School Board Politics, School District Size,

and the Bargaining Power of Teachers' Unions

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Abstract

This paper develops a public choice model of the bargaining power of teachers' unions.

The model predicts that the power of the unions rises with the number of eligible voters

in a district. As a bargaining outcome reflecting this power, we use the experience

premium for teachers. The premium is defined as the difference in salary between

experienced and inexperienced teachers. For a sample of 771 California school districts

in 1999-2000, a district's premium is positively related to the number of voters, a finding

consistent with the model's prediction.

1. Introduction

The unionization of teachers has been one of the most significant trends in public education over the last 30 years. Several studies have examined the effect of this trend on teachers' salaries, class sizes, working conditions, and educational productivity. For example, Baugh and Stone (1982) compare the salaries of teachers before and after they are represented by a union. Eberts and Stone (1987) compare the productivity of unionized public schools with the productivity of non-unionized schools. Kleiner and Petree (1988) estimate how average teacher salary and student achievement in states are related to the percentage of teachers in each state who are unionized. Hoxby (1996) compares school inputs and high school drop-out rates in unionized districts with inputs and drop-out rates in non-unionized districts. Stone (2002) provides a thorough summary of this literature.

Studies in this literature share a common method. They compare outcomes in unionized school districts with outcomes in non-unionized districts. This method has been fruitful, but it directs attention away from the differential effects unionization may have in different districts. Unions may be more powerful in some districts than in others and thus relatively more successful in achieving outcomes beneficial to their members.

Unlike the previous research, this paper focuses on these differential effects. We hypothesize that teachers' unions will be more powerful in large districts than in small ones. We derive this hypothesis from a public choice model of the political power of homeowners and teachers' unions. As Fischel (2001) observes, homeowners are the residual claimants of the surplus produced by public schools. If a public school district produces educational services more valuable than the taxes necessary to finance those services, it enhances the value of homes within its boundaries. As a consequence, homeowners have a powerful incentive to protect and

improve the quality of their local public schools. Teachers' unions seek to divert some of that public school surplus to their members. If a union secures higher salaries for its members than would be necessary to keep them employed in the district, it directs resources away from other useful activities and thus reduces the surplus that is capitalized into home values.

The competing interests of teachers and homeowners are played out in school board politics. The school board hires the administrators who represent the district in collective bargaining. If the teachers' union can help to elect school board members sympathetic to its interests, it will face relatively sympathetic administrators in collective bargaining. Unions can help elect school board members by various activities, including endorsements, campaign contributions, and neighborhood canvassing. Homeowners can employ the same strategies in support of candidates more sympathetic to their interests.

In this political competition, homeowners are at a particular disadvantage. Campaign contributions and other efforts on behalf of a school board candidate are a public good to the supporters of that candidate. As a consequence, each homeowner has an incentive to free ride on the efforts of others, leading to a total effort that is less than collectively optimal. Teachers face the same problem, but they have a method for overcoming it. They can organize a union and tax themselves though union fees to support candidates aligned with their interests.

This political disadvantage for homeowners is particularly acute in large districts. The effort required to influence school board elections increases with the number of eligible voters in a district. A teachers' union can meet these increased demands because union membership grows with district size and the funds that a union can raise from its members increase with its membership. In contrast, because the free-rider problem is more difficult to overcome in large groups, the support homeowners can muster for candidates they favor is unlikely to grow as

rapidly as the size of the district increases. Thus, the relative power of the teachers' union in collective bargaining should increase with district size as measured by the number of eligible voters in the district.

The relative power of the teachers' union should be reflected in teachers' salaries. In the typical contract between a public school district and its teachers' union, the salary of a teacher is determined solely by his or her education and years of teaching experience. A salary schedule with a high premium for experience rewards teachers who have been employed by a district for many years and are unlikely to leave it. A high premium creates a rent for senior teachers, which is not in the best interests of homeowners. We maintain, therefore, that the size of a district's experience premium is a reflection of the power of its teachers' union, and we test the hypothesis that these premiums increase with the number of eligible voters in a district.

The next section develops a model of collective bargaining that captures the essential elements outlined above. We then present empirical evidence on the experience premium in 771 unionized California school districts in 1999-00. We find that a school district's experience premium is positively and significantly related to the size of the district, a result consistent with the predictions of our public choice model.

2. A Model of Collective Bargaining

Our objective is a model relating the political power of the teachers' union to the salary schedule that emerges from collective bargaining. We proceed in two steps. First, we develop a model of collective bargaining in which the salary schedule is a function of the political power of the teachers' union. Second, given that function, we develop a model that determines the political power of the union.

A Model of Collective Bargaining Given the Union's Political Power

We develop a one-period model in which teachers currently employed in a school district negotiate with district administrators over working conditions and the salary schedule. After the contract is negotiated, the district may hire additional teachers whose salary is determined by the new contract. We refer to teachers employed in the district before negotiations as current teachers and denote the number of these teachers per pupil by m. We let n denote the total number of teachers per pupil employed in the district after the contract is negotiated, thus n-m is the number of new teachers per pupil.

In a typical contract, a teacher's salary is a function of his or her experience and education. A teacher's education tends to increase with experience, as teachers accumulate educational units over time. To simplify, we assume salary is a linear function of just one factor, which we refer to as experience. This function is $b + \pi e$, where b is the base salary for new teachers, e is years of experience, and π is the salary premium per year of experience. The per pupil cost of teacher compensation is thus $bn + E\pi$, where E is the total years of experience for all teachers in the district divided by the number of pupils.

The district's budget constraint is

$$x + bn + E\pi = y , \tag{1}$$

where x is per pupil expenditures on goods and services other than teacher compensation and y is revenue per pupil. Experience per pupil, E, is the price of the experience premium.

We assume throughout that revenue per pupil, y, is exogenous to the district. This assumption reflects the reality of California's school finance system, in which the state determines each district's revenue, and districts then bargain with their unions given that revenue. In that context, the political power of the union is focused on allocating that revenue among competing demands. In states where local school districts may raise their own tax revenue by raising local taxes, the union may also use its political power to encourage local voters to support tax increases. Courant, Gramlich, and Rubinfeld (1979) analyze this process.

Models of collective bargaining employ one of two general approaches (Farber, 1986). In one approach, employers and unions bargain over wages, and the employer then chooses the level of employment. In the second approach, employers and unions bargain over both wages and employment. The second approach yields an efficient contract, one in which the utility of employees can not be increased without decreasing the utility of their employer. The first approach does not generally yield an efficient contract. In the case of California school districts and their teachers' unions, bargaining occurs over both the salary schedule and maximum class sizes. Maximum class sizes determine the minimum number of teachers, and in that sense districts and teachers negotiate over both salaries and employment. In what follows, we assume that districts and unions bargain directly over the salary schedule (b and π) and employment (n). Because of the budget constraint, bargaining over salary schedules and employment also means that districts and unions are implicitly bargaining over the level of expenditures on goods and services other than teachers' salaries (x).

The union represents the interests of current teachers. These teachers are concerned about working conditions, so they prefer a higher teacher-pupil ratio and higher non-teacher expenditures. They also prefer higher salaries, which translates into a preference for a higher base salary and a higher experience premium. Current teachers may differ on the marginal value of the experience premium, however. Relative to teachers with many years of experience, young teachers may be more willing to trade improved working conditions for a decrease in the experience premium.

To represent their interests in collective bargaining, teachers choose a negotiator, who then evaluates options at the bargaining table. Choosing a negotiator is essentially choosing a utility function to evaluate bargaining options. In general, this is a complicated issue, but we simplify it with the following assumption: For a teacher with e years of experience, utility is $f(x,n)+b+\pi e$. That is, the utility a teacher derives from a contract is his or her salary under that contract ($b+\pi e$) plus a value for working conditions under the contract ($f(x,n)$). The utility of the salary schedule is separable from the utility of working conditions. Furthermore, the utility of working conditions is the same for everyone, and the utility of the salary schedule depends only on experience. More experienced teachers place a higher marginal value on the experience premium.

Under that assumption, the choice of a union negotiator comes down to the choice of the experience level to represent the preferences of union members. Suppose there are two candidates for negotiator, each proposing to use a different experience level to evaluate bargaining options. All teachers with more experience than the higher of the two levels will prefer the candidate proposing the higher level. On the other hand, all teachers with less experience than the lower of the two proposed levels will prefer the candidate proposing the

lower level. Consequently, in an election to be union negotiator, a candidate proposing the median experience level will defeat a candidate proposing any other level. We assume, therefore, that the utility function of the negotiator for the teachers' union is

$$U^t(x,n,b,\pi,\widetilde{e}) = f(x,n) + b + \pi\widetilde{e} , \qquad (2)$$

where $\widetilde{e}$ is the median experience of current teachers.

The school district's representative at the negotiating tables is ultimately responsible to the elected school board, which gives the union another avenue to affect collective bargaining outcomes. As Freeman (1986) puts it, "public sector employees help elect both the executive and legislative branches of government and thus play a role in determining the agenda for those facing them at the bargaining table." In this particular case, we assume that the district negotiator represents two fundamental interests: the district's homeowners and its teachers' union. In many respects, the interests of homeowners are congruent with the interests of the teachers' union. Everything else equal, homeowners prefer that their schools have higher non-teacher expenditures, higher teacher-pupil ratios, and better new teachers, all factors that improve school quality and enhance home values. We assume that all homeowners have the same utility, which we denote by $u(x,n,q)$, where q is the quality of new teachers the district is able to attract.

Because higher salaries help to attract a better pool of applicants for open positions (Loeb and Page, 2000), the preference of homeowners for higher quality teachers translates into a preference for higher starting salaries and higher experience premiums. We let w denote the salary that a teacher could earn in alternative employment, and we assume that the quality of new teachers a district can attract is positively related to its working conditions and salaries and

negatively related to this alternative salary. We denote this relationship by the function $q(x, n, b, \pi, w)$. The utility of homeowners is therefore

$$U^h(x, n, b, \pi, w) = u(x, n, q(x, n, b, \pi, w)). \qquad (3)$$

In representing the school board, the district negotiator must balance the interests of homeowners and the teachers' union. To capture this balancing act, we assume that the district negotiator evaluates bargaining outcomes by the utility function

$$U^d = \lambda U^t + (1 - \lambda)U^h, \qquad (4)$$

where λ reflects the relative power of the teachers' union in school board politics.

Collective bargaining is assumed to be efficient, which implies that the bargaining outcome can be represented as the choice of x, n, b, and π to maximize a weighted sum of U^d and U^t. Suppose that the two utility functions have equal weight in this sum. Then the weighted sum can be represented in terms of the fundamental interests of homeowners and the union as

$$U = (1 + \lambda)U^t + (1 - \lambda)U^h. \qquad (5)$$

The contract that emerges from collective bargaining maximizes U subject to the budget constraint in (1). In what follows, we first explore the comparative statics of this maximization problem assuming that λ is fixed. We then turn to the determination of λ.

The problem of maximizing U subject to the budget constraint in (1) is similar to the maximization problem in the standard theory of consumer demand. The main difference is that the budget constraint in the present case is non-linear because collective bargaining determines both salary and employment. This non-linearity makes some comparative statics results different than in the standard theory of consumer demand. These results are derived in the appendix.

Our main interest is in how the power of the union affects bargaining outcomes. If the union is stronger in one district than another, how do we expect bargaining outcomes to differ between the two districts? For our empirical work, what bargaining outcomes can we focus on as indicators of the relative power of a district's teachers' union? Our model has four outcomes, and we have argued that the utilities of both teachers and homeowners are increasing in all four. As a consequence, our model has no absolute indicators of union power, no outcome for which one party will always prefer a higher level and the other will always prefer a lower level, no matter what tradeoffs exist. In our model, indicators of union power come down to the relative value the two parties place on the four outcomes. Are certain outcomes less valuable to homeowners than to teachers?

We argue that the experience premium is such an outcome. To put our argument in its simplest terms, consider two salary schedules, each with the same ability to attract high quality teachers to the district. One schedule has a high base salary and a low experience premium; the other has a low base and a high premium. The schedule with the high premium directs more district resources to teachers who are already in the district and unlikely to leave it. It creates a rent for those teachers. As a consequence, current teachers are likely to favor that schedule. For the same reason, homeowners are likely to favor the schedule with the lower premium.

This simple characterization of the issue ignores two other possibilities. First, experienced teachers may be more effective than inexperienced teachers and thus command a premium. Lankford and Wyckoff (1997) and Ballou and Podgursky (2002) consider that argument, but reject it on empirical grounds. Teachers with three or four years of experience are more effective than new teachers, but experience beyond that point seems to add little to their

effectiveness. Consistent with that finding, most teachers' contracts put a limit on the credit a teacher receives for years of teaching experience in another school district.

A second rationale for an experience premium is turnover costs. School districts train new teachers, and it is therefore costly to lose them. By offering a contract in which salary is less than a teacher's true value in the first few years of employment but greater than the value in subsequent years, the district tends to screen out teachers who are likely to move within a few years. Ballou and Podgursky (2002) also consider this rationale for an experience premium, but they conclude that the turnover costs in teaching are not large enough to justify observed experience premiums.

This conclusion suggests a useful way to think about how homeowners and teachers are likely to view the tradeoffs between the base salary and the experience premium. If the base salary is high and the experience premium is low, turnover costs will be relatively high. An increase in the premium accompanied by a decrease in the base will reduce turnover costs in the future, but it will also increase the salary of experienced teachers who are unlikely to leave. Thus, to homeowners, a rent to current teachers is the cost of reducing future turnover. Current teachers will not see this rent as a cost, however. Thus, homeowners and teachers are likely to see very different tradeoffs between the experience premium and other contract outcomes. For a given increase in the experience premium, teachers will be willing to sacrifice a larger decrease in, say, non-teacher expenditures than homeowners are willing to sacrifice. As a consequence, the experience premium that is actually negotiated reflects the power of the teachers' union. Consistent with that argument, Ballou and Podgursky (2002) examine salary schedules in 165 large school districts in 1989-90 and find that the experience premium is larger in unionized districts.

In our model, the relative importance the union attaches to the salary premium is captured in the following assumption:

$$\frac{U_\pi^t}{U_x^t} > \frac{U_\pi^h}{U_x^h}, \ \frac{U_\pi^t}{U_n^t} > \frac{U_\pi^h}{U_n^h}, \text{ and } \frac{U_\pi^t}{U_b^t} > \frac{U_\pi^h}{U_b^h}, \tag{6}$$

where the subscripts represent partial derivatives. With that assumption and the assumption that the experience premium is a substitute for all other bargaining outcomes, we can show that

$$\frac{\partial \pi}{\partial \lambda} \geq 0. \tag{7}$$

That is, an increase in the power of the teachers' union increases the experience premium. The proof of this proposition is given in the appendix.

According to the comparative statics of our model, the experience premium is also a function of two other important variables. The first is years of teacher experience per pupil, E, which is the price of the experience premium. If the experience premium is a normal good, an increase in that price decreases the experience premium, that is,

$$\frac{\partial \pi}{\partial E} \leq 0. \tag{8}$$

On the other hand, an increase in the median experience of teachers, $\tilde{e}$, increases the marginal value that teachers place on the experience premium, which increases the premium. As shown in the appendix,

$$\frac{\partial \pi}{\partial \tilde{e}} \geq 0. \tag{9}$$

As a district's teaching staff matures, the increase in median experience will be accompanied by an increase in average experience, yielding offsetting effects on the experience premium. In a panel of school districts, Babcock and Engberg (1999) found that median experience is associated with higher premiums, suggesting that the second effect dominates. In our empirical

analysis, we include both median experience and teacher experience per pupil in an attempt to sort out the relative magnitudes of those offsetting effects.

A Model of the Union's Political Power

We have represented the utility of the district negotiator as a convex combination of the utilities of homeowners and the teachers' union. This representation embodies Freeman's point that, through the political process, public sector unions can influence the agenda of those facing them across the bargaining table. In fact, public sector unions do engage in a wide variety of political activities. Using survey data from unions of police officers and fire fighters, O'Brien (1992, 1994, 1996) documents these activities and shows that their intensity is positively correlated with collective bargaining outcomes favorable to union members. The most common political activities of these unions are candidate endorsements, lobbying of office holders, financial contributions to candidates for public office, publicity campaigns designed to increase public support for police officers and fire fighters, and direct involvement of union members in political campaigns.

Teachers' unions also endorse candidates for school board, contribute to the political campaigns of school board members, and work directly in support of their candidates for school board. For example, the United Teachers of Los Angeles contributed over $300,000 to three candidates it endorsed in the March 2003 primary election for four open seats on the governing board of the Los Angeles Unified School District (Pierson, 2003). In a runoff election, the union again contributed over $300,000 to its preferred candidate (Moore, 2003). The three candidates endorsed by the union were elected to the school board.

Presumably, these political activities are effective because information about candidates is costly to obtain and because voters have little incentive to be well informed. Information is

costly because it is difficult to distill into a few simple statements all the policies a school board is likely to consider. Voters have little incentive to be well informed because it is extremely unlikely that any one voter will cast a decisive vote. In such an environment, simple publicity can make a difference. An electoral campaign can also inform voters of a candidate's position, persuade them of the virtues of that position, and encourage likely supporters to vote.

In the case of school board elections, electoral campaigns can be especially effective. As we have argued, homeowners have a real stake in the quality of local public schools. A third of American households are renters, however, and renters have a lower stake in the quality of local public schools than do homeowners. Renters with children enrolled in those schools have a direct interest, but if the quality of local public schools declines they can move to another school district without the financial penalty that homeowners face. Furthermore, many renters do not have children in school and thus have very little knowledge or interest in those schools. Yet, renters can vote in local elections and are therefore a source of potential political support for candidates in school board elections. A candidate who can attract the support of these voters enhances his or her chances of election. Attracting this support is costly, however, which provides an avenue for unions and homeowners to influence election outcomes through campaign contributions and other means of supporting their preferred candidates.

We are not aware of any evidence of the effect of campaign contributions and other political activities on the outcomes of school board elections. However, there has been research on the effect of campaign contributions on elections to the U. S. House of Representatives. Levitt (1994) summarizes that research and reports estimates derived from elections where the same two candidates face each other in subsequent elections, an approach that eliminates bias from unmeasured attributes of candidates and districts. He finds that campaign contributions

have a small effect on election outcomes, although his approach does not account for the possibility that the contributions to one candidate may affect the contributions to other candidates. The model we develop incorporates those interactions.

In our model, we assume that both the teachers' union and homeowners can apply effort in support of their candidates for school board. To be specific, we refer to this effort as campaign contributions, although we envision a broader array of political activities than contributions. The more a union contributes to the candidates it supports, the more effective are the campaigns of those candidates, the larger is the vote in favor of those candidates, thus the larger is the political power of the union. Homeowners have the same possibilities to influence electoral outcomes; the more homeowners contribute, the less is the political power of the union.

Because renters are the best potential source of additional political support, we measure campaign contributions relative to the number of renters. Specifically, let c^t denote the union's contributions per renter, let c^h denote homeowners' contributions per renter, and let θ denote the percentage of eligible voters who are homeowners. Then the political power of the teachers' union is

$$\lambda = L(\theta, c^t, c^h) , \tag{10}$$

where $L_\theta < 0$, $L_{c^t} > 0$, and $L_{c^h} < 0$. This formulation assumes that the percentage of homeowners has a direct effect ($L_\theta < 0$) on election outcomes independent of the effect of homeowners' contributions. This direct effect represents the influence homeowners have through their votes in school board elections.

The campaign contributions of teachers and homeowners are determined in part by the utility from collective bargaining that each can expect for a given λ. Let $V^t(\lambda)$ be that utility for

teachers, and let $V^h(\lambda)$ be that utility for homeowners. These are indirect utility functions, the utility resulting from maximizing U subject to the district's budget constraint. The indirect utility of teachers is increasing in λ, and the indirect utility of homeowners is decreasing in λ.

From the perspective of the teachers' union, the marginal value of contributions depends on its indirect utility function, and it also depends on the contributions of homeowners. Similarly, the marginal value of homeowner's contributions depends in part on the contributions of the teachers' union. We assume the outcome is a Nash equilibrium in which each party's contributions are optimal given the contributions of the other party.

Campaign contributions are a public good in that all supporters of a particular candidate benefit from the contributions of any one supporter of that candidate. For homeowners, these contributions are voluntary, and thus each homeowner has an incentive to free-ride on the contributions of others. Warr (1983) and Bergstrom, Blume, and Varian (1986) have developed a model of voluntary contributions to a public good, which we apply to the campaign contributions of homeowners. In the model, each individual makes contributions taking the contributions of others as given. Under those assumptions, the price to an individual homeowner of increasing contributions by one dollar per renter is equal to the number of renters. Let Z denote the total number of eligible voters in the district. Then, $(1-\theta)Z$ is the number of eligible voters who are renters, and $p^h = (1-\theta)Z$ is the homeowners' price of contributions per renter. Now consider homeowner i. Let c_i^h denote his or her contribution per renter, and let c_{-i}^h denote the contributions per renter of all other homeowners. Homeowner i chooses c_i^h to maximize

$$V^h\left(L(\theta, c^t, c_i^h + c_{-i}^h)\right) - p^h c_i^h . \tag{11}$$

The first order condition for this maximization problem is

$$\frac{dV^h(\lambda)}{d\lambda}\frac{\partial L(\theta,c^t,c^h)}{\partial c^h}-p^h=0. \tag{12}$$

Assuming sufficient second order conditions hold, (12) implicitly defines the contributions per renter of all homeowners as a function of the price of those contributions, the percentage of homeowners, and the contributions per renter of the union. Because this function gives homeowners' contributions as a function of union contributions, we refer to it as a reaction function, denoted by $R^h(\theta,c^t,p^h)$.

The sufficient second order conditions yield clear comparative statics results. An increase in the price of contributions per renter decreases contributions per renter, that is,

$$\frac{\partial R^h}{\partial p^h}<0. \tag{13}$$

For teachers, contributions are not voluntary. The union determines a fee for all union members, which funds campaign contributions. The fee is $\frac{(1-\theta)Zc^t}{\tau Z}=\frac{1-\theta}{\tau}c^t$, where τ is the ratio of current teachers to eligible voters. The price of contributions per renter is therefore $p^t=\frac{1-\theta}{\tau}$. We assume that the union chooses its contributions by majority rule. Thus, the contributions maximize the utility of the teacher with median experience, who we assume to be the district representative in collective bargaining. That is, campaign contributions maximize

$$V^t\big(L(\theta,c^t,c^h)\big)-p^tc^t. \tag{14}$$

The first order condition for this maximization problem is

$$\frac{dV^t(\lambda)}{d\lambda}\frac{\partial L(\theta,c^t,c^h)}{\partial c^t}-p^t=0. \tag{15}$$

Assuming the sufficient second order conditions hold, the first order conditions define the contributions of the teachers' union as a function the percentage of homeowners, the price of

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contributions, and the contributions of homeowners. Let $R^t(\theta, c^h, p^t)$ denote this reaction function.

A Nash equilibrium is obtained when contributions from homeowners and the union satisfy the following two equalities:

$$c^t = R^t(\theta, c^h, p^t) \tag{16}$$

$$c^h = R^h(\theta, c^t, p^h)$$

The comparative statics of this equilibrium require us to make some assumptions about the stability of equilibrium. In particular, we assume that

$$\frac{\partial R^t}{\partial c^h} < -\frac{\partial L}{\partial c^h} \Big/ \frac{\partial L}{\partial c^t} \quad \text{and} \quad \frac{\partial R^h}{\partial c^t} < -\frac{\partial L}{\partial c^t} \Big/ \frac{\partial L}{\partial c^h} \tag{17}$$

The first condition implies a stable reaction from the union to a change in the contributions of homeowners. For example, if homeowners increase contributions, the union may respond by increasing its own contributions. Condition (17) requires that the union response is not so large that it overwhelms the homeowners' initial increase. In other words, the net effect of the homeowners' initial increase and the union's response is a decrease in union power. The second condition requires an analogous stability condition for the homeowners' reaction function.

The key results from our public choice model concern the effect on union power of changes in the price of contributions. First, an increase in the price of contributions for homeowners will increase the political power of the union, that is,

$$\frac{\partial \lambda}{\partial p^h} > 0. \tag{18}$$

The mathematics are outlined in the appendix, but the intuition is straightforward. Holding union contributions constant, an increase in the price of contributing for homeowners decreases homeowners' contributions. The union may react by decreasing its own contributions, which

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may stimulate a further decrease in homeowners' contributions and so on. However, these actions and reactions will only dampen the initial effect; they will not reverse it. As a result, an increase in the price of homeowners' contributions increases the political power of the union. Analogously, an increase in the price of contributions for the union decreases its political power,

$$\frac{\partial \lambda}{\partial p^t} < 0. \tag{19}$$

These two results lead to our main result. Consider an increase in the number of eligible voters holding constant the percentage of voters who are homeowners and the ratio of teachers to eligible voters. The increase in eligible voters increases the price of contributions for homeowners but does not change that price for the union. Thus, the political power of the union rises, that is,

$$\frac{\partial \lambda}{\partial Z} = \frac{\partial \lambda}{\partial p^t} \frac{\partial p^t}{\partial Z} + \frac{\partial \lambda}{\partial p^h} \frac{\partial p^h}{\partial Z} > 0. \tag{20}$$

Putting this result together with equation (7),

$$\frac{\partial \pi}{\partial Z} = \frac{\partial \pi}{\partial \lambda} \frac{\partial \lambda}{\partial Z} \geq 0, \tag{21}$$

an increase in eligible voters increases the political power of the union which increases the experience premium for teachers. This result forms the basis of our hypothesis test in the next section.

Our model yields one other testable hypothesis. An increase in the ratio of teachers to the voting population decreases the price of contributions for teachers but does not change the price of contributions for homeowners. Thus an increase in the ratio of teachers to eligible voters increases the political power of the union and thus increases the experience premium. That is,

$$\frac{\partial \pi}{\partial \tau} = \frac{\partial \pi}{\partial \lambda} \frac{\partial \lambda}{\partial p^t} \frac{\partial p^t}{\partial \tau} \geq 0. \tag{22}$$

Our model does not yield a testable hypothesis concerning the percentage of homeowners. An increase in that percentage has the direct effect of decreasing the political power of the union. However, it also has indirect effects because it decreases the price of contributions for both the union and homeowners.

Our model of political power is simple, but we believe it captures an important point. It is costly for individuals to make their interests represented in the political process. Furthermore, for a class of citizens with a common interest, such as the homeowners in a school district, political representation is a classic public goods problem that is exacerbated by the size of the political entity. The model of voluntary contributions employed above portrays this problem in its starkest form. When making campaign contributions, each homeowner takes the contributions of all other homeowners as given. In that sense, there is no cooperation among homeowners, despite their common interest.

In experiments concerning voluntary contributions to a public good, subjects typically contribute more than predicted by this model of voluntary contributions (Ledyard, 1995). Also, Brunner and Sonstelie (2003) find that contributions per pupil to California schools do fall with school size, but not as rapidly as predicted by the pure model of voluntary contributions. Thus, our model may overstate the free-rider problem in political representation. Nevertheless, the empirical analysis of Oliver (2000) supports the general idea that participation of individual citizens in the political process declines as the population of the political entity increases. In contrast, because a teachers' union has the power to tax its members, its resources grow proportionally to district size. Thus, we expect teachers' union to be relatively more powerful in large school districts as predicted by our model.

3. Empirical Results

To test the hypotheses from our collective bargaining model, we use data from California school districts in 1999-2000. In that year, California had 982 districts enrolling nearly six million students. According to the California Public Employment Relations Board, teachers in 886 of those districts were represented by a union. Of those 886 districts, 771 reported their salary schedules to the California Department of Education. These 771 districts constitute our sample. The districts excluded from our sample are primarily small in size, enrolling fewer than four percent of California students.

We use data from our sample to estimate three regressions, each regression corresponding to one of the choice variables in our model of collective bargaining. The dependent variables in these regressions are the district's experience premium for teachers, π, the district's base salary for new teachers, b, and the district's teacher-pupil ratio, n. The base salary and the experience premium derive from the salary schedules of school districts. Generally, salary schedules are a grid in which each column represents a different education level and each row, referred to as a step, represents the years of experience the teacher has within the district, i.e., teachers at step one are in their first year in the district. The education levels refer to the teacher's highest degree plus the number of academic semester units earned beyond that degree. Thus, each cell in the grid corresponds to the salary for the given combination of experience and education.

Districts vary in the number of columns in their schedules. At one extreme, some districts have only one column and give no extra salary for additional education. However, many districts have columns for 30, 45, 60, and 75 units beyond a bachelor's degree (BA). Nearly half of the school districts in our sample have 75 units as their final column; another 10

Table 1
Abbreviated Salary Schedule of District Averages, 1999-2000

	Education Level (Units Beyond a BA)			District Max Less Column 30
	30	60	District Maximum	
Step 1	31,913	33,904	34,844	2,932
Step 11	42,975	48,009	49,508	6,533
Step 21	44,677	52,571	55,379	10,702
Step 21 less step 1	12,765	18,666	20,534	

percent have a column for teachers with 90 units beyond a BA. About one-quarter of the districts stop short of that, with a highest column of 60 units. A much smaller share, 10 percent, stop at 45 units. Some districts award higher salaries for the completion of a master's degree, but we exclude such awards from our analysis.

Table 1 shows average salaries for districts in our sample. These salaries are reported for three experience levels and three education levels. The final column in Table 1 shows the average salaries for each district's highest column that does not require a master's degree.

We measure a district's base salary as the salary of a teacher at step one with a bachelor's degree and 30 units of additional coursework. This education level is typical of fully credentialed teachers just entering the workforce. In 1999-00, districts offered an average base salary of $31,913.

Several measures of an experience premium are possible. The primary measure we use is the difference between the base salary and the salary of a teacher with 20 years of experience (a teacher at step 21) at the highest column in the district. This 20-year salary averaged $55,379, for a total gain of $23,466. We divide this gain by 20 to yield an average annual experience premium. In 1999-2000, the annual experience premium averaged $1,173. This 20-year premium smoothes out some nonlinearities in the salary schedule. For example, the returns to

education and experience taper off as experience and education rise. If teachers acquire 60 units of education after 10 years of experience, their salaries increase by \$17,000, nearly two-thirds of the total increase over the 20-year span. However, the 10-year premium is highly correlated with the 20-year premium (ρ=0.7). When we estimate our model with the 10-year premium, the results are similar to the results using the 20-year premium.

Our 20-year experience premium corresponds to the path a typical teacher would take over their career as they move south-east through their salary schedule. This premium grows both because of work experience and education. In that sense, our premium has two components. Holding education constant at a BA plus 60 units, teachers who move from step one to step 21 gain an average of \$18,666 over 20 years, or about \$933 per year. On the other hand, teachers who move from the first to the last column while remaining at step 11 increase their salary by an average of \$6,533. In our empirical analysis, we estimate the effect of our regressors on the two components of the experience premium as well as on the premium itself.

We use a common set of independent variables in each of the three regressions. These independent variables can be partitioned into three categories – variables hypothesized to affect the power of the union in collective bargaining, variables hypothesized to affect the marginal value of various outcomes, and variables determining the district's budget constraint. Table 2 provides summary statistics for the variables in our regressions.

Table 2
Summary Statistics
(Number of Observations = 771)

	Mean	Standard Deviation	Minimum	Maximum
Dependent variables				
Experience premium ($1,000)	1.173	0.205	0.166	1.839
Base teacher's salary ($1,000)	31.913	2.920	20.500	41.835
Teacher-pupil ratio in grades K-12	0.051	0.008	0.034	0.115
Independent variables				
Eligible voters (thousands)	39.366	130.070	0.162	3,229.570
Teachers per eligible voter	0.011	0.007	0.002	0.125
Percentage of homeowners	0.651	0.123	0.193	0.957
Regional salary ($1,000)	47.199	4.323	40.875	56.689
Median teacher experience (years)	7.553	3.260	1.000	26.000
Teacher experience per pupil (years)	0.520	0.147	0.193	1.290
Unrestricted revenue per pupil ($1,000)	4.629	1.083	3.362	16.137
Restricted revenue per pupil ($1,000)	1.638	0.613	0.642	7.486
Elementary school district (0-1 variable)	0.502	0.500	0.000	1.000
High School district (0-1 variable)	0.101	0.302	0.000	1.000

Our collective bargaining model suggests three variables that are related to union power. First, our model predicts that the political power of the teachers' union is positively related to the number of eligible voters in the school district. We measure the number of eligible voters as the number of people who are 18 years or older in the 2000 Census. On average, California school districts had nearly 40,000 eligible voters.

Second, our theory suggests that an increase in the ratio of teachers to eligible voters should increase the political power of the union. The number of teachers comes from the California Basic Educational Data System (CBEDS) maintained by the California Department of Education.

Third, our theory predicts potentially offsetting effects of the percentage of homeowners on union power. To estimate the overall effect, our regressions include the percentage of households in a school district that own their homes. On average, 65 percent of households owned their homes. Data on this variable come from the 2000 Census.

Two independent variables hypothesized to affect the marginal value of the outcomes are the salary that a teacher could earn in alternative employment and the median level of teacher experience in the district. Because school districts must compete with other employers to attract employees, districts in regions with high non-teacher salaries would typically offer higher teacher salaries as well. As a measure of the alternative salary teachers could earn, we use a regional salary based on the Occupational Employment Statistics (OES) survey conducted by the California Employment Development Department. This survey collected employment levels and mean annual salaries in more than 700 occupations for a sample of 113,000 California establishments between 1999 and 2001. The OES reports data for 25 Metropolitan Statistical Areas (MSA) and five additional regions that cover the 24 counties not in a MSA. On average, each region contained 14 districts within its boundaries. Eleven regions had between two and six districts. The Los Angeles-Long Beach region contained 71 school districts. For each region, we calculate the regional salary as the weighted average of mean salaries in non-teaching occupations that require a bachelor's degree. The weight for each occupation's mean salary is the proportion of workers statewide in that occupation. On average, districts faced a regional salary of $47,199.

In our model, the median experience of teachers acts to increase the marginal value the union associates with an increase in the experience premium. District data on teacher experience come from CBEDS. In 1999-2000, the median experience level of teachers was 7.6 years.

A closely related variable included in our regressions is the total years of teacher experience per pupil (ρ=0.7). This variable is the price of the experience premium in the district's budget constraint. Data on teacher experience and student enrollment come from CBEDS.

A school district's budget constraint is also determined by its revenue. We focus on the general fund, which includes all revenue used to finance instructional activities. Excluded are capital, deferred maintenance, and cafeteria funds, which together account for less than 20 percent of total revenue. In 1999-2000, school districts averaged $6,268 of general fund revenue per pupil. A school district's general fund receives two main types of revenue: unrestricted and restricted. Unrestricted revenue can be spent on any legitimate expense and comprised 74 percent of all general fund revenue. Restricted revenue, such as state and federal categorical programs, provided the remaining 26 percent. These funds generally target certain student populations, such as special education students, or certain functions, such as pupil transportation. Each type of revenue, measured in per-pupil terms, is an independent variable in our model. These data come from the School District Revenue and Expenditure Report (J-200) maintained by the California Department of Education.

Our regressions include two more independent variables that capture an important institutional distinction among California school districts. Approximately 70 percent of California's public school students are enrolled in unified school districts, which include all grades from kindergarten through twelfth grade. Unified districts account for about half of the districts in the state. The remainder are either elementary school districts or high school districts. An elementary district generally includes kindergarten through eighth grade, and a high school district generally includes ninth through twelfth grades. Because costs in these three types of

districts may differ, the relationship between revenue and our dependent variables may also differ among them. Accordingly, we include two dummy variables indicating whether a district is either an elementary school district or a high school district.

In estimating the three models, variables are measured in natural logarithms so that coefficients are elasticities. The only exceptions are the dichotomous variables and variables measured in percentages, specifically, the dichotomous variables for elementary and high school districts, the ratio of teachers to eligible voters, and the percentage of homeowners. Our econometric model accounts for the fact that regional salary has the same value for all districts in the same region. As Moulton (1990) shows, correlation among the error terms of observations in a group, such as a region, may bias the standard errors of variables that are constant across observations in a group. To correct for this bias, we assume that the error terms have a region-specific component and compute standard errors that account for this error specification.

Table 3 presents parameter estimates for the three regressions. The first column reports estimates for the regression in which the 20-year experience premium is the dependent variable, the second column for the base salary as the dependent variable, and the third column for the teacher-pupil ratio. The standard errors for each estimate are listed in parentheses.

Table 3
Coefficient Estimates

	Dependent Variable		
	Experience Premium	Base Salary	Teacher-Pupil Ratio
Eligible voters	0.041 **	0.029 **	-0.019 **
	(0.008)	(0.004)	(0.003)
Teachers per eligible voter	2.269 **	2.612 **	-0.134
	(0.988)	(0.444)	(1.029)
Percentage of homeowners	-0.122 **	-0.041	0.048 **
	(0.061)	(0.028)	(0.024)
Regional salary	0.459 **	0.271 **	-0.139 *
	(0.116)	(0.068)	(0.070)
Median teacher experience	0.059 **	0.018 *	-0.132 **
	(0.025)	(0.009)	(0.013)
Teacher experience per pupil	-0.088 *	-0.067 **	0.269 **
	(0.050)	(0.020)	(0.028)
Unrestricted revenue per pupil	0.128 **	0.018	0.284 **
	(0.058)	(0.034)	(0.043)
Restricted revenue per pupil	-0.049	-0.021 *	0.078 **
	(0.034)	(0.011)	(0.020)
Elementary school district dummy	0.065 **	0.018 **	0.026 **
	(0.024)	(0.007)	(0.009)
High school district dummy	0.036	0.001	-0.105 **
	(0.024)	(0.012)	(0.019)
Constant	-2.057 **	2.232 **	-2.458 **
	(0.459)	(0.238)	(0.273)
R-squared	0.222	0.438	0.741

Notes: ** denotes significance at the five percent level; * denotes significance at the 10 percent level. Standard errors are in the parentheses. There are 771 observations in the regressions.

Our main hypothesis is that the experience premium increases with number of eligible voters in the district. Table 3 shows that the data corroborate this hypothesis. In the regression for the experience premium, the coefficient on eligible voters is positive and more than five times its standard error. Our interpretation is that larger districts have more powerful unions and that these unions use their power to increase the experience premium. While the effect on the

experience premium is only one indicator of the union's overall power, it is informative to examine the magnitude of the coefficient. The coefficient implies that the ten largest districts in our sample, which average 400,000 eligible voters (excluding Los Angeles with over 3.2 million eligible voters), would have an experience premium about ten percent higher than the average district in our sample with 40,000 eligible voters. If the average district had the average premium of $1,173, the larger districts would have a premium of $1,289. For a teacher with twenty years of experience, the predicted difference in annual salary would be $2,317.

The experience premium has two components: the direct effect of experience on salary holding education constant and the indirect effect of experience on education as teachers acquire more educational units throughout their career. We have estimated the effect of our set of regressors on each of these two components. For the first component, we take the annual gain in salary moving from step one to step 21 holding education constant at a BA plus 60 units. For the second, we take gains in salary due strictly from moving from the lowest to the highest column in the district holding experience constant at step 11. For the experience component, the coefficient on eligible voters is almost twice as large as the coefficient for the premium itself. The coefficient is also statistically significant. In contrast, there is no significant relationship between eligible voters and the education component.

Union power, as measured by the number of eligible voters, also has a positive and significant effect on the base salary, as seen in column 2 of Table 3. According to our estimates, the base salary of a district with 400,000 students would be about seven percent higher than the base salary of a district with 40,000 students. The higher base salary and experience premium in larger districts comes at the expense of the number of teachers. The teacher-pupil ratio is negatively related to the size of the district.

To check whether our models effectively capture the relationship between each dependent variable and the size of the school district, we plotted the residuals of each regression against log of eligible voters. The plots suggest that our measure of district size does not exclude any important nonlinear effects.

Our theoretical model has two other variables hypothesized to affect union power. The model predicts that the ratio of teachers to eligible voters is positively related to union power. As predicted, the coefficient on this ratio is positive and significant in the regression for the experience premium. It is also positive and significant in the regression for the base salary.

The percentage of homeowners also affects union power, although the model does not yield a clear prediction about the sign of this effect. An increase in the percentage of homeowners directly diminishes union power. However, the increase in homeowners also reduces the price of contributions for both homeowners and the teachers' union. A reduction in the homeowners' price reduces union power, but a reduction in the union's price increases union power. Table 3 reveals that the experience premium is negatively related to the percentage of homeowners in a district, suggesting that homeownership dilutes the relative power of the teachers' union.

Table 3 shows that school districts react to higher regional salaries by increasing their experience premium and base salary, but also by possibly lowering their teacher-pupil ratio. The table also indicates that the experience premium is positively related to the median years of teacher experience, which reflects the increased marginal value of the premium to unions with more experienced members.

The positive coefficient on unrestricted revenue suggests that the experience premium is a normal good. This normality implies that the experience premium should decrease in response

to an increase in its price. Consistent with this expectation, the estimated coefficient on the total years of teacher experience per pupil, the price of the premium, is negative although only significant at the 10 percent level. Taken together with the positive effect of median teacher experience, however, equal percentage increases in the experience variables would largely offset each other.

The results from the three baseline regressions support our main theoretical predictions. To test the robustness of our results, we explore three alternate specifications. First, we examine whether economies of scale explain the effects of district size. Second, we account for potential endogeneity in the experience regressors using instrumental variables. Third, we expand our model to include additional factors hypothesized to affect union power.

Economies of Scale

If districts experience economies of scale due to the fixed cost of administration, an increase in district size would have the same effect as an increase in revenue. Larger districts would choose more of all normal goods, including the experience premium. Note, however, that this alternative explanation is not consistent with the regression results. The experience premium and the teacher-pupil ratio are both normal goods in that an increase in unrestricted revenue per pupil increases each good. Yet, an increase in district size decreases the teacher-pupil ratio. Increases in the experience premium due to increases in district size come at the expense of the teacher-pupil ratio, not in companion with increases in the teacher-pupil ratio as would be expected if school districts experienced economies of scale.

A related point centers on economies of scale at the school level. Suppose there is an efficient class size at which the marginal benefit of reducing size equals its marginal cost. In rural areas where population density is low, it may be difficult to attain large enough classes

without transporting students long distances to school. As Kenny (1982) argues, such schools have to balance the economies of larger classes against transportation costs, resulting in class sizes lower than the efficient size and fewer resources available for other purposes. In school districts with many such schools, teacher-pupil ratios would tend to be higher than average and salaries and other expenditures would tend to be lower than average. Because school districts in rural areas also tend to be small in size, the experience premium and the base salary would be positively related to district size and the teacher-pupil ratio would be negatively related to size.

To determine whether school economies of scale may be the cause of the observed relationship between the experience premium and district size, we re-estimate our trio of baseline models, adding a control for the population density of the school district. A district's density is defined as the population residing within its boundaries divided by the square meters of land area within those boundaries. These data are available from the 2000 U.S. Census and enter our model in log form. The second columns of Tables A.1, A.2, and A.3 show the results from adding the population density for the experience premium, base salary, and teacher-pupil ratio models, respectively. For comparison, the first column in each of the tables shows the corresponding baseline estimates from Table 3.

The most important result is that the coefficient on eligible voters is still positive and significant in the experience premium and base salary regressions, and it is still negative and significant in the teacher-pupil ratio regression. Furthermore, in all three regressions, the coefficient on eligible voters is only slightly smaller in magnitude than in its corresponding baseline regression. The coefficient on population density, however, is not significant at the five percent level in any of the three regressions, indicating that school-level economies of scale do not appear to explain the relationship between the experience premium and school district size.

Endogeneity of Teacher Experience

Our empirical models assume that the experience premium is a function of the two experience variables in our model, average teacher experience per pupil and median experience. However, these variables may also be functions of the experience premium. Districts with a high experience premium may induce teachers to stay in the district longer, thus increasing average and median teacher experience in those districts. The possibility of a simultaneous relationship between the experience premium and the two experience measures raises the issues of identification and bias. To resolve both issues, we need variables that are related to the experience measures but not related to the experience premium. We propose that enrollment growth rates in previous years meet both conditions. Past enrollment growth rates affect the number of teachers hired in previous years and thus average and median experience in the current year. However, past enrollment growth rates are unlikely to affect a district's current collective bargaining outcomes. Accordingly, we re-estimate our regressions using two-stage least squares with past growth rates as additional variables in the first-stage regression. We use six five-year growth rates: 1970 to 1975, 1975 to 1980, and so on through 1995 to 2000.

The third columns of Tables A.1-A.3 show the two-stage least squares estimates (2SLS). In the first stage, the regression for average teacher experience per pupil has an F-statistic of 34.8, and the regression for median experience has an F-statistic of 31.3. The coefficients on the enrollment growth rates have the expected signs. The more recent growth rates have a negative effect on the experience variables; the more distant growth rates have a positive effect. In each first stage regression, three of the six growth rates are significant at the 5 percent level. Because our models have more instruments than regressors, they are overidentified. However, a Lagrange multiplier test does not reject the overidentifying restrictions. (The test statistic is the

sample size times the R-squared from a regression of the second-stage residuals on the first stage regressors. See Davidson and MacKinnon, 1993, pg 236.)

Our main theoretical prediction, that union power increases with the number of eligible voters, is supported by the 2SLS estimates. As Table A.1 shows for the experience premium, the coefficient on eligible voters is still positive, significant, and similar in magnitude to the previous model. The experience variables, however, are no longer significant due to the lower precision of the 2SLS estimator.

Additional Factors Hypothesized to Affect Union Power

The public choice model underlying our regressions assumes that political representation is imperfect, thus creating the possibility for interest groups to influence school board elections. Our model focuses on a few specific factors relevant to the influence of a teachers' union. However, other factors may also be relevant. This subsection discusses a number of these factors and reports the results of a regression in which the previous set of models is expanded to include these other factors. We are particularly concerned with factors that may be correlated with the explanatory variables in our baseline model.

The first factor is civic engagement. In communities in which residents are actively engaged in civic affairs, interest groups will be less influential. Putnam (1995) summarizes the empirical research on civic engagement, concluding that education and income are important predictors of engagement. This conclusion is particularly significant for our results because both education and income are correlated with homeownership. As a consequence, in our baseline model, homeownership may be acting as a proxy for civic engagement rather than the role posited for it in our public choice theory. To examine this possibility, we include measures of both education and homeownership in our expanded model. In particular, from the 2000 Census,

we included median family income in the school district and the percentage of the district's population with a bachelor's degree.

Putnam (1995) views civic engagement as nearly synonymous with social capital as described by Coleman (1990). By social capital, Putnam means the "features of social life—networks, norms, and trust—that enable participants to act together more effectively to pursue shared objectives." These features of social life may be more difficult to establish in racially and ethnically heterogeneous communities, and heterogeneity is likely to be correlated with school district size. Accordingly, in our baseline model, district size may be acting as a proxy for the potentially more important factor of racial and ethnic heterogeneity. To examine this possibility, our expanded model includes a measure of homogeneity. The measure is a Herfindahl index based on eight race and ethnicity classifications in the 2000 Census. To calculate a district's index, we first calculate each classification's share of district population, square those shares, and then sum them across all classifications. For a district with just one racial or ethnic group, the resulting index is unity. At the other extreme, for a district in which each group is equally represented, the index is 1/8.

Another factor that may affect the influence of a teachers' union is the political ideology of a school district's voters. Babcock and Engberg (1999) hypothesize that, given the historic ties between the Democratic Party and organized labor, a community's support for its teachers' union is related to the percentage of its voters that register as Democrats. To test that hypothesis, we include the percentage of voters in a school district's county that are registered as Democrats. These data come from the California Secretary of State's office.

The competitiveness of the market for public school quality may also affect union power. In areas with few school districts from which to choose, and therefore little competition for

quality, the relationship between school quality and house values may be relatively weak. This effect diminishes the incentive of homeowners to closely monitor the quality of their local public schools. Hoxby (1996) uses a Herfindahl index to measure the degree of public school competition. Following that example, we also include a Herfindahl index, calculated on a county basis. To calculate a county's index, we first calculate each district's share of its county's school enrollment, square those shares, and then sum them across all districts in the county. CBEDS provides data on district and county enrollment.

A district's competitive position in the market for new teachers might also be related to the characteristics of its students. Academic achievement is strongly related to family income, and a school in a low-income neighborhood is a challenging teaching assignment. Districts with many such schools may find it necessary to offer higher starting salaries to be competitive, thus we control for the percentage of a district's students who participated in the National School Lunch Program. To participate, the income of a student's family must be less than 185 percent of the poverty level. Data on this variable are from CBEDS.

We add these six additional variables to the previous trio of regressions and continue to use two-stage least squares. Median income enters in log form, but the percentages and Herfindahl indices enter in levels. The results are displayed in the final columns of Tables A.1 through A.3. Adding these six variables has little effect on the coefficients of interest.

Most important, the coefficient on eligible voters is still positive and significant in the experience premium regression. Furthermore, none of six additional variables in this regression are significant at a reasonable level. However, the ratio of teachers to voters is no longer significant. In the base salary regression, the coefficient on median household income is significant, and the coefficient on regional salary is no longer significant. This result is not

surprising, because median income and regional salary are positively correlated with a coefficient of 0.7. Finally, Table A.3 suggests that the percentage of a school district's population with a bachelor's degree may have some effect on the teacher-pupil ratio.

5. Conclusions

The economics of a school district is significantly affected by the relative power of its teachers' union in collective bargaining. We hypothesize that this power is positively related to the number of eligible voters in a district, a hypothesis derived from a public goods theory of school board politics. As an empirical indicator of a union's success in collective bargaining, we use the experience premium in the salary schedule for teachers. We find that this premium is positively related to the number of eligible voters, a finding consistent with our hypothesis.

By focusing on the experience premium, we do not intend to imply that this is the only outcome of interest to union members. Work rules, class sizes, and benefits are other important issues. We focused on the experience premium because we believe it is the clearest indicator of union success in diverting district resources to provide rents for union members. Unions that are successful in negotiating high experience premiums are also likely to be successful in negotiating other terms and conditions favorable to union members. Relative to the experience premium, these other terms and conditions may be more important to union members and more costly to the district.

Our theory of district size and union power is relevant to two other important findings in the economics of public schools. First, Hoxby (2000) finds that public school productivity is higher in metropolitan areas in which families have a wide range of school districts from which to choose. She hypothesizes that families in areas with many districts will be better able to

determine the effectiveness of districts in producing school quality and that consequently districts in these areas will be less able to divert rent to schooling producers. Our theory suggests another avenue through which choice among school districts may affect school productivity. Everything else equal, an area with more districts will also have smaller districts on average. Smaller districts have less powerful teachers' unions and thus divert fewer resources to producing rent for union members.

Second, our theory also suggests a different interpretation of the findings of Kenny and Schmidt (1994), who seek to explain the decrease in the number of school districts in the United States between 1950 and 1980. They find that the decrease in the number of school districts in a state is related to the increase in the number of its teachers that belong to the National Education Association teachers' union. In explaining this result, they argue that there is a fixed cost to organizing a union and thus organization will be less costly overall if unions have fewer districts to contend with. Teachers' unions thus lobby for policies to consolidate districts, an effort that will be more successful if many teachers are union members. Reinforcing this factor, teachers' unions are more likely to organize districts in states in which districts tend to be large. In contrast to this focus on the fixed cost of organizing, our theory points to the benefits of organizing a union. If union power increases with district size, as our theory predicts, the benefits of organizing are greater in large school districts, giving unions an incentive to lobby for district consolidation and making union membership more prevalent in states with large districts.

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7. Appendix

Utility Maximization

The Lagrangean function of the utility maximization problem (5) is

$$U + \mu(y - x - bn - E\pi),$$

and the first order conditions are

$$U_x - \mu = 0,$$

$$U_n - \mu b = 0,$$

$$U_b - \mu n = 0,$$

$$U_\pi - \mu E = 0, \text{ and}$$

$$y - x - bn - E\pi = 0.$$

Totally differentiating the first order conditions yields the matrix equation

$$A \begin{bmatrix} dx \\ dn \\ db \\ d\pi \\ d\mu \end{bmatrix} + \begin{bmatrix} 0 & 0 & U_{xw} & U_{x\lambda} & 0 \\ 0 & 0 & U_{nw} & U_{n\lambda} & 0 \\ 0 & 0 & U_{bw} & U_{b\lambda} & 0 \\ 0 & (1+\lambda) & U_{\pi w} & U_{\pi\lambda} & -\mu \\ 1 & 0 & 0 & 0 & -\pi \end{bmatrix} \begin{bmatrix} dy \\ d\tilde{e} \\ dw \\ d\lambda \\ dE \end{bmatrix} = 0 \tag{A1}$$

Following Edlefson (1981),

$$A^{-1} = \begin{bmatrix} N & -\alpha \\ -\alpha' & \delta \end{bmatrix},$$

where the matrix N is symmetric and negative semi-definite, and

$$N = \begin{bmatrix} N_{xx} & N_{xn} & N_{xb} & N_{x\pi} \\ N_{nx} & N_{nn} & N_{nb} & N_{n\pi} \\ N_{bx} & N_{bn} & N_{bb} & N_{b\pi} \\ N_{\pi x} & N_{\pi n} & N_{\pi b} & N_{\pi\pi} \end{bmatrix}, \text{ and } \alpha = \begin{bmatrix} \alpha_x \\ \alpha_n \\ \alpha_b \\ \alpha_\pi \end{bmatrix}.$$

Proof that $\dfrac{\partial \pi}{\partial \lambda} \geq 0$

The matrix N is proportional to the Hicksian substitution effects. In particular, let x^*, n^*, q^*, and π^* be compensated demands. Then,

$$\frac{\partial x^*}{\partial E} = \mu N_{x\pi},$$

$$\frac{\partial n^*}{\partial E} = \mu N_{n\pi},$$

$$\frac{\partial b^*}{\partial E} = \mu N_{b\pi}, \text{ and}$$

$$\frac{\partial \pi^*}{\partial E} = \mu N_{\pi\pi}.$$

From (A1),

$$\frac{\partial \pi}{\partial \lambda} = -(N_{\pi x} U_{x\lambda} + N_{\pi n} U_{n\lambda} + N_{\pi b} U_{b\lambda} + N_{\pi \pi} U_{\pi \lambda}).$$

Because N is symmetric and $U = (1+\lambda)U^t + (1-\lambda)U^h$, this expression can be written as

$$\frac{\partial \pi}{\partial \lambda} = -\mu^{-1}\left[\left(U_x^t - U_x^h\right)\frac{\partial x^*}{\partial E} + (U_n^t - U_n^h)\frac{\partial n^*}{\partial E} + (U_b^t - U_b^h)\frac{\partial b^*}{\partial E} + (U_\pi^t - U_\pi^h)\frac{\partial \pi^*}{\partial E} \right].$$

This expression can be rewritten as

$$\frac{\partial \pi}{\partial \lambda} = \mu^{-1}\left[\frac{\partial U^h *}{\partial E} - \frac{\partial U^t *}{\partial E} \right],$$

where $\dfrac{\partial U^t *}{\partial E}$ is the effect on U^t of a change in E, with income compensated to hold

$(1+\lambda)U^t + (1-\lambda)U^h$ constant. $\dfrac{\partial U^h *}{\partial E}$ is similarly defined. Because U is held constant, there

are two possibilities: either $\dfrac{\partial U^t *}{\partial E} \leq 0$ and $\dfrac{\partial U^h *}{\partial E} \geq 0$ or $\dfrac{\partial U^t *}{\partial E} > 0$ and $\dfrac{\partial U^h *}{\partial E} < 0$.

Suppose the second possibility is true. Then,

$$\left(\frac{U_x^t}{U_\pi^t}\right)\frac{\partial x^*}{\partial E} + \left(\frac{U_n^t}{U_\pi^t}\right)\frac{\partial n^*}{\partial E} + \left(\frac{U_b^t}{U_\pi^t}\right)\frac{\partial b^*}{\partial E} + \frac{\partial \pi^*}{\partial E} > 0$$

and

$$\left(\frac{U_x^h}{U_\pi^h}\right)\frac{\partial x^*}{\partial E} + \left(\frac{U_n^h}{U_\pi^h}\right)\frac{\partial n^*}{\partial E} + \left(\frac{U_b^h}{U_\pi^h}\right)\frac{\partial b^*}{\partial E} + \frac{\partial \pi^*}{\partial E} < 0.$$

Combining the above two equations,

$$\left(\frac{U_x^t}{U_\pi^t} - \frac{U_x^h}{U_\pi^h}\right)\frac{\partial x^*}{\partial E} + \left(\frac{U_n^t}{U_\pi^t} - \frac{U_n^h}{U_\pi^h}\right)\frac{\partial n^*}{\partial E} + \left(\frac{U_b^t}{U_\pi^t} - \frac{U_b^h}{U_\pi^h}\right)\frac{\partial b^*}{\partial E} > 0.$$

On the other hand, if x, n, and b are substitutes for π and if the union values π relatively more than homeowners value it,

$$\left(\frac{U_x^t}{U_\pi^t} - \frac{U_x^h}{U_\pi^h}\right)\frac{\partial x^*}{\partial E} + \left(\frac{U_n^t}{U_\pi^t} - \frac{U_n^h}{U_\pi^h}\right)\frac{\partial n^*}{\partial E} + \left(\frac{U_b^t}{U_\pi^t} - \frac{U_b^h}{U_\pi^h}\right)\frac{\partial b^*}{\partial E} < 0.$$

As a consequence of this contradiction, the first possibility must be true, which implies that

$$\frac{\partial \pi}{\partial \lambda} \geq 0.$$

Proof that $\dfrac{\partial \pi}{\partial E} \leq 0$

From (A1),

$$\frac{\partial \pi}{\partial E} = \mu N_{\pi\pi} - \pi\alpha_\pi.$$

Because $\dfrac{\partial \pi}{\partial y} = \alpha_\pi$, this expression can be written as

$$\frac{\partial \pi}{\partial E} = \mu N_{\pi\pi} - \pi\frac{\partial \pi}{\partial y}.$$

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The term $\mu N_{\pi\pi}$ is the Hicksian own-price substitution effect and thus the equation above is the standard Slutsky equation. Because N is negative semi-definite, $N_{\pi\pi} \leq 0$. Also, $\mu \geq 0$. Thus, if π is a normal good, $\dfrac{\partial \pi}{\partial E} \leq 0$.

Proof that $\dfrac{\partial \pi}{\partial \tilde{e}} \geq 0$

From (A1),

$$\frac{\partial \pi}{\partial \tilde{e}} = -(1 + \lambda) N_{\pi\pi}.$$

Because N is negative semi-definite, $\dfrac{\partial \pi}{\partial \tilde{e}} \geq 0$.

Nash Equilibrium

The Nash equilibrium is defined by

$$c^t = R^t(\theta, c^h, p^t)$$

$$c^h = R^h(\theta, c^t, p^h)$$

Totally differentiating these two equations yields

$$
\begin{bmatrix} 1 & -\dfrac{\partial R^t}{\partial c^h} \\ -\dfrac{\partial R^h}{\partial c^t} & 1 \end{bmatrix}
\begin{bmatrix} dc^t \\ dc^h \end{bmatrix}
=
\begin{bmatrix} \dfrac{\partial R^t}{\partial p^t} & 0 \\ 0 & \dfrac{\partial R^h}{\partial p^h} \end{bmatrix}
\begin{bmatrix} dp^t \\ dp^h \end{bmatrix}
$$

Because of the stability condition (18),

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$$D = \begin{vmatrix} 1 & -\dfrac{\partial R^t}{\partial c^h} \\ -\dfrac{\partial R^h}{\partial c^t} & 1 \end{vmatrix} > 0 \, ,$$

satisfying the conditions of the implicit function theorem. Applying that theorem,

$$\frac{\partial \lambda}{\partial p^h} = -\frac{\partial R^h}{\partial p^h} \left(\frac{\dfrac{\partial L}{\partial c^h} + \dfrac{\partial L}{\partial c^t} \dfrac{\partial R^t}{\partial c^h}}{D} \right).$$

From the stability condition (17), the numerator of the expression in parentheses is negative.

Thus,

$$\frac{\partial \lambda}{\partial p^h} > 0 \, .$$

By a similar argument,

$$\frac{\partial \lambda}{\partial p^t} < 0 \, .$$

Table A.1
Experience Premium Coefficient Estimates

	(1)	(2)	(3)	(4)
Eligible voters	0.041 **	0.036 **	0.047 **	0.047 **
	(0.008)	(0.009)	(0.012)	(0.013)
Teachers per eligible voter	2.269 **	2.215 **	1.481 *	1.255
	(0.988)	(1.000)	(0.879)	(1.094)
Percentage of homeowners	-0.122 **	-0.106 *	-0.078	-0.145 *
	(0.061)	(0.062)	(0.079)	(0.087)
Regional salary	0.459 **	0.417 **	0.347 *	0.216
	(0.116)	(0.131)	(0.188)	(0.187)
Median teacher experience	0.059 **	0.061 **	-0.021	-0.027
	(0.025)	(0.025)	(0.132)	(0.141)
Teacher experience per pupil	-0.088 *	-0.089 *	-0.072	-0.043
	(0.050)	(0.051)	(0.223)	(0.232)
Unrestricted revenue per pupil	0.128 **	0.135 **	0.142	0.151
	(0.058)	(0.059)	(0.108)	(0.115)
Restricted revenue per pupil	-0.049	-0.043	-0.044	-0.031
	(0.034)	(0.038)	(0.041)	(0.049)
Elementary school district dummy	0.065 **	0.059 *	0.077 **	0.088 **
	(0.024)	(0.030)	(0.031)	(0.032)
High school district dummy	0.036	0.039	0.040	0.033
	(0.024)	(0.024)	(0.038)	(0.040)
Constant	-2.057 **	-1.853 **	-1.520	-1.183
	(0.459)	(0.556)	(1.113)	(1.104)
Population density		0.006	0.001	0.0002
		(0.009)	(0.008)	(0.0077)
Median household income				0.053
				(0.044)
Percentage with bachelor's degree				(0.122)
				(0.150)
Racial homogeneity index				0.067
				(0.068)
Percentage of registered Democrats				0.073
				(0.139)
County homogeneity index				0.062
				(0.070)
Percentage of students on lunch program				(0.075)
				(0.076)
Estimation method	OLS	OLS	2SLS	2SLS
R-squared	0.222	0.224	0.208	0.222

Notes: ** denotes significance at the five percent level; * denotes significance at the 10 percent level. Standard errors are in the parentheses. There are 771 observations in the OLS regressions and 687 in the 2SLS regressions. Observations are lost because of incomplete data about past enrollment.

Table A.2
Base Salary Coefficient Estimates

	(1)	(2)	(3)	(4)
Eligible voters	0.029 **	0.023 **	0.020 **	0.020 **
	(0.004)	(0.006)	(0.007)	(0.006)
Teachers per eligible voter	2.612 **	2.549 **	2.687 **	2.448 **
	(0.444)	(0.452)	(0.702)	(0.673)
Percentage of homeowners	-0.041	-0.022	-0.040	-0.074 **
	(0.028)	(0.028)	(0.032)	(0.036)
Regional salary	0.271 **	0.221 **	0.240 **	0.124
	(0.068)	(0.065)	(0.089)	(0.081)
Median teacher experience	0.018 *	0.020 **	0.062	0.080
	(0.009)	(0.009)	(0.078)	(0.073)
Teacher experience per pupil	-0.067 **	-0.069 **	-0.140	-0.161
	(0.020)	(0.020)	(0.122)	(0.117)
Unrestricted revenue per pupil	0.018	0.026	0.043	0.052
	(0.034)	(0.034)	(0.054)	(0.054)
Restricted revenue per pupil	-0.021 *	-0.013	-0.001	-0.003
	(0.011)	(0.012)	(0.020)	(0.021)
Elementary school district dummy	0.018 **	0.011	0.009	0.010
	(0.007)	(0.009)	(0.010)	(0.009)
High school district dummy	0.001	0.005	-0.0003	0.002
	(0.012)	(0.012)	(0.0179)	(0.017)
Constant	2.232 **	2.473 **	2.266 **	2.374 **
	(0.238)	(0.249)	(0.555)	(0.490)
Population density		0.007 *	0.008	0.005
		(0.004)	(0.005)	(0.005)
Median household income				0.058 **
				(0.019)
Percentage with bachelor's degree				-0.018
				(0.042)
Racial homogeneity index				0.036
				(0.027)
Percentage of registered Democrats				0.074
				(0.076)
County homogeneity index				-0.029
				(0.034)
Percentage of students on lunch program				0.035 *
				(0.020)
Estimation method	OLS	OLS	2SLS	2SLS
R-squared	0.438	0.444	0.435	0.436

Notes: ** denotes significance at the five percent level; * denotes significance at the 10 percent level. Standard errors are in the parentheses. There are 771 observations in the OLS regressions and 687 in the 2SLS regressions. Observations are lost because of incomplete data about past enrollment.

Teacher-pupil Ratio Coefficient Estimates

	(1)	(2)	(3)	(4)
Eligible voters	-0.019 **	-0.012 **	-0.012	-0.012
	(0.003)	(0.005)	(0.009)	(0.008)
Teachers per eligible voter	-0.134	-0.060	-0.531	0.270
	(1.029)	(1.004)	(1.063)	(1.215)
Percentage of homeowners	0.048 **	0.026	0.009	0.023
	(0.024)	(0.032)	(0.036)	(0.051)
Regional salary	-0.139 *	-0.081	-0.104	-0.126
	(0.070)	(0.065)	(0.119)	(0.101)
Median teacher experience	-0.132 **	-0.135 **	-0.106	-0.088
	(0.013)	(0.013)	(0.082)	(0.084)
Teacher experience per pupil	0.269 **	0.271 **	0.150	0.125
	(0.028)	(0.028)	(0.098)	(0.100)
Unrestricted revenue per pupil	0.284 **	0.275 **	0.339 **	0.303 **
	(0.043)	(0.042)	(0.048)	(0.055)
Restricted revenue per pupil	0.078 **	0.069 **	0.086 **	0.103 **
	(0.020)	(0.022)	(0.027)	(0.030)
Elementary school district dummy	0.026 **	0.034 **	0.030 **	0.035 **
	(0.009)	(0.011)	(0.013)	(0.011)
High school district dummy	-0.105 **	-0.110 **	-0.129 **	-0.112 **
	(0.019)	(0.018)	(0.021)	(0.023)
Constant	-2.458 **	-2.738 **	-2.876 **	-2.730 **
	(0.273)	(0.266)	(0.606)	(0.548)
Population density		-0.008 *	-0.008	-0.008 *
		(0.004)	(0.005)	(0.004)
Median household income				-0.039
				(0.033)
Percentage with bachelor's degree				0.164 **
				(0.068)
Racial homogeneity index				-0.018
				(0.034)
Percentage of registered Democrats				0.070
				(0.092)
County homogeneity index				0.038
				(0.036)
Percentage of students on lunch program				-0.006
				(0.038)
Estimation method	OLS	OLS	2SLS	2SLS
R-squared	0.741	0.745	0.719	0.727

Notes: ** denotes significance at the five percent level; * denotes significance at the 10 percent level. Standard errors are in the parentheses. There are 771 observations in the OLS regressions and 687 in the 2SLS regressions. Observations are lost because of incomplete data about past enrollment.