138	1138	1138	989	1138
Mean LHS	2.579	0.956	0.683	0.802	0.806	0.484	0.789	0.738	0.596	0.448	0.0328
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.114	0.123	0.107	0.141	0.165	0.141	0.118	0.132	0.126	0.131	0.124

This table reports the coefficient on political party turnover in 2008 estimating Equation 2. Outcomes: The survey responses are from the *Prova Brasil* headmaster questionnaire. Teacher Council Meetings refers to the number of teacher council meetings that have been held in the school this year (ranges from 0-3). Coordinated Curriculum refers to whether the school has a teaching plan (*Projeto Pedagógico*). Curriculum Together refers to whether the headmasters and teachers developed the teaching plan together. Textbooks On-time refers to whether the school received its textbooks at the beginning of the school-year and Textbooks Correct refers to whether the appropriate textbooks were (eventually) received. Each of the Program variables refers to whether the school offers that particular program for students. Teacher Training Held refers to whether the school held any teacher training sessions. Finally, Teacher Training Participation refers to the share of teachers who participated in the teacher training sessions (conditional on the school holding at least one such session). Problems Index (Column 11) is constructed with headmaster's survey responses in a way that a higher index corresponds to fewer problems. Controls include school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet). 2011 is an indicator for outcomes in 2011 *Prova Brasil* edition.

TABLE A.36: POLITICAL TURNOVER AND SCHOOL PROBLEMS (AS REPORTED BY THE TEACHER)

Outcome:	Teacher Council Meetings (1)	Coordinated Curriculum (2)	Curriculum Together (3)	Relationship w/ Headmaster (Index) (4)	Relationship w/ Teachers (Index) (5)	Collaborative Environment (6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.042 (0.064)	-0.014 (0.007)	-0.038 (0.017)	-0.234 (0.311)	-0.059 (0.157)	-0.028 (0.031)
N	23,409	23,409	23,409	23,409	23,409	23,409
R-squared	0.025	0.020	0.055	0.007	0.022	0.327
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	2087	2087	2087	2087	2087	2087
Mean Dep Var	2.337	0.969	0.800	0.705	0.387	3.677
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.146	0.135	0.144	0.190	0.130	0.121

This table reports the coefficient on political party turnover from regressing each of the outcome variables (survey responses) on the running variable of the RDD ($IncumbVoteMargin$), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin| < Using\ Bandwidth$. The survey responses are from the *Prova Brasil* teacher questionnaire, which is administered to teachers who proctor the exam. Teacher Council Meetings refers to the number of teacher council meetings that have been held in the school this year (ranges from 0-3). Coordinated Curriculum refers to whether the school has a teaching plan (*Projeto Pedagogico*). Curriculum Together refers to whether the headmasters and teachers developed the teaching plan together. The Relationship with Headmaster Index is constructed as follows. We standardize the responses to a series of questions – regarding whether the teacher trusts the headmaster, whether the teacher believes the headmaster motivates her, is committed to the school, innovates, cares about the students, cares about the school personnel, and cares about the school as a whole, and whether the teacher respects the headmaster/feels respected by the headmaster – by subtracting the overall mean and dividing by the standard deviation of all teacher responses for each question. We then add all these standardized responses to arrive at the "Relationship w/ Headmaster Index." The Relationship with Teacher Index is constructed as follows. We standardize the responses to a series of questions – regarding whether the teachers share ideas and whether the teachers work together – by subtracting the overall mean and dividing by the standard deviation of all teacher responses for each question. We then add all these standardized responses to arrive at the "Relationship w/ Teacher Index." Finally, Collaborative Environment refers to how collaborative the teacher feels the school is (on a scale of 1-5, where 5 is very collaborative). Controls include school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator.

TABLE A.37: POLITICAL TURNOVER IN 2008 AND SCHOOL PROBLEMS 1 AND 3 YEARS AFTER ELECTION (AS REPORTED BY THE TEACHER)

Outcome:	Teacher Council Meetings (1)	Coordinated Curriculum (2)	Curriculum Together (3)	Relationship w/ Headmaster (Index) (4)	Relationship w/ Teachers (Index) (5)	Collaborative Environment (6)	Problems Index (7)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.085 (0.089)	-0.009 (0.012)	-0.029 (0.034)	-1.061 (0.406)	-0.274 (0.150)	-0.108 (0.048)	-0.098 (0.038)
2011	0.005 (0.045)	0.006 (0.008)	-0.005 (0.026)	0.107 (0.324)	0.040 (0.144)	0.059 (0.035)	0.021 (0.028)
$\mathbb{1}\{IncumbVoteMargin < 0\} \times 2011$	-0.082 (0.070)	-0.013 (0.012)	0.040 (0.035)	-0.463 (0.494)	-0.211 (0.210)	0.005 (0.054)	-0.033 (0.043)
Observations	21,699	21,699	21,699	21,699	21,699	21,699	21,699
R-squared	0.033	0.026	0.015	0.010	0.006	0.005	0.028
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	1224	1224	1224	1224	1224	1224	1224
Mean LHS	2.386	0.972	0.707	0.843	0.278	4.381	0.0965
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.109	0.117	0.140	0.0881	0.0998	0.108	0.0906

This table reports the coefficient on political party turnover in 2008 estimating Equation 2. Outcomes: The survey responses are from the *Prova Brasil* teacher questionnaire, which is administered to teachers who proctor the exam. Teacher Council Meetings refers to the number of teacher council meetings that have been held in the school this year (ranges from 0-3). Coordinated Curriculum refers to whether the school has a teaching plan (*Projeto Pedagógico*). Curriculum Together refers to whether the headmasters and teachers developed the teaching plan together. The Relationship with Headmaster Index is constructed as follows. We standardize the responses to a series of questions – regarding whether the teacher trusts the headmaster, whether the teacher believes the headmaster motivates her, is committed to the school, innovates, cares about the students, cares about the school personnel, and cares about the school as a whole, and whether the teacher respects the headmaster/feels respected by the headmaster – by subtracting the overall mean and dividing by the standard deviation of all teacher responses for each question. We then add all these standardized responses to arrive at the "Relationship w/ Headmaster Index." The Relationship with Teacher Index is constructed as follows. We standardize the responses to a series of questions – regarding whether the teachers share ideas and whether the teachers work together – by subtracting the overall mean and dividing by the standard deviation of all teacher responses for each question. We then add all these standardized responses to arrive at the "Relationship w/ Teacher Index." Finally, Collaborative Environment refers to how collaborative the teacher feels the school is (on a scale of 1-5, where 5 is very collaborative). Problem Index (Column 7) is constructed with teacher's survey responses in a way that a higher index corresponds to fewer problems. Controls include school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet). *2011* is an indicator for outcomes in 2011 *Prova Brasil* edition.

TABLE A.38: TEACHER CHARACTERISTICS BY POLITICALLY APPOINTED HEADMASTER

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Number of Teachers	Age	Female	B.A.	Graduate Training	Temporary Contract	Contract Type Missing
$\mathbf{1}\{IncumbVoteMargin < 0\}$	0.801 (1.615)	0.432 (0.727)	0.001 (0.019)	0.052 (0.047)	0.011 (0.054)	0.105 (0.073)	-0.019 (0.020)
Headmaster Politically Appointed at Baseline	0.127 (1.110)	-0.783 (0.535)	-0.040 (0.014)	-0.027 (0.034)	-0.045 (0.035)	0.064 (0.039)	-0.028 (0.018)
$\mathbf{1}\{IncumbVoteMargin < 0\}$	-0.176 (1.674)	-0.662 (0.774)	-0.032 (0.020)	-0.082 (0.050)	-0.040 (0.055)	-0.059 (0.074)	0.039 (0.020)
Headmaster Politically Appointed at Baseline							
Observations	9,520	9,520	9,520	9,520	9,520	6,092	6,092
R-squared	0.004	0.012	0.023	0.029	0.034	0.017	0.006
Controls	No	No	No	No	No	No	No
Clusters	2069	2069	2069	2069	2069	1346	1346
Mean Dep. Variable	18.77	38.71	0.854	0.719	0.284	0.213	0.0266
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.134	0.153	0.122	0.123	0.112	0.107	0.158

This table reports the coefficient on Political turnover from regressing teacher characteristics estimating Equation 2. The teacher characteristics are from the School Census and are averaged at the school-level. Politically appointed headmasters are those who report being some type of “appointee” on the Prova Brasil headmaster questionnaire.

TABLE A.39: POLITICAL TURNOVER AND SCHOOL PROBLEMS (REPORTED BY HEADMASTER AND TEACHER)

Outcome	School Problems Index: Reported by Headmaster and Teacher			
	(1)	(2)	(3)	(4)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	-0.092 (0.026)	-0.094 (0.026)	-0.071 (0.026)	-0.069 (0.026)
New 4th Grade Teachers (share)		-0.001 (0.089)	-0.012 (0.098)	
4th Grade Teachers that Have Left (share)		0.249 (0.089)	0.320 (0.098)	
New Teachers Except 4th Grade (share)			-0.122 (0.050)	-0.089 (0.044)
Teachers Except 4th Grade that Have Left (share)			0.059 (0.053)	0.030 (0.047)
Headmaster is new to the school (as Headmaster)			-0.114 (0.011)	-0.114 (0.011)
New Municipal Personnel (share)			-0.019 (0.037)	-0.021 (0.038)
Municipal Personnel Who Left (share)			0.134 (0.043)	0.133 (0.044)
Observations	15,544	15,544	15,544	15,544
R-squared	0.117	0.118	0.148	0.146
Controls	Yes	Yes	Yes	Yes
Clusters	1594	1594	1594	1594
Using Bandwidth	0.110	0.110	0.110	0.110

This table reports the coefficient on political party turnover estimating Equation 1 and controlling by the various types of personnel replacements. Outcome: School Problems Index: Reported by Headmasters and Teacher. Index is constructed with survey responses from the Prova Brasil questionnaire, which is administered to headmasters and teachers who proctor the exam, and in a way that a higher index corresponds to fewer problems. New Headmaster are those that report being the headmaster of their current school for less than two years on the *Prova Brasil* headmaster questionnaire. The share of teachers that are new to a school is computed using the School Census and corresponds to the share of teachers in a school who are in that school at time t (one year after the respective election) but were not in that same school at time $t - 2$ (the year before the respective election). The share of teachers that have left a school is also computed using the School Census and corresponds to the share of teachers in a school who were in that school at time $t - 2$ (the year before the respective election) but are no longer in that same school at time t (one year after the respective election). The shares are split by which grade the teacher was assigned to, also according to School Census. "Except 4th Grade" category includes teachers assigned to other grades and to no specific grade, besides not assigned to teaching. New municipal personnel (share) is the ratio between the number of new labor contracts that had been added 12 months after the election divided by the total number of contracts that existed the month prior to the election and Municipal Personnel Who Left (share) is analogous and uses number of terminated contracts. Controls include a 2012 election-cycle indicator and school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet).

TABLE A.40: TEACHER REPLACEMENT BY GRADE-LEVEL

Panel A: Share of Teachers New to the School									
Outcome	All	1st-4th	5th-8th	1st	2nd	3rd	4th	Multi-Grade	Residual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\mathbb{1}_{\{IncumbVoteMargin < 0\}}$	0.1021 (0.0194)	0.0260 (0.0083)	0.0015 (0.0025)	0.0087 (0.0028)	0.0064 (0.0024)	0.0048 (0.0022)	0.0062 (0.0022)	0.0250 (0.0201)	0.0496 (0.0157)
Observations	32,883	32,883	32,883	32,883	32,883	32,883	32,883	32,883	32,883
R-squared	0.0309	0.0082	0.0004	0.0083	0.0033	0.0024	0.0034	0.0082	0.0077
Clusters	2056	2056	2056	2056	2056	2056	2056	2056	2056
Mean Dep Variable	0.472	0.0970	0.0117	0.0255	0.0262	0.0228	0.0225	0.220	0.143
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.130	0.122	0.108	0.144	0.130	0.127	0.0980	0.158	0.160
Panel B: Share of Teachers that Left the School									
Outcome	All	1st-4th	5th-8th	1st	2nd	3rd	4th	Multi-Grade	Residual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\mathbb{1}_{\{IncumbVoteMargin < 0\}}$	0.0985 (0.0195)	0.0254 (0.0088)	0.0021 (0.0019)	0.0092 (0.0030)	0.0049 (0.0026)	0.0054 (0.0024)	0.0058 (0.0024)	0.0314 (0.0198)	0.0396 (0.0148)
Observations	32,883	32,883	32,883	32,883	32,883	32,883	32,883	32,883	32,883
R-squared	0.0277	0.0095	0.0013	0.0086	0.0038	0.0032	0.0038	0.0082	0.0183
Clusters	2056	2056	2056	2056	2056	2056	2056	2056	2056
Mean Dep Variable	0.454	0.101	0.0121	0.0278	0.0269	0.0230	0.0231	0.212	0.129
Using Bandwidth	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.133	0.139	0.0911	0.144	0.137	0.133	0.146	0.131	0.158

This table reports the coefficient on political party turnover estimating Equation 1. The share of teacher that are new to the school (Panel A) is computed using the School Census and corresponds to the share of teachers in a school who are in that school at time t (one year after the respective election) but were not in that same school at time $t - 2$ (the year before the election). The share of teachers that have left a school (Panel B) is also computed using the School Census and corresponds to the share of teachers in a school who were in that school at time $t - 2$ (the year before the respective election) but are no longer in that same school at time t (one year after the respective election). In both panels, All (Column 1) includes 1st to 8th grades, Multi-Grade teachers and the Residual category and replicates our baseline results for teacher replacements. Column 2 represents teachers in Elementary School Grades and Column 3 those in Middle School. Columns 4-7 show every Elementary School grade separately. Multi-grade (Column 8) includes teachers assigned to a multi-grade classroom for Elementary or Middle School. Residual (Column 9) includes teachers that are not assigned to teaching or whose grade has not been specified.

TABLE A.41: HEADMASTER AND TEACHER REPLACEMENT BY SKILL TYPE

Outcomes	Headmaster Replacement			Individual Teacher Left		
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.241 (0.031)	0.272 (0.046)	0.237 (0.036)	0.074 (0.014)	0.073 (0.018)	0.070 (0.015)
Individual Quality Index	-0.022 (0.027)	-0.033 (0.040)	-0.006 (0.031)	-0.053 (0.009)	-0.061 (0.011)	-0.058 (0.010)
$\mathbb{1}\{IncumbVoteMargin < 0\}X$	-0.092 (0.040)	-0.006 (0.059)	-0.093 (0.047)	-0.017 (0.012)	0.000 (0.016)	-0.010 (0.013)
Observations	9,391	4,733	6,985	355,218	213,175	315,538
R-squared	0.105	0.090	0.097	0.014	0.014	0.015
Controls	No	No	No	No	No	No
Clusters	2413	1421	1942	2616	1786	2415
Mean LHS	0.487	0.475	0.505	0.476	0.480	0.475
Using Bandwidth	0.157	0.0700	0.110	0.124	0.0700	0.110
Optimal Bandwidth	0.157	0.157	0.157	0.124	0.124	0.124

This table reports the coefficient on political party turnover estimating Equation 2. Outcomes: Headmaster Replacement (Columns 1-3) is an indicator variable for whether the school has a new headmaster, those that report being the headmaster of their current school for less than two years on the *Prova Brasil* headmaster questionnaire. Individual Teacher Left (Columns 4-6) is an indicator variable equal to one if the teacher was in a school at time $t - 2$ (the year before the respective election) but are no longer in that school at time t (one year after the respective election) and is computed using the School Census. Headmaster's quality index refer to the headmaster characteristic at $t - 2$ and the components are age, having college, having graduate training, salary, years of experience as a headmaster and in education, according to *Prova Brasil* headmaster questionnaire. Teacher's quality index refer to the teacher characteristic at $t - 2$ and the components are age, having college and having graduate training, as reported on School Census.

TABLE A.42: PERSONNEL REPLACEMENTS: BY POLITICAL TRANSITION TYPE

Outcome:	Headmaster	Teachers (Share)		Municipal Personnel (Share)	
	Replacement	New	Who Left	New	Who Left
	(1)	(2)	(3)	(4)	(5)
$\mathbb{1}\{IncumbCandidateVoteMargin < 0\}$	0.363 (0.037)	0.101 (0.026)	0.075 (0.025)	0.081 (0.024)	0.039 (0.021)
Ideology Transition	0.052 (0.065)	-0.069 (0.043)	-0.093 (0.040)	-0.128 (0.047)	-0.131 (0.051)
$\mathbb{1}\{IncumbCandidateVoteMargin < 0\}X$	-0.099 (0.085)	0.077 (0.054)	0.116 (0.051)	0.127 (0.057)	0.114 (0.059)
Observations	9,128	35,178	35,220	2,136	2,136
R-squared	0.148	0.030	0.029	0.064	0.016
Controls	No	No	No	No	No
Clusters	1724	1852	1957	1956	1956
Mean Dep Variable	0.409	0.481	0.466	0.273	0.218
Using Bandwidth	0.110	0.110	0.110	0.110	0.110
Optimal Bandwidth	0.104	0.134	0.128	0.185	0.133

This table reports the coefficient on political party turnover estimating Equation 2. Outcome: Headmaster Replacement (Column 1) is an indicator variable for whether the school has a new headmaster, those that report being the headmaster of their current school for less than two years on the *Prova Brasil* headmaster questionnaire. The share of teachers that are new to a school (Column 2) is computed using the School Census and corresponds to the share of teachers in a school who are in that school at time t (one year after the respective election) but were not in that same school at time $t - 2$ (the year before the respective election). The share of teachers that have left a school (Column 3) is also computed using the School Census and corresponds to the share of teachers in a school who were in that school at time $t - 2$ (the year before the respective election) but are no longer in that same school at time t (one year after the respective election). New municipal personnel (share) is the ratio between the number of new labor contracts that had been added 12 months after the election divided by the total number of contracts that existed the month prior to the election (Column 4) and Municipal Personnel Who Left (share) is analogous and uses number of terminated contracts (Column 5). Ideology Transition is an indicator variable that equals 1 if the winning party is from a different ideology (Left or Right) as the incumbent party. Party ideology is classified as belonging to the left vs. the right according to *Atlas Politico - Mapa do Congresso*.

TABLE A.43: SCHOOL PERSONNEL REPLACEMENTS BY ABOVE-MUNICIPAL MEDIAN SCHOOL QUALITY

Outcomes	Headmaster	Teachers (Share)	
	Replacement	New	Who Left
	(1)	(2)	(3)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.260 (0.051)	0.073 (0.023)	0.077 (0.021)
$\mathbb{1}\{School\ Rank > Median\}$	0.017 (0.034)	-0.028 (0.014)	-0.024 (0.013)
$\mathbb{1}\{IncumbVoteMargin < 0\}X$	0.018	0.010	0.012
$\mathbb{1}\{School\ Rank > Median\}$	(0.049)	(0.017)	(0.017)
Observations	6,719	8,330	8,330
R-squared	0.102	0.072	0.067
Controls	Yes	Yes	Yes
Clusters	1755	1921	1921
Using Bandwidth	0.110	0.110	0.110
Optimal Bandwidth	0.108	0.130	0.133

This table reports the coefficient on political party turnover estimating Equation 2. Outcome: Headmaster Replacement (Column 1) is an indicator variable for whether the school has a new headmaster, those that report being the headmaster of their current school for less than two years on the *Prova Brasil* headmaster questionnaire. The share of teachers that are new to a school (Column 2) is computed using the School Census and corresponds to the share of teachers in a school who are in that school at time t (one year after the respective election) but were not in that same school at time $t - 2$ (the year before the respective election). The share of teachers that have left a school (Column 3) is also computed using the School Census and corresponds to the share of teachers in a school who were in that school at time $t - 2$ (the year before the respective election) but are no longer in that same school at time t (one year after the respective election). $\mathbb{1}\{School\ Rank > Median\}$ is an indicator variable equal to 1 if the school average test score is above the median of schools within a municipality. Controls include a 2012 election-cycle indicator and school-level controls (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet).

TABLE A.44: EXPENDITURE ON EDUCATION AND PERSONNEL EXPENDITURE

Panel A Outcome:	Municipal level Financial Resources: 1 year after the election					
	Expenditures on Education (Share)			Expenditures on Personnel (Share)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.0174 (0.0067)	0.0184 (0.0080)	0.0146 (0.0064)	0.0202 (0.0054)	0.0158 (0.0077)	0.0178 (0.0061)
Observations	2,565	1,943	2,794	3,360	1,942	2,793
R-squared	0.0239	0.0254	0.0236	0.0896	0.0956	0.0919
Mean Dep Variable	0.299	0.297	0.299	0.497	0.498	0.497
Using Bandwidth	0.0983	0.0700	0.110	0.140	0.0700	0.110
Optimal Bandwidth	0.0983	0.0983	0.0983	0.140	0.140	0.140

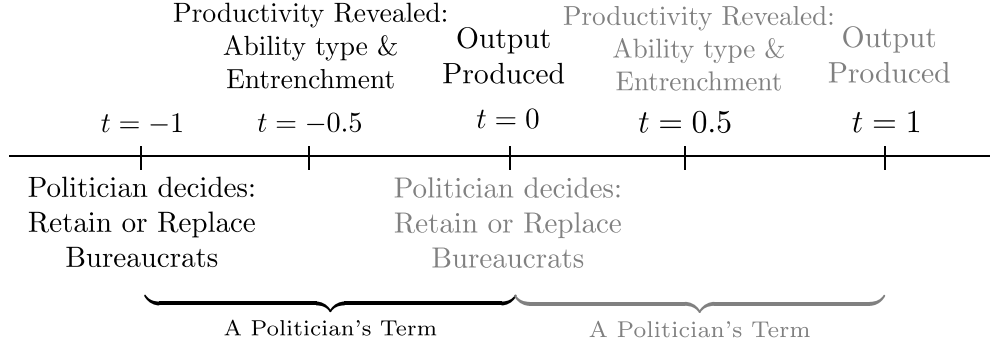
Panel B Outcome:	Municipal level Financial Resources: 2 years after the election					
	Expenditures on Education (Share)			Expenditures on Personnel (Share)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.0020 (0.0067)	0.0021 (0.0083)	0.0017 (0.0067)	-0.0044 (0.0059)	-0.0115 (0.0077)	-0.0061 (0.0060)
Observations	2,731	1,885	2,716	2,846	1,885	2,716
R-squared	0.0130	0.0125	0.0128	0.0646	0.0682	0.0651
Mean Dep Variable	0.298	0.297	0.298	0.488	0.488	0.488
Using Bandwidth	0.111	0.0700	0.110	0.117	0.0700	0.110
Optimal Bandwidth	0.111	0.111	0.111	0.117	0.117	0.117

Panel C Outcome:	Municipal level Financial Resources: 3 years after the election					
	Expenditures on Education (Share)			Expenditures on Personnel (Share)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{IncumbVoteMargin < 0\}$	0.0029 (0.0066)	0.0046 (0.0087)	0.0025 (0.0069)	-0.0092 (0.0049)	-0.0096 (0.0072)	-0.0094 (0.0056)
Observations	2,889	1,924	2,771	3,518	1,924	2,771
R-squared	0.0105	0.0111	0.0102	0.1643	0.1484	0.1549
Mean Dep Variable	0.303	0.302	0.303	0.504	0.506	0.505
Using Bandwidth	0.116	0.0700	0.110	0.153	0.0700	0.110
Optimal Bandwidth	0.116	0.116	0.116	0.153	0.153	0.153

This table reports the coefficient on political party turnover from regressing each of the variables on the running variable of the RDD ($IncumbVoteMargin$), political party turnover ($\mathbb{1}\{IncumbVoteMargin < 0\}$), and the interaction of these two variables for the set of municipalities with $|IncumbVoteMargin| < Using$ Bandwidth. It shows municipal-level regressions, using data from the Brazilian Federal Treasury for both election cycles 2008 and 2012 in Panels A-C. Panel A refers to different categories of municipal financial resources assessed one year after the election, Panel B refers to resources assessed two years after the election and Panel C refers to resources assessed three years after the election. Expenditures on Education (share) is the share of the municipality's total budget spent on education and Expenditures on Personnel (share) is the share of the municipality's total budget spent on personnel and labor related expenses across all sectors in the municipality – not only education. Panel D shows school-level regressions, using data from the *Prova Brasil* headmaster questionnaire (for both election-cycles). Controls in Panel D include school-level controls taken from the School Census (whether: the school is located in an urban or rural area, the school is connected to the electric grid, the school is connected to the water network, the school is connected to the sewage system, the school's trash is regularly collected, and the school has Internet) and a 2012 election-cycle indicator.

**Online Appendix B. Conceptual Framework
Political Turnover, Bureaucratic Turnover and the Quality
of Public Services**

By MITRA AKHTARI, DIANA MOREIRA & LAURA TRUCCO

Figure B.1. : Model Timeline

A period represents a politician's term. Every period the politician in office, a *challenger* or an *incumbent*, decides to retain or replace bureaucrats. By the end of the politician's term, a bureaucrat with ability a_i and loyalty j produces a public good (a_i) and a political service (s_j). Figure ?? summarizes the timing. For each bureaucrat who is not retained, the politician can choose the loyalty of the newly-hired replacement but cannot choose his ability. Any newly-hired bureaucrat in period $t = 0$ will have ability $a_i \in \{a_1, a_2, a_3\}$ randomly drawn from a distribution with mean $E[a]$, where $a_1 < E[a] < a_2 < a_3$, and the ability is revealed only after hiring (in period $t = 0.5$).

A bureaucrat can be either loyal to the challenger or the incumbent. $j \in [\textit{incumbent}, \textit{challenger}]$ defines whether bureaucrat is aligned to the Incumbent's party or the challenger's party. When politicians and bureaucrats are aligned we call the bureaucrat a loyalist. A loyalist bureaucrat produces a higher political service than a non-loyalist (i.e., $s_{loyalist} > s_{non-loyalist}$). Considering the challenger is taking office, the political service output the bureaucrat produces is:

$$s_j = \begin{cases} S & \text{if } j = \textit{challenger} \\ 0 & \text{if } j = \textit{incumbent} \end{cases}$$

where $S > 0$

We assume that the expected total output produced by a newly hired loyalist is higher than the total output produced by a mid-ability non-loyalist (Assumption 1), but the opposite holds for the high-ability bureaucrat (i.e., Assumption 2: $s_{non-loyalist} + a_3 > s_{loyalist} + E[a]$):

$$\begin{array}{ll} \text{Assumption 1:} & S + E[a] > 0 + a_2 \\ \text{Assumption 2:} & 0 + a_3 > S + E[a] \end{array}$$

Bureaucrats can become entrenched with probability (π). To simplify the model, only a_2 can become entrenched. Entrenchment leads to higher production of the political service output for the loyal politician ($S^{entr} > S$) and also decreases his ability-productivity ($a_2^{entr} < a_2$). The entrenchment is captured by a parameter $\delta > 0$:

Bureaucrats in office can become entrenched with probability π . We assume for simplicity that only a_2 type can get entrenched. Relative to a non-entrenched bureaucrat, an entrenched bureaucrat produces lower public good output ($a_2^{entr} < a_2$), and produces a larger political service output only when he is a loyalist ($s_{loyalist}^{entr} > s_{loyalist}$).

$$s^{entr} = S + \delta > S \quad \text{and} \quad a_2^{entr} = a_2 - \delta < a_2$$

hence we have $s_j^{entr} = \begin{cases} S^{entr} & \text{if } j = \text{challenger} \\ 0 & \text{if } j = \text{incumbent} \end{cases}$

We assume that an entrenched bureaucrat produces lower public good than the expected public good from a newly-hired bureaucrat:

$$\text{Assumption 3:} \quad a_2 - \delta < E[a]$$

Politicians & Society The politician values both outputs, while society only values the public good. Let $\gamma_t(a_i, j)$ be the share of bureaucrats in period t with attributes (a_i, j) . Given a distribution of bureaucrats in $t = 0$, the politician chooses to retain or replace them to maximize bureaucrats' total output in period $t = 1$:

Society's welfare:

$$\sum_{i=1,2,3} \sum_{j=incumbent}^{challenger} a_i \times \gamma_1(a_i; j) + \sum_{j=incumbent}^{challenger} -\delta \times \gamma_1(a_2; j) \times \pi$$

Politician's Objective function:

$$\sum_{i=1,2,3} \sum_{j=incumbent}^{challenger} (s_j + a_i) \times \gamma_1(a_i; j) + \sum_{j=incumbent}^{challenger} [(s_j^{entr} + a_2^{entr}) - (s_j + a_2)] \times \gamma_1(a_2; j) \times \pi$$

To match our empirical setting, we investigate the case where there was an

incumbent in charge in period $t = -1$, and we contrast the decision of a challenger in charge in period $t = 0$ against the decision that would have occurred if the incumbent party had continued in office.

Proposition 1: Upon arrival a challenger (that follows an incumbent administration) will face the following distribution of bureaucrat in the bureaucracy at $t=0$:

$$\begin{aligned} \gamma_0(a_1; challenger) &= 0 \\ \gamma_0(a_2; challenger) &= 0 \\ \gamma_0(a_2^{entr}; challenger) &= 0 \\ \gamma_0(a_3; challenger) &> 0 \\ \gamma_0(a_1; incumbent) &> 0 \\ \gamma_0(a_2; incumbent) &> 0 \\ \gamma_0(a_2^{entr}; incumbent) &> 0 \\ \gamma_0(a_3; incumbent) &> 0 \end{aligned}$$

In words: the former administration (incumbent party) has replaced all low-level ability bureaucrats and has retained all high-level ability bureaucrats, both regardless of loyalty status. The former administration has also replaced mid-level ability non-loyalists, while retaining mid-level ability loyalists. Note that despite that all the low-ability bureaucrats were fired at $t = -1$, at $t = 0$ there are still some low-ability bureaucrats (i.e., $\gamma_0(a_1; incumbent) > 0$) due to the bad draw in the process of hiring new loyalists.

Proposition 2: A challenger replaces an additional share of bureaucrats relative to the continued incumbent, precisely $\gamma_0(a_2; incumbent) + \gamma_0(a_2^{entr}; incumbent)$.

A challenger makes the following decision regarding bureaucrats' allocation (considering the types with positive mass at time 0 according to proposition 1):

- *Replace* $(a_1, a_2, a_2^{entr}; incumbent)$. This is due to *assumption 1* since the expected total output of a newly-hired loyalist (i.e., loyalist to the challenger) will be higher: $S + E[a] > a_2 + 0 > a_2^{entr} + 0 > a_1 + 0$. Hence a total of: $\gamma_0(a_1; incumbent) + \gamma_0(a_2; incumbent) + \gamma_0(a_2^{entr}; challenger)$ will be replaced.
- *Retain* $(a_3; incumbent)$ and $(a_3; challenger)$. This is due to *assumption 2* since the expected total output of a newly-hired loyalist will be lower: $S + a_3 > a_3 + 0 > S + E[a]$

If, however, it is a continuing incumbent party, the continuing incumbent will:

- *Replace* $(a_1; incumbent)$. This is because the expected output of a newly-hired loyalist is higher than the total output of lowest ability loyalist $S + E[a] > S + a_1$.
- *Retain* $(a_3, a_2, a_2^{entr}; incumbent)$ and $(a_3; challenger)$. This is because the total output of a mid-ability loyalist (or a high-ability non-loyalist) is higher

than the expected output of a newly-hired loyalist: $a_2 + S > E[a] + S$ and $a_3 + S > a_3 + 0 > E[a] + S$. Since from the perspective of the incumbent, total output of a mid-ability bureaucrat is the same regardless of entrenchment, the inequality also holds for entrenched bureaucrats: $a_2^{entr} + S^{entr} = a_2 + S > E[a] + S$

Proposition 3 A challenger replaces an additional share of bureaucrats (i.e., "politically motivated replacements") relative to the continued incumbent. Public good output might be smaller or larger depending on π :

if $\pi = 1$ (i.e. all a_2 gets entrenched) \rightarrow bureaucrats' public goods output is larger under the challenger administration. Since $a_2 - \delta < E[a]$ due to assumption 3.

if $\pi = 0$ (i.e. no a_2 gets entrenched) \rightarrow bureaucrats' public goods output is smaller under challenger administration. Since $a_2 > E[a]$ due to assumption 1.

$0 < \pi < 1$ can lead to either a larger or smaller output, it will depend on the parameter values.

No Entrenchment (π). We discuss in greater detail the case of $\pi = 0$ as it better matches our empirical finding that political turnover leads to adverse consequences for public education.

Note that the average ability of employed bureaucrats may also increase when the challenger chooses to replace low-ability bureaucrats. However, this same set of low-ability bureaucrats would also have been replaced by the continuing incumbent, thereby increasing the average ability level in their bureaucracy.

$$E_{t=-1}[a|\text{incumbent admin. at } t=-1] < E_{t=0}[a|\text{incumbent admin. at } t=0]$$

However, the challenger also replaces an additional number of bureaucrats. This decision leads to a lower ability of employed bureaucrats (relative to what one would observe if a continuing incumbent had continued):

$$E_{t=0}[a|\text{challenger admin. at } t=0] << E_{t=0}[a|\text{incumbent admin. at } t=0] \quad (\text{E1})$$

And, under certain parameter values, also leads to a decrease in average quality over time

$$E_{t=0}[a|\text{challenger ruling at } t=0] < E_{t=-1}[a|\text{incumbent ruling at } t=-1] \quad (\text{E2})$$

The required condition for statement (E2) to hold is the following:

$$\underbrace{(E[a] - a_1) \times \gamma_0(a_1, \textit{incumbent})}_{\text{benefit of firing low-level ability}} < \underbrace{(a_2 - E[a]) \times \gamma_0(a_2, \textit{incumbent})}_{\text{cost of firing mid-level ability}}$$

Therefore, even in the absence of entrenchment the model does not predict public good output would decrease overtime. The consequence for society's welfare of a challenger taking office (relative to welfare in time $t - 1$) is given by:

$$\begin{array}{c} \Delta \text{ Society's Welfare:} \\ \underbrace{(E[a] - a_1) \times \gamma_0(a_1, \textit{incumbent})}_{>0} + \underbrace{(E[a] - a_2) \times \gamma_0(a_2, \textit{incumbent})}_{<0} \end{array}$$

While, society's welfare of a challenger taking office (relative to the case when the incumbent continues in office)

$$\Delta \text{ Society's Welfare: } (E[a] - a_2) \times \gamma_0(a_2, \textit{incumbent}) < 0$$

Hence, when there is no entrenchment ($\pi = 0$) political transitions leads to lower public good output.

Implications and Predictions

This simple model generates predictions that we can test in our empirical setting. The model predicts that when a challenger takes office (relative to the case when incumbent continues):

Prediction 1. A challenger replaces an additional share of bureaucrats relative to the continued incumbent. Public good output might be smaller or larger depending on entrenchment (π). A challenger will fire an additional $\gamma_0(a_2; \textit{incumbent}) + \gamma_0(a_2^{\textit{entr}}; \textit{incumbent})$ fraction of bureaucrats. As a result total bureaucrats' output might be smaller or larger depending on the extent of entrenchment (π).

Prediction 2. Assuming no entrenchment (i.e., $\pi = 0$), bureaucrats' output under the challenger will be lower than under the continued incumbent. This difference can be attributed to the lower average quality of bureaucrats that results from replacements.

Prediction 3. Assuming no entrenchment (i.e., $\pi = 0$), in choosing to replace a bureaucrat, the challenger trades off a bureaucrat who produces a larger public good output and little political services against another bureaucrat who produces a smaller expected public good output but also produces a higher political service. Replacement patterns should reflect this trade-off.

Proofs

Prediction 1. (this is demonstrated by Proposition 1) A bureaucrat will be replaced if he produces a total output smaller than the expected total output of a newly hired bureaucrat:

$$s_j + a_i < S + E(a)$$

So, following Assumptions 1 and 3 ($S + E[a] > a_2 > E[a]$ and $a_2 - \delta < E[a]$), bureaucrats of types a_2 and a_2^{entr} aligned with the incumbent will be fired only by the challenger:

$$\begin{aligned} a_2 : \quad & \text{Incumbent's payoff} > S + E[a] > \text{Challenger's payoff} \\ & S + a_2 - \pi\delta > S + E[a] > a_2 - \pi\delta \\ a_2^{entr} : \quad & \text{Incumbent's payoff} > S + E[a] > \text{Challenger's payoff} \\ & (S + \delta) + (a_2 - \delta) > S + E[a] > a_2 - \delta \\ & S + a_2 > S + E[a] > a_2 - \delta \end{aligned}$$

For types a_1 and a_3 the decision to fire or not is the same for incumbents or challengers, no matter the alignment of the bureaucrat:

$$\begin{aligned} a_1 : \quad & S + E[a] > S + a_1 > a_1 \longrightarrow \text{always fired} \\ a_3 : \quad & S + a_3 > a_3 > S + E[a] \longrightarrow \text{never fired} \end{aligned}$$

The challenger replaces a share of bureaucrats (i.e., $\gamma_0(a_1; incumbent) + \gamma_0(a_2; incumbent) + \gamma_0(a_2^{entr}; incumbent)$), while the incumbent replaces only $\gamma_0(a_1; incumbent)$ share of bureaucrats.

As fired bureaucrats will be replaced by a loyal bureaucrat with expected ability $E[a]$, this excess firing will lead to a difference in bureaucratic output of:

$$\gamma_0(a_2; incumbent)(E[a] - (a_2 - \pi\delta)) + \gamma_0(a_2^{entr}; incumbent)(E[a] - (a_2 - \delta))$$

This difference can be positive or negative depending on the extent of entrenchment (π). Below we abbreviate "incumbent" as "inc."

$$\begin{aligned}
& \gamma_0(a_2; inc.)(E[a] - (a_2 - \pi\delta)) + \gamma_0(a_2^{entr}; inc.)(E[a] - (a_2 - \delta)) > 0 \\
& (\gamma_0(a_2; inc.) + \gamma_0(a_2^{entr}; inc.))(E[a] - a_2) + \gamma_0(a_2^{entr}; inc.) \times \delta + \gamma_0(a_2; inc.) \times \pi\delta > 0 \\
& \gamma_0(a_2^{entr}; inc.) \times \delta + \gamma_0(a_2; inc.) \times \pi\delta > (\gamma_0(a_2; inc.) + \gamma_0(a_2^{entr}; inc.))(a_2 - E[a]) \\
& \frac{\gamma_0(a_2^{entr}; inc.)}{\gamma_0(a_2; inc.) + \gamma_0(a_2^{entr}; inc.)} \times \delta + \frac{\gamma_0(a_2; inc.)}{\gamma_0(a_2; inc.) + \gamma_0(a_2^{entr}; inc.)} \times \pi\delta > a_2 - E[a] \\
& \frac{\gamma_0(a_2^{entr}; inc.)}{\gamma_0(a_2; inc.) + \gamma_0(a_2^{entr}; inc.)} + \frac{\gamma_0(a_2; inc.)}{\gamma_0(a_2; inc.) + \gamma_0(a_2^{entr}; inc.)} \times \pi > \frac{a_2 - E[a]}{\delta} \\
& \pi + (1 - \pi) \times \pi > \frac{a_2 - E[a]}{\delta} \\
& -\pi^2 + 2\pi > \frac{a_2 - E[a]}{\delta}
\end{aligned}$$

Since $\frac{a_2 - E[a]}{\delta} < 1$ due to assumptions 2 and 1. Then, there will be $\pi^* \in (0, 1)$ where:

If $\pi > \pi^*$, $-\pi^2 + 2\pi > \frac{a_2 - E[a]}{\delta} \rightarrow$ Public good output will be larger under the challenger

If $0 < \pi < \pi^*$, $-\pi^2 + 2\pi < \frac{a_2 - E[a]}{\delta} \rightarrow$ Public good output will be smaller under the challenger

Prediction 2. Following the proof on prediction one, if there is no entrenchment ($\pi = 0$), bureaucratic output will be smaller if the challenger takes office. The difference in bureaucrat's output when a challenger takes office (relative to an incumbent) will be:

$$\gamma_0(a_2; incumbent)(E[a] - a_2)$$

As $a_2 > E[a]$ from Assumption 1, this will be negative and bureaucratic output will be lower if a challenger takes office.

The average ability of the employed bureaucrats will also decrease. As a_1 bureaucrats will always be fired and a_3 are always retained, the changes in average abilities will be:

$$\text{Incumbent takes office : } \gamma_0(a_1; incumbent)(E[a] - a_1)$$

$$\text{Challenger takes office : } \gamma_0(a_1; incumbent)(E[a] - a_1) + \gamma_0(a_2; incumbent)(E[a] - (a_2 + \pi\delta))$$

So the difference in average ability will also be $\gamma_0(a_2; incumbent)(E[a] - (a_2 + \pi\delta))$ and will decrease when a challenger takes office compared when the incumbent does so.

Prediction 3. We discuss empirically two examples consistent with the politi-

cian trading off.

Example 1: The excess replacement rate that occurs when a challenger takes office is lower for the highest ability bureaucrat relative to the excess replacement among those of lower ability.

$$\begin{aligned}
 &P(\text{Replaced}|a_3, \text{Challenger admin.}) - P(\text{Replaced}|a_3, \text{Incumbent admin.}) \\
 &\quad < \\
 &P(\text{Replaced}|a_1 \text{ or } a_2, \text{Challenger admin.}) - \\
 &P(\text{Replaced}|a_1 \text{ or } a_2, \text{Incumbent admin.})
 \end{aligned}$$

To see this we compare the likelihood that bureaucrats with varying abilities will be replaced under the challenger administration and the continuing incumbent administration. Note that we assume no entrenchment, and there will be no type a_2^{entr} .

The decisions of the challenger and the incumbent will differ only with respect to the bureaucrats that are loyal to the incumbent. Bureaucrats that are loyal to the challenger will be replaced at the same rate under a continuing incumbent administration and a challenger administration. Under the challenger, there will be the following distribution of bureaucrats that are loyal to the incumbent:

$$\begin{aligned}
 \gamma_0(a_3; \text{incumbent}) &= 1 \\
 \gamma_0(a_2; \text{incumbent}) &= 0 \\
 \gamma_0(a_1; \text{incumbent}) &= 0
 \end{aligned}$$

Under the continuing incumbent, there will be the following distribution of bureaucrats that are loyal to the incumbent:

$$\begin{aligned}
 \gamma_0(a_3; \text{incumbent}) &= 1 \\
 \gamma_0(a_2; \text{incumbent}) &= 1 \\
 \gamma_0(a_1; \text{incumbent}) &= 0
 \end{aligned}$$

From this we can see that:

$$\begin{aligned}
 &P(\text{Replaced}|a_3, \text{Challenger admin.}) - P(\text{Replaced}|a_3, \text{Incumbent admin.}) = 0 - \\
 &0 = 0
 \end{aligned}$$

While

$$P(\text{Replaced}|a_1 \text{ or } a_2, \text{Challenger admin.}) = 1 > P(\text{Replaced}|a_1 \text{ or } a_2, \text{Incumbent admin.})$$

Example 2: The second example is more straightforward and driven by how we interpret an ideology transition. Political turnover that is accompanied by ideology transition leads to a challenger who faces a much larger number of bureaucrats that are loyal to the incumbent. In the model, the excess replacement rate that occurs when a challenger takes office is higher when the number of bureaucrats that are loyal to the incumbent is higher. Since the additional bureaucrats that are replaced are the mid-ability non-loyalists. If the number of non-loyalists across all ability-levels is larger, there will be higher number of mid-ability non-loyalist to replace. Hence, the prediction that political turnover accompanied with political transition result in a higher replacement rate of bureaucrats.