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PUBLIC SECTOR UNION GROWTH AND BARGAINING LAWS: A PROPORTIONAL HAZARDS APPROACH WITH TIME-VARYING TREATMENTS

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ABSTRACT

This study uses a Cox proportional hazards model to estimate the relationship between state-level collective bargaining policies and union growth in the public sector. The proportional hazards analysis is performed with data on approximately eight hundred municipal police departments. The timing of unionization in these departments clearly indicates that unionization rarely precedes the enactment of a statute. Where bargaining laws have not been enacted, formal collective bargaining between municipalities and their police is virtually nonexistant. Moreover, the proportional hazards analysis that controls for the effects of other state-level and municipal-level covariates indicates that the bargaining laws and policies are the most important determinant of unionization among police. Among different types of bargaining policies, "duty-to-bargain" provisions lead to higher unionization rates than do statutes that permit, but do not require, employers to bargain with police. However, after controlling for for the effects of other covariates, there appears to be no difference in the unionization rates between the states that have duty-to-bargain provisions along with an interest arbitration mechanism and those states that have duty-to-bargain provisions without such a dispute resolution mechanism.

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I. Introduction

Entering the 1960s, few public sector employees were organized. By 1980, approximately 43% of all government employees in the United States were members of unions.[1] For certain occupational groups, particularly the protective services, collective bargaining establishes salaries and working conditions for the vast majority of departments in the United States.[2] This explosion in public sector unionism has occurred while private sector unionization has declined dramatically. It also coincides with the passage of state laws that provide various degrees of protection of public employees' rights to organize and to bargain collectively. The role that these laws play in the growth of public sector unionism is the central focus of this study.

II. Previous Research and Current Methodology

Largely because the coverage of the National Labor Relations Act (NLRA) extends across most areas of private sector employment, econometric investigations of the relationship between policy variables and union growth using private sector data are necessarily very limited. The most convincing studies are perhaps case studies of groups that were at times covered by the NLRA and at other times not covered; for example, supervisors in the Foremen's Association of America[3] in the late 1930s and early 1940s, or agricultural workers in the United Farm Workers in California in the late 1960s.[4] In contrast, the public sector provides a better laboratory for examining the linkages between public policies and union growth given the extreme variation in public sector collective

bargaining laws across states and across different occuptional groups. Despite this fact, there have been very few investigations of the relationship between bargaining laws and union growth in the public sector.[5] The data and methodologies used in previous studies are quite limited and not entirely appropriate for uncovering the relationships of interest. By employing municipal-level data with dates of unionization among United States police departments, this study employs a proportional hazards technique to uncover the impact of different bargaining laws and other state and municipal characteristics on police unionization.

Level of Analysis

Previous studies of the relationship between bargaining laws and public employee unionism focus exclusively on unionization among teachers. They rely on aggregate state-level data and therefore suffer from several inherent limitations. First, it is generally argued in these studies that it is easier to form new bargaining units where legislation is more favorable to public employee bargaining. The state-level percent organized or percent covered measures used as dependent variables, however, are affected not only by the formation of new units, but also by subsequent employment effects of collective bargaining.[6] Second, state-level percent organized variables give equal weight to a given percentage increase in unionization in different states, even though the same percent increase represents very different numbers of bargaining units and covered employees from state to state. For example, a given percentage increase in New Hampshire's percent organized may correspond to the formation of only a very small number of bargaining units covering

relatively few employees, while in California the same percentage increase may mean a very large number of new units were formed. Finally, state-level analyses cannot provide any information on the kinds of municipalities that are more or less likely to enter bargaining relationships with their departments.

This study focuses on the municipal-level, which is normally the level at which bargaining units are formed for most public sector occupations. The data for this study pertain to approximately 1,000 municipal police departments and describe the history of unionization, as well as characteristics of the department, the municipality and the state.

Model Specification: Proportional Hazards Framework

With municipal-level data, more appropriate specifications than those used previously can be employed. The existing state-level studies are generally cross-sectional and can only document whether unionization tends to be higher in states that have laws; they reveal nothing about the more interesting question of whether or not the legislation is necessary to permit the growth. Even where the longitudinal information has been brought to bear on the question, several problems remain. Institutionally, the decision to form a bargaining unit carries with it a great deal of inertia. There is little evidence of decertification in the public sector or of unionized municipal departments going out of business.[7] However, models that express percent organized (as a level) as a function of bargaining laws implicitly assume that municipal departments choose whether or not to organize in each period. For example, a department that unionizes in the first period after the enactment of a

law adds to the level of unionization in each subsequent period analyzed. The inaccurate assumption about the underlying process of forming municipal bargaining units will greatly overstate the precision of the estimated parameters. This particular problem is overcome to some extent by analyzing changes in the percent unionized variable.[8] Still, even this specification suffers from all of the inherent limitations associated with state-level data described above.

With more detailed municipal-level data, the process of bargaining unit formation can be modelled as a duration study: what determines the length of time that will pass before a department unionizes? By posing the problem this way, each municipal police department is treated as providing information on one possible transition into unionization. Several alternative dependent duration variables are developed in the next section. Whatever assumptions are used to define different duration variables, exact values of any dependent duration variable can be calculated only for unionized departments. Duration variables for nonunion departments must be treated as "right-censored"; that is, it is not known how much longer than the current period the municipality's nonunion status will last.

Let the dependent duration variable to be defined in the next section be represented by Y_i. To analyze the multivariate determinants of Y_i, a Cox proportional-hazards (PH) model is employed. Let: $f(Y)$ represent the probability density function of the duration variable; $F(Y)$ the cumulative probability function; and $H(Y) = f(Y)/(1-F(Y))$ the hazard function describing transitions into unionization. The basic approach of the PH model is to assume multiplicative effects of the independent variables according to the form:[9]

$$H(Y) = H(Y)\exp(X\beta)$$

where X is a vector of municipal- and state-level variables that influence the decision to form a bargaining unit. No specific form is assumed for H(Y); therefore, it is not necessary to develop a model in which different elements of the X vector may influence different structural parameters of the H(Y) function. The X's are assumed to induce parallel shifts in H(Y), whatever the particular properties of H(Y) may be. The PH model is therefore used to test whether the bargaining law variables are associated with an upward shift in the union hazard rate function.

III. Data and Variable Definitions

Dependent Variables: Nonunion Duration and Post-Law Duration

The likelihood function that describes transitions into unionization for each city and town is generated from a duration variable, Y_i. To calculate Y_i, specific information on dates of transition of police departments into unionization are required. To that end, I use responses from a 1979 survey conducted by Freeman, Ichniowski and Lauer.[10] This survey contains the questions: "Does your city have a written labor contract covering wages, hours, and conditions of employment for police personnel?" and "What year was the first written labor contract signed?" Here, it is assumed that cities responding affirmatively to the first question have continually been party to a police contract since the date given in response to the second question. This information covers nearly 1,000 municipalities with populations above 10,000 that report municipal police employment in the Municipal Yearbook in 1978.[11] This survey

specifically asks if a written collective bargaining agreement was negotiated, so that other sorts of police associations that do not formally bargain are treated as non-union.

Two different duration variables are used as the dependent variable: nonunion duration (NUDUR) calculated as the number of years a city remains nonunion after a given fixed year; and a post-law duration (PLDUR) calculated as the number of years a city remains nonunion after the year a bargaining law is enacted. For NUDUR, two dates were considered as possible starting dates for calculating the durations: the year in which the first police department in the United States had a written labor contract (which is 1911 in this sample), or a year just preceding the enactment of the first police bargaining policy in the United States (which is 1959, in Wisconsin). Since the data indicate that very few departments unionized between 1911 and 1959, the first approach would greatly increase the length of "nonunion durations" in pre-law years and reduce dramatically the proportion of city-years that had union transitions in the pre-law period. The second approach is adopted in this study for calculating NUDUR since it is less likely to indicate an increase in post-law union transition probabilities. NUDUR, then, is defined: year of unionization - 1955. The nine departments in the sample that obtained their first written collective bargaining agreement prior to 1956 are assigned a value of 1 for NUDUR. Those departments that were still nonunion in 1979, the year of the survey, receive a value of 24 for NUDUR and are treated as right-censored observations.

Analyzing NUDUR is a useful starting point for comparing the number of years municipalities remain nonunion across groups that were and were

not covered by bargaining laws. There are several distinct limitations in how parameters on bargaining law variables in this analysis can be interpreted. These parameters will be underestimates of the effect of bargaining laws on the propensity of police departments to organize. Specifically, as defined in more detail in the next section, a municipal observation is assigned a value of one for a given bargaining law dummy variable if it is in a state that enacted such a law and if the municipality did not unionize prior to the law's enactment. (The important distinction is that cities that unionized before a law was enacted are included in the "no law" comparison group.) The principal difficulty with analyzing and interpreting PH models of NUDUR is that bargaining laws were enacted in different years in different states. Specifically, a municipality can only be treated as having or not having a law, and it is this legal status that is being associated with the municipality's value of NUDUR. Without additional controls these NUDUR models are treating city's with laws as having laws throughout the entire period. If parameters from a PH model indicate that bargaining laws are associated with lower values of NUDUR, those parameters underestimate the effects of laws on union growth in these NUDUR models since many laws were not enacted until late in the 1959 to 1978 period.

One way to adjust for this problem is to incorporate a variable that measures the number of years that pass before a law is enacted. (The next section presents the exact definition of this control variable as well as limitations inherent in this approach.) Another, more direct, approach is to consider the alternate dependent duration variable, PLDUR. PLDUR, which equals "year of unionization - year of law," directly

corrects the dependent variable by eliminating from the duration measure any "pre-law" years. PH models analyzing PLDUR will provide accurate comparisons of the effects of different kinds of laws on unionization propensities within a sample of municipalities that have laws. The obvious difficulty here is how to incorporate municipal observations that unionized prior to a law or that are in states that never had a law. Several possible answers to this question will be explored and will be a central part of the development of the empirical results. All alternatives will involve including a "year of law" covariate. The discussion now turns to the definition of bargaining law and "year of law" variables.

Bargaining Laws: The Timing and Substance of Time-Varying "Treatments"

Within the PH framework, the laws play a role similar to time-varying treatment variables in biological mortality studies. As described above, the definition of a given law variable depends on whether a city was covered by a law while it was still nonunion. In other words, a municipality is treated as part of a "no law" category if either of two conditions are met: (1) if the municipality is in a state that never had a bargaining policy or law; or (2) if the municipality is in a state that enacted a law but unionization occurred prior to enactment of the law.[12]

Also indicated above is the fact that because different sets of cities were covered by laws in different years, a year of law (LAWYR) must be considered in the analysis. LAWYR is incorporated in NUDUR models in order to try to get better estimates of the effects of the bargaining laws on unionization propensities. Specifically, where LAWYR is greater, city's have been exposed to the law for less time, and the

probability of being unionized by 1978 will be lower (if the laws do increase unionization). In models analyzing NUDUR the proportional hazards parameter on LAWYR should therefore be negative. There are, however, additional difficulties when including a LAWYR variable. "No law" cities by construction are not affected by either the parameters on the law variables or those on the LAWYR variable. In the presence of a variable like LAWYR, where the definition of the variable directly depends on another covariate control variable (here the dummy law variables), precise methods for testing the significance of the estimated parameters on the other "treatment"-type dummy variables have yet to be developed.[13] Despite these various difficulties, it is clear that in NUDUR models where LAWYR is included in the model, the parameters on the bargaining law variables will increase in magnitude and the parameter on the LAWYR variable will be negative if laws do in fact spur police unionization.

In moving to PH models with PLDUR as the dependent variable, LAWYR is defined in a slightly different way and conceptually serves a very different purpose. Since all "pre-law" years are eliminated from the dependent variable in this case, the parameter on LAWYR will indicate whether union transition rates (values of PLDUR) tend to be higher (shorter) in later time periods. For example, in Wisconsin, values of PLDUR are calculated as years after 1959 that a city remains nonunion, while in Massachusetts PLDUR equals the number of years after 1965. Since the rate of unionization in Wisconsin may be somewhat slower than in Massachusetts simply because the general climate toward public employee unionism was less favorable in the late 1950's than in the mid-1960's, LAWYR is introduced as an additional covariate in the PH model. Since the Wisconsin bargaining policy in 1959 was the first in the United

States, this covariate will be defined as: LAWYRB = year of law - 1958. The common perception is that acceptance of public employee unionism grew over the 1958 to 1978 period, so that the estimated parameter on LAWYRB is expected to be positive. While PH-models using PLDUR as the dependent variable can be directly applied to a sample of cities with laws, much of the empirical analysis considers results obtained from expanding this analysis in different ways to include the "no law" observations.

Yet to be addressed is the fact that the content of the laws and policies, as well as their timing, varies significantly from state to state. A degree of subjectivity is required in categorizing these different legal environments. In developing these categories, I focus on two related dimensions: the degree to which bargaining rights are protected and the degree to which impasse procedures ensure closure of the bargaining process.

The first category is "bargaining permitted" (BP). These legal frameworks establish the legality of collective bargaining for covered employees. However, under such frameworks employers are not obligated to bargain with employees. These policies are often stated as giving employees some weak form of rights "to meet and confer with" or "to present proposals to" their employers.

The second law category is comprised of states which have a "duty-to-bargain" provision (DTB). In moving from BP to DTB environments, the choice to bargain or not shifts from the employer to the employees. Employees may be more likely to try to organize where employers have an affirmative obligation to bargain with representatives of the police than where employers may still choose not to bargain.

Still, a DTB provision does not necessarily ensure closure to the bargaining process. In the private sector, the strike threat forces negotiators to evaluate impasses and ultimately moves the parties to some resolution of differences in their positions. However, police strikes are illegal in the United States (except in very rare circumstances). One can imagine an employer in a DTB environment "bargaining" but not conceding to any union demands since the strike threat may be significantly dampened for these public employees. By 1978, fourteen states had enacted some form of compulsory interest arbitration statutes for police negotiations. These environments form the fourth law category (ARB). Under such a statute, police labor organizations need not rely on the final consent of the public employer to determine the terms and conditions of their employment, but rather a neutral third party has power to arbitrate contract terms. If employees perceive that this shift in final decision making authority enhances the opportunity for securing greater wage gains, employees would have an additional stimulus for forming an employee organization. What limited empirical evidence there is on the impact of arbitration on salaries provides some support for this claim.[14] In any case, as long as employees perceive the potential for such an impact of arbitration, this could be enough to stimulate union growth.

To summarize the conceptual arguments concerning why these categories of laws may be associated with different union transition rates, employers may be able to resist unionization efforts to a lesser and lesser extent in moving from "no law" environments where no union representation mechanism is available, to "BP" environments where the legality of bargaining is established, and finally to environments with a duty-to-bargain provision that obligates employers to bargain when employees

organize. Among those states with duty-to-bargain provisions (DTB or ARB equals one), it is possible that compulsory arbitration provisions increase police wage rates of unionized departments so that the demand for unionization among police would be even greater in ARB states than in DTB states.

Other Covariates

While there is no comprehensive, well-defined theory of union growth that clearly identifies other variables that might also influence unionization propensities, previous empirical studies on union growth and representation elections can be used to identify aspects of police departments and municipalities that might also affect unionization rates. First, it is important to incorporate other state characteristics as controls since bargaining laws and policies are defined along state boundaries. Here, the state-level controls include four geographic region dummy variables (Northeast, North Central, South, and West), the percentage of a state's non-agricultural work force who are public employees, and the percentage of a state's private sector nonagricultural work force that is unionized. The region controls and the percent union variable will indicate how favorable the climate is toward unionization. If patterns in the locus of public sector unionization parallel those in the private sector, one would expect an increase in the union hazard function (i.e., positive coefficients) for Northeastern and North Central cities and a negative union hazard function among Southern cities. Similarly, the percent union varible should obtain a positive coefficient. High levels of private sector unionism should correspond to

higher area wages and may increase the expectations about a reasonable wage increase. This would again lead to a positive correlation between this variable and union growth in the public sector. Where a greater proportion of a state's workforce is in public employement, a greater degree of acceptance of unionism may have been fostered. Conversely, the taxpaying public may find it more important to be represented by public managers who will oppose unionism (and keep labor costs down) where there are relatively more public employees.

Several municipal-level control variables are available for a large proportion of the municipalities in the sample: population, number of departmental employees, per capita income, per capita municipal revenue, central city dummy variable, and three government-type dummy variables (Council-Manager, Mayor-Council, and Commission).[15]

The first two variables acknowledge the importance of unit size in the unionization process. In the private sector, the most common finding is that unit size is negatively related to union support in certification elections.[16] The sign of the correlation in this public sector sample may be different for several reasons. First, the private sector samples are generally certification elections from the 1970s or early 1980s. They do not include the earliest unionization campaigns of the 1930s and 1940s, many of which may have had relatively large units. Here, in contrast, the study is designed to consider the process of unionization among all municipalities with populations over 10,000 from the time when virtually none of the municipal police departments were organized. Also, it is reasonable to expect bureaucratization to increase with city size. In order to obtain a louder voice in these environments, employees may develop a greater interest in unionization. (Since population is

available for a slightly larger sample of municipalities than is the department size variable, and since these two variables are highly correlated, empirical results are reported in the next section for models incorporating only the population control.)

Ability-to-pay variables (revenue and income) might indicate an increase in the public employer's ability to satisfy more of the diverse interests groups, including the police department, vying for a share of the municipal budget. In this way, managers in wealthier cities and towns might be better able to avoid unionization. Conversely, the incentive to unionize may be greater where municipal revenues are larger. In this way, these controls play a role similar to firm profitability in private sector unionization studies. The impact of profitability on unionization rates in bargaining unit level studies has received little attention in the existing private sector studies.[17]

Central cities may be associated with relatively high area wages, a greater degree of private sector unionization, and perhaps more hazardous duties for its police. If these forces make police more likely to consider unionization, this variable will cause an upward shift in the union hazard function. Finally the degree of bureaucratization of different government structures might affect the responsiveness of an employer to employee desires, so that certain government structures might be more highly correlated with the probability of municipal unionism.

While a number of these controls do vary over the period considered, it is necessary to assume that the rankings of municipalities along the dimensions of the controls are reasonably stable over the period (e.g., relatively populous cities at the start of the period still ranked high in population by the end of the period examined).[18] It is also necessary

to assume that unionization of a municipality's police department does not affect that city's relative ranking along the dimensions of the control variables (e.g., if a relatively wealthy suburban town organizes in the early 1960s, it is still relatively wealthy by the end of the period.) While these assumptions may be more problematic for some controls (particularly the revenue variables) than for others (such as central city status or government type), these state and municipal characteristics may be correlated with the locus and rate of police unionization and with state bargaining laws. Therefore, they are potentially important controls that help guard against overestimating the impact of bargaining laws on union transition probabilities.

IV. Empirical Results

NUDUR models

Parameters on bargaining law variables from PH models using different samples and different dependent variables are presented in Table 1. The Column (1) specification with NUDUR as the dependent variable addresses the question: Do nonunion municipalities that were covered by a law at some point prior to 1978 unionize earlier in the 1958-1978 period? From the column (1) estimates, municipalities in DTB and ARB have significantly lower post-1955 "nonunion durations"; that is, municipalities in these environments are characterized by relatively high probabilities of a union transition. The point estimate on the BP variable is positive, but insignificant. As described in the previous section, the column (1) model is not an appropriate test for gauging the magnitude of the change in the probability of unionization that occurs as a city becomes covered by some law. Specifically, these parameters under-

TABLE 1: The Effect of Bargaining Laws on Police Unionization: Estimates from Proportional Hazards Models

Dependent Variables	(1) NUDUR	(2) NUDUR	(3) PLDUR	(4) PLDUR	(5) PLDUR	(6) PLDUR	(7) PLDUR	(8) PLDUR
Observations	793	793	506	506	793	1332	1138	1359
1. Bargaining Laws								
a. ARB	.336*	1.856[s]	1.915***	1.819***	1.488[s]	3.117[s]	3.101[s]	2.711[s]
	(.191)	(.399)	(.162)	(.211)	(.194)	(.306)	(.307)	(.287)
b. DTB	.445**	1.999	1.693***	1.602***	1.551	3.146	3.012	2.590
	(.211)	(.419)	(.226)	(.259)	(.204)	(.314)	(.311)	(.262)
c. BP	.078	1.069	-	-	.566	1.747	1.529	1.442
	(.171)	(.283)			(.174)	(.217)	(.218)	(.218)
2. Years Before Enactment of Law								
a. LAWYRA	-	-.093***	-	-	-	-	-	-
		(.021)						
b. LAWYRB	-	-	-	.018	.158***	.057***	.038*	.092***
				(.025)	(.015)	(.021)	(.022)	(.109)
3. Other Controls	b	b	b	b	b	b	b	b
-2* log-likelihood	5523.6	5504.2	3885.4	3885.0	5210.6	6391.33	6045.60	6410.55

*** - two-tailed p-value < .01
** - two-tailed p-value < .05
* - two-tailed p-value < .10

a - Asymptotically normal standard errors in parentheses.
b - Other controls are: three region dummies; percent of private sector workforce in the state that is unionized; percent of state workforce in public employment; two government-type dummies; central city dummy; population; per capita income; and per capita city revenue
s - Significance tests inappropriate on law dummy parameters in columns marked with s.

estimate the effect of the laws since laws were enacted at many different points in time after the 1955 starting time for the NUDUR variable. By the same token, even though $\beta_{DTB} > \beta_{ARB}$ in column (1), ARB laws may in fact increase unionization probabilities more than DTB laws if ARB laws are enacted later in the 1955-1978 period than DTB laws.

A first method for accounting for the fact that bargaining laws were enacted in different years is to incorporate LAWYRA (i.e., years after 1955 that a law was enacted) in the model.[19] For "no law" municipalities the LAWYRA variable, like the dummy law variables, is set to zero so that unionization probabilities for cities in these environments are not influenced by this adjustment factor. While formal significance tests of the parameters on the law dummy variables cannot be performed when the LAWYRA covariate is added to the equation, one does observe that the magnitudes of all the parameters increases substantially. The LAWYRA variable is not, however, an entirely satisfactory control for the fact that the enactment of a law occurs at different points in time. Post facto, it is known with certainty that cities for which a law variable equals one did not unionize in pre-law years. However, $\beta_{LAWYRA} = -.093$ suggests that a one year increase in LAWYRA corresponds to an adjustment of union transition probabilities of only .088 per year (i.e., $1 - \exp[-.093]$). A direct way to utilize this information is to adjust the dependent variable directly (by subtracting all "pre-law" years from the duration variable). This leads to the analysis of PLDUR as a dependent variable.

PLDUR models

PLDUR (i.e., year of unionization - year of law) is analyzed in the column (3) model within a sample of municipalities for which one of the law variables is equal to one. This analysis directly asks the question: how much do different laws affect the probability of remaining nonunion from the time the law is enacted? Since this sample only includes municipalities with some law variable equal to one, BP is omitted as the comparison group. The parameter estimates from PH models without and with the LAWYRB control (which equals number of years after 1958 that the law was enacted) are presented in columns (3) and (4) respectively. Both models produce similar estimates. Using those in column (4), one can calculate the relative differences in these hazard rates of unionization between any pair of law groups. Arbitration statutes are associated with unionization rates that are some 6.16 times greater than those in BP environments (i.e., exp [1.819]), while DTB laws are associated with unionization rates that are 4.96 times higher than those in BP states. (Significance tests for the law parameters are performed in the column (4) model since LAWYRB is defined for all observations in this sample.) The relative difference between unionization probabilities in ARB and DTB environments is given by exp [1.819 - 1.602] = 1.24. From the estimation of other related models, however, this ARB vs. DTB difference in the column (4) model is judged to be insignificant.[20]

In these column (3) and (4) models that are not confounded with the question of how to treat "no law" municipalities, several interesting results emerge. Unionization rates are similar in environments that have a duty-to-bargain provision regardless of whether a compulsory interest arbitration mechanism is available. Whether or not an arbitration

mechanism increases (or might be perceived to increase) police salaries above the levels in other DTB environments, unionization rates are not increased further because of an arbitration mechanism. Also interesting, within this restricted sample of municipalities, LAWYRB has a positive but insignificant parameter estimate. From this model's estimate the general climate toward public employee unionism did not increase significantly over the 1958 to 1978 period. For example, post-law unionization rates are no lower in states like Connecticut or Massachusetts which enacted their DTB provisions in 1965 than in a state like Oklahoma which enacted its DTB provision six years later. While the column (3) and (4) models provide interesting insights and a useful benchmark for comparing differences in unionization rates associated with different kinds of laws, these models do not provide any information on the important comparison between unionization rates in environments with and without laws.

To return to this central question, the no law cities are introduced back into the sample in column (5). To do this, PLDUR for "no law cities" is defined as the length of time after 1958 that a municipality remains nonunion. Again LAWYRB is set equal to zero for this group of observations, and since the definition of the LAWYRB variable depends on whether or not a city has some law variable equal to one, significance tests are not performed. This model produces estimates of the effects of the various laws relative to no law environments that are substantially larger than the "underestimates" in column (1), but smaller than those in the column (2) model with the problematic LAWYRA control. However, there is a clear reason for suspecting that the law vs. no law comparisons made from the column (5) parameters are also underestimates of the effect that

these bargaining laws have on unionization rates. Specifically, this sample eliminates from consideration the fact that none of the cities in the law categories unionized while they had previously been in no law environments. To address this problem in sample construction, the column (6)-(8) models are developed.

PLDUR models with "Expanded" Samples

In columns (6)-(8), a new sample for analysis is constructed. Specifically, there is one observation for each legal environment that a nonunion municipality experiences. For example, Maine enacted a DTB policy in 1969. A city in Maine which did not unionize before 1969 will be represented by two observations. The first has PLDUR = 1969 - 1958 = 11, LAWYRB = 0, and all law variables equal to zero. This no law municipal observation is also censored because Maine enacted a statute before it could be determined how many more years would pass before this city would unionize in a no law environment. Such a city would be represented by a second observation as well for which: PLDUR = year of unionization - 1969; LAWYRB = 1969 - 1958 = 11; and DTB = 1. If the city in question unionized by 1978 it is not censored; otherwise, this second observation is censored. Cities in Maine that unionized before 1969 are treated just as they were in the column (5) sample with one uncensored observation that has PLDUR = year of unionization - 1958, and LAWYRB and all law dummy variables equal to zero. Cities in states that never enacted laws are also unaffected and are represented by one observation.

Estimates from the model that maintains the desirable features of PLDUR as the dependent variable (as opposed to NUDUR) as well as the

"pre-law" information on cities that eventually were covered by laws are presented in column (6). All law parameters are in fact larger than the column (5) underestimates. They also are larger than the estimates in column (2). Also when compared to the column (1), (2), or (5) parameters, those in column (6) yield estimates of the DTB vs. BP and ARB vs. BP that are much more similar to the ones obtained from the column (4) model which is specifically designed to make such a comparison (i.e., in Column (6), $\beta_{ARB} - \beta_{BP} = 1.370$ and $\beta_{DTB} - \beta_{BP} = 1.399$; while in column (4) the comparable figures are 1.819 and 1.602). In column (7), the model is reestimated with a restricted sample. Here those "no law" observations in states that never had a law are deleted. This leaves two kinds of no law observations in the sample: (1) uncensored observations for cities that unionize before the enactment of their state's law; and (2) censored observations that represent the "pre-law" existence of cities that had not unionized by the time their states enacted a law. The column (7) estimates are similar to those obtained in column (6). Using the column (6) specification, one obtains the following estimates for the relative unionization probabilities across legal environments: ARB, DTB, and BP increase unionization rates by 22.5 times, 23.2 times, and 5.7 times above those in no law environments. While the column (6) model incorporates several desirable features, the magnitudes of the effects for ARB and DTB are much larger than those in previous columns. Several simple calculations of the annual rates of unionization in the first few years after DTB and ARB laws are passed relative to annual unionization rates in states without laws also suggest DTB and ARB effects of this magnitude.[21]

The column (6) specification incorporates several important features that help provide more accurate estimates of the effect of bargaining laws on union transition rates: (1) by using PLDUR as the dependent duration variable, durations are calculated from the time the law is enacted; (2) the "expanded" sample still includes important information on nonunion municipalities that were eventually covered by a law but did not unionize prior to the law; (3) municipalities that are in states that never pass a law are still in the sample, but "no law" observations are assigned a value of zero for the LAWYRB control indicating that the duration variable begins from an earlier starting date. One final elaboration to the column (6) specification is also possible with the "expanded" sample approach. Specifically, one can also use this approach to account for the fact that several states amended their initial bargaining laws. The most common amendment is that in seven states an arbitration mechanism was added within the framework of a duty-to-bargain law. In these states, if most of the unionization occurred after the amendment (i.e., during ARB years and not DTB years), the results in the column (6) specification may be overstating the effect of DTB laws and understating the effect of ARB provisions.

To incorporate these amendments into the model, an additional observation is added to the column (6) sample any time a municipality remains nonunion past the time that a bargaining law is amended. For example, Wisconsin moved from no law to BP (in 1959), from BP to DTB (in 1962) and from DTB to ARB (in 1971), thereby passing through all four legal environments. In the column (6) sample and specification, there will be one observation for any Wisconsin municipality that unionized

before 1959, and two observations for those municipalities that did not unionize before 1959. Under the final elaboration, a Wisconsin municipality that did not unionize until the ARB law was enacted (say in 1975) would be represented by the following four observations:

(1) Nonunion until 1959; PLDUR = 1; LAWYRB = 0; law = none; censored = yes.

(2) Nonunion between 1959 and 1962; PLDUR = 3; LAWYRB = 1; law = BP; censored = yes.

(3) Nonunion between 1962 and 1971; PLDUR = 9; LAWYRB = 4; law = DTB; censored = yes.

(4) Unionized in 1975; PLDUR = 4; LAWYRB = 13; law = ARB; censored = no.

Had this hypothetical Wisconsin city not unionized by 1978, the fourth observation would be also censored and PLDUR would equal 7.

When the PH model is reestimated with the newly expanded sample, the parameters in column (8) are estimated. When compared to column (6), the effects of the bagaining laws are reduced somewhat, while the parameter on LAWYRB increases. Again, in the column (8) model, when the ARB and DTB variables are collapsed into one dummy variable the explanatory power of the model is not decreased significantly.

The underestimates of the bargaining law effects produced from the column (1) NUDUR model indicate that the parameters in the DTB and ARB variables are significant. Still it is important to put the magnitudes of the parameters on the bargaining law variable from other models into some comparative context because of the limitations on formal significance testing in models that include a LAWYRB covariate. First, while

the parameter on LAWYRB in the columns (5)-(8) specifications is significant, reestimating these same models without the LAWYRB leaves the parameters on the bargaining laws and their associated standard errors unchanged. While it might be argued that such models without the LAWYRB covariate are not completely specified, the results further suggest the significance of the bargaining law parameters.

The Relative Impact of Bargaining Laws and Other Covariates

An alternative way to gauge the relative importance of the bargaining laws on police unionization rates is to compare the law parameters to parameters on other variables in the model. Column (1) of Table 2 presents the complete set of parameters from the Table (1), column (8) model. Since the magnitudes of the β parameters are affected by the units of measurement for the dependent variables, the relative magnitudes of the various β's do not gauge the relative "importance" of the covariates. Column (2) of Table 2 presents the means and standard deviations of the covariates for the N = 793 sample. (The N = 793 sample is used to calculate sample characteristics instead of the N = 1359 sample since the latter includes more than one observation for certain municipalities and, therefore, would not give an accurate picture of the "average" municipality.) Column (3) calculates for the dummy variables in the model the quantity: $\exp[\beta]$. This calculation yields the ratio of the union hazard rate for a municipality with the given characteristic and one without it (all other covariates the same). Column 4 presents the relative increase in the union hazard rate that would result from a one standard deviation increase in a given covariate. This is given by: $\exp[\beta(\bar{x} + \sigma_x)]/\exp[\beta\bar{x}]$. These calculations indicate that the factor that is most important in influencing unionization rates is the nature of the bargaining law.

TABLE 2
The Impact of Bargaining Laws, State Characteristics, and Municipal Characteristics on Police Unionization

Covariates	(1) β-parameters and (standard errors) from Table 1 Col. (8) Model	(2) Means and (standard deviations) of Covariates	(3)[a] Relative Increases in Unionization Probability from 0 to 1 increase (dummy variables)	(4)[b] Relative Increase in Unionization Probability from a one standard deviation increase (all variables)
1. Bargaining Laws				
a. ARB	2.711[s]	.172	15.044	2.779
	(.287)	(.377)		
b. DTB	2.590	.175	13.330	2.676
	(.262)	(.380)		
c. BP	1.442	.332	4.229	1.972
	(.218)	(.471)		
2. LAWYRB	.092***	6.166	---	1.688
	(.019)	(5.639)		
3. Region				
a. Northeast	.286	.170	1.331	1.111
	(.217)	(.376)		
b. Central	-.472***	.328	.624	.801
	(.147)	(.470)		
c. South	-.459*	.281	.632	.813
	(.251)	(.450)		
4. Percent Union	3.692***	.249	---	1.404
	(.913)	(.092)		
5. Percent Public	2.525	.159	---	1.059
	(3.203)	(.020)		
6. Central City	.513***	.230	---	1.241
	(.124)	(.421)		
7. Population	.050 E-6)	67881	---	1.009
	(.210 E-6)	(188229)		
8. Per Capita Income	.043 E-4	4887	---	1.005
	(.370 E-4)	(1271)		
9. Per Capita City Revenue	.357 E-3	289	---	1.071
	(.222 E-3)	(193)		
10. Government-Type				
a. Mayor-Council	-.068	.298	.934	.969
	(.200)	(.458)		
b. Council-Manager	.181	.641	1.198	1.091
	(.196)	(.480)		

s - significance tests not performed on parameters for law dummy variables
a - calculated by: $\exp[\beta]$
b - calculated by: $\exp[\beta(\bar{x} + \sigma_x)]/\exp[\beta\bar{x}]$
*** - two-tailed p-value < .01
** - two-tailed p-value < .05
* - two-tailed p-value < .10

The results obtained with the PH model for a national municipal-level sample of police departments gives additional support to Saltzman's conclusion based on state-level analyses of teacher unionism: bargaining laws are the single most important determinant of public sector unionization.[22]

Among other covariates, there are significant effects associated with the degree of private sector unionization in the state, the region variables,[23] and central city status. The insignificant impact of the population variable does not necessarily contradict the observation that the largest cities in the United States are more likely to have unionized police departments. Central city and population are highly correlated. Once one controls for the central city effect, one does not find that municipalities with relatively large populations experience increased propensities to unionize. While the city income and revenue variables both have positive parameters, neither is judged to be significant.

Survival Plots

A useful way to summarize the data and to underscore the importance of the bargaining laws is to present plots of the survival functions for various "representative" cities. Figure 1 shows the survival plots for four municipalities that have average characteristics but differ only according to the legal environment for police bargaining. These estimates are obtained using the Table 2 model (i.e., the Table 1, column (8) model). The survival plots for the BP, DTB and ARB municipalities begin in 1965, 1968, and 1968, respectively. These years represent the average of the years in which these forms of bargaining law were enacted. However, in evaluating the survival functions, the unionization probabilities for the BP, DTB, and ARB municipalities do not include any LAWYRB

FIGURE 1: Survival Probability Plots For The "Average" Municipality Under The Four Different Legal Environments

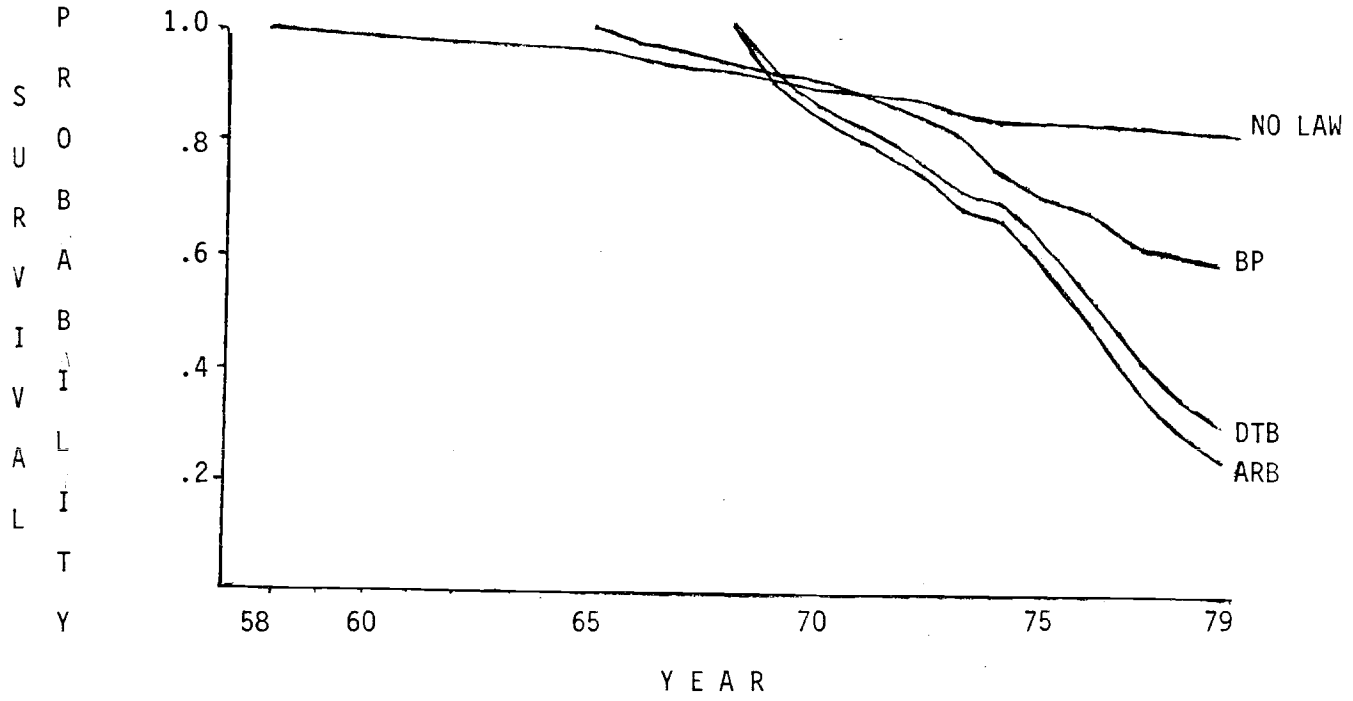
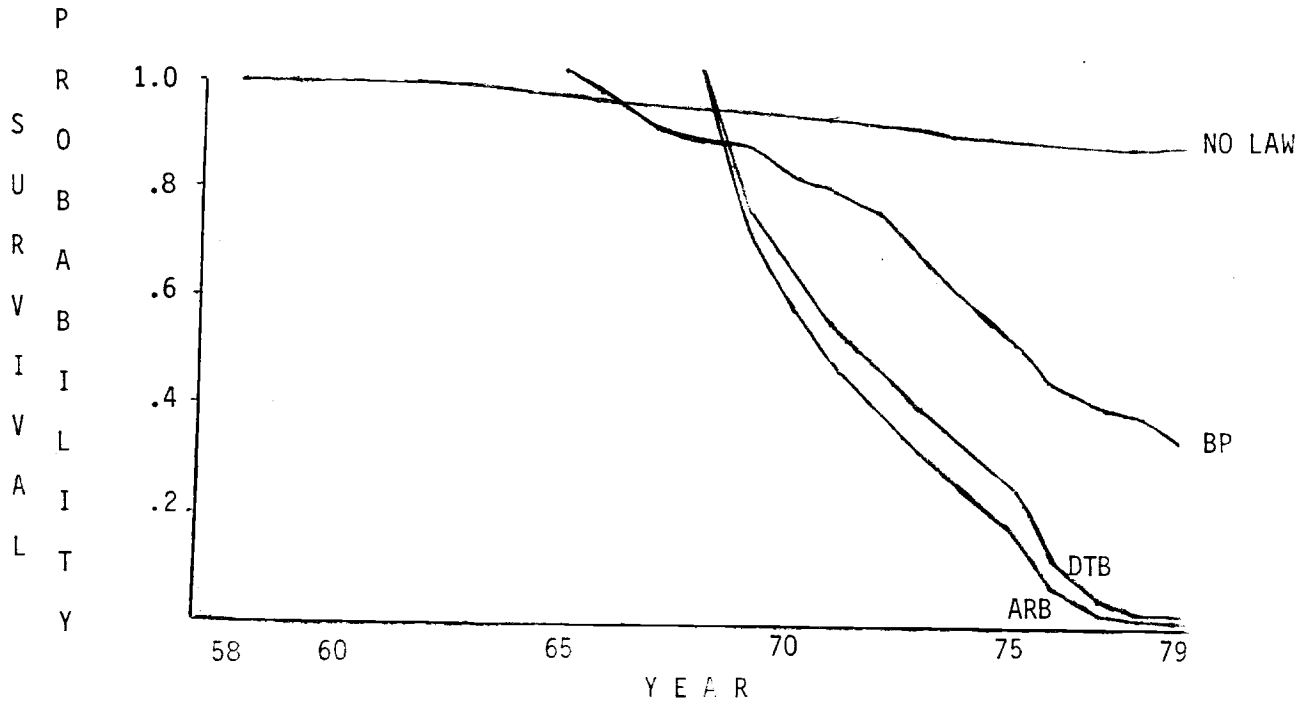


FIGURE 2: Survival Probability Plots For Each Legal Environment's "Average" Municipality



effect. Figure 1 then shows a municipality that is the same in all respects except the nature of the bargaining law. One observes that the no law environments are characterized by very little unionization. The 1979 survival probability for this type of average municipality is approximately .83. The BP, DTB, and ARB municipalities have 1979 survival probabilities of .59, .29, and .25, respectively.

In Figure 2, the plots represent the survival functions for four municipalities that have the average characteristics of a no law, BP, DTB, and ARB municipality. The plots are quite similar to those in Figure 1, underscoring the fact that the legal environment more than any characteristic dictates the union hazard probabilities. The differences between the "nonunion survival" rates of the no law municipality and those of municipalities in other legal environments is slightly larger than the differences in Figure 1. This reflects the fact that "no law" cities have lower values of PCTUNION and are less likely to be in the Northeast region (both of these characteristics are positively associated with the union hazard function). From Figure 2, one estimates survival probabilities in 1979 for the average no law, BP, DTB, and ARB municipalities of .87, .36, .02, and .01, respectively. The survival plots clearly indicate the central finding of this study: changes in unionization rates among municipal police in the United States occurred after the enactment of bargaining laws.

Conclusion

Using a proportional hazards framework for estimating the rate of unionization among municipal police departments, this study documents the critical role played by the nature of the statutory bargaining

environments. The police bargaining laws are clearly not a result of already existing bargaining. The speed with which unionization occurs in the first few years after enactment of laws, particularly those laws with some sort of duty-to-bargain provision, perhaps suggest some form of pent-up demand for unionization. However, the experience in the private sector where unionism continues to decline in spite of the protections of the National Labor Relations Act (NLRA) suggests that bargaining statutes may be a necessary but insufficient condition for union growth. Other factors specific to the public sector might help to account for the rapid rate of public sector unionization after bargaining laws were enacted. Unlike the standard private sector model of the effects of unionization where increased wages come at the expense of employment levels, it may be possible that public sector unionization may simultaneously increase wages and employment.[24] Also, public sector laws may be more effective safeguards of employees' bargaining rights, since these laws may have stricter enforcement of stiffer penalties for violations than does the NLRA in the private sector.[25] Finally, public employers as agents of the government may be less likely than private sector employers to violate the letter or spirit of a bargaining statute.

FOOTNOTES

1. Freeman, Richard B. "Unionism Comes to the Public Sector," National Bureau of Economic Research working paper no. 1452 (September 1982), p. 2.

2. Ibid., p. 9.

3. See for example Ross, Phillip, The Government as a Source of Union Power (Providence, RI: Brown University Press, 1965), pp. 260-262.

4. Kushner, Sam, Long Road to Delano (New York: International Publishers, 1975).

5. The most recent study which employs the most rigorous empirical tests to date is Saltzman, Gregory, "Bargaining Laws as a Cause and Consequence of Teacher Unionism," Industrial and Labor Relations Review, vol. 38, no. 3 (April, 1985), pp. 335-351. Also see Moore, William, "An Analysis of Teacher Union Growth," Industrial Relations, vol. 17, no. 2 (May 1978), pp. 204-215.

6. Interestingly, the very limited empirical evidence on this point suggests that public unions may raise both wages and employment levels; therefore, percent organized statistics may increase not just from the formation of new units, but from relative increases in manning after departments unionize. See Zax, Jeffrey, "Municipal Employment, Municipal Unions and Demand for Municipal Services," National Bureau of Economic Research Working Paper No. 1728, (October, 1985).

7. Approximately 10% of all municipal police departments in this study's data set have been contacted for data verification. No unionized department reported decertification of their police union after an initial collective bargaining agreement was signed. To date there have been no systematic investigations of whether public employees do in fact choose to decertify after an initial contract is won. The best known cases of decertification are probably those involving striking public employees. Any city in this study's data set whose police department went on strike between 1972 and 1978 was contacted. No striking unionized department in this data set was decertified.

8. The only analysis on public sector unionism that analyzes changes in a percent organized variable is contained in Saltzman, p. 345. However, this analysis does not correlate this change variable to all categories of bargaining laws.

9. For the original exposition, see Cox, D. R., "Regression Models and Life Tables," Journal of the Royal Statistical Society, Series B, vol. 34 (1972), pp. 187-220. More recently, see developments in Kalbfleisch, John D. and Ross Prentice, The Statistical Analysis of Failure Time Data (New York: Wiley and Sons, Inc., 1980).

10. Freeman, Richard B., Casey Ichniowski and Harrison Lauer, "Collective Bargaining Laws and Threat Effects of Unionism in the Determination of Police Compensation," National Bureau of Economic Research no. 1578 (March 1985), p. 6.

11. International City Management Association, Municipal Yearbook, 1978 (Washington, D.C.: ICMA, 1978).

12. A small number of municipal observations in states that eventually enacted a law prohibiting police bargaining are kept in the no law comparison group.

13. For a brief discussion of problems with significance testing in the presence of additional time-varying covariates, see Lawless, J. F., Statistical Models and Methods for Lifetime Data, (New York: John Wiley and Sons, 1980). For an application of when to use significance tests of whether certain medical treatments do or do not reduce mortality rates, see Crowley, John and Marie Hu, "Covariance Analysis of Heart Transplant Survival Data," Journal of the American Statistical Associaton, vol. 72, no. 357 (March, 1977).

14. For cross-section estimates of the impact of arbitration statutes, see Olson, Craig, "The Impact of Arbitration on the Wages of Firefighters," Industrial Relations (Spring, 1980), vol. 19, no. 13, pp. 325-339. For more qualified support of the positive effect of arbitration on salaries, see Feuille, Peter and John Delaney, "Collective Bargaining, Interest Arbitration, and Police Salaries," Industrial and Labor Relations Review (forthcoming).

15. Municipal Control variables are available from International City Managers Association, "Master Code" Data Tape (Washington, D.C.: I.C.M.A., 1978). Government type, municipal revenue, per capita income, population and department size also appear in the published volume I.C.M.A. Municipal Yearbook, 1978.

16. See for example Rose, Joseph, "What Factors Influence Union Representation Elections?" Monthly Labor Review, vol. 95 (October 1972), pp. 49-51; Chaison, Gary, "Unit Size and Union Success in Representation Elections," Monthly Labor Review, vol. 96 (February, 1973), pp. 51-52; or Cooke, William, "Determinants of the Outcomes of Union Certification Elections," Industrial and Labor Relations Review, vol. 36 (April 1983), pp. 402-414.

17. In one review of what have generally been industry-level studies, Bain concludes that profit levels seem to have a positive correlation with union growth and labels this a "prosperity effect". Bain, George S., "Certifications, First Agreements, and Decertifications: an Analytical Framework" (Canada Department of Labour, Government of Canada, 1981), p. 3.

18. For a discussion of the problems that arise when incorporating variables that have time-varying values, see Lawless, pp. 393-394.

19. For a useful parallel, see Crowley and Hu for their discussion on the purpose of a "waiting time until treatment" variable in their mortality study, pp. 32-33.

20. Specifically, a comparison of the log-likelihood statistics from the Table 1 Column (4) model and a similar one in which DTB and ARB are collapsed into one variable, indicate no significant difference in the model. This general conclusion concerning the similarity in the effects of DTB and ARB on unionization probabilities is confirmed by similar tests for the models in columns (5)-(8) in Table 1.

21. Of the 985 municipal police departments for which contract dates are available, 200 would have DTB = 1 and 150 would have ARB = 1. Of the DTB municipalities, 25% organized within two years of the DTB law's enactment and 53% were organized within five years. For the 150 ARB municipalities, the comparable two-year and five-year figures are 49.3% and 69.3%. By contrast, through the entire 21 year period from 1958 to 1978, only 9.3% of the 237 municipalities in states without laws unionized -- or as a rough approximation .44% each year over the 1958-1978 period. By contrast, to have 53.0% (in DTB environments) or 69.3% (in ARB environments) organized during the first five years after a law is enacted corresponds to an annual organization rate of approximately 10.6% and 13.9%. While these are simple calculations that do not account for a number of factors, these different "annual rates" of unionization suggest that the column (6) estimates are in fact reasonable.

22. Saltzman, p. 345.

23. The significance of the set of region controls is judged by comparing the chi-square statistics for the Table 1, Column (8) model with and without the three region variables.

24. See Zax, pp. 24-26.

25. For a critical review of the increase in management unfair labor practices and a discussion of the weakness in penalties under the NLRA, see Weiler,Paul, "Promises to Keep: Securing Workers' Rights to Self-Organization Under the NLRA," Harvard Law Review (June, 1983), pp. 1769-1827.