

Political Screening:  
Theory and Evidence from the Argentine Public Sector\*

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**Abstract**

Politicians can benefit by ensuring that public sector positions requiring political services are occupied by partisans. We study a model in which this political screening is achieved by varying the amount of required political services and associated compensation in otherwise similar positions. Past vote shares provide information on the population share of partisans, and we predict a U-shaped relationship between an employee's salary and the incumbent politician's vote share at the time of hiring. We test for this effect using individual data from a large national income survey from Argentina, a country with widespread political patronage. Reduced form results are consistent with the model, showing that political conditions at the time of hiring have long-lasting effects on public employees' wages. We use structural estimates of our model to quantify political patronage. Our results indicate that partisan employees earn an economically significant premium of 18-19%.

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# 1 Introduction

Every incumbent government has at its disposal an army of potential political activists: the public employees whose livelihood is tied to the state (Wilson, 1961; Alesina, Baqir, and Easterly, 2000). In environments such as the present-day US, civil service laws prevent incumbent politicians from requiring political services from anyone but top-level political appointees. In other systems, a large portion of public employees from garbage collectors to ministry bureaucrats are in some form of “patronage contract” with the administration. Providing political services such as campaigning for votes or favoring politically connected contractors in procurement decisions is an implicit or explicit part of the job requirements.

Despite the public scrutiny of political patronage all around the world, relatively little is known about how patronage actually works. As a result there are at best incomplete, and often no answers to questions such as: How much patronage is there? How does it affect the operation of the public sector? What is the impact of civil service reforms designed to limit patronage? In this paper, we offer a new model of political patronage, test its implications for public sector wages on data from Argentina, and use the model to quantify wage differentials due to patronage among public employees.

In line with conventional wisdom and previous studies, we treat patronage as an exchange relationship where public employees receive benefits in return for political support. However, we recognize that there is heterogeneity in individuals’ willingness to participate in these patronage contracts. As a result, a politician can gain by making sure that positions requiring extensive political support are occupied by the right people. How can such screening be accomplished on a large scale (such as the state or national level)? While a local politician may be able to personally screen applicants, a governor needs to resort to more subtle methods. We propose that a natural solution is to tailor wages and political requirements in otherwise similar positions in such a way that those willing to provide more support (“partisans”) self-select into positions where this support is valued more. For example, a secretary applying for a ministry job may be qualified to work in several different offices within the ministry, and may choose between jobs with different combinations of required political services and wages based on his or her political preferences.

At the time of hiring, political preferences regarding the incumbent politician are private in-

formation. However, the population share of partisans is known from vote shares in the previous election, and this will be reflected in the optimal menu of patronage contracts. We therefore predict an association between vote shares at the time of hiring and current salaries. In particular, the vote share has two opposing effects on the salary of the average public-sector employee. A negative *incentive effect* comes from a trade-off faced by the politician: to ensure that partisans provide political services at a reasonable price, services from nonpartisans have to be sacrificed.<sup>1</sup> As the population share of partisans increases, more partisans are hired, and the politician is more willing to forego the services of nonpartisans. This reduces the salary of nonpartisans, and consequently the salary of partisans whose rents can decrease. At the same time, there is a positive *composition effect* of the vote share on the salary of public employees. Since a higher vote share means that the average employee is more likely to be a partisan and receive rents, his salary is higher. Under general assumptions these opposing effects imply a U-shaped relationship between vote shares and public wages.

To test for the association between past vote shares and public-sector salaries predicted by the model, we take advantage of a large national income survey from Argentina. This is a country known to have a large public sector with well-developed patronage systems, and the authority to set public wages is decentralized to the province level. We match to each public employee in our sample the vote share of the current provincial governor at the time the employee was hired (or retained) by this administration. We then run individual-level regressions of public employees' current salaries on the vote share of the current governor at the time of hiring. Our data allows us to control for a wide range of individual characteristics, province fixed-effects, and several time-varying province characteristics. We find that the salary of the average public employee has a robust U-shaped relation to the vote share of the incumbent governor at the time of hiring. Employees hired following an election with a vote share around 50% receive the lowest salaries. A ten percentage points lower or higher vote share yields a 3.5% higher salary, and moving an additional ten percentage points in vote share in either direction adds another 6%. Based on our model, these findings are consistent with the negative incentive effect dominating for low vote shares, while the positive composition effect determines wages for high vote shares. We argue that standard models of politically targeted

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<sup>1</sup>This is the usual second-best distortion in screening contracts offered to “low” types: their performance is distorted to give “high” types an incentive to perform at the optimal level.

policies do not explain the data.<sup>2</sup>

Patronage is inherently difficult to quantify. Our model predicts that within a province, partisan employees receive higher salaries than similar nonpartisan employees because partisans are offered rents to choose positions where they provide a high level of political support. Partisanship, however, is unobservable. Having established that our model is able to deliver the reduced form relationship between vote shares and wages, we go one step further by estimating the model’s structural parameters, and attempt to quantify the partisan wage premium. Nonlinear Least Squares estimates imply that public employees with similar individual characteristics earn salaries that are on average 18-19% higher if they are partisans. In our sample, this disparity is comparable to the wage effect of completing high school, and is much larger than standard estimates of the public vs. private sector wage differential.

This paper contributes to several literatures in economics and political science. There are few formal models of political patronage and they tend to focus on the moral hazard that arises when the politician cannot observe the actions of his employees (e.g., how they vote) (Robinson and Verdier, 2003; Stokes, 2005; Enikolopov, 2007; Keefer and Vlaicu, 2008). In many cases, however, political support is readily observable, so that moral hazard is not an issue. This is likely to be the case when political support takes the form of campaigning on behalf of the politician (e.g., attendance at rallies, turning out to vote, bringing friends or neighbors to party meetings, etc.), giving identifiable campaign contributions, or making politically motivated decisions in office (e.g., awarding procurement contracts to “friendly” contractors). In other cases, moral hazard may be impossible to resolve. For example, in democratic elections patrons will necessarily lack information on the political support received from their clients in the form of votes. In these cases, the adverse selection problem we study may be more relevant.<sup>3</sup>

On the empirical side, Kitschelt and Wilkinson (2007) provide an overview of the political science literature on various forms of clientelism. Our paper builds on the studies by Calvo and Murillo (2004) and Remmer (2007) who investigate patronage in the Argentinian public sector

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<sup>2</sup>In particular, a swing-voter model implies the opposite relationship, with wages being *highest* around a 50% vote share.

<sup>3</sup>In some previous studies, political preferences matter but are readily observable so the adverse selection problem we study does not exist. This is the case when political patronage is based on closely knit social networks: see Clark (1975) on the Irish in Boston, or Banerjee and Pande (2007) and Munshi and Rosenzweig (2008) on Indian castes. See Padro i Miquel (2007) for a theory of targeted redistribution under this assumption.

using province-level data. Relative to these studies, our work benefits from an explicit theoretical framework and individual-level data which allows us to be more precise about the mechanisms we explore. There is also a large literature on the public-sector labor market, focusing mostly on the public-private wage gap (for a survey, see Gregory and Borland, 1999). Only a handful of papers explore the political motivations behind public wages.<sup>4</sup> In important work closely related to ours, Borjas (1980, 1986) argued that wage differentials among US government employees in the 1970s could be explained by the political importance of the constituents they served as well as their ability to provide those services. These political considerations were significant in explaining wage differences in a cross section of public employees working for different federal agencies (Borjas, 1980) or for different US state governments (Borjas, 1986). In contrast to Borjas’s general model of political demand and supply, we focus specifically on the mechanism of political patronage. Our model highlights the role played by public employees’ political preferences, and implies a novel relationship between current wages and the incumbent’s vote share at the time of hiring. The Argentine data we use offers an interesting complement to the results regarding wages in the US government, and our approach allows us to deal with unobserved heterogeneity using fixed effects. In contrast to all the papers mentioned above, we are able to quantify patronage by offering structural estimates of the premium earned by partisan employees.

Finally, at the broadest level, our paper is related to the literature investigating politicians’ strategies for eliciting electoral support through targeted redistribution (e.g., Cox and McCubbins, 1986; Lindbeck and Weibull, 1987; Dixit and Londregan, 1996, 1998; Manacorda, Miguel and Vigorito, 2009). We show that the incumbent’s vote share has an interesting long-run effect on one such strategy, the public wages embodied in political screening contracts.<sup>5</sup>

In summary, this paper makes three contributions. First, we provide a theory of political patronage which highlights political screening through appropriately designed patronage contracts.<sup>6</sup>

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<sup>4</sup>Matsusaka (2008) studies the effect of citizen initiatives in US cities using a model in which the number of city employees reflect patronage but their wages, set through union bargaining, do not. While the current US civil service laws may indeed shelter city employees’ pay from political influence, Argentine provincial governors face no such constraints in setting wages.

<sup>5</sup>Our finding that vote shares at the time of hiring have long-lasting impacts on wages also relates this paper to work studying the long-run impact of economic conditions on workers starting a new job (e.g., Beaudry and DiNardo, 1991; Oreopoulos, von Wachter, and Heisz, 2008; Kahn, 2009). To our knowledge, the long-run impact of political conditions on public employees has not been studied previously.

<sup>6</sup>The theory of screening contracts has been applied to a wide range of issues from procurement and regulation to optimal income taxation and labor contracts (see Bolton and Dewatripont (2005, Ch 2) for a textbook treatment). To our knowledge, the application to political patronage is new.

Second, this model predicts a novel relationship between past vote shares and current salaries, and we find support for this prediction in the Argentine public sector. Third, we quantify the impact of patronage by structurally estimating the partisan wage premium.

In the remainder of the paper, Section 2 motivates our approach through anecdotal evidence on the use of patronage contracts from US political machines in the mid-20th century. Section 3 presents the one-period model, its extension to multiple periods, and discusses two extensions. Section 4 contains our empirical work. We first explore the reduced form relationship between vote shares and public wages, then argue that other models do not explain the data, and finally present structural estimates of the partisan premium. Section 5 discusses potential implications for civil service reforms and concludes.

## 2 Screening and the “patronage contract”

Screening applicants to ensure that the right people are hired is a major part of every patronage system. Beginning in the late 19th century, this recognition led advocates of the US civil service reform to question the effectiveness of a system which only prohibits political firing without regulating hiring decisions. “[If] you can pre-screen public employees and only hire those who are loyal to your organization, then they’re going to feel you have a claim on them. No matter what a federal judge says, some of them are going to be afraid of losing their jobs and others are going to feel obligated to carry out the bargain they’ve made.” (M. Shakman, quoted in Freedman, 1994, 48)

In the US, where voter registration is a matter of public record, checking the political allegiance of applicants is straightforward. The Rutan case, which led to the landmark *Rutan v. Republican Party of Illinois* anti-patronage ruling of the Supreme Court in 1990, began after C. Rutan was repeatedly denied promotion at the Illinois Department of Rehabilitation Services. When she asked why she was not being promoted, “she was told that her voting record had been checked and that her name didn’t “clear” the governor’s office.” (Freedman, 1994, 105). In city machines from New York to Chicago, another standard practice was to screen applicants by requiring the sponsorship of party officials on job applications.

Ensuring that the right people get hired is important since holders of patronage jobs are expected

to provide political services in various forms. “In Illinois, as elsewhere, public employees like parks and sanitation workers, often formed the backbone of the teams that rang doorbells, collected signatures on petitions and gathered crowds for political candidates.” (Tolchin, 1990). In the Chicago machine in the middle of the 20th century,

“[e]veryone was expected to work for the party. High level office-holders [...] were excused from precinct work of the door-to-door variety, but the alderman expected them to give service in the form of free legal advice to the people of the ward. Job holders also had to buy tickets to various party fundraising events and were required to contribute a percentage of their salaries to the ward organization. Generally, they were assessed between 2% and 3% of their total pay. Patronage workers were held strictly accountable for their political performance, but not for their performance on the job.” (Freedman, 1994, 40).

The “patronage contract” specifying the political services expected in return for a paycheck can be more or less explicit. In the Rutan case, applicants to public-sector jobs in Illinois were given a “promotion form” to sign. On it, each person was required to answer yes or no to the following questions:

“Would you be willing to become an active Sangamon Country Republican Foundation Member? (The foundation is a voluntary, financial assistance organization)

Would you be willing to canvass and work your precinct or neighborhood for candidates the Central committee recommends as qualified for local, state, and national offices?” (Freedman, 1994, p106).

In other cases, information about the required political support is known and passed along among workers without explicit threats or instructions from party representatives.<sup>7</sup> During litigations against the patronage machine of Nassau County, NY, employees described how fellow workers told them about the requirement to pay an assessment of 1% of each paycheck to the party. This “norm” was specific enough to include the provision that the payments should be made

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<sup>7</sup>This paragraph and the next draw on Freedman (1994, Ch 4) as well as a series of articles entitled “Hempstead Party Favors” in *Newsday*, September 22-24, 1991.

in lump sums, not in installments. Everyone obeyed, even though most workers were never directly approached or threatened by a party official.

Given that patronage workers are expected to provide these services, it is natural that they are paid more than nonpartisan employees in similar jobs. In 1990, in the patronage machine of Nassau County, NY, it was found that some partisan government employees earned \$11,000-13,000 more than similar nonpartisan employees. Of course, systematic evidence that would allow discerning the patronage motive in public-sector salaries is scarce. Our work below provides an indirect way to test for patronage by exploiting the information that past vote shares may contribute to optimally designed screening contracts. Using this framework, we are able to offer quantitative estimates of large-scale patronage.

### 3 The model

#### 3.1 Setup

Consider the problem of a politician in office who is designing a patronage system to fill medium- to low-level public-sector jobs.<sup>8</sup> Suppose that each of these jobs can constitute a “patronage job” which Wilson (1961, p370) defines as positions “the pay for which is greater than the value of the public services performed. This ‘unearned increment’ permits the machine to require that the holder perform party services as well.” Thus, we assume that employees have the opportunity to provide some political support  $x \geq 0$  to the politician. The variable  $x$  can correspond to different types of behavior, from taking decisions favoring the politician while performing the job to outright campaigning. Assume that the level of support is contractible: the politician can require support  $x$  as a condition of employment, and if the applicant accepts, the contract is perfectly enforced. In practice, the politician could contract on  $x$  by maintaining an organizational culture inside an institution, such as a ministry, that requires a certain amount of partisan support  $x$ . Even though this will not be part of the formal job requirements, the existence of such expectations could be common knowledge among potential applicants, as described in Section 2.

The politician’s payoff from an employee who provides output  $y$  and political support  $x$  and

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<sup>8</sup>High-level positions where performance is crucial for policy and electoral success are likely to be filled by hand-picked appointees whom the politician knows personally. The screening system we consider below is different.



who earns salary  $s$  is

$$v(x) - s + \mu(y), \tag{1}$$

with  $v$  and  $\mu$  increasing and concave. Thus, the politician values political support but does not like to pay for it, perhaps because he has less money to spend on increasing electoral support by providing public goods. Political support may be valued because it increases future electoral success, or it might increase the utility derived from holding office (e.g., by raising the politician's status). In addition, the politician may value the output of the employee.<sup>9</sup>

There is a large population of applicants, each of whom can be of two type, either Partisan or Nonpartisan ( $i = P, NP$ ) and this is private information. Partisans and nonpartisans differ in their willingness to provide political support to the incumbent politician. We capture this by assuming that partisans have a lower cost and lower marginal cost of providing political support:  $c_P(x) < c_{NP}(x)$ ,  $c'_P(x) < c'_{NP}(x)$ , where these cost functions are increasing and convex. Partisans and nonpartisans do not differ in their ability to perform on-the-job: the cost of providing output  $y$  is the same for everyone,  $\kappa(y)$ .<sup>10</sup> (The consequences of relaxing this assumption are discussed in Section 3.4.)

An applicant's payoff from accepting a contract  $(x, y, s)$  offered by the politician is  $s - c_i(x) - \kappa(y)$ . If he does not accept, he gets an outside option worth  $u$ , such as the utility from working in the private sector. The population share of partisans is known from past vote shares: it is  $p \in (0, 1)$ .<sup>11</sup>

### 3.2 The static problem

Consider the following one-period model. First, the politician decides on a set of contracts  $(x, y, s)$  to be offered. Multiple contracts can be interpreted, e.g., as corresponding to separate positions that

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<sup>9</sup>We do not assume that the politician faces a binding budget constraint in setting public wages. While such constraints may be relevant for a local politician, our empirical work studies provincial governors who might have considerable latitude in redistributing resources across departments and projects. If creating additional positions is costly, the payoff in equation (1) received from each employee will determine how many are hired.

<sup>10</sup>One interpretation of this assumption is that exogenous professional requirements have already narrowed down the pool of applicants to individuals equally capable of performing the job, at least to the extent that the politician cares about performance. Within this group, the only relevant difference remaining between workers is partisanship.

<sup>11</sup>In reality, people may differ in other relevant dimensions, for example some people may like the politician but may be unwilling to engage in patronage. Here, we ignore these differences and focus on basic political preferences. In a country where voting is compulsory, such as Argentina, vote shares provide a measure of partisanship that is both accurate and easily accessible to a politician. There are of course other proxies politicians may be able to use in specific settings, and we will control for some of these in our empirical work below.

only differ in the associated contract. Next, an applicant is randomly selected from the population to decide whether to accept one of the contracts offered or to reject all of them. Accepted contracts are enforced, and the corresponding payoffs are realized.

As a benchmark, consider the first best case in which the politician observes the agent's type, and so can offer different contracts to partisans and nonpartisans. For the former, the politician maximizes  $x_i - s_i - \kappa(y_i)$  subject to the participation constraint  $s_i - c_i(x_i) - \kappa(y_i) \geq u$ . The first-best pair of contracts  $(\hat{x}_P, \hat{y}_P, \hat{s}_P)$  and  $(\hat{x}_{NP}, \hat{y}_{NP}, \hat{s}_{NP})$  is characterized by  $c'_i(\hat{x}_i) = v'(\hat{x}_i)$ ,  $\kappa'(\hat{y}_i) = \mu'(\hat{y}_i)$ , and  $\hat{s}_i = c_i(\hat{x}_i) + \kappa(\hat{y}_i) + u$ , for  $i = P, NP$ .<sup>12</sup> In the first best, all employees provide the same level of output, partisans provide a higher level of support, and both agents are paid according to the services they provide and their outside options. Because types are observable, the population share  $p$  of partisans plays no role in the equilibrium contracts.

With asymmetric information, the politician faces the problem of screening applicants. A simple way to do this is to design contracts under which partisans and nonpartisans have the incentive to self-select into the appropriate positions. In a large public sector with many applicants, this method might be more efficient than, for example, attempting to gather information about each applicant's political preferences.<sup>13</sup>

The optimally designed screening contracts  $(x_P^*, y_P^*, s_P^*)$  and  $(x_{NP}^*, y_{NP}^*, s_{NP}^*)$  solve the following problem:

$$\max_{\substack{x_P, y_P, s_P \\ x_{NP}, y_{NP}, s_{NP}}} p(v(x_P) - s_P + \mu(y_P)) + (1 - p)(v(x_{NP}) - s_{NP} + \mu(y_{NP})),$$

subject to the participation constraints

$$s_P - c_P(x_P) - \kappa(y_P) \geq u \quad (PC_P)$$

$$s_{NP} - c_{NP}(x_{NP}) - \kappa(y_{NP}) \geq u \quad (PC_{NP})$$

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<sup>12</sup>Throughout, we assume that hiring both types is optimal.

<sup>13</sup>Moreover, if the politician wants to avoid public scrutiny, the contracting solution based on self-selection might be more attractive than others which would require his direct involvement. In Section 5 below, we argue that civil service systems with explicit political and non-political positions (as in the US) may be understood as codifying such a system of screening contracts.

and the incentive constraints

$$s_P - c_P(x_P) - \kappa(y_P) \geq s_{NP} - c_P(x_{NP}) - \kappa(y_{NP}) \quad (IC_P)$$

$$s_{NP} - c_{NP}(x_{NP}) - \kappa(y_{NP}) \geq s_P - c_{NP}(x_P) - \kappa(y_P). \quad (IC_{NP})$$

The participation constraints ensure that applicants are willing to work in the public sector even if that involves providing political support, while the incentive constraints guarantee that each type of agent chooses the contract designed for him. Standard arguments may be used to check that in optimum the nonpartisans' participation constraint and the partisans' incentive constraint has to bind. Solving the resulting problem, we find that the optimal pair of contracts is defined by the following equations

$$x_P^* = \hat{x}_P \quad (2)$$

$$c'_{NP}(x_{NP}^*) = (1-p)v'(x_{NP}^*) + pc'_P(x_{NP}^*) \quad (3)$$

$$y_P^* = y_{NP}^* = \hat{y} \quad (4)$$

$$s_{NP}^* = c_{NP}(x_{NP}^*) + u + \kappa(\hat{y}) \quad (5)$$

$$s_P^* = c_P(x_P^*) + u + \kappa(\hat{y}) + c_{NP}(x_{NP}^*) - c_P(x_{NP}^*) \quad (6)$$

In this screening solution, partisans provide the efficient level of political support (equation (2)), and receive a high salary which not only compensates them for the effort provided and the foregone outside option, but also contains a rent of  $(c_{NP}(x_{NP}^*) - c_P(x_{NP}^*))$  (equation (6)). This rent gives partisans an incentive to choose the contract which requires providing a high level of political support. To minimize the partisan rent, the politician sacrifices the support of nonpartisans relative to the first best ( $x_{NP}^* < \hat{x}_{NP}$  from equation (3)). This allows him to offer a lower salary in the nonpartisan contract (equation (5)) and hence receive the partisans' political services at a lower price.

Since partisans and nonpartisans do not differ in their ability to perform on-the-job, they provide the same level of output (equation (4)). Yet, comparing equations (5) and (6), we see that partisans get a higher salary:  $s_P^* - s_{NP}^* = c_P(x_P^*) - c_P(x_{NP}^*) > 0$ . This "partisan premium" reflects both the different levels of political support required in the positions designed for partisans and nonpartisans,

and the rents associated with the partisan contracts.

This simple model implies that public-sector salaries are affected by past vote shares: in equation (3),  $x_{NP}^*$  is a function of  $p$ , and in turn both  $s_P^*$  and  $s_{NP}^*$  depend on  $x_{NP}^*$ . Without information on individual partisanship, the salaries  $s_P^*$  and  $s_{NP}^*$  are unobserved. However, for a cohort of employees hired after a given election, we can observe the salary of an average employee (an employee chosen at random):  $\tilde{s}(p) \equiv ps_P^* + (1-p)s_{NP}^*$ . Using (5) and (6), we have the following result.

**Lemma 1** *The salary of the average employee is*

$$\tilde{s}(p) = p[c_P(x_P^*) - c_P(x_{NP}^*(p))] + c_{NP}(x_{NP}^*(p)) + u + \kappa(\hat{y}). \quad (7)$$

How do salaries change as the vote share of the incumbent politician changes? Taking the derivative and using equations (2) and (3), we get

$$\frac{\partial \tilde{s}}{\partial p} = [c_P(x_P^*) - c_P(x_{NP}^*(p))] + (1-p)v'(x_{NP}^*) \frac{\partial x_{NP}^*}{\partial p} \quad (8)$$

The term in brackets is a *composition effect*. As the share of partisans  $p$  rises, more partisans are hired, and because partisans' salary contains a premium, this raises the observed average salary. The second term is an *incentive effect* which is a consequence of the basic trade-off faced by the politician: To ensure that partisans provide political services at a reasonable price, services from nonpartisans have to be sacrificed. For a low  $p$ , when most employees are nonpartisans, this is very costly. As  $p$  increases, however, sacrificing political support from nonpartisans in order to ensure the cheap support of partisans becomes more attractive, leading to a decrease in  $x_{NP}^*$ . The decreasing support from nonpartisans means lower nonpartisan salaries - and also lower salaries for partisans whose rent can now be reduced without affecting their incentives to choose the right contract. The decreasing salaries of both groups lead to the second (negative) term in (8).

Given the positive composition effect and the negative incentive effect, the sign of (8) is ambiguous in general. However, note that for  $p \rightarrow 1$ , the incentive effect disappears (as long as  $\frac{\partial x_{NP}^*}{\partial p}$  is finite). When all employees are partisans, a small change in partisan shares has a negligible effect on the screening contracts offered, and only the composition effect remains. Thus,  $\frac{\partial \tilde{s}}{\partial p}$  is positive for large  $p$ . Moreover, since  $\frac{\partial x_{NP}^*}{\partial p} < 0$  the composition effect increases with  $p$ : as nonpartisans provide

less support, the difference between the salaries of partisans and nonpartisans rises. Thus, we know that the positive term in (8) dominates for high  $p$ , and becomes smaller as  $p$  declines. The sign of  $\frac{\partial \bar{s}}{\partial p}$  depends on the behavior of the negative term, the incentive effect, and we have the following result.<sup>14</sup>

**Proposition 1** *If the incentive effect is small in absolute value for all values of  $p$ , average salary is an increasing function of past vote share. If it dominates for low  $p$ , average salary is decreasing when the vote share is low and increasing when it is high.*

### 3.3 Multiple periods

Since politicians are typically in office for several years, contracts may be signed for the long term. In this section we show that the optimal contracts derived above remain essentially unchanged in this dynamic setting. Thus, the incentive and composition effects described above also apply to this environment.

In line with the above treatment, we assume that in period  $t = 0$ , the politician can commit to a contract which specifies, for each period  $t$ , a level of political support  $x^t$  and corresponding salary  $s^t$  (for simplicity, we ignore the output  $y$  which plays no role in what follows). Let  $\mathbf{s}_i = (s_i^0, \dots, s_i^T)$  and  $\mathbf{x}_i = (x_i^0, \dots, x_i^T)$  for  $i = P, NP$ . In essence, the politician commits to not exploiting the information gained when an applicant reveals his type by selecting a particular contract. We assume that employees also commit to abide by the terms of a signed contract. However, once hired, the employee may decide to quit in any future period, with no possibility of being re-hired.

In models where screening occurs in a deterministic environment and long-term commitment is possible, it is well known that the optimal solution is to offer a series of contracts replicating the static solution (Laffont and Tirole (1993) call this “false dynamics”). However, things are generally different when parameters of the model might vary stochastically (Battaglini, 2005). In this section, we allow for one such variation: in the applicants’ outside option  $u$ . In particular, we assume that in every period  $t$ , the outside option  $u^t$  is drawn from some distribution with cdf  $F()$ , independently across periods. We show that even if  $u$  is stochastic, the optimal solution features false dynamics with some version of the static contracts offered period after period.

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<sup>14</sup>The behavior of the incentive effect depends on higher order derivatives of the cost functions. The Appendix provides sufficient conditions for a class of functions used in our empirical work below.

Assume first that the realization of  $u^t$  is observed by everyone, and contracts can therefore be specified to depend on it:  $s_i^t = s_i(u^t)$ ,  $x_i^t = x_i(u^t)$ . (We relax this assumption in the next section.) Let  $\delta$  denote the common discount factor, and  $E$  the expectation operator. With  $u^t$  observable, and assuming that the politician finds it optimal to hire both types, we have the following problem

$$\max_{\substack{\mathbf{x}_P, \mathbf{s}_P \\ \mathbf{x}_{NP}, \mathbf{s}_{NP}}} \sum_{t=0}^T \delta^t E [p(v(x_P^t) - s_P^t) + (1-p)(v(x_{NP}^t) - s_{NP}^t)]$$

subject to, for  $i, j = P, NP$ , an incentive constraint

$$\sum_{t=0}^T \delta^t E [s_i^t - c_i(x_i^t)] \geq \sum_{t=0}^T \delta^t E [s_j^t - c_i(x_j^t)],$$

and a series of participation constraints

$$\sum_{\tau=t}^T \delta^{\tau-t} E [s_i^\tau - c_i(x_i^\tau)] \geq \sum_{\tau=t}^T \delta^{\tau-t} E [u^\tau] \text{ for } t = 0, \dots, T.$$

The incentive constraint ensures that in period  $t = 0$ , the agent chooses the contract designed for him. The participation constraints ensure that the agent does not have an incentive to quit in any period  $t$ .

The following lemma, proved in the Appendix, describes the solution of the contracting problem.

**Lemma 2** *The politician commits to a sequence of static second-best contracts. In these contracts, an agent provides the same level of political support in each period, while the payments depend on the realization of the outside option. In particular, for all  $t$ ,  $s_i^t = s_i^*(u^t)$  and  $x_i^t = x_i^*$ , where  $x_P^*$  and  $x_{NP}^*$  are defined in (2) and (3), and*

$$\begin{aligned} s_{NP}^*(u_{NP}^t) &= u^t + c_{NP}(x_{NP}^*) \\ s_P^*(u_{NP}^t) &= c_P(x_P^*) + u^t + c_{NP}(x_{NP}^*) - c_P(x_{NP}^*). \end{aligned}$$

Thus, we have the following counterpart to Lemma 1:

**Corollary 1** *When  $u^t$  is observable, the salary of the average employee in period  $t$  is a function*

of the vote share  $p$  and the realization of  $u^t$  :

$$\tilde{s}^t(p) = p[c_P(x_P^*) - c_P(x_{NP}^*(p))] + c_{NP}(x_{NP}^*(p)) + u^t. \quad (9)$$

Comparing (7) and (9), we see that the implications of the static model extend naturally to multiple periods. The vote share at the time of hiring, upon which screening is based, has a composition and an incentive effect on the average employee's salary in every future period. In addition, the period- $t$  salary is a function of the outside option in that period.

### 3.4 Extensions

Before proceeding to testing our theory, we briefly discuss two extensions of the model.

#### 3.4.1 Private information about the outside option

We have assumed that the outside option  $u$  is observed by the politician and the salary  $s$  can be specified to depend on it. For example, the politician may have a good idea about the market opportunities of particular employees. However, in some cases the outside option may be an employee's private information. For example, the outside option might reflect offers a worker receives from private firms. In this section, we explore how the above comparative statics extend to this case.

Consider first a static problem where for each applicant,  $u$  is drawn i.i.d. from a distribution with cdf  $F()$  as above. The politician knows the distribution, but not the realizations of  $u$  - this is the private information of each applicant. Note that screening on  $u$  is not possible: if an applicant with outside option  $\bar{u}$  was better off taking the contract corresponding to  $\bar{u}$  than claiming some other  $u'$ , then this would be true for all applicants of the same type (partisan or nonpartisan), including applicants whose outside option is in fact  $u'$ . Thus, the optimal contracts will have to be independent of the realization of  $u$ . But if that is the case, the realization of  $u$  does not affect the incentive constraints ( $IC_P$ ) and ( $IC_{NP}$ ), since these do not depend directly on the outside option. Moreover, if the contract satisfies the participation constraint ( $PC_i$ ) of a type- $i$  agent with outside option  $\bar{u}$ , then it also satisfies the participation constraint of all agents of the same type with outside options  $u < \bar{u}$ .

Therefore, in the static case, the optimal contracting problem becomes:

$$\max_{\substack{x_P, s_P \\ x_{NP}, s_{NP}, \bar{u}}} F(\bar{u})[p(v(x_P) - s_P) + (1 - p)(v(x_{NP}) - s_{NP})],$$

subject to

$$\begin{aligned} s_P - c_P(x_P) &\geq \bar{u} \\ s_{NP} - c_{NP}(x_{NP}) &\geq \bar{u} \\ s_P - c_P(x_P) &\geq s_{NP} - c_{NP}(x_{NP}) \\ s_{NP} - c_{NP}(x_{NP}) &\geq s_P - c_{NP}(x_P). \end{aligned}$$

Clearly, for any  $\bar{u}$ , the solution is the second-best pair of contracts corresponding to  $\bar{u}$ :  $(x_P^*, s_P^*(\bar{u}))$  and  $(x_{NP}^*, s_{NP}^*(\bar{u}))$ . Plugging into the objective, the optimal cutoff  $\bar{u}^*$  can be found by solving

$$\max_{\bar{u}} F(\bar{u})[p(v(x_P^*) - c_P(x_P^*) + c_P(x_{NP}^*)) + (1 - p)v(x_{NP}^*) - c_{NP}(x_{NP}^*) - \bar{u}].$$

The average employee's salary and its derivative w.r.t.  $p$  is now

$$\begin{aligned} \tilde{s}(p) &= p[c_P(x_P^*) - c_P(x_{NP}^*(p))] + c_{NP}(x_{NP}^*(p)) + \bar{u}^*(p) \\ \frac{\partial \tilde{s}}{\partial p} &= [c_P(x_P^*) - c_P(x_{NP}^*)] + (1 - p)v'(x_{NP}^*)\frac{\partial x_{NP}^*}{\partial p} + \frac{\partial \bar{u}^*}{\partial p}. \end{aligned}$$

Relative to equation (7), the cutoff outside option  $\bar{u}^*$  contributes another term to the average salary. The derivative  $\frac{\partial \bar{u}^*}{\partial p}$  is easily seen to be positive: for a given cutoff, a larger  $p$  raises the politician's payoff from the average employee, which makes it more attractive to expand the workforce even if this means hiring expensive employees with high outside options. In this case with private information about the outside option, the realization of an individual's outside option has no effect on the salary.<sup>15</sup>

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<sup>15</sup>Extending this case to multiple periods is straightforward since the politician never learns the outside option. The solution, just like in a deterministic case, is to commit to a pair of time-invariant contracts replicating the static contract:  $(x_i^t, s_i^t) = (x_i^*, s_i^*(\bar{u}^*))$ .



### 3.4.2 Different on-the-job productivity

An interesting extension of the model arises when job applicants are allowed to vary by their on-the-job ability as well as partisanship. That is, given any qualifications and other formal requirements, some applicants may have a lower cost  $\kappa$  of producing output  $y$  (higher ability). It is interesting to ask how political screening contracts affect the equilibrium output produced. For example, a common concern regarding patronage is that political hiring leads to less productive employees.<sup>16</sup>

Suppose each type of employee  $i = P, NP$  can have high ability (1) or low ability (2), with  $\kappa_{i1}(y) < \kappa_{i2}(y)$  and  $\kappa'_{i1}(y) < \kappa'_{i2}(y)$ . Let  $q_i$  be the probability that type  $i$  has high ability, so, e.g., the probability of an applicant being a high ability partisan is  $pq_P$ . In this case, the politician may want to offer 4, rather than two different contracts. That is, he may want to screen on ability as well as political preferences.

As is typical in multidimensional screening models, the solution quickly becomes very complex. The general characterization of the optimal contracts in this model follows from Armstrong and Rochet (1999), who show that the optimum can take several forms depending on the correlation between the two screening dimensions (in our case, ability and partisanship) and the shape of the utility functions. In many cases, the presence of the political motive leads to a distortion in the output produced. For example, if partisanship is positively correlated with ability ( $q_P - q_{NP} > 0$ ), in the optimal contracts, all high-ability employees provide the efficient level of output but all low-ability employees provide too little output. Moreover, if  $q_P - q_{NP}$  is sufficiently large, one can show that as the share of partisans  $p$  increases, the distortion in both the political support of nonpartisans *and* in the output of low-ability employees increases. Thus, relative to a situation with no partisans, output  $y$  is more distorted under patronage.

At the same time, there are also cases when the presence of the political motive may actually help efficiency. When  $q_P < q_{NP}$ , so that ability and partisanship are negatively correlated, there are cases when the optimal contract involves efficient output by both low and high-ability partisans. (By contrast, if ability was the only dimension of private information, low-ability employees would always provide too little output in the optimal screening contracts.) The intuition for this is that under negative correlation, the actions of low-ability partisans and high-ability nonpartisans are

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<sup>16</sup>We are not aware of previous studies directly addressing this question, but there are papers asking whether higher public sector wages lead to the selection of less corrupt bureaucrats (e.g., Besley and McLaren, 1993).

especially important to the politician, therefore it is optimal to raise the political support and output of these groups. When output is relatively less valuable, its efficient level is lower, and the politician might benefit from raising it all the way to the efficient level. Thus, interestingly, the efficiency gain in output requires that the politician’s utility from political support relative to output be *high* enough, i.e. that the political motive be strong.<sup>17</sup>

## 4 Testing for partisan effects in public-sector wages in Argentina

In this section, we take the theory to the data. After describing the background and our data, we present reduced form estimates of the relationship between vote shares and salaries. We then use the structural model to quantify the partisan premium in the Argentine public sector.

### 4.1 Background

To test for the effect of vote shares at the time of hiring on the salary of public employees, we take advantage of a large income survey conducted in the twenty four Argentine provinces in 2001. Argentina provides a perfect laboratory to test for patronage in public-sector wages for a number of reasons. First, patronage, and in particular the use of public employment for political gain has been extensively documented in the sociology and political science literature (for example, Auyero, 2000, Brusco et al. 2004, Calvo and Murillo, 2004, Stokes, 2005, Weitz-Shapiro, 2006, Remmer, 2007).

A second important feature of the Argentine case is that provincial public-sector employment is regulated by provincial institutions, therefore control over personnel and wages is the exclusive responsibility of the local government. In contrast to countries with enforceable national service rules, provincial employment in Argentina is not under the supervision of federal regulatory agencies. The provincial executives, embodied in the office of the governor and their local ministries of economy, make all relevant decisions on public-sector wages and employment.<sup>18</sup> As a result, there

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<sup>17</sup>With more detailed information on partisanship and output than is available in our dataset, one could test for the sign and magnitude of the correlation between partisanship and ability. This seems like an interesting avenue for future research.

<sup>18</sup>Collective bargaining in the Argentine public sector is a relatively recent phenomenon. Unions were suspended by the military government until 1983, and democratic governments through the 1990s routinely restricted collective negotiations with public employees when those interfered with national economic policies. In the period we consider, few provinces had collective bargaining laws, although in practice informal negotiation mechanisms may have existed (Cetrangolo, 1997). See also Etchmendy and Collier (2007) on the “resurgence” of Argentine unions after our period

is significant variation in public-sector wages and employment across provinces. Public employees represent approximately 20 percent of total employment in the metropolitan provinces of Buenos Aires, Cordoba, and Santa Fe, but include over 40 percent of total employment in the Northern provinces of Salta, La Rioja, and Santiago del Estero. Similar differences can be observed in public-sector wages, with average salaries in the Tierra del Fuego and the City of Buenos Aires more than doubling those of poorer provinces such as Jujuy or Catamarca. This variation in public-sector wages is explained by more competitive private sector salaries, socio-demographic features of the employee population, and, we argue, partisan differences that deserve further scrutiny.

Finally, an important aspect of the Argentinian case is that voting is compulsory. Even though enforcement is not perfect, turnout in elections tends to be extremely high compared to the typical numbers in Western countries. Since the 1983 democratic transition, turnout levels have remained above 70% for both presidential and congressional elections. Vote shares, consequently, provide an accurate measure of district level political preferences (partisanship).

## 4.2 Data and specification

The survey we use in this article was conducted by the Argentine census bureau (INDEC) in 2001 for the SIEMPRO agency. The survey includes individual level data measuring wages, employment status and sector, year of hiring, educational achievement, type of search that resulted in employment, and a battery of socio-demographic questions for a total of 23,430 respondents who are currently employed full time in the public or private sector. The sampling frame, which also forms the basis of the official census, is designed to be representative of the Argentine population living in towns of 5,000 or more (84% of the population).<sup>19</sup> In this sample, a total of 5,610 respondents are employed in the public sector, representing a remarkable 23.9% of the economically active population (we use 4,786 observations with no missing variables). The share of public employees in the survey conforms to the national statistical figures of the Argentine census bureau, and is comparable to the share of public employees observed in Scandinavian countries or France (Gregory and Borland, 1999).

Because we concentrate on within public-sector wage differences, rather than the public-private

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of study.

<sup>19</sup>Details on the survey methodology can be found in SIEMPRO (2001).

Table 1: Definitions and summary statistics

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
<i>WAGE</i>	Natural logarithm of individual respondent's salary	4786	6.25	0.74	1.39	9.23
<i>P</i>	Vote share of the incumbent governor	4786	0.49	0.09	0.35	0.82
<i>WOMEN</i>	1 if the respondent is a woman	4786	0.52	0.50	0	1
<i>AGE</i>	Respondent's age $\times 0.1$	4786	4.07	1.07	1.50	8.50
<i>SCHOOLING</i>	Education achieved by respondent (0 = some primary school or less, 1 = completed primary school,...5 = completed college or higher)	4786	3.25	1.80	0	5
<i>EXPERIENCE</i>	Number of years since hired $\times 0.1$	4786	1.15	0.90	0	5.40
<i>OCCUPATION</i>	Respondent's occupation coded at the 2-digit level from the National Job Classification, 1998. (52 occupations are represented in our sample.)	4786				
<i>CITY</i>	1 if respondent lives in a town of at least 100,000, 0 o/w	4786	0.54	0.50	0	1
<i>OLDSYSTEM</i>	1 if hired before 1983	4786	0.25	0.43	0	1
<i>SAMEGOVERNOR</i>	1 if hired by current governor	4757	0.51	0.50	0	1
<i>NETWORK</i>	1 if the respondent found this job through an acquaintance, 0 o/w	4734	0.41	0.49	0	1

Source: Individual data is from SIEMPRO (2001). The electoral data is from the Ministry of the Interior, available at <http://andy.towson.com/totalpais/index.html>. The electoral data was matched to individuals based on the year they were hired, as explained in the text.

wage gaps, we use as a dependent variable the log of the individual public employee's monthly salary in 2001. All contracts in Argentina are signed on the basis of a monthly salary, which conforms to working weeks of 44 hours. While some differences in the contracted working hours could affect the estimates of the public-sector wage gap vis-à-vis the private sector, the weekly hours of all public-sector employees is similar across provinces and salaries are readily comparable. Definitions and summary statistics of our variables are in Table 1.

Based on our theory, the main independent variable of interest is the vote share of the governor hiring an employee in the election preceding the hiring decision. This is the vote share that, along with all the observable characteristics of an employee, provides the most accurate information about the probability of being a partisan. Because our dependent variable is the 2001 salary, we are only concerned with vote shares of the governor who is in office in 2001.<sup>20</sup> Thus for employees hired by the current governor, we use the vote share of the governor in the election preceding the hiring. For

<sup>20</sup>Furthermore, given the importance of parties in Argentine politics, we are not concerned with the person of the governor but rather his or her party affiliation. In the remainder of this paper, whenever we refer to the "governor," we mean "the governing person or his party."

employees hired by a previous administration, we use the vote share of the current governor when he first came into office. This is when the entering governor decided to retain the employee hired by his predecessor, and therefore this is the vote share that provides information about that person’s partisanship.<sup>21</sup> Table 2 gives the year each governor first entered into office.<sup>22</sup> To illustrate the matching, consider the governor of Chaco currently in office, first elected in 1995 and then re-elected in 1999. We use the 1999 vote share for employees hired after 1999, and the 1995 vote share for everyone else, including those hired prior to 1995. Note that, due to the presence of several small parties in some provinces, it is possible to win an election with less than 50% of the votes.<sup>23</sup>

Figure 1 plots the mean public-sector salaries by province and previous election against the relevant vote share. Fitting a quadratic curve or a nonparametric local regression suggests a U-shaped relationship.<sup>24</sup> Based on the theory, this is consistent with a dominant incentive effect for low vote shares and a larger composition effect as the vote share rises, as in Proposition 1. Thus, the raw data seems consistent with the theory. Of course, the graph ignores important factors which may influence both vote shares and wages, and we therefore turn to regression analysis.

With a quadratic approximation, a reduced form specification corresponding to (7) can be written as

$$S_j = \alpha_1 P_{rt} + \alpha_2 P_{rt}^2 + \beta \mathbf{X}_j + \mu_r + \varepsilon_j, \quad (10)$$

for employee  $j$  in province  $r$  hired after election  $t$ . Here,  $S_j$  is the log monthly salary,  $P_{rt}$  is the vote share at the time of hiring as explained above,  $X_j$  is a vector of individual characteristics,  $\mu_r$  is a province-level fixed effect, and  $\varepsilon_j$  is an error term. Note that the fixed effect  $\mu_r$  will pick up all time-invariant differences across provinces, including the province-level differences in employees’ outside options (such as differences in private sector wages or unemployment rates) reflected in the 2001 salaries, as well as all differences between current governors (including their

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<sup>21</sup>Note that our theory assumes that patronage contracts are enforceable as long as the politician is in office, and that employees decide to enter into such contracts based on their current political preferences. Under these assumptions whether a person’s political preferences change over time is irrelevant.

<sup>22</sup>Most governor’s elections were conducted in 1999 and every 4 years before that. Provinces have the constitutional authority to schedule the election date. The electoral calendar can be retrieved from <http://andy.towsa.com/totalpais/calendario.html>.

<sup>23</sup>In the period we consider, 3 elections (Tierra del Fuego 1999, Corrientes 1997, and Chaco 1995) had runoffs. For these, we take the first round vote share of the eventual winner. For several elections, candidates were supported by a coalition of one major and several smaller parties. In these cases, we take the vote share of the entire coalition. In each case our choice is guided by which vote share is likely to be the most informative about partisanship.

<sup>24</sup>Although based on the figure one might worry about a couple of influential outliers with high vote shares, we show that the results of our regressions below are in fact reinforced when we drop these provinces.

Table 2: Province characteristics

Province	Year current governor first elected	Party of current governor <sup>a</sup>	Average vote share of current governor since first elected	Average GDP per capita 1983-2000 <sup>b</sup>	Average unemployment 1983-2000 <sup>c</sup>
Buenos Aires	1987	UCR	49.6%	0.284	15.1%
Capital Federal	1996	UCR	41.8%	n/a	9.7%
Catamarca	1991	PJ	51.4%	0.244	11.5%
Chaco	1995	PJ	44.7%	0.133	10.8%
Chubut	1991	UCR	54.8%	0.629	12.4%
Cordoba	1998	UCR	49.6%	0.283	12.1%
Corrientes	1997	Other	48.5%	0.233	11.9%
Entre Rios	1999	UCR	49.1%	0.280	10.7%
Formosa	1983	PJ	52.5%	0.163	8.0%
Jujuy	1983	PJ	48.6%	0.216	9.3%
La Pampa	1983	PJ	50.0%	0.378	5.8%
La Rioja	1983	PJ	69.8%	0.324	7.2%
Mendoza	1999	UCR	37.9%	0.228	5.0%
Misiones	1987	UCR	50.2%	0.183	6.4%
Neuquen	1983	Other	52.9%	0.721	9.0%
Rio Negro	1983	UCR	45.8%	0.369	n/a
Salta	1995	PJ	51.1%	0.213	13.4%
San Juan	1999	Other	55.7%	0.212	9.5%
San Luis	1983	PJ	54.0%	0.593	6.2%
Santa Cruz	1983	PJ	57.7%	0.687	3.7%
Santa Fe	1983	PJ	47.1%	0.365	14.7%
Santiago del Estero	1983	PJ	54.8%	0.139	5.5%
Tierra del Fuego	1999	PJ	36.8%	1.165	9.2%
Tucuman	1999	PJ	36.4%	0.257	16.0%
Mean			49.6%	0.361	9.7%
Std. dev.			7.2%	0.245	3.4%

Notes: *a*: If the governor was supported by a party alliance, the dominant party is listed. UCR: Union Civil Radical, PJ: Partido Justicialista, Other: other provincial party

*b*: Million pesos, 1986 prices. Source: Universidad Nacional de La Plata as described in Porto (2004).

*c*: Source: Porto (2004) and INDEC, [www.indec.mecon.ar](http://www.indec.mecon.ar). Four missing values (Cordoba 1996, Neuquen 1991, Misiones 1989, Santiago del Estero 1988) were imputed using the average of the neighboring years. Observations prior to 1991 are missing for the province of Buenos Aires and Santa Fe.

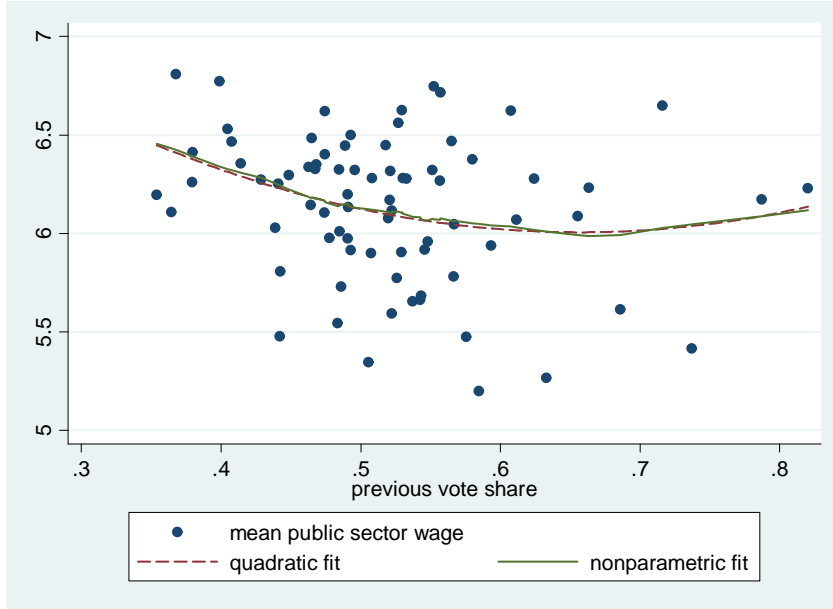


Figure 1: Mean public-sector salary and vote shares in the Argentine provinces, 1983-2001. Each dot represents the 2001 mean log salary of public-sector employees hired (or retained) by the 2001 governors after a given election. The nonparametric fit is a locally weighted scatterplot smoothing with a bandwidth of 0.8 times the number of observations.

vote share in the most recent election). The vector  $X_j$  includes the following (see Table 1): the number of years since the employee was hired (experience) and its square; age and its square, highest educational attainment (dummies for elementary education, some high-school, completed high-school, some college education, completed college education), gender, 52 dummies for the individual's job classification coded at the 2-digit level, an indicator for the size of the locality, and a dummy for employees first hired before the 1983 democratic transition. Note that by construction the experience variable controls for all common time-effects across provinces. In some specifications we also include a dummy for whether the employee was hired under a different administration (post-1983), and information about whether the employee found the job through a social contact. These last two variables may be observed by the politician and used in the process of screening candidates. In some specifications we also control for provincial GDP and unemployment at the time of hiring (see Table 2). To the extent that initial conditions have long-lasting effect on salaries, these might be important determinants of workers' outside options which will not be captured by the fixed effects.

### 4.3 Reduced form results

Table 3 presents the results from estimating equation (10). We report both heteroskedasticity-robust standard errors, and standard errors that additionally allow for two-way clustering at the province and election-year level following the method proposed by Cameron, Gelbach and Miller (2008).<sup>25</sup> Column (1) confirms the U-shaped relationship between past vote shares and individual salaries when individual and province characteristics are controlled for. In particular, Column (1) controls for gender, age, schooling and experience as well as province fixed effects. The impact of  $P$  on salaries is initially negative, but the magnitude of the effect declines, and becomes positive at around  $P = 47\%$ . The negative coefficient on the main effect and positive coefficient on the squared term are both individually and jointly significant (F-test p-value = 0.003).

Column (2) adds an indicator for an individual's profession, a dummy for large cities, and another dummy for employees first hired before the democratic transition of 1983. Figure 2 graphs the estimated effect of  $P$  based on the point estimates from Column (2). The graph shows the % change in public-sector wage relative to the lowest partisan share in the data (35.4% in Chaco in the 1995 election). According to these estimates, the average public-sector employee in Chaco hired between the 1995 and 1999 elections currently earns a 3.3% *higher* wage than a similar employee hired in an environment where around half of the voting population was partisan, such as Salta between 1995 and 1999 ( $P = 47.2\%$ ). Based on Column (2), the magnitude of this effect is comparable to the average wage differential between large cities and towns with less than 100,000 inhabitants holding everything else constant (3.8%). From our theory, the negative wage effect of the vote share is explained by the incentive effect: in provinces with a low partisan share, the political support purchased from nonpartisan employees is very valuable. This results in high salaries for nonpartisans, and hence also for partisans, who need to be compensated for selecting the contracts designed for them. As the share of partisans rises, the support purchased from nonpartisans can be replaced with the support of partisans, consequently the salaries can decrease.

In Figure 2, an environment with a 60% partisan share for the incumbent results in similar salaries as the lowest partisan share in Chaco. As  $P$  increases further, salaries rise at an increasing rate. Based on the point estimates, the partisan environment in San Luis in the same time period

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<sup>25</sup>Since our dependent variable is for a single year, clustering at the province  $\times$  year level is inappropriate as this would assume that, in a given province, *only* employees hired in the same year face correlated shocks.



Table 3: The effect of partisan shares on public-sector wages (fixed effects regressions)

	(1)	(2)	(3)	(4)
<i>P</i>	-2.255 (1.147)** [1.218]*	-2.031 (1.087)* [1.016]**	-2.106 (1.122)* [1.257]*	-0.836 -0.905 [0.898]
<i>P</i> <sup>2</sup>	2.376 (0.976)** [1.056]**	2.138 (0.921)** [0.907]**	2.156 (0.943)** [1.055]**	1.074 -0.804 [0.691]
<i>WOMEN</i>	-0.351 (0.018)*** [0.018]***	-0.279 (0.020)*** [0.019]***	-0.268 (0.022)*** [0.020]***	-0.432 (0.018)*** [0.029]***
<i>AGE</i>	0.884 (0.063)*** [0.044]***	0.802 (0.060)*** [0.049]***	0.788 (0.065)*** [0.045]***	0.754 (0.031)*** [0.041]***
<i>AGE</i> <sup>2</sup>	-0.09 (0.007)*** [0.005]***	-0.082 (0.007)*** [0.006]***	-0.079 (0.007)*** [0.005]***	-0.085 (0.004)*** [0.006]***
<i>SCHOOLING</i> <sub>1</sub>	0.221 (0.033)*** [0.032]***	0.141 (0.032)*** [0.040]***	0.131 (0.035)*** [0.047]***	0.171 (0.021)*** [0.019]***
<i>SCHOOLING</i> <sub>2</sub>	0.391 (0.035)*** [0.053]***	0.25 (0.036)*** [0.046]***	0.249 (0.039)*** [0.053]***	0.264 (0.022)*** [0.027]***
<i>SCHOOLING</i> <sub>3</sub>	0.644 (0.035)*** [0.062]***	0.425 (0.037)*** [0.050]***	0.419 (0.040)*** [0.049]***	0.427 (0.025)*** [0.032]***
<i>SCHOOLING</i> <sub>4</sub>	0.665 (0.062)*** [0.093]***	0.493 (0.062)*** [0.071]***	0.455 (0.066)*** [0.066]***	0.464 (0.039)*** [0.054]***
<i>SCHOOLING</i> <sub>5</sub>	0.92 (0.032)*** [0.064]***	0.704 (0.038)*** [0.054]***	0.692 (0.042)*** [0.059]***	0.643 (0.026)*** [0.025]***
<i>EXPERIENCE</i>	0.304 (0.036)*** [0.077]***	0.339 (0.035)*** [0.067]***	0.325 (0.039)*** [0.071]***	0.477 (0.024)*** [0.047]***
<i>EXPERIENCE</i> <sup>2</sup>	-0.038 (0.010)*** [0.021]*	-0.037 (0.010)*** [0.018]**	-0.036 (0.011)*** [0.020]*	-0.071 (0.007)*** [0.010]***
<i>CITY</i>		0.038 (0.018)** [0.036]	0.031 (0.020) [0.039]	0.082 (0.015)*** [0.015]***
<i>OLDSYSTEM</i>		-0.135 (0.031)*** [0.046]***	-0.143 (0.033)*** [0.048]***	-0.184 (0.033)*** [0.046]***
<i>OCCUPATION</i>	No	Yes	Yes	Yes
Observations	4786	4786	4078	14345
Provinces	24	24	22	24
R-squared	0.36	0.43	0.43	0.36

Notes: Dependent variable is *WAGE*. Column (3) excludes the Federal Capital and the province of Buenos Aires. Column (4) is a falsification test on private sector employees. All regressions include a full set of province fixed effects. Robust standard errors in parentheses, robust standard errors clustered two-way by province and election year in brackets (see Cameron et al., 2008).

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

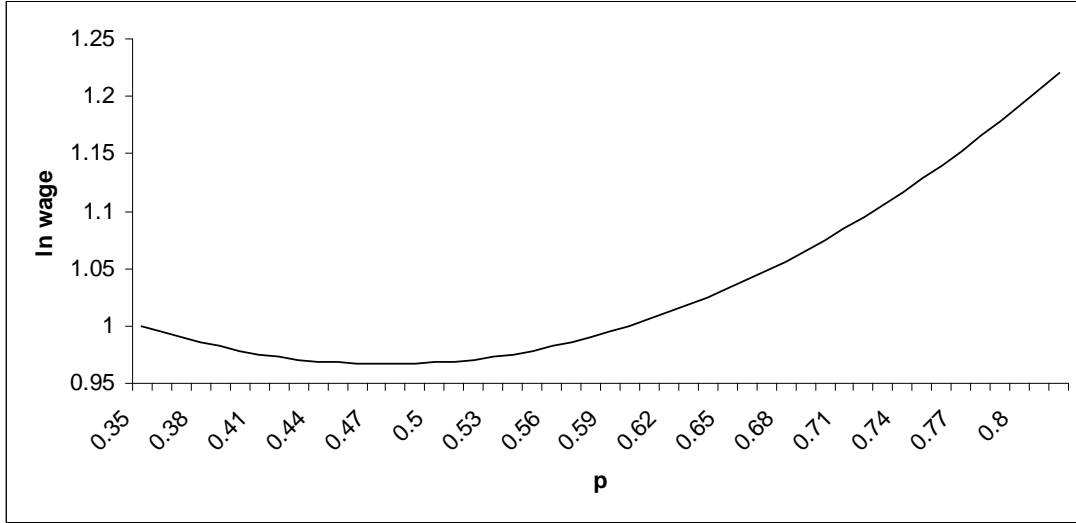


Figure 2: Predicted public-sector salary as a function of the vote share.

Log wage as a function of  $P$  (holding everything else constant), based on the point estimates in Table 3, column (2). (Chaco 1995 = 1).

( $P = 71.6\%$ ) resulted in public salaries that are 9.1% higher than in Chaco.<sup>26</sup> Based on the theory, this is explained by the composition effect: the high partisan share results in many partisan employees. In equilibrium, partisans are paid more than their nonpartisan colleagues both because they provide more political support and because they receive rents to ensure self-selection.

Column (3) shows that the above findings are robust to dropping the Federal Capital and the province of Buenos Aires. The potentially different dynamics of the provincial public sector close to the federal center do not drive the results. Finally, Column (4) performs a simple falsification test by running the regression on the private sector employees in our dataset. The coefficient estimates on  $P$  and  $P^2$  drop by more than a half and become highly insignificant. As expected, the implications of our model of political screening do not show up in the private sector data.<sup>27</sup>

To further test the robustness of our findings, the first two columns of Table 4 include other variables which a politician might use to gain information about a potential employee's partisanship. To the extent that these are correlated with vote shares, it is important to check if omitting them might have biased the results reported above. Column (1) includes an indicator for employees hired

<sup>26</sup>Because 90% of our sample is characterized by vote shares between 36-66%, the quantitative predictions for very high vote shares should be interpreted with care.

<sup>27</sup>Based on Figure 1, we also checked the sensitivity of our results to outliers. Dropping the 5 elections with the highest vote share in the data makes our results stronger: the coefficient estimates on both  $P$  and  $P^2$  double in size (results available upon request).

Table 4: Robustness (fixed effects regressions)

	(1)	(2)	(3)	(4)
<i>P</i>	-2.125 (1.088)* [0.939]**	-1.979 (1.093)* [1.040]*	-2.144 (1.263)* [1.644]	-2.029 (1.188)* [0.303]***
<i>P</i> <sup>2</sup>	2.223 (0.922)** [0.827]***	2.101 (0.926)** [0.923]**	2.465 (1.044)** [1.342]*	1.646 (0.985)* [0.329]***
<i>SAMEGOVERNOR</i>	0.043 (0.030) [0.068]			
<i>NETWORK</i>		0.032 (0.018)* [0.024]		
<i>GDP PER CAPITA</i>			-0.617 (0.217)*** [0.257]**	
<i>UNEMPLOYMENT</i>			-0.007 (0.005) [0.008]	
Observations	4757	4734	4084	4129
Provinces	24	24	22	24
R-squared	0.43	0.43	0.43	0.37

Notes: Dependent variable is *WAGE*. All regressions include a full set of province fixed effects as well as all the independent variables listed in Table 3. Column (4) excludes employees hired since the most recent election. Robust standard errors in parentheses, robust standard errors clustered two-way by province and election year in brackets. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

by the current administration (possibly in earlier election cycles) as opposed to a governor from a different party. As one might expect, these employees receive a wage premium of 4%, but this is not statistically significant. The effect of the past vote share remains robust. Column (2) includes an indicator for whether the employee was hired through a referral. Presumably, hiring through social networks can provide at least some information on partisanship, and employees hired in this manner receive a 3% wage premium.<sup>28</sup> The estimated effect of past vote share remains large and significant.

Finally, we ask whether our results are robust to including time-varying province characteristics which will not be captured by the fixed effects. In particular, Beaudry and DiNardo (1991) and subsequent authors have argued that, in the private sector, economic conditions at the time of hiring can have long-lasting effects on workers' salaries. Although it is unclear whether these factors would be correlated with the vote share of the incumbent governor,<sup>29</sup> they certainly could

<sup>28</sup>Of course it could also be that these referrals mainly transmit professional, rather than political information.

<sup>29</sup>Recall that *P* measures the incumbent's vote share regardless of the party of the incumbent. In fact, the difference in mean winning vote shares between elections won by the Peronists (51.5%) and the Radicals (48.9%) between 1983-

be, so it is important to check if our results are robust. In Column (3) of Table 4, we include provincial GDP per capita and provincial unemployment at the time of hiring. We match these variables based on the same year as the vote share  $P$ .<sup>30</sup> As can be seen, our estimates of the vote share coefficients change very little, with the point estimates on both  $P$  and  $P^2$  becoming slightly larger than those reported earlier. Clustering makes the effect of  $P$  insignificant, although  $P$  and  $P^2$  remain jointly significant (p-value = 0.003). Our results confirm that in the public sector, apart from the economic factors identified in previous research, *political* factors at the time of hiring could also have long term impacts on wages.<sup>31</sup>

#### 4.4 Alternative explanations

We have shown that the pattern of public-sector wages and partisan shares in Argentina is consistent with a screening model of patronage. In this section we briefly consider potential alternative models and argue that there are no obvious alternatives that would explain the data.

First, we note that in standard models of targeted redistribution where politicians acquire votes by favoring pivotal voter groups (swing voters) or by increasing turnout among loyal supporters (core voters), expenditures are correlated with *current* electoral results. In models such as Cox and McCubbins (1986), Lindbeck and Weibull (1987), and Dixit and Londregan (1996, 1998), politicians allocate resources among voters based on partisanship to win the next election (or as a reward for votes after an election). Since a politician cannot increase his vote share retrospectively and there is no reason to reward supporters for electoral results in the distant past, these models have no implications for the relationship between *past* vote shares and *current* wages.

Second, in these models, the relationship between vote shares and expenditures is very different from the U-shaped pattern we find. In swing-voter models, expenditures as a function of vote shares tend to be *inverse* U-shaped as very low or high vote shares usually indicate the presence of few swing voters. In core-voter models, expenditures increase monotonically with the share of partisans. (See, e.g., Case (2001) and Ansolabehere and Snyder (2006) for empirical work on these

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2001 is not statistically significant ( $t = -1.29$ ). Thus, omitted province characteristics correlated with vote shares *conditional* on the party would not necessarily be correlated with  $P$  in our regressions.

<sup>30</sup>We lose several observations due to missing values, including all of Rio Negro and the Federal Capital. See Table 2 for details.

<sup>31</sup>In Column (3), the unemployment rate at the time of hiring has the expected negative effect on current wages but it is insignificant. Surprisingly, GDP per capita also has a negative effect.

models.)

Could some other theory based on recent elections drive our empirical results? The province fixed effects would pick up any impact that the last election may have on all employees in a province,<sup>32</sup> but differential impacts across cohorts may be possible. As a final robustness check, Column (4) of Table 4 re-runs our baseline regression omitting every employee hired since the most recent election. These are the employees most likely to be affected by the standard mechanisms of targeted redistribution. Our findings remain robust, these employees do not drive the results. Consistent with our screening theory of patronage, elections at the time of hiring, in some cases going back as much as 18 years, have an impact on wages currently paid.

#### 4.5 Structural estimates of the partisan premium

In this section we attempt to quantify one aspect of political patronage. What is the premium earned by partisan employees relative to similar workers who are not partisans? Due to the nature of patronage, questions like this are inherently hard to answer. One option is to compute wage differentials between political districts controlling for skill composition, costs of living and other factors, as done by Alesina, Danninger, and Rostagno (2001) for the case of Southern vs. Northern Italy. However, interpreting such differentials solely in terms of patronage will always raise questions about potential omitted variables. Instead, we use our model to provide a structural estimate of the partisan wage premium.

We start by assuming functional forms in our model that are consistent with the reduced form patterns described above. In particular, we consider the following specification of the cost of effort functions and the politician’s payoff

$$\begin{aligned}
 c_{NP}(x) &= \frac{1}{2}e^{x^2} \\
 c_P(x) &= \alpha \frac{1}{2}e^{x^2} \\
 v(x) &= \gamma x
 \end{aligned}
 \tag{11}$$

where  $\alpha \in (0, 1)$  and  $\gamma > 0$  are parameters. The smaller  $\alpha$ , the more willing partisans are to provide

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<sup>32</sup>The province fixed effects also control for any story based on (time-invariant) differences between current provincial governors that might affect the salaries they pay (e.g., differences in the governors’ “quality”).

political services relative to nonpartisans. The specification (11) is flexible in the sense that the two parameters allow for the second-order approximation, around any given  $p$ , of a salary function (7) derived from arbitrary functions  $c_{NP}$ ,  $c_P$  and  $v$ . The Appendix shows that this choice of functional forms leads to a U-shaped relationship between the average salary and the vote share  $p$ .

Next, assume that for each individual  $j$  the sum of the outside option  $u_j$  and the equilibrium cost of effort  $\kappa_j(\hat{y})$  can be written as

$$u_j + \kappa_j(\hat{y}) = \beta \mathbf{X}_j + \mu_r + \varepsilon_j,$$

where, as above,  $r$  indexes the province,  $\beta$  are parameters,  $\mathbf{X}_j$  is a vector of individual characteristics,  $\mu_r$  are province fixed effects, and  $\varepsilon_j \sim N(0, \sigma^2)$  is a random shock. Equation (7) then becomes

$$\tilde{s}_j = p_r \frac{\alpha}{2} (e^{(x_P^*)^2} - e^{x_{NP}^*(p_r)^2}) + \frac{1}{2} e^{x_{NP}^*(p_r)^2} + \beta \mathbf{X}_j + \mu_r + \varepsilon_j, \quad (12)$$

and the parameters  $(\alpha, \gamma, \beta, \sigma)$  can be estimated using Nonlinear Least Squares. In particular, for given values of the parameters,  $x_P^*$  and  $x_{NP}^*(p_r)$  solve (2) and (3) with the functional forms in (11):

$$\begin{aligned} x_P^* e^{(x_P^*)^2} &= \frac{\gamma}{\alpha} \\ x_{NP}^* e^{(x_{NP}^*)^2} &= \frac{\gamma(1-p)}{1-p\alpha}. \end{aligned} \quad (13)$$

These can be solved numerically, so that Equation (12) becomes a function only of the data and the parameters to be estimated. The results of estimating (12) are in Table 5.

Given our estimates of  $\alpha$  and  $\gamma$ , the partisan premium can be computed. It is convenient to measure this as the ratio of partisan to nonpartisan salaries. This gives

$$premium(p_r) = \exp(s_P(p_r) - s_{NP}(p_r)) = \exp(c_P(x_P) - c_P(x_{NP})),$$

where we have used the fact that  $s$  is measured on the log scale, and where the second equality follows from (5) and (6). Figure 3 presents our estimates of the partisan premium as a function of the vote share. The estimated premium rises from 1.184 for the lowest vote share in our sample to 1.192 for the highest vote share, with a mean of 1.187 across all elections. Averaging for all

Table 5: Structural estimates (Nonlinear Least Squares)

	Estimate	Standard error
$\alpha$	0.113	0.003
$\ln(\gamma)$	-0.593	0.076
<i>WOMEN</i>	-0.351	0.010
<i>AGE</i>	0.881	0.036
<i>AGE</i> <sup>2</sup>	-0.089	0.004
<i>EXPERIENCE</i>	0.287	0.019
<i>EXPERIENCE</i> <sup>2</sup>	-0.034	0.006
<i>SCHOOLING1</i>	0.220	0.019
<i>SCHOOLING2</i>	0.389	0.020
<i>SCHOOLING3</i>	0.643	0.020
<i>SCHOOLING4</i>	0.663	0.035
<i>SCHOOLING5</i>	0.920	0.018

Notes: Dependent variable is *WAGE*. The regression includes a full set of province fixed effects. The estimation was implemented in Matlab. The asymptotic covariance matrix was estimated using the heteroskedasticity-robust sandwich formula  $H^{-1}(\sum_i s_i s_i')H^{-1}$ , where  $H$  is the estimated Hessian of the objective, and  $s_i$  is the first derivative with respect to the parameters of the  $i$ -th individual's contribution to the objective (Wooldridge, 2002, p358).

employees within a province, the premium is lowest in Tucuman with 1.185 and highest in La Rioja with 1.19.

Based on our estimates, these partisan premia are comparable to the average wage effect of completing high-school in our sample.<sup>33</sup> Another way to gauge the magnitude of the premium is to compare it to the public-private wage gap. To get a crude estimate of this gap, we ran our benchmark regression from Table 3, column 2 on the entire sample including both private and public employees, with a dummy for the latter group (output available upon request). The coefficient on the public-sector dummy indicates a statistically significant wage gap of 8.4%.<sup>34</sup> Thus, in relative terms, our estimate of the within-public sector partisan premium ( $\simeq 18\%$ ) is considerably larger than the standard public-private wage differential.

While we are not aware of any previous estimate of partisan premia, some suggestive evidence in Ronconi and Murillo (2004) and Alesina, Danninger, and Rostagno (2001) is in the ballpark of the numbers obtained above. Ronconi and Murillo (2004) report that between 1996 and 2000, provincial governors in Argentina often offered teachers bonuses in exchange for not participating in strikes. The authors argue that political attitudes towards the incumbent governors were an

<sup>33</sup>In Table 3 Column (2), finishing high-school (*SCHOOLING2* to *SCHOOLING3*) raises wages by a factor of 1.175.

<sup>34</sup>This is towards the high end of comparable wage gaps reported in Gregory and Borland (1999, Table 5) for developed countries (mostly between 3-11%).

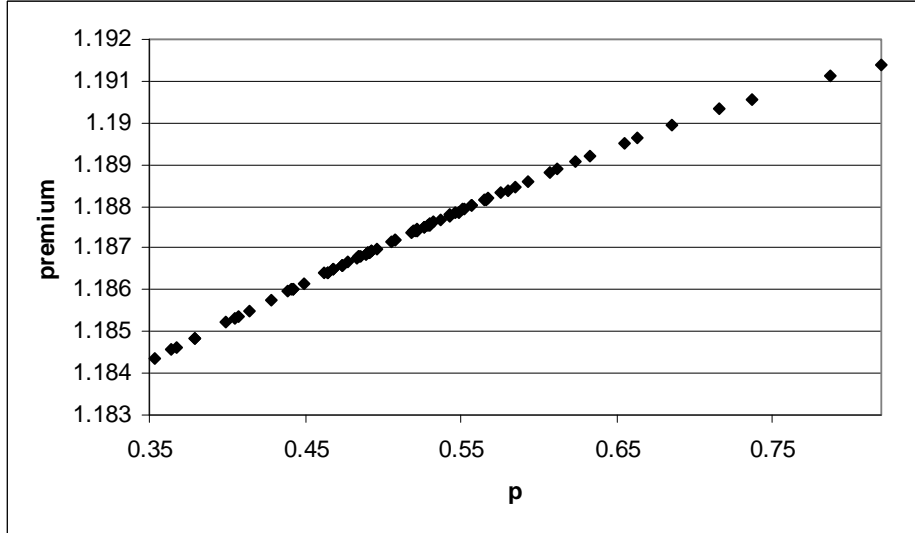


Figure 3: Estimated partisan premium.

important determinant of these strikes. Assuming that a rational governor will pay the lowest bonus necessary to keep some teachers in the classroom, these bonuses will be accepted by the partisans. Thus, it is plausible to interpret the bonuses as the premia paid to partisans for the political service of not going on strike, while the nonpartisans did not provide any services.<sup>35</sup> The “premium” paid by the thirteen provinces offering bonuses in this period ranged from 4 to 26%, with an average of 11%, which is similar in magnitude to our estimates. More generally, our estimates are remarkably close to the 11-18 % difference in real wages found by Alesina, Danninger, and Rostagno (2001) in the public sector of Southern vs. Northern Italy.

## 5 Conclusion

We have presented a model of political patronage in which a politician screens public-sector employees in an effort to maximize the level of political support extracted from them and minimize its cost. In settings where personal screening is impractical and there are no readily available indicators of political preferences (such as family ties or ethnicity), the politician may be able to use a system of screening contracts. Here, positions with different combinations of political requirements and compensation are offered, and partisans self-select into positions that require a large degree of

<sup>35</sup>Ronconi and Murillo (2004) explain that the bonuses were only paid if no classes were missed. In our model, such all-or-nothing contracts would correspond to  $x_P = 1$  and  $x_{NP} = 0$ .



political support in exchange for high pay. Past vote shares provide information on the population share of partisans, and the politician takes this into account in designing the optimal patronage contracts. Thus, the model predicts an association between the incumbent’s past vote share and current wages in the public sector. Individual-level data across provinces in Argentina is consistent with the theory, indicating that public-sector salaries have a U-shaped relation to the vote share of the incumbent governor at the time of hiring.

Our analysis highlights one of the subtle ways that politicians have at their disposal to implement a system of political screening in the public sector. While in established democracies direct interference with civil service procedures often receives attention from the media and the courts, a system based on self-selection constraints might be difficult to detect. One solution to quantify this type of patronage is through the estimation of explicit theoretical models, and our paper is a first step in this direction. Using our model, we were able to quantify one aspect of political patronage by providing structural estimates of the wage premium earned by partisan employees.

In the past 30 years, civil service reform has been on the agenda in both developed and developing countries. For example, between 1981 and 1991, such reforms were a component in 90 World Bank loans to 44 different countries totalling over \$ 4.6 billion.<sup>36</sup> To conclude, we briefly discuss potential implications of our paper for these policies.

Our approach underscores the importance of policies that tie public wages to observable employee characteristics, such as civil service pay scales based on qualifications and entrance exams. Our model shows how, in a world without such restrictions, politicians can use salary differences in otherwise similar positions to screen applicants based on political preferences. In contrast, tying salaries to individual characteristics such as education or experience prevents the politician from offering a partisan premium, a necessary ingredient of the system of screening contracts. Thus, pay-setting policies in the public sector can help reduce political screening.

A standard feature of civil service reforms is the designation of “political” positions in which patronage is legal and “career” positions in which it is not, as in the US system. Although career positions are heavily regulated, politicians have considerable freedom in shaping political positions.<sup>37</sup>

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<sup>36</sup>Lindauer and Nunberg (1996). See Halligan (2003) for a description of recent reforms in Australia, Canada, New Zealand, UK and the US.

<sup>37</sup>In the US, the 1883 Pendleton Act establishing the civil service system initially left 89% of federal employees in political positions. This share decreased to 14% in 1950 but rose to almost 50% by the mid 1990s (Ingraham and Moynihan, 2003).

The distinction between career and political positions is similar to the nonpartisan and partisan contracts in our theory. The self-selection constraint of partisan employees implies that laws reducing the salary and political support in nonpartisan contracts allow the politician to reduce the rents offered in the partisan contracts. Thus our model shows that the regulation of career jobs may also lead to lower payments for political services in political positions, even if those are not regulated directly.

Considering the distinction between political and career positions in terms of our theory also suggests an interesting explanation for the emergence of these policies. Typical accounts of civil service reforms view them as driven by public demands for more transparency and efficiency in government.<sup>38</sup> However, relative to a world with implicit screening contracts, separating political and career positions codifies the existence of partisan and nonpartisan contracts and makes it explicit that political support is expected from employees in the latter but not in the former. If self-selection based on partisanship is important, then civil service reform may be attractive to incumbent politicians because it can enhance the efficiency of political screening. Investigating these and other implications of our approach for civil service reforms may be an interesting topic for future research.

## 6 Appendix

### 6.1 Proof of Lemma 2

We first solve the problem ignoring, for each type, all but the first participation constraint. (This is equivalent to assuming that the applicant, once hired, cannot quit.) We show that the static second-best contracts solve this problem. Since this solution satisfies the deleted constraints, it is also a solution to the complete problem.

Consider the problem

$$\max_{(x_i, s_i)_{i=P, NP}} \sum_{t=0}^T \delta^t E [p(v(x_P^t) - s_P^t) + (1-p)(v(x_{NP}^t) - s_{NP}^t)]$$

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<sup>38</sup>Especially pertinent is Rauch and Evans (2000), who argue that a well-designed civil service system allows the self-selection of bureaucrats who are right for the job.

subject to two incentive constraints ( $IC_i$ )

$$\sum_{t=0}^T \delta^t E [s_i^t - c_i(x_i^t)] \geq \sum_{t=0}^T \delta^t E [s_j^t - c_i(x_j^t)],$$

and two participation constraints ( $PC_i$ )

$$\sum_{t=0}^T \delta^t E [s_i^t - c_i(x_i^t)] \geq \sum_{t=0}^T \delta^t E [u^t].$$

The same arguments as in the standard static case can now be used to establish that ( $PC_{NP}$ ) and ( $IC_P$ ) bind, while ( $PC_{NP}$ ) and ( $IC_P$ ) do not. In particular, assume ( $PC_P$ ) binds. Then ( $IC_P$ ) is

$$\sum_{t=0}^T \delta^t E [u^t] \geq \sum_{t=0}^T \delta^t E [s_{NP}^t - c_P(x_{NP}^t)],$$

but since  $c_{NP}(x_{NP}^t) > c_P(x_{NP}^t)$  for all  $x_{NP}^t$ , this would imply

$$\sum_{t=0}^T \delta^t E [u^t] > \sum_{t=0}^T \delta^t E [s_{NP}^t - c_{NP}(x_{NP}^t)],$$

contradicting ( $PC_{NP}$ ). Since ( $PC_P$ ) does not bind, ( $IC_P$ ) has to, or else all payments  $s_p^t$  could be reduced. Next, assume that ( $IC_{NP}$ ) binds. Using the binding ( $IC_P$ ), ( $IC_{NP}$ ) would then become

$$\sum_{t=0}^T \delta^t E [c_P(x_P^t) - c_P(x_{NP}^t)] \geq \sum_{t=0}^T \delta^t E [c_{NP}(x_P^t) - c_{NP}(x_{NP}^t)].$$

But since  $c'_P(x) < c'_{NP}(x)$  for all  $x$ , this cannot be the case.

Substituting the binding constraints into the objective and taking first-order conditions gives

$$\begin{aligned} c'_P(x_P^t) &= v'(x_P^t) \\ c'_P(x_{NP}^t) &= (1-p)v'(x_{NP}^t) + pc'_P(x_{NP}^t) \end{aligned}$$

so that  $x_i^t = x_i^*$  for all  $t$ . The corresponding payment streams  $s_i$  can be obtained from the constraints. Clearly,  $s_i^t = s_i^*(u^t)$  is a solution.

## 6.2 An example

Let  $c_{NP}(x) = c(x)$ ,  $c_P(x) = \alpha c(x)$ , and  $v(x) = \gamma x$  for some  $\alpha \in (0, 1)$  and  $\gamma > 0$ , with  $c', c'' > 0$ . We now show that a sufficient condition for  $\tilde{s}(p)$  in equation (7) to be U-shaped is that  $\frac{c''(x)}{c'(x)}$  be U-shaped:

**Assumption A1** For some  $\bar{x} > x_{NP}^*(0)$ ,  $(\frac{c''}{c'})' < 0$  for  $x < \bar{x}$  and  $(\frac{c''}{c'})' > 0$  for  $x > \bar{x}$ .

The first order conditions (2) and (3) are

$$\begin{aligned} c'(x_P^*) &= \frac{\gamma}{\alpha} \\ c'(x_{NP}^*) &= \frac{\gamma(1-p)}{1-p\alpha}, \end{aligned}$$

and the derivative of average salary with respect to  $p$  (equation (8)) is

$$\frac{\partial \tilde{s}}{\partial p} = \alpha(c(x_P^*) - c(x_{NP}^*)) - \gamma^2 \frac{(1-\alpha)(1-p)}{c''(x_{NP}^*)(1-p\alpha)^2}. \quad (14)$$

Take the derivative once again and rearrange to get

$$\frac{\partial^2 \tilde{s}}{\partial p^2} = \frac{\gamma^2(1-\alpha)^2}{(1-p\alpha)^3 c''(x_{NP}^*)} \left[ 1 - \frac{c'(x_{NP}^*)c'''(x_{NP}^*)}{(c''(x_{NP}^*))^2} \right],$$

so that  $\frac{\partial^2 \tilde{s}}{\partial p^2} \sim (c''(x_{NP}^*))^2 - c'(x_{NP}^*)c'''(x_{NP}^*) \sim -\left(\frac{c''(x_{NP}^*)}{c'(x_{NP}^*)}\right)'$ .

Note that for  $p \rightarrow 1$  the second term in (14) disappears so  $\frac{\partial \tilde{s}}{\partial p} > 0$  for  $p$  large enough.

Next, consider  $\frac{\partial \tilde{s}}{\partial p}|_{p=0} = \alpha(c(x_P^*) - c(x_{NP}^*)) - \gamma^2 \frac{1-\alpha}{c''(x_{NP}^*)}$  and note that for  $\alpha = 1$ ,  $\frac{\partial \tilde{s}}{\partial p} = 0$ . Take

$$\begin{aligned} \frac{\partial(\frac{\partial \tilde{s}}{\partial p}|_{p=0})}{\partial \alpha} &= c(x_P^*) - c(x_{NP}^*) + \alpha c'(x_P^*) \frac{\partial x_P^*}{\partial \alpha} + \frac{\gamma^2}{c''(x_{NP}^*)} \\ &= c(x_P^*) - \frac{c'(x_P^*)^2}{c''(x_P^*)} - \left[ c(x_{NP}^*) - \frac{c'(x_{NP}^*)^2}{c''(x_{NP}^*)} \right] \end{aligned}$$

Because  $\left(c - \frac{(c')^2}{c''}\right)' \sim (c'''c' - (c'')^2) \sim \left(\frac{c''}{c'}\right)'$  and  $x_P^* > x_{NP}^*$ ,  $\left(\frac{c''}{c'}\right)' > 0$  guarantees that  $\frac{\partial(\frac{\partial \tilde{s}}{\partial p}|_{p=0})}{\partial \alpha} > 0$ . Since for  $\alpha = 1$ ,  $\frac{\partial \tilde{s}}{\partial p} = 0$ , this implies  $\frac{\partial \tilde{s}}{\partial p}|_{p=0} < 0$ .

To summarize, under Assumption A1,  $\frac{\partial \tilde{s}(p)}{\partial p}|_{p=0} < 0$  but  $\frac{\partial \tilde{s}}{\partial p}$  will eventually rise with  $p$  until  $\frac{\partial \tilde{s}(p)}{\partial p} > 0$  for  $p$  high enough.

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