

1 Introduction

The quality of public education in the across the world, and particularly in the developing world, remains low: functional illiteracy is widespread, and children do not master basic arithmetic operations. How can these educational outcomes be improved? Previous studies have found that incentives, whether these be electoral or performance-related, can help raise the quality of public services [Gulzar and Pasquale, 2017, Duflo et al., 2012]. Often relying on quasi-experimental research designs, these studies provide compelling evidence that actors respond to policy interventions.[Finan et al., 2015] But it remains unclear how these incentives connect to the broader institutional environment: who delivers these public services and to whom do they respond?

In this paper, I build on extensive fieldwork research across Brazil to argue that public education is captured by local political elites. Similar to coalition building in presidential contexts, mayors secure broader support for their policy agenda through the allocation of public sector positions to city councilors and their loyalists [Laver and Shepsle, 1990, Power, 2010]. This effectively crowds out electoral accountability, as mayors prioritize building support by other political elites over voter welfare [Ferejohn, 1986]. By catering to the city council through patronage appointments, mayors ultimately cause instability in the local educational bureaucracy, with negative downstream consequences for public school students.

To analyze how politics affect staff turnover, I analyze the relationship between municipal education staff turnover and the share of seats controlled by the executive in the local city council. In line with qualitative accounts and theoretical expectations, mayors who face stronger legislative opposition resort to greater patronage, in particular during the first year of administration. Mayors therefore resort to patronage in order to shore up legislative support, with negative consequences for student learning. I leverage data on over 2 million school teachers and school principals to estimate the effect of share of executive seats on turnover. Different model specifications confirm that turnover increases (decreases) as the share of seats held by the mayor coalition decrease (increase).

To estimate the effect of patronage on quality of education, I combine qualitative and quantitative evidence. Interviews conducted with educational bureaucrats and politicians confirm that turnover has a negative impact on teachers' ability to educate students. To validate these accounts I combine administrative data on education from the *Prova Brasil*, a nation-wide standardized exam designed to measure student learning. I construct a multiple datasets to test these claims: the

main specification contains over 1 million classrooms spread across the national territory. Using the national school census (*Censo Escolar*), I construct a school-specific turnover index that tracks year-by-year volatility in teacher staff. A set of estimations, combining multi-level modeling and fixed effects, provide strong evidence that teacher turnover has a negative effect on student learning.

This study contributes to an emerging literature on the politics of personnel and public services [Pepinsky et al., 2017, Finan et al., 2015, Gulzar and Pasquale, 2017]. Focusing on political actors refines our understanding of local politics and how intra-elite bargain reshape bureaucracies, leading to welfare loss for the broader population, as subnational actors divert resources from public services [Ferraz et al., 2012]. It also shifts focus from provision to the implementation of public services, echoing a long-standing literature on state capacity and the necessity for bureaucratic autonomy [Kohli, 2004, Evans, 1995].

The paper is structured as follows. Section 1 provides an overview of the scholarly debate over public goods provision and personnel, as well as more specific treatments of the subject in Brazil. In section 2 I present the main theoretical argument, with a formal treatment of the subject. Section 3 presents the institutional context and data, followed in section 4 by the research design and main results. Section 5 concludes.

2 Related literature

In this section I review extant literature on public goods provision and the politics underlying it, focusing on more recent studies of bureaucratic personnel and political leaders reshape these institutions. I also highlight how my research incorporates multiplicity in political actors and how this affects bargaining over public sector jobs. I address this gap by adapting previous analyses of executive-legislative bargaining to bureaucratic control at the local level.

Bureaucratic personnel and public goods provision

Bureaucracies have a clear impact on the delivery of public services. A long-standing literature on state capacity provides a theoretical and substantive foundation to analyze bureaucratic institutions [Centeno et al., 2017, Kohli, 2004]. A first generation of scholars, focusing on the successful developmental cases of East Asia, highlighted the need for a technocratic and autonomous bureaucracy [Johnson, 1982, Kohli, 2004]. A Weberian wall separating bureaucrats from elected offi-

cials was considered indispensable for the successful provision of economic growth [Evans and Rauch, 1999].

Recent studies have added nuance to these claims, finding that high bureaucratic performance can coexist with political interference. Toral 2019 finds in Brazil that school principals appointed by mayors tend to perform better than their non-appointed counterparts in standardized test scores. Gulzar and Pasquale [2017] show that local politicians who are able to internalize electoral benefits make bureaucrats exert more effort, increasing local employment. Akhtari et al. [2015], on the other hand, highlight the pitfalls of political capture, showing that party turnover can lead to the replacement of school principals, with detrimental effects for student learning.

This recent wave of studies shed light on the intersection between politicians and bureaucracies. However, few of these studies explicitly model the multiple actors involved in managing bureaucracies. Understanding their diverse goals and action space provides a firm theoretical foundation to how different politicians can reshape bureaucracies. To do so I turn to the well-established literature on executive-legislative bargaining, applying its insights to the analysis of local government and administration.

Presidential coalitionism and patronage

For every elected mayor in Brazil, a group of legislators are also elected into office. These political actors have competing claims over the local bureaucracy, with important implications for public service delivery. This structure parallels other settings with an institutionalized separation of powers and a bureaucratic pie to be split among the actors [Grindle, 2012, McCarty, 2004]. Divergent political interests can lead to strategic interaction between executive and legislative actors. A rich literature in Brazil explores these relations, with important insights to how executive and legislators bargain over bureaucracy. Raile et al. [2011], Power [2010].

In the Brazilian federal context, executive-legislative relations are analyzed under the prism of presidential coalitionism. Executive leaders garner legislative support from the National Congress by exchanging key positions in the federal bureaucracy, appointing members of their legislative coalition into cabinet positions. [Raile et al., 2011]. In a setting characterized by weak party cohesion and programmatic commitments Ames [1995], Lucas and Samuels [2010], bureaucratic positions for members of the coalition provide material incentives for legislators to

support the executive agenda Batista [2013], Neto [2006], Figueiredo and Limong [1999].

[something about coalitions](#)

In municipalities, mayors have to garner legislative support from city councilors to secure budgetary approval and implement desired policies. Due to weak programmatic commitments at the local level, public sector jobs are used to legislative support.¹ Mayors enjoy full discretion into how to appoint workers into the public sector, and use patronage to coopt legislative support from members of the coalition, a practice known locally as *empregoismo*. As noted by a former mayor of the municipality of Sobral, "city councilors knocked on my door with a list of names for people they wanted me to hire."² These hires induce changes in personnel, with important consequences for bureaucracies and educational services.

Bureaucratic turnover and inexperienced education

Bureaucracies exposed to turnover experience productivity shocks, often with detrimental effects. As new staff enters the bureaucracy, they must learn and acquire skills to deliver services to the population Gailmard and Patty [2007]. Focusing on education, studies show that students taught by inexperienced teachers perform worse than those attending class with an experienced teacher Clotfelter et al. [2007]. Akhtari et al. [2015] finds that students attending a school with a recently appointed school principal perform worse in standardized test scores. When bureaucratic turnover is driven by patronage, political concerns take precedence over meritocratic ones Colonnelli et al. [2017].

"I am aware that the position is temporary. Especially because it is a political position, decided by the administration. If the current administration is out of power, we are automatically dismissed." - Interview with school principal A, August 2019.

Negotiations between executive and the legislative thus have a knock-on effect on the quality of educational services, as political considerations lead to bureaucratic turnover at the school and administrative level. In this study, the primary focus is on bureaucrats working within the boundaries of a school: school principals and teachers. In the following section I describe the institutional context for public education in Brazil, as well as the data employed for the the estimation.

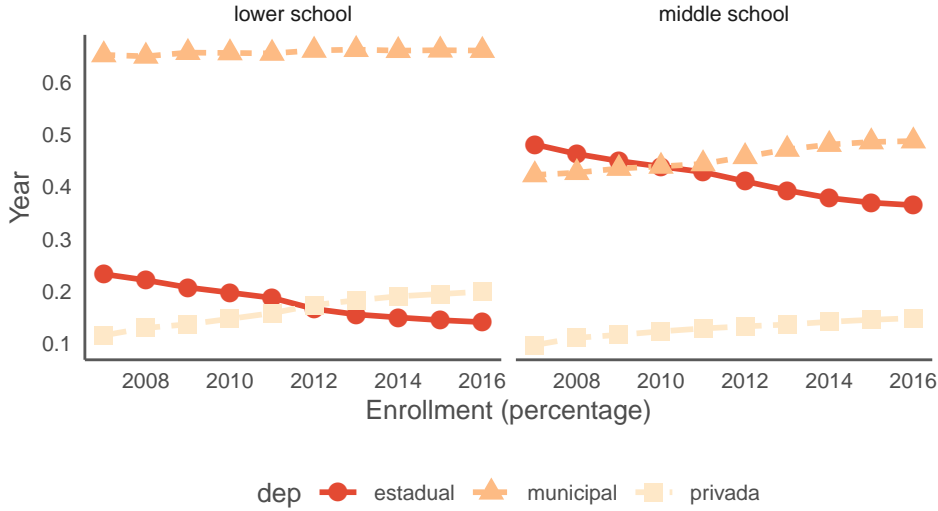
¹Interview with C, August and September 2019.

²Interview with C, August 2019.

3 Institutional context and data

3.1 Education in Brazil

In Brazil, responsibility for primary education is delegated to local governments Paschoal and Machado [2009]. The municipal educational system has increased in relevance over the past few decades, as municipalities took on a larger proportion of students from state-level governments. Figure ?? plots the total number of students in primary education per government level, including private schools. As of 2016, over 25 million students were enrolled in over 115 thousand municipal schools.



The Setting

The government G and opposition O compete over legislative votes to enact their preferred policies.³ There are two possible outcomes: a policy x favored by the government, and the status quo, denote as y , preferred by the opposition. In order to implement her policy the mayor must pass a simple majority vote in the city council, comprised of an odd number N of legislators. The total amount of political resources available is W_G and W_O , which for the mayor includes public sector appointments.

Each city councilor is characterized by a publicly observed policy preference v_i for all $i \in N$, where $v_i > 0$ denotes that the mayor's proposal x is preferred

³Note that I use the terms *mayor* and *government* interchangeably.

by legislator i . Let $\mathbf{v} = (v_1, \dots, v_n)$ describe the preference profile for the city councilors. In this setting, v_i measures the degree to which an individual city councilor supports the mayor, with higher values of v denoting stronger support for the mayor and vice versa. Payoffs are realized when city councilor i votes, independent of the outcome of the voting procedure. This sincere voting preference closes the possibility of general equilibria in which i 's voting behavior affect j .

We solve the game through backward induction. The timing of the game is as follows:

1. Government G offers a bribe schedule $a \in (a_1, \dots, a_n) \in \mathbb{R}_+^n$.
2. Opposition O observes the bribe schedule m and makes a counter-offer $b \in (b_1, \dots, b_n) \in \mathbb{R}_+^n$.
3. City councilors cast their votes at the end of bribing period.
4. Nature sums legislative votes, legislative outcome is decided and payoffs are realized.

Given a bribe schedule (a, b) , councilor i prefers to vote for the mayor's proposal x if $a_i + v_i > b_i$ and the status quo y otherwise. Since indifferent councilors vote for the status quo, the opposition needs to only match bribes from M , adjusting for individual preferences, i.e. $b_i = a_i + v_i$. For the mayor, she needs to construct the cheapest winning coalition in order to defeat the opposition.

Following Groseclose and Snyder (1996) and Banks (2000) we focus our analysis on the set of equilibria in which the mayor wins.⁴ In this context, the amount of patronage resources W_G is sufficiently large relative to W_O and \mathbf{v} that the mayor's preferred policy x is implemented over y . Let $U(\mathbf{v}, W_O)$ denote the set of unbeatable patronage schedules for the mayor, and for any patronage schedule let $S(a) = \sum_{i=1}^n a_i$ be the total amount of patronage disbursed. The mayor then solves

$$\min_a \{S(a) : a \in U(\mathbf{v}, W_B)\} \quad (1)$$

Note that for any equilibrium strategy, it must be the case that mayor M uses a leveling schedule: every city councilor in her coalition C is equally expensive for the opposition O to bribe. More formally, for any $a \in \mathbb{R}_+^n$, let $C(a) = \{i \in N : a_i > 0\}$ denote the set of individuals who receive a bribe from the government G .

⁴Since strategies for both players are symmetrical, any set of equilibria in which the mayor loses can be modeled as cases in which the the opposition loses.

One can show that there is a bribe schedule a' such that for any $i, j \in C(a)$, $a'_i + v_i = a'_j + v_j$. The intuition is that the mayor has no incentive to make voters differentially expensive, because the opposition O will simply ignore the more expensive voters and target the least favorable members of the coalition. We refer to these strategies as leveling schedules.

We can characterize the set of equilibria in the game by introducing additional notation. Let $U^l(\mathbf{v}, W_O) \subseteq U(\mathbf{v}, W_O)$ denote the set of unbeatable leveling schedules. These are bribe schedules such that $a_i + v_i = a_j + v_j \equiv t(a)$. The bribe $a_i = t(a) - v_i$ is the sum of two terms. The first is the common "transfer" among all voters in $C(a)$, the second ($-v_i$) is individual specific. The latter term makes voters indifferent between x and y absent any bribe from B ; the former represents the per capita amount necessary to make $C(a)$, together with any unbribed voters, unaffordable for B .

I impose the following two assumptions:

$$A1 : v_{(n+1)/2} < 0$$

$$A2 : v_1 < 2W_B/(n+1)$$

$A1$ implies that absent any bribes by A , y will defeat x . Therefore A must bribe at least one voter. $A2$ implies that A must bribe at least a majority of voters, otherwise B will have sufficient resources to bribe $(n+1)/2$ voters and win. $A2$ also implies that for all $a \in U^l(\mathbf{v}, W_B)$, it must be that $t(a) \geq 2W_B/(n+1)$, otherwise B can bribe a majority from $C(a)$ itself and win the vote.

These assumptions allow us to restrict our analysis to unbeatable monotonic leveling schedules, which we denote as U_m^l .⁵ We can simplify the total expenditure on patronage by the government, $S(a)$, as

$$S(a) = \sum_{i \in C(a)} a_i = k(a) \cdot t(a) - \sum_{i \leq k(a)} v_i$$

Note that the choice of $k(a)$ and $t(a)$ fully characterize any schedule $a \in U_m^l(\mathbf{v}, W_B)$. We can thus fully characterize the optimization problem of A in equation 1 as

$$\min_{k, t} k \cdot t - \sum_{i \leq k} v_i$$

subject to the constraint that the induced schedule $a \in U_m^l$. We can re-

⁵A detailed explanation can be found in the appendix.

formulate this as an unconstrained problem by noting the following. First, if $a(k, t, \mathbf{v})$ is unbeatable, it must be that $k \geq (n + 1)/2$, so by A1 it must be that if $a_i(k, t, \mathbf{v}) = 0$, then $v_i < 0$. Therefore, B receives all non-bribed voters for free. For $a(k, t, \mathbf{v})$ to be unbeatable, then, it must be that B cannot afford the remaining $(n + 1)/2 - (n - k) = k - (n - 1)/2$ voters, or

$$t \cdot (k - (n - 1)/2) \geq W_B$$

Solving this for equality yields the optimal transfer from A to members of $C(A) = \{1, \dots, k\}$, conditional on k :

$$t(k, W_B) = \frac{W_B}{k - (n - 1)/2} \quad (2)$$

Defining minimal winning expenditures as

$$E(k, \mathbf{v}, W_B) = k \cdot t(k, W_B) - \sum_{i \leq k} v_i \quad (3)$$

we can state A 's problem as

$$\min_k \{E(k, \mathbf{v}, W_B) : k \in (n + 1/2), \dots, n\} \quad (4)$$

Denote the solution to expression 4 as $k^*(\mathbf{v}, W_B)$. This solution implicitly generates a solution to expression 1 through expression 3 and the induced bribe schedule above. Therefore, characterizing the optimal k^* is sufficient to fully characterize the optimal behavior of the mayor.

Results

First, characterize a solution for k^* . Because k is finite, calculus cannot be employed. Instead, we deploy a discrete version of these techniques. First let's define $\Delta(k) = E(k + 1) - E(k)$ as the difference in expenditure from adding another coalition member. Note that if $\Delta(k) \geq 0$ then A does not want to add another member to the coalition. Conversely, if $\Delta(k) < 0$, then A is strictly better off by adding the $k + 1$ th member of the coalition.

Next, suppose that $\Delta(k)$ is increasing in k . The following algorithm can then

be used to identify k^* : if $\Delta((n+1)/2) \geq 0$, then we know from $\Delta(k)$ increasing that A is better off by setting k^* to $(n+1)/2$. If $\Delta((n+1)/2) < 0$, then we know that k^* must be greater than $(n+1)/2$, so we next solve for $\Delta((n+3)/2)$, and so on.

We can therefore search for the optimal k^* with the following algorithm:

$$k^* = \begin{cases} (n+1)/2 & \text{if } \Delta((n+1)/2) \geq 0 \\ \max\{k : \Delta(k-1) < 0\} & \text{otherwise} \end{cases} \quad (5)$$

We can also further characterize the change in minimum winning expenditures in equation 3 as

$$\Delta(k) = \left[\frac{(k+1)W_B}{k+1 - (n-1)/2} - \sum_{i \leq k+1} v_i \right] \quad (6)$$

$$= \frac{-W_B(n-1)}{2(k+1 - (n-1)/2)(k - (n-1)/2)} - v_{k+1} \quad (7)$$

$$\equiv T(k, W_B) - v_{k+1} \quad (8)$$

Using equation 5 and substituting in equation 7 we have the following.

Proposition 1. (a) $k^*(\mathbf{v}, W_B) = (n+1)/2$ if and only if $v_{(n+3)/2} \leq -W_B(n-1)/4$; (b) $k^*(\mathbf{v}, W_B) = n$ if and only if $v_n > -2W_B/(n+1)$.

Banks also identifies how the optimal coalition k^* respond to marginal changes in voter preference intensity. Given an arbitrary amount W_B and preference profile \mathbf{v}' , let $k' = k^*(\mathbf{v}', W_B)$. If $k' = (n+1)/2$, then we know that $k' \leq k^*(\mathbf{v}, W_B)$ for all \mathbf{v} , so suppose $k' > (n+1)/2$.

From equation 5 we infer that $\Delta(k'-1, \mathbf{v}', W_B) < 0$, which from equations 7 and 8 is equivalent to $v'_k > T(k'-1, W_B)$. Now suppose that the preference profile changes from \mathbf{v}' to \mathbf{v} , and $v_{k'}$ is such that $v_{k'} \geq v'_k$. Then, $v_{k'} > T(k'-1, W_B)$, and hence $\Delta(k'-1, \mathbf{v}, W_B) < 0$. But then from equation 5 it must be the case that $k^*(\mathbf{v}, W_B) \geq k'$. Therefore, the following holds:

Proposition 2. For all W_B , if \mathbf{v} and \mathbf{v}' are such that $v_{k'} \geq v'_{k'}$, where $k' = k^*(\mathbf{v}', W_B)$, then $k^*(\mathbf{v}, W_B) \geq k^*(\mathbf{v}', W_B)$

In words, if the preference intensity of the marginal bribed voter weakly increases, then the optimal coalition size also weakly increases. Substantively, the

number of voters bribed by A weakly increases as the voter who receives the largest bribe finds A 's preferred alternative, x , more attractive. Similarly

Proposition 3. *For all W_B , if \mathbf{v} and \mathbf{v}' are such that $v_{k'+1} \leq v'_{k'+1}$, where $k' = k^*(\mathbf{v}', W_B)$, then $k^*(\mathbf{v}, W_B) \leq k^*(\mathbf{v}', W_B)$*

The “convexity” of E guarantees that local information is sufficient to generate comparative statistics regarding changes in preferences $\mathbf{v}' \rightarrow \mathbf{v}$. We can characterize the change in total expenditures as a result of a shift in voter preferences. Given two preferences \mathbf{v} and \mathbf{v}' , write \mathbf{v} and \mathbf{v}' if $v_i \geq v'_i$ for all $i \in N$. From equation 3 we have

$$\begin{aligned} E(k, \mathbf{v}, W_B) - E(k, \mathbf{v}', W_B) &= \\ &= k \cdot t(k, W_B) - \sum_{i \leq k} v_i - \left[k \cdot t(k, W_B) - \sum_{i \leq k} v'_i \right] \\ &= \sum_{i \leq k} (v'_i - v_i) \end{aligned}$$

Since $v'_i - v_i \leq 0$, the difference in expenditure between moving from a favorable to a less favorable legislature is always non-positive, i.e. the government has to spend less resources to pass her preferred policy. This holds despite the fact that when these preferences shift there is an increase in the overall size of the coalition. This result has a similar flavor to Groseclose and Snyder Jr [1996], who motivate their model by stating that it may be optimal to increase the size of the coalition (instead of buying a simple majority) because doing so overall can lead to a reduction in the amount of expenditures by the vote-buyer.

Discussion

Enacting policy requires the exchange of political currency for votes. Whether it be in presidential coalitionism, or in the local city council politics, mayors who wish to govern have to engage in transactions with the legislature. What I showed in this section was that political misalignment between the government and the legislature can in fact be counterproductive: more patronage occurs, leading to worse public service outcomes.

The model also highlights a key aspect of clientelism that is often neglected electoral accountability models: voters have a limited voice. Ultimately, the exchanges which occur between the legislature and the mayor have little to do with

the voter at the end of the pipeline, and more to do with the city councilors. The first order requirement for the government is to ensure that it has enough legislative votes in order to enact the very policies that the voter may or may not desire. This transactional cost is not illegal: rather, it is necessary for democratic relations between different branches of government.

In the next section, I test whether the empirical implication of the model is correct: does more patronage occur in municipalities with greater political misalignment between the mayors and city councilors. I test additional implications of the model, including whether shifts in the resources controlled by the opposition can affect the government's patronage strategy.

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