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The Impact of Representation Case Hearings on Certification Election Outcomes

Robert L. Chiaravalli†
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This Article presents an empirical model of election outcomes that applies to elections occurring pursuant to a representation case hearing and subsequent Decision and Direction of Election by a Regional Director of the NLRB. The model emphasizes the impact of delay, changes in the bargaining unit, and showing of interest. The results imply that the probability of union victory is adversely affected by either delay or change in the bargaining unit and also demonstrate that showing of interest is a significant determinant of election outcome, thus supporting the infrequently held view that authorization cards are a reliable gauge of pro-union sentiment.

A substantial part of the literature devoted to the study of NLRB election outcomes in representation cases focuses on the impact of procedural elements, such as the shift from consent to stipulated elections, on election outcome. While such an approach sheds some light on the effect of NLRB actions upon election outcome, relatively little work has been done on representation elections that occur pursuant to a representation case hearing and Decision and Direction of Election (DDE) by a Regional Director of the NLRB. In such Regional Director Directed Elections (RDDE's), the role of the NLRB is both larger and more explicit than in either consent or stipulated elections, because of the legal complications and adjudicated outcomes inherent in all RDDE's. The actions of the NLRB in these elections are manifested through both delay and the potential for changes in the definition of appropriate bargaining unit. No previous empirical study has adequately studied these factors to determine their effect on election outcome.

This Article presents an empirical model that applies to elections occurring pursuant to a representation case hearing and subsequent DDE by the Regional Director, that focuses on the impact of delay, changes in the bargaining unit, and showing of interest on election outcome. The results imply that the probability of union victory is adversely affected by

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†† Department of Economics and Labor Research Center, University of Rhode Island.
either delay or change in the bargaining unit. The results also demonstrate that showing of interest is a significant determinant of election outcome, thus supporting the infrequently held view that authorization cares are a reliable gauge of pro-union sentiment. This article contrasts with the results of previous studies considering RDDE’s only peripherally.

I
THE MODEL

The outcome of an RDDE depends on the same factors which determine both consent and stipulated certification elections. The differences arise from the more substantial role played by the NLRB in RDDE’s. In all RDDE’s, the NLRB investigates and decides issues relating to the scope and composition of the appropriate bargaining unit. Such adjudicative processes increase the time between the filing of the certification petition and the election, and may ultimately modify the election unit.

Existing empirical studies of certification election outcomes have utilized national data, which necessitates controlling for social, political, and economic differences between states. However, this study utilizes data from a single industrial Midwestern state, which eliminates the need to control for factors such as the existence of right to work laws, the extent of unionization, or the industrial mix of each state. This single state approach has the advantage of both simplifying the model and allowing empirical results to be based on data containing far less measurement error than other studies to date.

This Article examines the impact of NLRB adjudicative processes on the probability of union victory by analyzing such factors as change of bargaining unit and delay. In the setting of a single state these determinants can be broadly classified as the relevant economic environment, worker perception of unionization, specific NLRB procedures, and the circumstances of the election itself.

The indicator chosen to reflect the relevant economic environment is the local unemployment rate at the time of the election. This factor directly relates to the availability of alternative wage and employment opportunities for workers eligible to vote in the election. As the local unemployment rate changes, worker perceptions of job security also change. During periods of high unemployment, employees are more likely to vote in favor of the union as a means of insuring personal job security.

The level of unemployment may also affect the level of employer resistance. As the local unemployment rate rises, firms faced with a decrease in product demand will find their ability to pass on higher costs
associated with unionization curtailed. In this situation one expects the employer to wage a more vigorous campaign, thus decreasing the likelihood of union victory. Because an increased unemployment rate affects employer behavior as well as employee perceptions, the overall effect of such an increase cannot be predicted a priori.

Worker expectations about the effectiveness of unions in changing working conditions also influence election outcome. These expectations depend upon personal sentiments about the need for changes as well as the potential for future improvements in wages and working conditions. As a reflection of the attitudes and perceptions of workers, the percent showing of interest is potentially a significant indicator of these expectations. The reliability of showing of interest is, however, the subject of substantial differences of opinion. If authorization cards are a reliable indicator of union sentiment, greater worker confidence in the ability of the union to secure improved wages and working conditions will result in a higher percent showing of interest. This translates into an increased probability of union victory.

The significance of showing of interest is considered here as an empirical question to be resolved in the equation estimated. However the showing of interest will affect the level of union activity both systemically and strategically. Systemically, NLRB rules and regulations require at least a 30 percent showing of interest before an election petition can be filed. Strategically, financial and staff constraints force unions to concentrate their efforts on organizing drives deemed most productive. Some unions require a certain "safe minimum" level of showing of interest prior to filing an election petition. Hence their involvement will be limited to either elections with relatively large probability of victory or those deemed important for other reasons.

The ability of the NLRB to change the scope and composition of the proposed bargaining unit through an adjudicative hearing can substantially affect election outcome. Changes in the scope and composition of the appropriate bargaining unit can adversely affect the expected benefits of unionization, and hence the number of union votes, because the bargaining unit actually voting may not be the one considered "best" by the union.

The delay between the filing of the petition and the actual election is critical. A long delay can be casually related to the waning of pro-union enthusiasm. The uncertainties associated with union representation, the inundation of workers with campaign information, and doubts about the

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ability of the union or the government to protect workers in disputes that either arise or intensify during a long election campaign. Greater delay also benefits the employer to the extent it has greater financial resources available for the campaign than does the union. Delay is particularly important in instances where an employer first severely underestimated the extent of union enthusiasm. In addition to these increased uncertainties, delay also increases the likelihood of employee turnover, where newly eligible employees who may be less favorably inclined toward unionization are eligible to vote.

Since this study deals exclusively with RDDE's, delays seen here are longer than in either consent or stipulated elections. Increased delay is also associated with lower voter participation rates, a factor reinforcing the adverse impact of delay on the probability of union victory.\(^3\)

Finally, specific aspects of the election itself affect the outcome. The definition of the appropriate bargaining unit determines the number of workers eligible to vote. The number of eligible voters affects election outcome since it affects the "group dynamics" of the election campaign.\(^4\) As Cooke points out, smaller unit size creates a desire for conformity based on peer pressure, face to face communication occurs with greater frequency, and other aspects of group cohesiveness.\(^5\) As unit size rises, these cohesive factors diminish in importance, as personal and viewpoints become less homogeneous within the unit.

The resources devoted to the election by both parties also depend on the bargaining unit size. Since more eligible voters means greater campaign costs to both the union and the employer, the question arises as to whether economies of scale exist in the diffusion of information. This factor is particularly important in multi-location bargaining units where the addition of a second location can be expected to favor the employer over the union. With a second location, coordination of election activity becomes increasingly complex because more people are involved and because the group of potential voters is less homogeneous. The employer will tend to have an inherent advantage due to its preexisting managerial apparatus which is already familiar with the individual participants. Translating running of the firm to incorporating election campaigning as well entails the economies of scale alluded to previously. The existence of this asymmetrical cost advantage by employers can be expected to cause the number of locations to be inversely related to the probability of union victory.


\(^5\) Id. at 413.
II

DATA AND ESTIMATED MODEL

The data base utilized in this study was obtained from the National Labor Relations Board through a Freedom of Information Act request. These data cover 45 RDDE's involving 4,852 eligible voters in a large industrial Midwestern state between August 1979 and March 1981. Information available for each election includes the petition filing date, date of the election, the number of employer locations, changes in the bargaining unit from the petitioned unit, showing of interest, the number eligible to vote, the vote tally (and its breakdown), and the number of votes challenged. This study used data on the local unemployment rate taken from Employment and Earnings. The chosen value corresponded to the month of the election and to the smallest available geographical breakdown which included the location of the election. While this measure will entail some error due to differences in unemployment rates within the geographical areas covered, this approach is more accurate than that of studies using statewide unemployment rates. Summary statistics for these variables are given in Table I.

Table 1
Sample Mean Values for Variables of Interest

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Showing of Interest</td>
<td>0.688</td>
</tr>
<tr>
<td>Number Eligible</td>
<td>107.8</td>
</tr>
<tr>
<td>Percent Changing Bargaining Unit</td>
<td>0.178</td>
</tr>
<tr>
<td>Number of Employer Locations</td>
<td>1.2</td>
</tr>
<tr>
<td>Delay (weeks)</td>
<td>10.6</td>
</tr>
<tr>
<td>Unemployment Rate at Election Date</td>
<td>13.1</td>
</tr>
<tr>
<td>Percent of Elections in 1980</td>
<td>0.933</td>
</tr>
<tr>
<td>Participation Rate</td>
<td>0.875</td>
</tr>
<tr>
<td>Tally</td>
<td>96.4</td>
</tr>
<tr>
<td>Number of Votes for:</td>
<td></td>
</tr>
<tr>
<td>Union</td>
<td>50.3</td>
</tr>
<tr>
<td>Company</td>
<td>46.0</td>
</tr>
<tr>
<td>Number of Challenges</td>
<td>3.7</td>
</tr>
</tbody>
</table>

The probability of union victory was estimated utilizing a maximum likelihood logit technique (see Appendix) with the following explanatory variables:
- The number of bargaining unit locations;
- The percent showing of interest by workers;
- The number of weeks of delay between filing of petition and election;
- The number of workers eligible to vote (unit size);
The prevailing local rate of unemployment at the time of election;  
The voter participation rate;  
A variable representing the existence of bargaining unit changes; and  
The number of votes challenged.  

This model postulated that the probability of union victory for a given election was negatively related to the number of bargaining unit locations, changes in the bargaining unit, delay, and the number of eligible voters. The percent showing of interest was expected to be positively related to union victory, while the relation of the unemployment rate to union victory probability cannot be predicted.

Two other variables, the number of votes challenged and the voter participation rate, were included to control for differences in characteristics of the actual elections. The number of votes challenged represents the extent to which issues relating to the unit composition are contested by the parties. This serves as a proxy variable for differences between elections to the extent rivalry exists between the employer and the union. Since the available data do not indicate which party originated the challenge, the expected effect of this variable cannot be predicted a priori.

The voter participation rate, or the proportion of eligible persons actually voting was used to control for between elections in the strength of voter sentiment about the potential benefits of union representation. A high voter participation rate is consistent with strongly-held beliefs about the benefits or costs of union victory, resulting from effective campaigns by either or both sides in the election. Since labor turnover during an election campaign can alter the number of eligible votes, failure to control for this factor creates an indeterminacy in the expected sign of the participation rate. Because this study controls only for the number of eligible voters and not for their composition, the model cannot predict the effect of changes in voter participation rate on union victory.

III
RESULTS

Maximum likelihood estimates of the equation coefficients are given in Table 2. The signs of all coefficients conform to a priori expectations. The coefficients percent showing of interest, delay, the number eligible to vote, and the local unemployment rate are statistically significant at the

6. The term "negatively (inversely) related" means that the two variables considered tend to move in opposite directions, while a "positive (direct) relationship" implies that both variables tend to move in the same direction.

7. The statistical significance of a coefficient is a result where one is able to say that a particular coefficient is significantly different than zero with a probability of being incorrect (on average) of 10 percent or less. This is important since if the correct value of a coefficient is zero, that particular variable does not belong in the equation, and is therefore not a determinant of the probability of union success.
### Table 2
Logit Coefficient for Probability of Union Victory Equation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Maximum Likelihood Asymptotic Standard Error (absolute value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Employer Locations</td>
<td>-0.336 -0.700 0.48</td>
</tr>
<tr>
<td>Percent Showing of Interest</td>
<td>2.80** 1.48 1.89</td>
</tr>
<tr>
<td>Bargaining Unit Change</td>
<td>-0.609 -0.883 0.69</td>
</tr>
<tr>
<td>Delay (weeks)</td>
<td>-0.145** -0.085 1.70</td>
</tr>
<tr>
<td>Number Eligible Voters</td>
<td>-0.002* 0.001 1.52</td>
</tr>
<tr>
<td>Unemployment Rate at Election Date</td>
<td>-0.055* -0.033 1.68</td>
</tr>
<tr>
<td>Number of Challenges</td>
<td>0.116 0.130 0.89</td>
</tr>
<tr>
<td>Participation Rate</td>
<td>0.646 0.994 0.65</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.070 -0.233 0.30</td>
</tr>
</tbody>
</table>

*Significant at .10  **Significant at .05  ***Significant at .01

ten percent level or above. With respect to the variables with indeterminate signs, the results imply that the probability of union victory is negatively related to the local unemployment rate, and positively related to both the participation rate and the number of votes challenged.

The negative and statistically significant coefficient of the unemployment variable is consistent with higher prevailing unemployment at the time of election being adverse to union victory probability. This result contrasts sharply with the finding by Cooke that an increase in the unemployment rate also increases union victory probability. The discrepancy is related to the fact that this data base consists entirely of RDDE's, which by their nature and more highly contested than the majority of elections included in Cooke's data base. While Cooke concludes, "It can be inferred . . . that with respect to the effects of unemployment on voting, the effect of fewer alternative employment opportunities overrides the effect of stronger resistance," the results of this article imply that for RDDE's, the impact of employer resistance on election outcome tends to be the dominant factor.

The coefficient of the number of challenged votes indicates that highly contested elections tended to result in more favorable outcomes for the union. The coefficient of the participation rate is consistent with increases in the voter participation rate tending to favor union victory.

8. See Cooke, supra note 4.
9. Id. at 405.
10. Two other major differences exist as well. First, the average unemployment rate for this sample is twice that of Cooke's data, so that the impact of unemployment is substantially greater in these data. While his linear (in the Unemployment Rate at Election Date) specification would still imply a positive coefficient, the opposite is true for this quadratic specification, which yields a negative sign for both sample averages. Second, Cooke utilizes statewide average unemployment rates for the year before the election as a measure of the economic conditions relevant to the election, which creates measurement errors due to the probable divergence of local and state unemployment rates as well as specification error if the current unemployment rate is more appropriate.
The size of the voter participation result implies that a substantial change in the rate of voter participation is necessary to measurably alter the outcome of all but the closest elections.

The number of bargaining unit locations is inversely related to the probability of union victory: each additional location lowers the probability of union victory by 8.4 percent. The non-statistical significance of the number of locations variable is at least partially the result of small sample size, where 84.4 percent of all elections involved a single location, and the strong correlation between this variable and the number eligible to vote.

This study postulates that the impact of "size" on election outcome works through both the number of locations and the number of eligible voters. The number of eligible voters is inversely related to the probability of union victory. The coefficient, which is statistically significant at the ten-percent level, indicates that an increase of approximately twenty-three eligible voters evaluated at the sample mean decreases the probability of union victory by one percent. While this is a fairly inelastic response, it is greater than that found by Cooke, where approximately sixty-three additional voters were required to create the same impact on the probability of union victory.11

However, the present data base, like those of earlier studies, does not contain data on changes in the scope and composition of the bargaining unit. The negative correlation between the number of eligible voters and union is likely to be causally related to labor turnover which, while keeping the number and skill composition and scope of eligible voters constant, affect the political homogeneity of the persons involved. Omission of such a variable (if a meaningful measure could even be constructed) is expected to influence the magnitude and even the sign of the variable for number of eligible voters. The participation rate, the number of locations, and changes in the bargaining unit may partly correct for this omission; however, they are at best imperfect proxy variables.

The variable relating to unit change is negative, which is consistent with alteration of a bargaining unit leading to a unit with a more decided employer preference, where the potential gains of unionization may well be less evenly distributed, and which is no longer considered "best" by the union for winning a representation election. The magnitude implies that such adjudicative proceedings by the NLRB have a substantial impact on election outcome, where change of bargaining unit lowers the

11. Cooke, supra note 4, at 410-14. The specification utilized by Cooke is in terms of the inverse of the number eligible to vote, implying that given the partial derivative of this variable 0.811, the partial derivative with respect to NELIG (the number eligible to vote) itself equals \(-0.811/(\text{NELIG})^2\), which evaluated at his sample mean of 71.8 for NELIG gives the result cited of \(-0.00016\).
Table 3
Probability of Union Victory as Delay Varies*

<table>
<thead>
<tr>
<th>Delay (weeks)</th>
<th>With Unit Change</th>
<th>Without Unit Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>0.444</td>
<td>0.595</td>
</tr>
<tr>
<td>10</td>
<td>0.374</td>
<td>0.524</td>
</tr>
<tr>
<td>12</td>
<td>0.309</td>
<td>0.451</td>
</tr>
<tr>
<td>16</td>
<td>0.200</td>
<td>0.315</td>
</tr>
<tr>
<td>20</td>
<td>0.123</td>
<td>0.205</td>
</tr>
<tr>
<td>26</td>
<td>0.056</td>
<td>0.098</td>
</tr>
<tr>
<td>52</td>
<td>0.001</td>
<td>0.002</td>
</tr>
</tbody>
</table>

*Assuming all continuous variables equal sample means.

The probability of union victory by 15.2 percent. The fact that the coefficient is not statistically significant can be attributed at least partly to those factors discussed for the variable for the number of employer locations.

The impact of NLRB intervention into RDDE's is also seen in the negative delay coefficient. This result shows that delay slows or halts the momentum of unions in certification elections, decreasing the probability of union victory. An estimate at the sample mean of each variable in the model indicates that one week of delay decreases the probability of union victory by 3.6 percent. Although Cooke also obtained a negative coefficient for delay, the major difference between the data bases utilized is that while these data contain the actual period of delay in days, Cooke's data contain only the month of each event. He outlined the potential for substantial error measurement associated with his data by stating that "... if this measure shows that delay in one election was one month longer than in another, the actual difference in delay might have been anywhere from one day to nearly two months ...".

Table 3 shows estimated victory probabilities as delay changes for units with and without a unit change. As the delay increases from 8 to 12 weeks, the probability of union victory falls from 59.5 percent to 45.1 percent for elections involving unchanged units and 44.4% to 30.9% for changed bargaining units. If the delay stretches to 16 weeks, these probabilities fall to 31.5 percent and 20 percent, respectively, while at 26 weeks victory probability is less than 10 percent for both groups. These figures reveal the substantial extent to which actions by the NLRB in terms of both definition of bargaining unit and delay are capable of altering election outcomes. For example, if NLRB actions delayed elections

12. Id. at 411.
13. Id. at 407 n.2.
for 8 weeks, rather than the 10.6 week sample average observed here, the results of this study indicate that the probability of union victory would rise by about five percent, about one-tenth the value of the probability of union victory for this sample.

Finally, the positive and statistically significant coefficient for percent showing of interest indicates that, at the sample mean probability, a 1 percent rise in percent showing of interest increases union victory probability by 0.7 percent or that a 10 percent rise in this variable increases victory probability by 6.9 percent. These results are consistent with the role of the percent showing of interest as an accurate gauge of group preferences for unionization and the extent to which signing of authorization cards is an indication of sincere intentions to attain union representation by the persons involved. Because no previous empirical studies included this variable, estimates of the coefficient, of any variables correlated with showing of interest will tend to be biased, which is likely to occur with the coefficients for unit size and the participation rate.

Estimated probabilities of union victory as a function of showing of interest are presented in Table 4. When the percent showing of interest is 30 percent, estimated union victory probability equals 25.3 percent with no unit change, and 15.6 percent for changed units. As showing of interest rises, these probabilities increase, approaching 70.7 percent and 56.7 percent, respectively, when the percent showing of interest equals 100 percent. One important implication of these values relates to elections where unfair labor practices are committed. Where a union has a greater than 50 percent showing of interest, the NLRB sometimes orders union representation without an election in response to pervasive employer unfair labor practices, relying on the 50 percent showing of interest as an accurate measure of majority union sentiment. However, the results of this study indicate that a 50 percent showing of interest is consistent with a union victory probability of no more than 40 percent. The presumption that the percent showing of interest translates into a roughly equivalent probability of union victory is therefore not supported by these empirical results. For the probability of union victory to exceed 50 percent, the required percent showing of interest must reach between 60 and 65 percent in the absence of unit change). This closely parallels the findings of McGuinness, where unions were victorious in 52 percent of elections where the percent showing of interest was between 50 and 70 percent. Thus, while percent showing of interest is a strong, significant

14. A biased coefficient is one that on average is not equal to the true value of the coefficient, where this is related to the mean of the sampling distribution of the estimated coefficient.
Table 4
Probability of Union Victory as Percent Showing Interest Varies*

<table>
<thead>
<tr>
<th>Percent Showing Interest</th>
<th>Probability of Union Victory With Unit Change</th>
<th>Probability of Union Victory Without Unit Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0.156</td>
<td>0.253</td>
</tr>
<tr>
<td>40</td>
<td>0.196</td>
<td>0.310</td>
</tr>
<tr>
<td>50</td>
<td>0.244</td>
<td>0.373</td>
</tr>
<tr>
<td>60</td>
<td>0.299</td>
<td>0.440</td>
</tr>
<tr>
<td>70</td>
<td>0.361</td>
<td>0.510</td>
</tr>
<tr>
<td>80</td>
<td>0.428</td>
<td>0.579</td>
</tr>
<tr>
<td>90</td>
<td>0.497</td>
<td>0.645</td>
</tr>
<tr>
<td>100</td>
<td>0.567</td>
<td>0.707</td>
</tr>
</tbody>
</table>

*Assuming all continuous variables equal sample means.

indicator of group preference for unionization, some care is necessary in utilizing this variable as the basis for representation decisions in the absence of actual certification elections.

IV
Conclusions

The empirical results of this paper are consistent with the hypothesis that adjudicative proceedings by the NLRB exert a significant influence on certification election outcomes. By examining RDDE's, which necessarily entail substantial intervention by the Board, this study found that change of bargaining unit and delay are potentially capable of substantially reduce the probability of union victory. Change of bargaining unit was found to lower union victory probability by 15.2 percent, while each additional week of delay is associated with a 3.6 percent decrease in this probability. The impact of the percent showing of interest was also evaluated. This variable, which was not considered by any previous empirical studies in this area, was found to be a statistically significant determinant of election outcome. The results indicate that the percent showing of interest is an accurate measure of pro-union sentiment and imply the need for caution in utilizing authorization cards as the basis for a Board-ordered certification in the absence of an NLRB-conducted election.

The impact of the participation rate on the probability of union victory was found to be small enough that it would be a decisive factor only in the most closely contested elections. The participation rate most likely influences the margin of victory more than its probability. Finally, the unemployment rate is negatively related to the probability of union victory in RDDE's, demonstrating the relatively greater importance of em-
ployer resistance in RDDE's than in other types of certification elections. Employer resistance, however, is also felt through changes in the composition of the bargaining unit, altering its political composition. Controlling merely for the number of eligible voters only inadequately accounts for the effect of labor turnover, implying the need for caution in interpreting these and all other empirical results on this topic.

APPENDIX

This paper utilizes logit analysis, a maximum likelihood estimation technique, to estimate the probability of union victory (P). The dependent variable equals 1 if the union won the election, 0 otherwise. Use of ordinary least squares in the context of such a dichotomous dependent variable (called the linear probability model) leads to several problems. These include heteroskedastic errors which are not normally distributed and the possibility of obtaining estimated probabilities that lie outside the closed interval from 0 to 1 if weighted least squares is utilized to attempt to remedy the heteroskedasticity problem. Logit analysis utilizes the cumulative logistic density function, which is bounded between 0 and 1, to obtain consistent parameter estimates for an equation where the dependent variable is the log of the odds (logit) of the particular event occurring. Thus while the logit varies between minus and plus infinity, estimated probabilities remain within the interval from 0 to 1. Estimated coefficients are not partial derivatives in the usual sense, but indicate the partial derivative of the logit of the event for which the dependent variable is 1 with respect to the variable in question.

The specific logit equation estimated in this paper is:

\[
\ln \frac{p_i}{1-p_i} = \beta_1 + \beta_2 NLOCAT + \beta_3 PCTINT + \beta_4 UNTCHG \\
+ \beta_5 DELAY + \beta_6 NELIG + \beta_7 UNEMP \\
+ \beta_8 CHALL + \beta_9 PARTIC
\]

where: NLOCAT is the number of locations for the bargaining unit in question; PCTINT is the percent showing of interest; UNTCHG is a dummy variable indicating whether the petitioned bargaining unit was changed, equal to 1 if yes, 0 otherwise; DELAY is the number of weeks between the filing of petition and election; NELIG is number eligible to vote (unit size); UNEMP is the prevailing local rate of unemployment at the time of the election; CHALL indicates the number of ballots challenged; and PARTIC is voter participation rate.

Partial derivatives of the probability of union victory with respect to each variable are obtained by multiplying the coefficient of a variable by
the product $P$ times $(1-P)$, where $P$ is obtained using sample means of each variable (unless otherwise specified).