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Union Organizing Decisions in a Deteriorating Environment: The Composition of Representation Elections and the Decline in Turnout*

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Abstract

It is well known that the organizing environment for labor unions in the U.S. has deteriorated dramatically over a long period of time, contributing to the sharp decline in the private sector union membership rate and resulting in many fewer representation elections being held. What is less well known is that, since the late 1990s, average turnout in the representation elections that are held has dropped substantially. These facts are related. I develop a model of union decision making regarding selection of targets for organizing through the NLRB election process with the clear implication that a deteriorating organizing environment will lead to systematic change in the composition of elections held. The model implies that a deteriorating environment will lead unions not only to contest fewer elections but also to focus on larger potential bargaining units and on elections where they have a larger probability of winning. A standard rational-voter model implies that these changes in composition will lead to lower turnout. I investigate the implications of these models empirically using data on turnout in over 140,000 NLRB certification elections held between 1973 and 2009. The results are consistent with the model and suggest that changes in composition account for about one-fifth of the decline in turnout between 1999 and 2009.

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1 Introduction and Background

It is well known that the union membership rate in the U.S. private sector has been falling for almost 40 years, from about 25 percent in the early 1970s to less than 7 percent in 2012 and 2013.[1] It is also well known that union organizing activity in the private sector, measured by the number of National Labor Relations Board (NLRB) supervised representation elections, has been declining over the same period, from over 7,000 elections per year in the early 1970s to between 1,500 and 2,000 elections per year in the 2005-2009 period.[2] These facts reflect a long run deterioration in the economic and organizing environment faced by unions in this country.

What is less well known is that turnout in these elections, while historically very high (almost 90 percent, on average) has dropped substantially since the late 1990s.[3] In this study, I develop a model of union decision making regarding selection of targets for organizing through the NLRB election process with the clear implication that a deteriorating organizing environment will lead not only to fewer elections (less organizing activity) but also to systematic changes in the composition of elections held. The model implies that a deteriorating environment will lead unions to attempt to organize larger potential bargaining units and where they have a larger probability of winning an election. I then use a standard rational-voter model to demonstrate that these changes in composition will lead to lower turnout in the elections that are held. Finally, I present statistical evidence consistent with these models using data on turnout in over 140,000 NLRB certification elections closed between 1973 and 2009.

In the remainder of this section, I present some background on union representation elections, including statistics on the number of elections, union win rates, and turnout over time. In then present, in section 2, a model of union decision making regarding selection of organizing targets, and I derive the empirical implications of this model in the context of a deteriorating organizing environment. In section 3, I present a simple economic model of an individual's vote/no-vote decision and I derive its implications for observed turnout rates. In section 4, I show that, taken together, the model of union selection of targets for organization and the model of the individual vote decision imply that turnout will fall in a deteriorating organizing environment. In section 5, I present a statistical model of turnout rates that ac-

[1] Derived from tabulation of various supplements to the Current Population Survey (CPS).

[2] Derived from tabulation of the NLRB election data that form the basis of my analysis here.

[3] This is in sharp contrast to turnout in national political elections, where turnout is much lower but there is no evidence of a decline. Tabulation of self-reported voting behavior from the November voting supplements to the CPS shows that the probability of a citizen voting in presidential elections averaged 65 percent prior to 2000 and 71 percent subsequently. The comparable figures for off-year elections are 51 percent before 2000 and 53 percent subsequently.

counts for unobserved heterogeneity in vote probabilities across elections. Section 6 contains the results of my analysis of the decline in turnout, and section 7 concludes.

1.1 Background on Union Representation Elections

The National Labor Relations Act (NLRA), passed in 1935, codified in law the right of workers in the private sector to be represented by a union of their choice.[4] This law specified a secret ballot election mechanism that allows workers to express their preferences for union representation. In broad strokes, the NLRA allows a group of workers or a union (or potential union) acting on their behalf to petition the NLRB to hold an election with a "showing of interest" by workers in the potential bargaining unit. An employer can also request an election if a question arises about workers' preferences for union representation. After issues involving the definition of the appropriate group of workers involved are resolved, the NLRB holds an election.[5] If the union receives more than 50 percent of the votes cast in the election, then the NLRB certifies that the union is the exclusive representative of the workers for the purposes of collective bargaining. This certification is valid for one year. If the union and employer reach agreement on a contract within that period, then the union continues as the bargaining agent of the workers. If the union and employer do not reach agreement within that period, then the union is no longer recognized as the bargaining agent of the workers.[6]

1.2 High-Level Facts

In order to set the stage for the theoretical and empirical analyses, I present some aggregate facts regarding the level of election activity over time, union success in elections, and voter

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[4] Additional legislation that served to modify the NLRA includes 1) the Labor-Management Relations (Taft-Hartley) Act, passed in 1947 over President Truman's veto and 2) the Labor-Management Reporting and Disclosure (Landrum-Griffin) Act, passed in 1959.

[5] There are many rules governing employer and union behavior during organizing campaigns, and either side may file "unfair labor practice" charges against the other side with the NLRB. The NLRB adjudicates these charges either before or after the election.

[6] While not directly related to this study, it has been argued that the election process is too cumbersome and that employers can manipulate the process through coercive means that make it difficult 1) for unions to win these elections (e.g., Weiler, 1983; Freeman, 1985) and 2) to reach agreement on a first contract even where they win elections (Prosten, 1978; Ferguson, 2008). One result of this is a proposed revision of the NLRA, the Employee Free Choice Act (EFCA) that would provide for 1) recognition of a union as the bargaining agent of the workers on the basis of a "card check" and 2) first-contract arbitration, whereby an arbitrator sets the terms of the first contract in the event that the union and the employer do not reach agreement in a timely manner. The EFCA was being actively considered by Congress in 2009, but political and economic realities of the time removed any chance it had for passage. See Johnson (2002) and Riddell (2004) for analyses of the Canadian experience with card check recognition that imply a substantial advantage to unions.

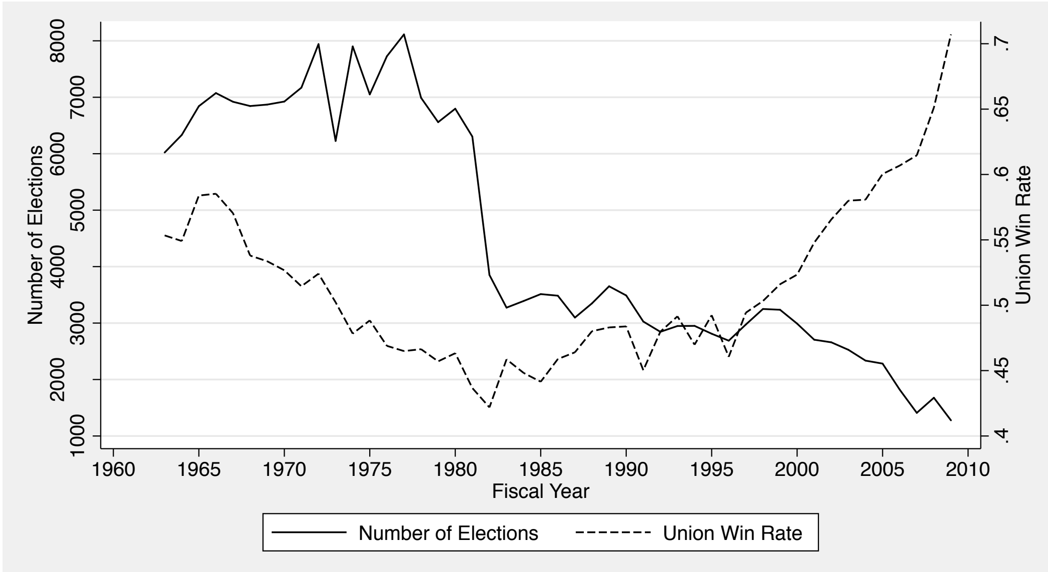

Figure 1: Number of Elections and Union Win Rate in Elections, by Fiscal Year

turnout.

I have data on 237,022 individual elections involving a single union "closed" by the NLRB between July 1962 and August 2009.[7] Of these, 213,548 elections are "certification" elections to determine if a union should represent a group of currently non-unionized workers. The remaining 23,474 elections are "decertification" elections to determine if an existing union should continue to represent a group of currently unionized workers. I focus here only on the certification elections.

1.2.1 The Level of Election Activity and Union Success in Elections

As shown by the solid line in Figure 1 (left scale), the number of certification elections fell sharply in the early 1980s, dropping from about 7,000 per year earlier to less than 4,000 per year in the mid-1980s. The number of elections continued to decline slowly before declining more sharply again beginning in the late 1990s. The number of elections fell from over 3,000 per year in the late 1990s to about 1,500 per year in the late 2000s. This change indicates

[7] These are administrative data for federal fiscal years 1963-2009. I compiled the data from 1973-2009 over a long period of time using data provided by the NLRB. The NLRB no longer has the earlier years of these data available, and I have not been able to obtain sufficiently detailed data on election characteristics and outcomes after August 2009. I thank Alexandre Mas for providing the data from 1962 through 1972, which he had transcribed from published NLRB reports. Early in the period the federal fiscal year ran from July to June before switching to October to September. I recode the earlier fiscal years to run from October to September. On this basis, I have data on elections closed during the 1963-2009 fiscal years (other than those closed in September 2009) as well as during the last quarter of the 1962 fiscal year.

the sharp deterioration in the organizing environment in the early 1980s and between 1999 and 2009.[8]

The union win rate in elections held is shown by the dashed line in figure 1 (right scale). The union win rate fell from over 55 percent in the mid-1960s to less than 45 percent in the early 1980s, then slowly increased to about 50 percent by 1999, and then increased sharply to 70 percent by 2009.

1.2.2 Voter Turnout

Measurement of voter turnout is potentially complicated by the presence of challenged ballots in many elections. There are challenges in about 40 percent of elections where data are available on the number of challenges.[9] The NLRB investigates the validity of challenges only if their aggregate number could have changed the election outcome. The number reported as eligible to vote is the *ex ante* number, including any workers whose eligibility is later questioned while the number of pro- and anti-union votes recorded is the number net of disallowed ballots in cases where challenges are investigated. Thus, a turnout rate calculated as the ratio of the sum of the pro and con votes to the number reported as eligible will not be accurate in the presence of sustained challenges unless all challenges are resolved and the numbers adjusted accordingly. Data are available on the number of challenges sustained only for fiscal years 2000-2009, but these data show that there are sustained challenges in only 1.7 percent of elections with challenges. On this basis, I ignore challenges in my analysis and assume that the reported vote counts can be compared appropriately to the reported number of eligible voters.

I proceed examining turnout in 143,175 elections closed between fiscal years 1973 and 2009.[10] I restrict the sample to observations without missing data on key variables in order to keep the sample fixed as I explore specifications. There are 2,078 elections (1.45 percent of the sample) with missing data on at least one variable. My final sample contains 141,097 elections.

The broad facts regarding mean turnout based on these data are presented in figure 2. The average turnout rate across elections held steady at about 89 percent until the late-1990s and subsequently fell to about 79 percent by 2009. Figure 2 also contains the time series of the aggregate turnout rate (the ratio of the total number of votes across all elections to

[8] Farber and Western (2001, 2002) investigate the causes of the earlier deterioration.

[9] There are no data available on the number of challenges in elections closed prior to July 1972 or in elections closed between December 1978 and September 1980.

[10] I do not have data on all variables used in my analysis for elections closed prior to fiscal year 1973. As a result I do not use the data for the 1963-1972 period in what follows.

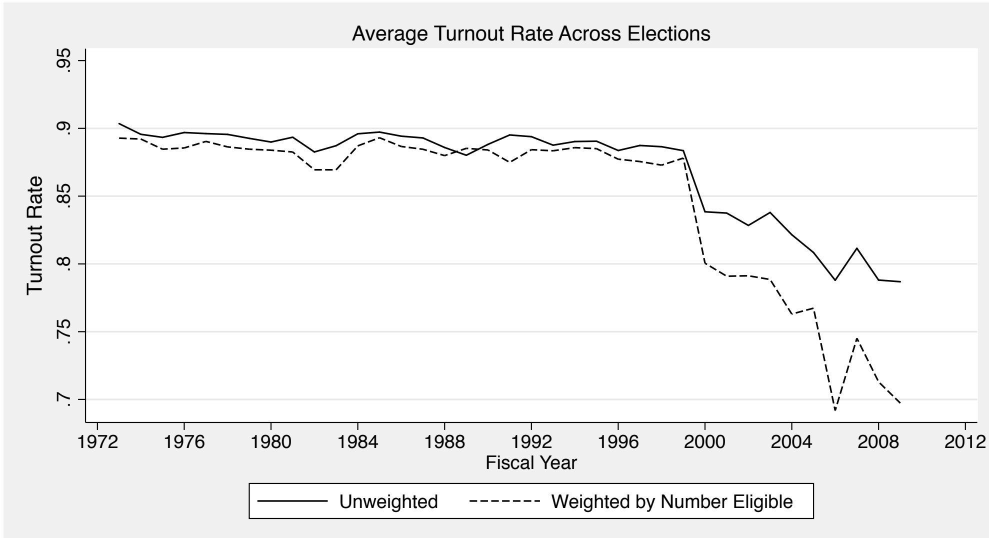

Figure 2: Turnout rate in Union Representation Elections, 1972-2009

the total number of eligible voters across all elections). The aggregate turnout rate shows a similar time-series pattern though it falls more sharply, from 89 percent to 70 percent over the same period. The sharper decline of the aggregate turnout rate reflects a shift in composition of elections from smaller elections with higher turnout to larger elections with lower turnout.

Turnout rates in union representation elections are very high compared to those we see in the usual political elections. This could reflect several factors. First, these elections are quite small relative to the usual elections for public office. The median number of eligible voters is 23 with a mean of 60. The 25th percentile is 10 eligible voters and the 75th percentile is 58 elgibile voters. Fully 86 percent of elections have 100 or fewer eligible voters. Second, these elections are about workers' livelihoods, so the stakes can be very high. Third, these elections are generally held at the workplace during working hours, so the cost of voting is relatively low.

2 The Union Decision to Hold a Representation Election

The set of elections that are held is the result of a selection process by labor unions about how much organizing to undertake and where to focus their organizing activity. In this section, I present an economic model of union decision making to understand this process. This model provides a context within which to understand the time-series patterns of election activity and turnout presented in the previous section.

An economically rational labor union will contest elections only where there is a positive expected value associated with the election. This suggests that among all possible potential bargaining units, called "targets" here, elections are more likely when the likelihood of a union victory is higher. This has potentially important implications for changes in the quantity of election activity, election outcomes, and voter turnout over time. Clearly, the potential bargaining units in which elections are held at any point in time are not representative of the pool of targets as a whole since elections are more likely to be held in places where workers are thought to be favorable to unions. Additionally, unions may perceive larger benefit to organization in certain types of workplaces, and, in these cases, they will be willing to contest an election even where workers may be less favorably disposed to unions.[11]

Consider a union's decision regarding whether or not to contest an election at a specific target. The union bases its decision on several factors:[12]

- the per-worker benefit to the union of a union victory (V),
- the per-worker cost to the union (net of union dues) of negotiating a contract and administering a unionized workplace (C_a),
- the per-worker cost to the union of the organization effort (C_o), and
- the probability of a union victory in an election (π).

The definition of the benefits and costs as per-worker organized (the number of eligible voters, N) is simply a normalization that eases exposition.

The per-worker expected value to the union of contesting an election at target i is

$$E(V_i) = \pi_i(V_i - C_{ai}) - C_{oi}. \tag{1}$$

A rational union will undertake to organize the target if $E(V_i)$ is positive. This implies that the condition for an election to be held is

$$\pi_i > \frac{C_{oi}}{(V_i - C_{ai})}. \tag{2}$$

The right hand side of equation 2 defines a critical value for the probability of a union victory. This is

$$\pi_i^* = \frac{C_{oi}}{(V_i - C_{ai})}, \tag{3}$$

[11] See Dinlersoz, Greenwood, and Hyatt (2014) for an interesting theoretical and empirical analysis of union choice of organizing targets.

[12] I abstract here from the fact that a union victory in many cases does not result in the successful negotiation of a contract. This difficulty in negotiating a first contract has increased over time. While there are no systematic data on representative samples of union-won elections, Weiler (1984) analyzed a small number of surveys and found that the fraction of union wins yielding first contracts fell from 86 percent in 1955 to 63 percent in 1980. Ferguson (2008) reports that only 39 percent of union wins between 1999 and 2004 yielded a first contract. See also, Prosten (1978) and Cooke (1985).

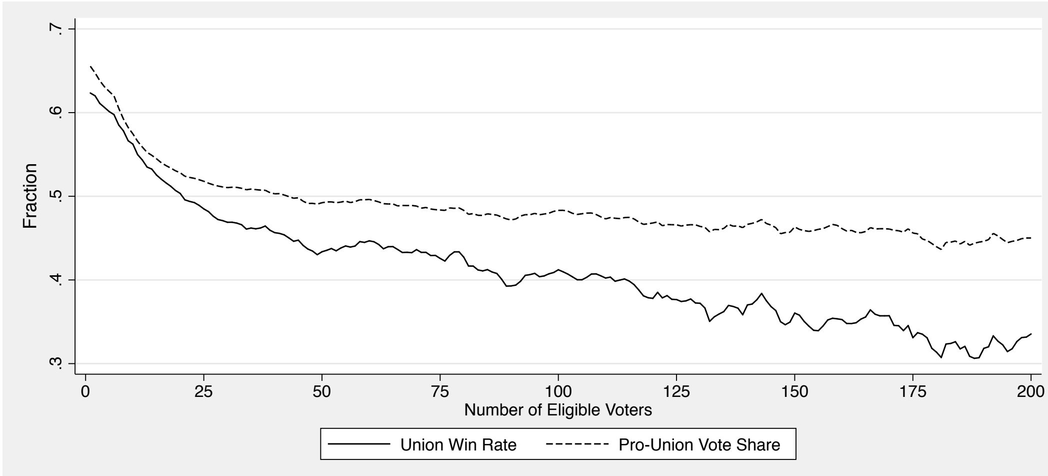

Figure 3: Union Win Rate and Pro-Union Vote Share, by Election Size (5-voter moving average)

and unions will contest elections where $\pi_i > \pi_i^*$.

An important characteristic of the target is its size (N_i). Size may have a direct effect on the probability of a union victory. Additionally, the number of workers could also have an important effect on the appeal of the target to the union even holding the probability of a union victory fixed. A union victory in a large election could have important positive spillovers for the union in terms of bargaining leverage and "marketing value" in other organizing campaigns ($\frac{\partial V_i}{\partial N_i} > 0$). Additionally, perhaps due to the existence of fixed costs, there are likely to be decreasing costs per worker of holding the organizing drive ($\frac{\partial C_{oi}}{\partial N_i} < 0$) and decreasing costs per member of servicing a bargaining unit once there is a union victory ($\frac{\partial C_{ai}}{\partial N_i} < 0$). Together, these imply that the critical value for the probability of a union victory is decreasing in election size ($\frac{\partial \pi_i^*}{\partial N_i} < 0$) so that unions will contest larger elections where they have a smaller chance of winning.

This selection by unions implies that observed union win rates will be negatively related to the number of eligible voters. Figure 3 contains plots of the union win rate and pro-union vote share rate in elections by number of eligible voters. Consistent with the union selection model, the union win rate and pro-union vote share fall with election size.[13]

Substantial evidence exists that the political and legal environment for unions worsened substantially in the early 1980's (Weiler (1990), Gould (1993), and Levy (1985)). This could affect both the distribution of π and the cost of organization to the union (C_o). A shift

[13] Farber (2001) presents an analysis of election outcomes that uses this model to understand the relationship of outcomes with election size.

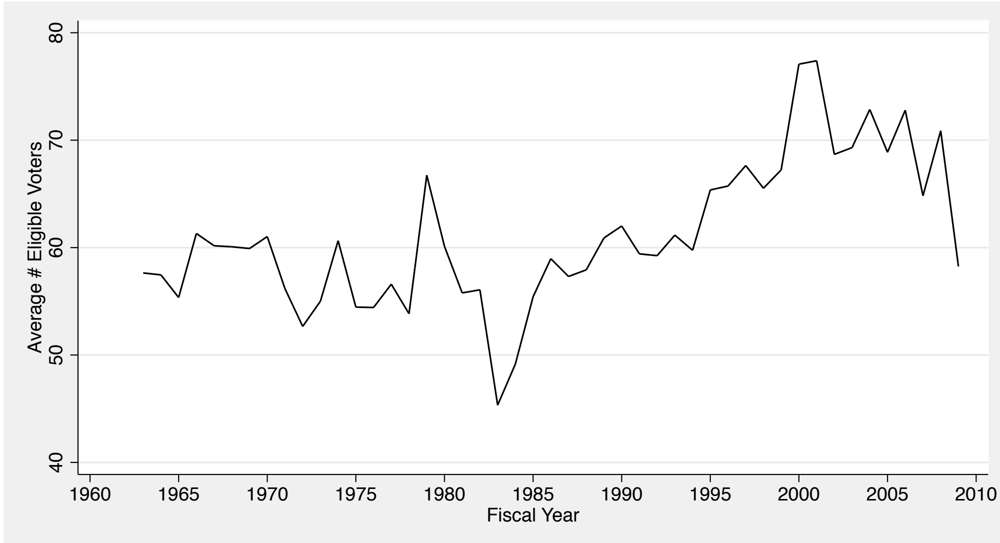

Figure 4: Average Election Size, by Fiscal Year.

to the left in the distribution of π (implying fewer good targets for organization) does not, by itself, imply a change in the critical value for the probability of a union victory (π^*). The first-order result will be that fewer elections will be held. But, since the selection rule remains unchanged, union success in elections that are held will not be greatly affected.[14] However, it is likely that the adverse changes in the organizing environment increase the cost of organization (C_o). The result will be an increase in π^* implying that the set of elections actually contested will, on average, offer a higher probability of union success. Taken together, the effects of adverse changes in the organizing environment on the distribution of π and on C_o will result in fewer elections being held and greater union success in those elections that are held. This is consistent with the decline in the number of elections held and the increase in union win rates over time shown in figure 1.

Another implication of the model for the composition of elections held as the organizing environment worsens is that unions will tend to organize larger potential bargaining units. This results from an increase in the fixed component of organizing costs due to the deteriorating environment. Since these increased fixed costs are spread over more workers in larger potential bargaining units, the per-worker cost of organization will decline with unit size. As a result, unions will cut back organizing of smaller units more than organizing of larger units. The time-series pattern of average unit size, shown in figure 4, generally shows the expected increase in unit size over time. However, the growth is not monotone. Average

[14] In fact, the extent to which union success will be affected depends on the underlying distribution of π before and after the shift.

election size grew substantially from 45 in 1983 to 67 in 2000 before falling subsequently to 58 in 2009.

3 An Economic Model of Voting

In this section, I develop an economic model of the decision to vote that highlights the economic factors influencing turnout. The key factors in the economic model are 1) the probability that a worker is pivotal (that his/her vote will change the outcome of the election), 2) the stakes (the difference in value to the potential voter of the different outcomes, a union win or a union loss in this case), and 3) the costs and benefits of the act of voting itself. The model provides the necessary foundation for understanding how differences across elections in these key factors affect voter turnout.

In a rational voter model, the decision to vote is based on a comparison of expected utility conditional on voting ($E(U|V)$) with expected utility conditional on not voting ($E(U|NV)$). Expected values are used since the outcome of the election is uncertain. Consider the following framework, which borrows heavily from the analysis of Coate, Conlin, and Moro (2008).[15]

In a given workplace, the expected fraction of workers who are pro-union is denoted by μ. These workers, if they vote, vote in favor of union representation. Similarly, anti-union workers, if they vote, vote against union representation. Pro-union workers receive a benefit of $b_p > 0$ if the union wins the election. Anti-union workers receive a "benefit" of $b_c < 0$ if the union wins the election. For simplicity, I assume $b_p = -b_c = b$ in what follows.

I define C_i as the cost of voting to worker i net of the direct benefit worker i receives from the act of voting itself, independent of any expected benefit that comes from the possibility that his vote would alter the election outcome. As such, C_i may well be negative. I assume C_i varies across workers and is distributed with CDF $G(\cdot)$.

A vote is pivotal if it changes the outcome of the election. The NLRA specifies that the union is certified as the bargaining agent of the workers if and only if a majority of those voting vote in favor. Thus, unions lose ties. For this reason, a pro-union worker's vote will be pivotal only if the election would be tied without his vote, and an anti-union worker's vote will be pivotal only if, without his vote, the union would win the election by one vote. Denote the probability that the vote would be tied without a particular worker's vote by

[15] The rational choice theory of voting has a long history, dating at least to Downs (1957) and Riker and Ordeshook (1968). Further refinement of the models and the introduction of game theoretic considerations, where decisions to vote depend on the decisions of others, has occurred. Early models are due to Ledyard (1981) and Palfrey and Rosenthal (1983, 1985). Frerejohn and Fiorina (1974) present an alternative framework for understanding the voting decision based not on expected utility maximization but on the minimax regret decision criterion.

ΔW_+. Denote the probability that the union would win by one vote without a particular worker's vote by ΔW_-.

On this basis, a pro-union worker will vote if and only if

$$C_i \leq b\Delta W_+. \tag{4}$$

Given the assumed distribution for costs and noting that μ represents the probability that a randomly selected worker is pro-union, the probability that a randomly selected worker votes in favor of union representation is

$$p_p = \mu G(b\Delta W_+). \tag{5}$$

Analogously, an anti-union worker will vote if and only if

$$C_i \leq b\Delta W_-. \tag{6}$$

Given the assumed distribution for costs, the probability that a randomly selected worker votes against union representation is

$$p_c = (1-\mu)G(b\Delta W_-). \tag{7}$$

The turnout rate in the election is[16]

$$p = p_p + p_c = \mu G(b\Delta W_+) + (1-\mu)G(b\Delta W_-). \tag{8}$$

It is clear from this relationship that the turnout rate is negatively related to the cost of voting (C_i) through the distribution of costs ($G(\cdot)$) and postively related to the stakes (b) and to the probability that a worker's vote is pivotal (ΔW_+ and ΔW_-).

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[16] The probabilities of voting (p_p and p_c) depend on the decisions of all workers. As such, an equilibrium concept is needed to define the outcome. A natural choice is a symmetric Nash equilibrium such that all voters are making decisions regarding whether to vote consistent with equations 4 or 6, as appropriate, conditional on common information regarding the fraction pro-union (μ), the distribution of costs ($G(\cdot)$, and the benefit of getting the preferred outcome (b). The probabilities of being pivotal depend on the vote probabilities, and the result is that the probabilities of voting are complicated implicit functions. The probability that a pro-union worker's vote is pivotal (the probability of a tie not including the vote of worker i), based on a multinomial distribution for the vote counts, is

$$\Delta W_+ = Pr(n_p = n_c) = \sum_{i=0}^{INT(n/2)} \frac{n!}{i!i!(n-2i)!} p_p^i p_c^i p_a^{n-2i},$$

where $n = N-1$, the number of eligible voters less one and $INT(\cdot)$ returns the truncated integer value of its argument. The probability that an anti-union worker's vote is pivotal is the probability that the union wins by one not including the vote of worker i. Based on a multinomial distribution for the vote counts, this is

$$\Delta W_- = Pr(n_p = n_c + 1) = \sum_{i=0}^{INT((n-1)/2)} \frac{n!}{(i+1)!i!(n-2i-1)!} p_p^{i+1} p_c^i p_a^{n-2i-1}.$$

3.1 What Determines the Probability that a Voter is Pivotal?

In order to refine the prediction that the turnout rate increases with the probability that a worker's vote is pivotal (ΔW_+ and ΔW_-) and relate it to observable quantities, I make two assumptions that greatly simplify the analysis. First, I ignore the distinction between pro- and anti-union workers and assume they have the same probability of being pivotal and, hence, vote with the same probability in any given election.[17] Second, I use the probability of a tie as an indicator of the probability that a worker's vote will be pivotal.[18] I then derive an approximate expression for the likelihood of a tie in a given election as a function of the number of votes cast in the election (v) and the share of workers who are pro-union (μ), and I analyze how this probability varies with election characteristics (size and closeness).

In an election with v votes cast, let $h = v/2$ represent the number of votes cast in each direction that results in a tie. In this case, the probability of a tie is

$$P_T = \frac{(2h)!}{h!h!}\mu^h(1-\mu)^h. \tag{9}$$

Using Stirling's approximation for $h!$, the probability of a tie is[19]

$$P_T = \frac{2^{2h}}{\sqrt{\pi h}}\mu^h(1-\mu)^h. \tag{10}$$

The comparative statics are more easily examined using the natural logarithm of the probability of a tie, and this is

$$\ell n(P_T) = 2h\ell n(2) - 0.5\ell n(\pi h) + h(\ell n(\mu) + \ell n(1-\mu)). \tag{11}$$

Differentiating $\ell n(P_T)$ with respect to election size (h) yields[20]

$$\frac{\partial \ell n(P_T)}{\partial h} = 2\ell n(2) - 0.5/h + (\ell n(\mu) + \ell n(1-\mu)). \tag{12}$$

This is negative for all values of h and μ, implying, not surprisingly, that the probability of a tie decreases as elections get larger. Differentiating with respect to the pro-union share of the workforce (μ) yields

$$\frac{\partial \ell n(P_T)}{\partial \mu} = h\left[\frac{1-2\mu}{\mu(1-\mu)}\right]. \tag{13}$$

[17] This ignores the asymmetry between pro- and anti-union workers induced by the NLRA rule that union's lose ties.

[18] The probability of a tie is not precisely the probability that a worker's vote is pivotal, but the two probabilities are closely related. Additionally, while a tie is not possible in elections with an odd number of votes cast, my analysis below, which relies on a continuous approximation to $h!$ (where h is the 1/2 the number of votes cast) in calculating the probability of a tie, neatly solves this problem.

[19] Stirling's approximation for $h!$ is $h! \approx \sqrt{2\pi h} \cdot (n/e)^n$.

[20] In fact, h is 1/2 election size, but this does not affect the interpretation.

This is positive when $\mu < 0.5$ and negative when $\mu > 0.5$, which implies, again not surprisingly, that the probability of a tie increases as the workforce becomes more evenly divided between pro- and anti-union. Finally, the second cross derivative of $\ell n(P_T)$ with respect to h and μ is

$$\frac{\partial^2 \ell n(P_T)}{\partial \mu \partial h} = \left[\frac{1-2\mu}{\mu(1-\mu)}\right], \tag{14}$$

which again is positive when $\mu < 0.5$ and negative when $\mu > 0.5$. This implies that the marginal effect of a move toward closeness (a move in μ toward 0.5) on the probability of a tie increases as the election becomes larger.

3.2 Empirical Implications of the Economic Model

There are at least five empirical predictions of the model.

1. Turnout will fall as the cost of voting increases (C).

2. Turnout will increase with the stakes (b).

3. Turnout will fall with the number of eligible voters because the probability that a worker's vote is pivotal falls with the number of eligible voters.

4. Turnout will increase as the election is expected to be closer because the probability that a worker's vote is pivotal increases as preferences for and against union representation become more even ($|\mu - 0.5|$ declines).

5. The marginal effect of closeness (lower $|\mu - 0.5|$) will be larger in larger elections (higher h).

The first two predictions are intuitive and follow directly from equations 4 and 6.[21] The last three predictions follow from the analysis of the probability of a tie (the probability of a voter being pivotal) summarized in equations 9-14.[22]

[21] Unfortunately, I have no direct measures of the stakes to workers of unionization. My empirical analysis will focus on variables related to the likelihood of a vote being pivotal and on one variable related to the cost of voting.

[22] An empirical finding that turnout is lower in large elections or higher in closer elections (predictions 3 and 4) could result from larger or closer elections being different in (unspecified) other ways related to turnout. Finding additionally that the marginal effect of closeness increases with election size (a second order prediction of the model), as prediction 5 suggests, would add weight to the interpretation that worker perceptions of the probability of being pivotal are important in the decision to vote.

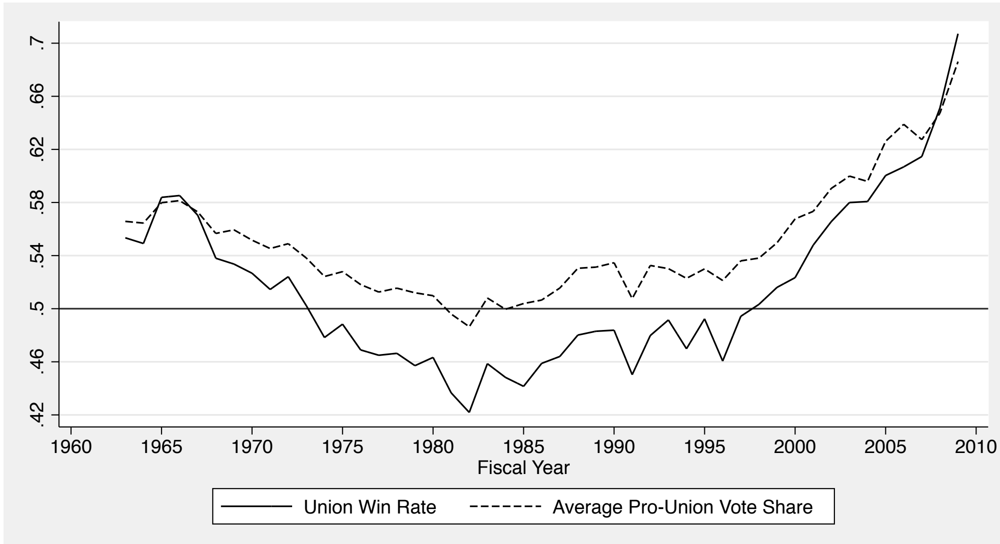

Figure 5: Average Union Win Rate and Pro-Union Vote Share, by Fiscal Year.

4 Implications of the Models for the Decline in Turnout

Taken together, the model of union selection of targets for organization and the model of the individual vote decision implies that turnout will fall in a deteriorating organizing environment. This happens in two stages. In the first stage, the deterioration of the organizing environment causes unions to choose a different distribution of targets for organization. As I noted in section 2, these targets will be larger and will skew toward elections where unions have a higher probability of winning. In the second stage, this change in the average characteristics of elections will result in lower turnout through individual vote/no-vote decisions. Individual votes are less likely to be pivotal in larger elections and in elections that are less closely contested.

Preliminary evidence suggests that the move toward larger elections is not an important factor explaining the decline in turnout between 1999 and 2009. Figure 4 shows that the period of growth in election size coincides with the deterioration in the organizing environment beginning in the 1980s. However, average election size declined between 1999 and 2009, which suggests that changing election size is not a factor that will explain the decline in voter turnout over that period.

On the other hand, preliminary evidence shows that the move between 1999 and 2009 toward elections where the union has a higher chance of winning could be an important factor in explaining the decline in turnout over this period. Figure 5 contains plots of the union win rate and average pro-union vote share over time, and it shows that both of these measures increased sharply between 1999 and 2009 and, importantly, were above 0.5 for this entire period. The movement of the vote share away from 0.5 since the late 1990s clearly implies that elections were becoming less close since over this period, and the timing of this reduction in closeness is remarkably similar to the timing of the decrease in voter turnout (figure 2).

5 A Statistical Description of Turnout Rates

The simplest statistical model of the turnout rate is a binomial model based on the assumption that individuals' decisions to vote are independent and have identical probability within a given election. The probability that an eligible worker votes, p, is defined in equation 8 and the probability that a worker in that election does not vote is $1 - p$. The number of votes cast in the election (v) with N eligible voters has a binomial distribution such that

$$Pr(v|N) = \binom{N}{v} p^v (1-p)^{N-v}. \tag{15}$$

Given that voting probabilities vary across elections, I specify p as a linear function of a vector of variables, X so that $p = X\beta$, and this is also the expected turnout rate.

A model such as this may fit mean turnout rates quite well, but it does not tell the whole story. If there is unmeasured variation in the probability of a worker voting across elections of a given size and other observed characteristics, then this model will under-predict dispersion across elections in turnout rates. In order to address this problem, I allow the probability that a worker votes to vary across elections with a given set of observed characteristics, and I assume that these probabilities follow a beta distribution. This distribution has positive density only on the unit interval, and it has the additional advantages of having a flexible functional form and of yielding a tractable result when mixed with the binomial distribution (Evans, Hastings, and Peacock, 1993).

On this basis, I assume that p is distributed as beta such that

$$g(p; m, \alpha) = \frac{\Gamma(\alpha)}{\Gamma(m\alpha)\Gamma((1-m)\alpha)} p^{m\alpha - 1}(1-p)^{(1-m)\alpha - 1}, \tag{16}$$

where m and α are positive parameters and $\Gamma(\cdot)$ is the gamma function.[23] The parameters of this beta distribution (m and α) have convenient relationships with the mean and variance of the distribution of p:[24]

[23] The gamma function is defined as $\Gamma(x) = \int_0^\infty exp(-z)z^{x-1}dz$.

[24] The beta distribution has a flexible functional form. The distribution is uni-modal (inverse U-shaped) if $m\alpha > 1$ and $(1-m)\alpha > 1$. Otherwise, the distribution is bimodal (U- or J- shaped). A special case is that the distribution is uniform if $\alpha = 2$ and $m = 0.5$.

- The expected value of p is m, and
- The variance of p is $\sigma_p^2 = m(1-m)/(1+\alpha)$.

Over-dispersion is captured by the parameter α. As $\alpha \to \infty$, the variance of p goes to zero. Smaller values of α imply positive variance in the expected fraction voting across elections.

The conditional (on a particular value of p) distribution of the number of votes cast is given in equation 15. Integrating over the beta prior distribution for p (equation 16), the expression for the unconditional probability of the number of votes cast in an election with N eligible voters is

$$f(v|N) = \binom{N}{v} \frac{\Gamma(\alpha)\Gamma(m\alpha + v)\Gamma((1-m)\alpha + N - v)}{\Gamma(m\alpha)\Gamma((1-m)\alpha)\Gamma(N+\alpha)}. \tag{17}$$

In order to illustrate the importance of allowing for unmeasured variation in p and to provide a baseline for the decline over time in turnout, I start by estimating a simple binomial model of the turnout rate at the election level where the probability that an individual votes (p) is a linear function of a set of year fixed effects. I estimate this model using the sample of 141,097 elections between fiscal years 1973 and 2009 described above. I then estimate the beta-binomial model with the parameter m (the mean of the distribution of the probability of voting) also specified as a linear function of year fixed effects.[25] The beta-binomial model adds a single parameter (α) and improves the log-likelihood dramatically (from -750,302.6 in the binomial case to -334,411.8 in the beta-binomial case). The estimated value of α in the beta-binomial is 7.61 (s.e. = 0.0432). This estimate implies substantial variation across elections in the vote probability. At a value for the mean probability of voting of 0.873 (the estimated value of m for 1999), the implied standard deviation of the vote probability across elections is 0.113.

I next estimate an augmented specification of the beta-binomial model that additionally allows the parameter α to vary by year (adding an additional 36 parameters). This is equivalent to estimating a separate beta-binomial model for each year, and this specification has the important advantage of allowing the variance of the vote probability to vary by year with a degree of freedom in addition to the effect of the mean.[26] The fit of the model is

[25] Analogously to the specification of p in the binomial model as $p = X\beta$, I specify $m = X\beta$. This allows the mean vote probability across elections to vary with observable variables. Introducing observable variables correlated with p in this way will generally increase the estimate of α in the beta distribution, as less variation is attributed to unobservables.

[26] In fact, the variance of the probability of voting has been changing over time. When α is allowed to vary by year, the standard deviation of the probability of voting implied by the year-specific estimates of α increases by 65 percent between 1999 and 2009. If I did not allow for this movement over time in α, changes in the variance over time could substantially affect the estimates of the yearly mean vote probabilities.

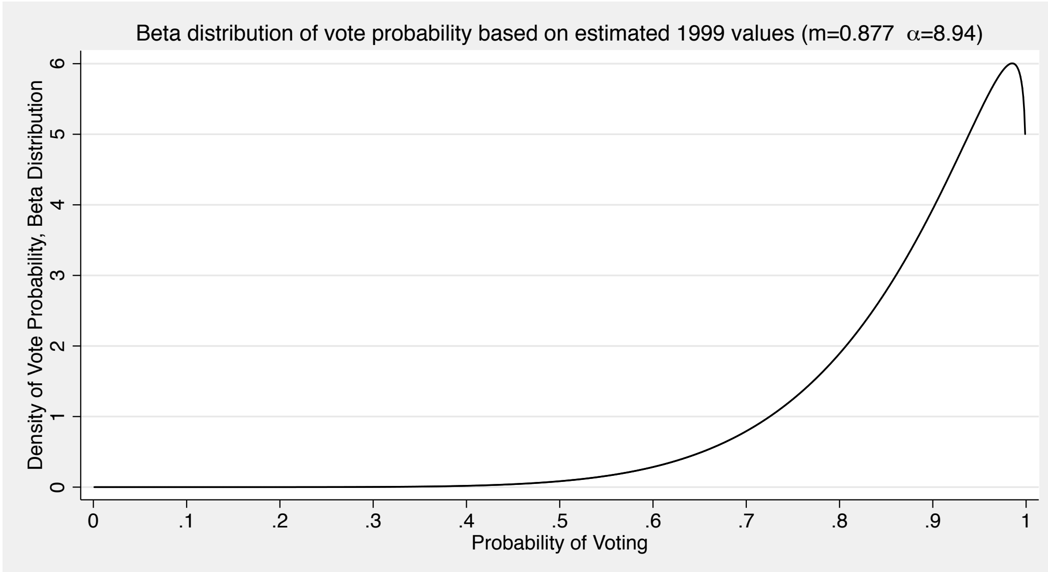

Figure 6: Beta Density Function of Vote Probability (Equation 16)

further improved (log-likelihood of -330,224.0). I continue using the augmented specification of the beta-binomial with year fixed effects determining α.

Figure 6 contains a plot of the estimated density function for p assuming a mean vote probability of $m = 0.877$ and $\alpha = 8.94$ as estimated for fiscal year 1999 using the beta-binomial model for election turnout. The figure illustrates that there are many elections with very high expected vote probabilities. The standard deviation of this distribution is 0.1042 and the 75th and 90th percentiles of this distribution are 0.956 and 0.982 respectively. There are substantial numbers of elections with very high turnout probabilities (well above the estimated mean of 0.877).

Figure 7 presents plots of the estimated year effects (1999=0) in the predicted mean probability that an individual votes from the binomial and beta-binomial models. The year effects from the binomial model reflect changes from 1999 in the probability of voting in elections with no allowance for heterogeneity across elections. Consistent with the observed decline in overall average turnout shown in figure 2, there is a sharp drop in average turnout of about 18 percentage points between 1999 and 2009. The estimates from the beta-binomial model, which allows for variation across elections in the individual probability of voting, shows a smaller but still substantial decline of 11.7 percentage points in the mean of the distribution of vote probabilities over the same period. This is very close to the 12 percentage point decline in election average turnout shown in figure 2.

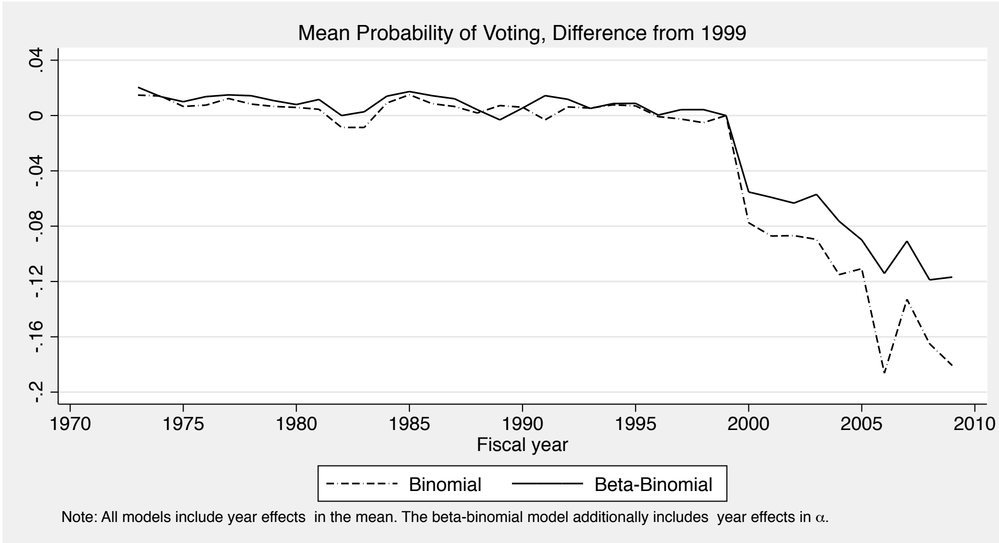

Figure 7: Year Effects in the Mean Probability of Voting (1999=0), 1973-2009.

6 Statistical Analysis of the Decline in Mean Turnout

The first column of table 1 contains estimates of the beta-binomial model with fiscal year fixed effects determining both parameters of the distribution (m (the mean) and α). This is equivalent to estimating separate models for each fiscal year with common parameters across all elections in a given year. I take the decline in mean turnout estimated in this model of 11.7 percentage points (s.e. = 0.007) between 1999 and 2009, shown in the solid line in figure 7, as the decline for which an accounting is needed.

I now add variables in sequence that can affect the the mean probability of voting in order to account for the decline in turnout since 1999.

6.1 Mode of Election

The large majority of representation elections are held on site (at the workplace). However, beginning around 1990, a small but increasing fraction of elections have been conducted by mail or with a combination of on-site and mail ballots (mixed elections) rather than on-site. It is likely that mail elections impose a greater cost burden on potential voters, and the economic model predicts that turnout will fall with the cost of voting. This suggests that the shift toward mail ballots could account for some of the decline in turnout.

NLRB procedures regarding representation cases state that mail balloting is used only in unusual circumstances at the discretion of the NLRB Regional Director.[27] While there is

[27] The NLRB document, *An Outline of Law and Procedure in Representations Cases,* ch. 22, states that

Table 1: Beta-Binomial Model of Voter Turnout

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Determinants of m						
Constant (base year 1999)	0.8765	0.8798	0.9005	0.9568	0.9833	0.9476
	(0.0022)	(0.0022)	(0.0128)	(0.0128)	(0.0125)	(0.0126)
Mail or Mixed	----	-0.1164	-0.1047	-0.1057	-0.0937	-0.0964
		(0.0036)	(0.0035)	(0.0035)	(0.0034)	(0.0034)
$\ell n(N) \cdot I(N \leq 100)$	----	----	----	-0.0154	-0.0187	-0.0087
				(0.0004)	(0.0004)	(0.0006)
$I(N > 100)$	----	----	----	-0.0688	-0.0851	-0.0455
				(0.0015)	(0.0015)	(0.0023)
$E((\mu - 0.5)^2 \vert s)$	----	----	----	----	-0.3799	0.2411
					(0.0069)	(0.0069)
$E((\mu - 0.5)^2 \vert s) \cdot \ell n(N) \cdot I(N \leq 100)$	----	----	----	----	----	-0.1823
						(0.0090)
$E((\mu - 0.5)^2 \vert s) \cdot I(N > 100)$	----	----	----	----	----	-0.7581
						(0.0342)
Region FE's (8)	No	No	Yes	Yes	Yes	Yes
Industry FE's (9)	No	No	Yes	Yes	Yes	Yes
Year FE's (37)	Yes	Yes	Yes	Yes	Yes	Yes
Change in Mean	-0.1168	-0.1085	-0.1027	-0.1030	-0.0823	-0.0826
1999 to 2009	(0.0070)	(0.0069)	(0.0068)	(0.0067)	(0.0065)	(0.0064)
Determinants of α						
Constant (1999=0)	8.935	8.447	9.557	9.396	9.944	10.056
	(0.3324)	(0.3143)	(0.3651)	(0.3573)	(0.3829)	(0.3889)
Year FE's (37)	Yes	Yes	Yes	Yes	Yes	Yes
$\ell n(L)$	-330224.0	-329587.0	-326969.3	-325900.1	-324323.7	-324079.5

Note: This model is estimated by maximum likelihood over the sample of 141,097 elections closed between 1973 and 2009 with no missing data on any of the variables included in any specification. The base fiscal year is 1999. Asymptotic standard errors are in parentheses.

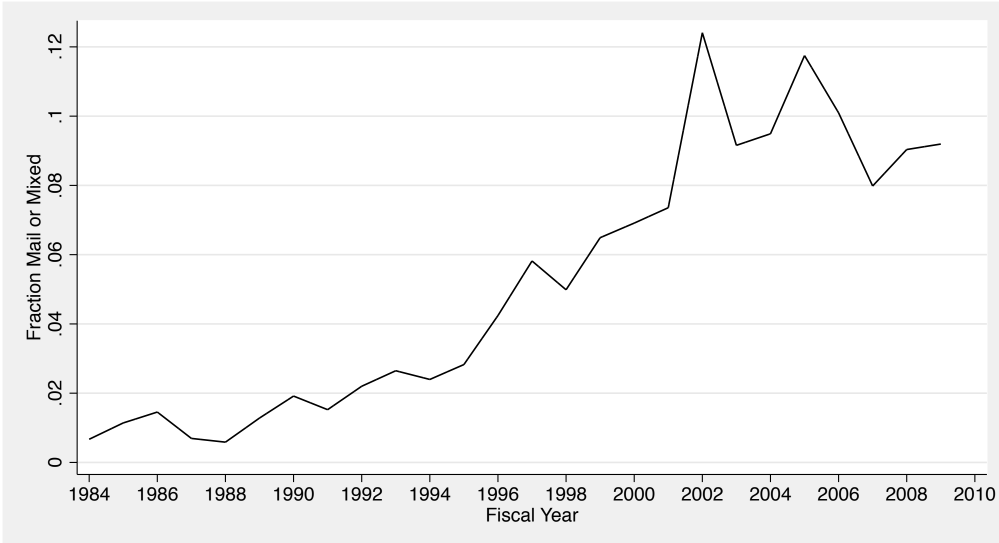

Figure 8: Fraction of Elections Held by Mail, by Fiscal Year

no information on the mode of election prior to fiscal year 1984, only 1.1 percent of elections between 1984 and 1990 were mail or mixed elections. On this basis, I proceed assuming that all elections prior to fiscal 1984 were carried out on-site. From 1991 onward, 93.8 percent of elections were on-site, 5.9 percent were by mail ballot, 0.3 percent were mixed.[28] In my analysis, I combine the mail and mixed elections into a single category that I call "mail".

Figure 8 contains a time-series plot of the fraction of elections that are by mail. The fraction of elections with mail ballots increased from less than 1 percent in 1984 to 6.5 percent in 1999. Subsequently the fraction with mail ballots increased further to about 12 percent by 2002 before declining to 9 percent by 2009. I have no explanation for the increase in use of mail ballots in the last two decades.

Figure 9 contains plots of turnout in mail and on-site elections by fiscal year. Average turnout was much lower in mail elections (69.7 percent) than in on-site elections (87.7 per-

"Mail balloting is used, if at all, in unusual circumstances, particularly where eligible voters are scattered either because of their duties or their work schedules or in situations where there is a strike, picketing, or lockout in progress. In these situations the Regional Director considers mail balloting taking into consideration the desires of the parties, the ability of voters to understand mail ballots, and the efficient use of Board personnel." NLRB procedures also allow for limited mixed elections, with ballots for those eligible voters who cannot vote in person. This does not include absentees or those who are on vacation. See *http://www.nlrb.gov/publications/manuals/r_-_case_outline.aspx.* Accessed on September 25, 2009.

[28] Not surprisingly, given the fact that mail balloting is used at the discretion of the regional director is that there is substantial variation across NLRB regions in usage rate of mail balloting. Between 1984 and 2009 the usage rate of mail balloting ranged from less than two percent in the Newark office to more than 12 percent in the Seattle office.

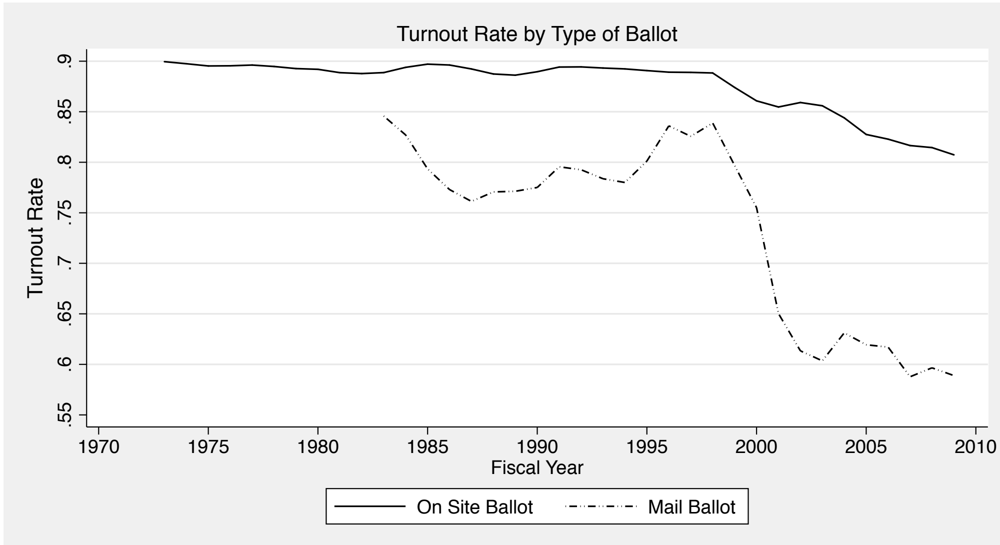

Figure 9: Turnout in On-Site and Mail Elections, by Fiscal Year

cent) held between 1984 and 2009. Turnout fell in on-site elections since the late 1990s, but it fell much more in mail elections. The increased use of mail elections combined with the lower and falling turnout in mail elections has the potential to account for some of the decline in turnout since the late-1990s.

I re-estimated the beta-binomial model including additionally an indicator for mail elections in the mean (m) function, and the results are contained in column 2 of table 1. The fit of the model is improved significantly, and the estimates imply that the mean probability of voting is 11.64 percentage points lower in mail elections than in on-site elections. The shift toward mail elections can account for 0.83 percentage points (7.1 percent) of the 11.68 percentage point decline in the mean probability of voting between 1999 and 2009 (compare columns 1 and 2 of table 1).

6.2 Region and Industry

The distribution of elections by region and industry has shifted substantially in the last 30 years. In this section, I examine the extent to which these shifts can account for the decline in turnout in representation elections.

Figure 10 contains plots of the distribution of elections across NLRB offices in the four census regions.[29] This figure shows that, since the mid-1990s, the distribution of elections

[29] In the estimation of the beta-binomial model where I include controls for region, I use indicators for each of the 8 Census divisions containing NLRB offices rather than the cruder 4-category census region.

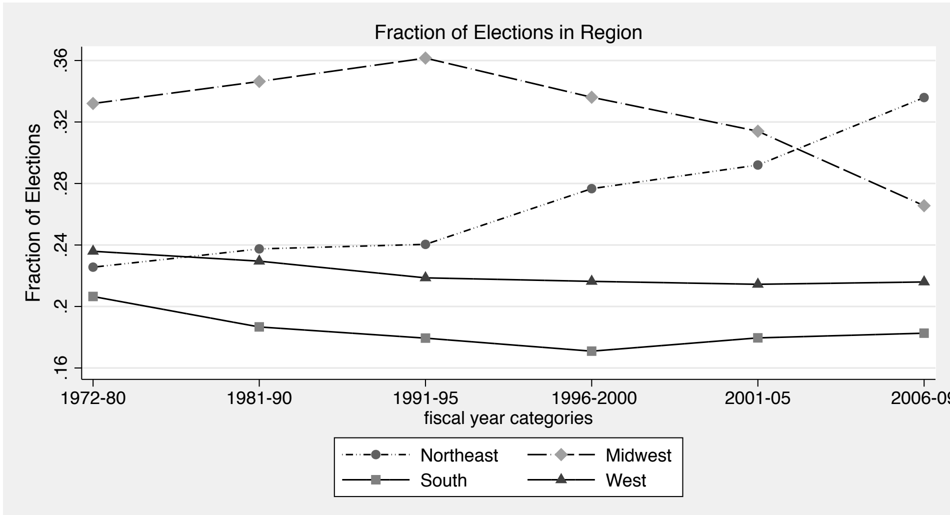

Figure 10: Geographic Distribution of Elections Over Time

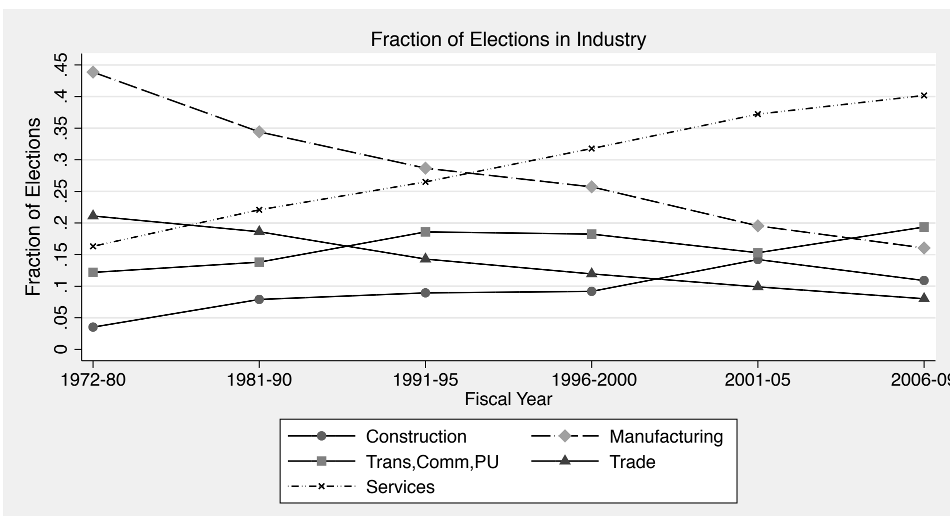

Figure 11: Industrial Distribution of Elections Over Time

has shifted away from the Midwest (falling from 36 percent in 1991-95 to 27 percent in 2006-09) and toward the Northeast (increasing from 24 percent in 1991-95 to 34 percent in 2006-09). Turnout over the sample period was slightly higher in the Midwest region (89.1 percent) than in the Northeast region (87.0 percent) so that the geographic shift in the locus of elections has the potential to explain part, but certainly not all, of the decline in turnout.

Figure 11 contains plots of the distribution of elections across broad industry groups.[30]

[30] There are a few small (in terms of number of elections) industry groups not included in this figure. They

The two important changes over time are a steady decline in the share of elections in manufacturing (from 44 percent in the 1970s to 16 percent in the 2006-09 period) and a steady increase in the share of election in service industries (from 16 percent in the 1970s to 40 percent in the 2006-09 period). Average turnout is substantially higher in manufacturing elections (90.9 percent) than in elections in services (84.7 percent). Thus, while the timing of the shift in the industrial distribution of elections does not match the timing of the drop in turnout (compare figures 7 and 11), the change in industrial distribution has the potential to explain some (but again not all) of the decline in turnout.

The third column of table 1 contains estimates of the beta-binomial model of turnout that additionally includes indicators for 8 Census regions and 9 industry categories. These variables contribute significantly to the fit, reducing the log-likelihood by 2,617.7, but changes in the distribution of elections by industry and region account for only a small part of the decline in the mean probability of voting between 1999 and 2009. The estimated decline, calculated from the year fixed effects in the mean, falls by 0.58 percentage points (5.3 percent), from 10.85 percentage points without controlling for industry and region to 10.27 percentage points when accounting for these variables (compare columns 2 and 3 of table 1).

It might be the case that the variation in turnout by region and industry reflects differences in economic incentives. For example, the stakes to the workers of unionization or the cost of organization might differ by industry or region. However, I have no specific expectations regarding how economic incentives to vote might vary in these dimensions.

Taken together, changes in the distribution of elections by industry, region, and mode account for 1.4 percentage points (12 percent) of the 11.7 percentage point decline in the mean probability of voting between 1999 and 2009 (compare columns 1 and 3 of table 1).

6.3 Election Size and Voter Turnout

The economic model of voter turnout has the clear prediction that, because the probability that a vote will be pivotal declines with election size, turnout will be lower in elections with more eligible voters. This is supported by figure 12, which show that turnout falls sharply with the number of eligible voters. The model of union organizing behavior implies that unions will contest larger elections, on average, as the organizing environment becomes less favorable. Figure 4 shows that average election size increased between the mid-1980s and 2000 and subsequently fell back to the level of the mid-1990s. Since the average number of eligible voter in elections held has been declining since 2000, changing election size is not likely to explain the decline in turnout over this period. Nonetheless, it is important to

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are agriculture, forestry, and fisheries (0.08 percent of elections), mining (0.90 percent), finance, insurance, and real estate (1.90 percent), and public administration (0.39 percent).

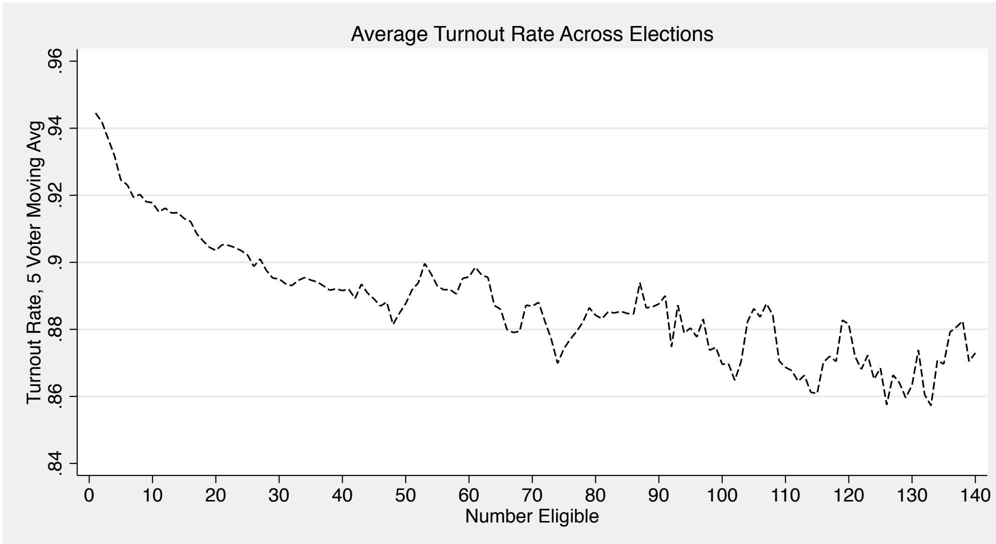

Figure 12: Turnout Rate by Number of Eligible Voters, 5-Voter Moving Average.

examine the relationship between turnout and election size.

I re-estimated the beta-binomial model additionally including two variables to capture the effect of election size on turnout. The first is the logarithm of the number eligible for number eligible less than or equal to 100. This variable ($\ell n(N) \cdot I(N <= 100)$), equals zero for elections with more than 100 eligible voters. The second is a dummy variable for elections with more than 100 voters. In other words, I specify the effect of size as a log linear function of number eligible for elections with no more than 100 eligible voters (86 percent of elections) and a constant value for larger elections.[31]

The results of this estimation are contained in column 4 of table 1. These estimates confirm that the mean probability of voting falls significantly with election size. The estimates imply that an increase in election size from 10 to 100 eligible voters reduces the mean vote probability by 3.5 percentage points.[32] The change in the mean probability of voting between 1999 and 2009 is virtually unaffected by controlling for election size (compare columns 3 and

[31] Fitting a linear spline with a single knot at $\ell n(100)$ yielded a virtually identical fit. Experimentation with knots at other values yielded very similar results. Estimation with sets of dummy variables for various values of size (e.g., dummy variables for each value from 1-20 eligible and for 4 larger categories) did not improve the fit of the model.

[32] The choice of $N = 100$ as the point where the vote probability function flattens is supported by the estimates. The specification enforces a constant mean vote probability for elections with $N > 100$ that is 6.88 percentage points lower than the vote probability with $N = 1$. The estimated slope of the downward sloping part of the function predicts that the difference in vote probability between $N = 1$ and $N = 100$ is 7.09 percentage points. These two estimates are statistically distinguishable but very close (a difference of 0.21 percentage points with a standard error for the difference of 0.09 percentage points).

4 of table 1). Given that average election size was declining between 2000 and 2009, it is not surprising that none of the decline in the mean vote probability can be accounted for by this factor.

An alternative explanation for the finding that turnout is negatively related to election size is based on social pressure. It is likely that the act of voting is easier to monitor in smaller elections. On this basis, if voting is considered a workplace good, then an additional benefit of voting in smaller elections is that the worker would be less likely to bear the disapproval of coworkers. One simple test of this alternative is based on turnout in mail elections. Since the voting in mail elections is not observable, the social benefit of voting in smaller elections is not relevant so that the relationship between turnout and election size should be weaker. The number of mail elections is too small to estimate a separate full model, but I did estimate the simple relationship between the turnout rate and election size alone separately for on-site and mail elections. In fact, the negative marginal effect of election size on turnout is much larger for mail elections than for on-site elections. For mail elections, the decline in turnout moving from an election with 10 eligible voters to 100 eligible voters is 3.7 percentage points. The same decline for mail elections is 6.7 percentage points. This suggests strongly that social pressure is not an explanation for the negative relationship between turnout and election size.

6.4 Expected Closeness of the Election

As I discussed earlier, the model of union organizing behavior implies that, as the bargaining environment deteriorates, unions will try to organize workplaces where they have a larger chance of success. I presented evidence in section 4 that the movement toward elections with a higher pro-union vote share will result in elections being less close, on average.

The economic model of the vote/no-vote decision I presented in section 3 implies that a worker's vote is more likely to be pivotal when preferences are close to evenly split between pro- and anti-union.[33] An even split of preferences is represented in the model by $\mu = 0.5$. While μ is not observed, I assume that elections differ in their underlying fraction pro-union and that there is a known prior distribution for μ. I develop a useful proxy for μ in a particular election based on the posterior distribution of μ given a beta prior distribution for μ and the observed pro-union vote share in that election. The inverse measure of closeness that I use is the expected squared deviation of the pro-union vote share from 0.5. This is $E((\mu - 0.5)^2|s)$, where s is the number of pro-union votes.

[33] I say "close to evenly split" rather than "evenly split" because pro-union voters are more likely to be pivotal when the expected vote is evenly split without their vote. In this case, the overall expected fraction pro-union is somewhat greater than 0.5, with the difference from 0.5 declining with election size.

In order to derive an estimate of $E((\mu-0.5)^2|s)$ for each election in my sample, I develop and estimate a statistical model of the pro-union vote share in elections. I start with a simple binomial model of the number of pro-union votes. Recall that μ is the fraction of the eligible voters who are pro-union, and assume that pro- and anti-union workers vote with the same probability. In this case, the probability that there are s pro-union votes cast in an election with n total votes cast is

$$Pr(s|n) = \binom{n}{s}\mu^s(1-\mu)^{n-s}. \tag{18}$$

Because μ can vary across elections with both observable variables and unobservables, I assume that μ has a beta distribution across elections. The beta density function for μ is

$$g(\mu;\theta,\nu) = \frac{\Gamma(\nu)}{\Gamma(\theta\nu)\Gamma((1-\theta)\nu)}\mu^{\theta\nu-1}(1-\mu)^{(1-\theta)\nu-1}. \tag{19}$$

The parameters of this distribution (θ and ν) have convenient relationships with the mean and variance of the distribution of μ:

- The expected value of μ is θ, and
- The variance of μ is $\sigma_\mu^2 = \theta(1-\theta)/(1+\nu)$.

Over-dispersion is captured by the parameter ν. As $\nu \to \infty$, the variance of μ goes to zero. Smaller values of ν imply larger variance in the expected fraction pro-union across elections.

The expression for the unconditional beta-binomial distribution of s pro-union votes cast out of n total votes is

$$f(s|n) = \binom{n}{s}\frac{\Gamma(\nu)\Gamma(\theta\nu+s)\Gamma((1-\theta)\nu+n-s)}{\Gamma(\theta\nu)\Gamma((1-\theta)\nu)\Gamma(n+\nu)}. \tag{20}$$

The goal of this exercise is to compute the (inverse) measure of closeness, $E((\mu-0.5)^2|s)$. This is calculated from the posterior distribution of the number of pro-union votes (a mixture of the beta prior distribution and the observed pro-union vote share).[34] The workplace-specific posterior mean of μ given the observed pro-union vote share is

$$E(\mu|s) = \left[\frac{n}{n+\nu}\right]\left(\frac{s}{n}\right) + \left[\frac{\nu}{n+\nu}\right]\theta. \tag{21}$$

This is a weighted average of the observed pro-union vote share and the prior mean. The weight on the observed pro-union vote share relative to the weight on the prior mean varies directly with the number of voters and inversely with the variance of the prior distribution (indexed inversely by ν).

[34] Details of this derivation are contained in Appendix I.

Using the beta-binomial distribution and after some algebra, the inverse measure of closeness is

$$E((\mu-0.5)^2|s) = 0.25 - \left[\frac{n+\nu}{n+\nu+1}\right] E(\mu|s)(1-E(\mu|s)), \tag{22}$$

where $E(\mu|s)$ is defined in equation 21. In order to calculate this measure, I need estimates of the parameters θ and ν. I use equation 20 to form a likelihood function using data on the number of pro-union and total votes cast in each election. I allow for observable variation across elections in the mean pro-union vote probability by specifying the mean (θ) as a function of observable variables ($\theta = X\delta$).

Based on preliminary examination of the data on variation in the pro-union vote share with the number of eligible voters, I include the same two measures in X to account for election size that I used in the turnout analysis. These are 1) the logarithm of the number eligible for number eligible less than or equal to 100 and 2) an indicator variable for elections with more than 100 voters. As suggested by the model of union behavior, I expect that the fraction pro-union will be negatively related to election size due to the process used by unions to select targets for organization. The X vector additionally includes an indicator for mail elections and controls for 8 regions, 9 industries, and 37 fiscal years. The parameter ν, which controls the variance, is specified as a function of year fixed effects.

I estimate this beta-binomial model using the data on the 141,097 elections underlying the turnout analysis. The estimated year effects for the mean pro-union vote probability show an increase since 1999 of about 15 percentage points. This is consistent with the trend in the pro-union vote share in the raw data illustrated in figure 5. While not presented here, the results show a strong and significant negative relationship between the pro-union share and the number of eligible voters. The predicted mean pro-union vote share is about 9 percentage points lower in elections with 50 eligible voters than in elections with 10 eligible voters. This pattern is consistent with the model of union organizing behavior.

There is substantial heterogeneity across elections of a given size in the fraction pro-union. Using 1999 as an example, the estimate of ν for 1999 is 4.04. The implied standard deviation of μ for 1999 is $\sqrt{\frac{\theta(1-\theta)}{\nu+1}}$. Evaluated at $\theta = 0.554$ (the average predicted value of θ in 1999), the standard deviation of μ is 0.221.

With these estimates in hand, I predict the expected value of μ conditional on the observed pro-union vote share in each election in my sample based on equation 21. I then use this together with equation 22 to calculate the inverse metric of expected closeness for each election ($E((\mu-0.5)^2|s)$).

Figure 13 contains a bar graph of the average turnout rate for various levels of the square root of the inverse closeness index. There is clear evidence that the turnout rate drops substantially as $\sqrt{E(\mu-0.5)^2|s}$ exceeds 0.2. This is consistent with a worker's vote/no-vote decision being positively related to the probability of being pivotal.

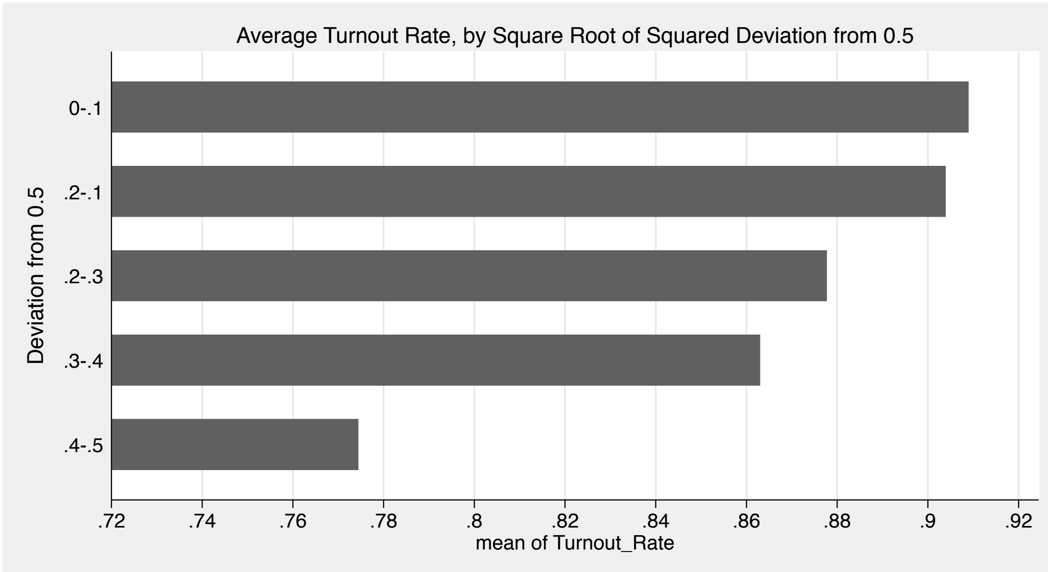

Figure 13: Average Turnout Rate, by Square Root of Expected Squared Deviation of Union Share from 0.5 ($\sqrt{E(\mu - 0.5)^2|s}$).

The solid line in figure 14 (left scale) is a plot of the yearly average of the inverse measure of expected closeness ($E((\mu - 0.5)^2|s)$). This was fairly constant through the late 1990s but increased sharply between 1999 and 2009. This reflects the increase in pro-union vote share away from 0.5 over the same period, shown by the dashed line in figure 14 (right scale), that results from union selection of more favorable organizing targets in a deteriorating organizing environment. Clearly, elections have become less close since the late 1990s, and the timing of this increase is remarkably similar to the timing of the decrease in voter turnout (figure 2). There is potential for the declining closeness of elections between 1999 and 2009 to account for at least some of the decline in turnout over the this period.

I re-estimated the beta-binomial model of turnout additionally including the inverse closeness measure, and the resulting estimates are contained in column 5 of table 1. The estimates show a strong and significant negative relationship between the inverse measure of closeness and the mean probability of voting. Turnout is clearly higher in elections that are expected to be closer, and the move toward elections that are expected be less close accounts for a substantively important share of the decline in voter turnout between 1999 and 2009. The average value of $E((\mu - 0.5)^2|s)$ increased from 0.054 in 1999 to 0.108 in 2009, and point estimate of its coefficient in column 5 of table 1 is -0.3799. This reduction in average closeness implies a decrease in voter turnout between 1999 and 2009 of $0.3799 \cdot (0.108 - 0.054) = 0.0205$ (2.05 percentage points). More directly, the change in the 2009 year effect (1999=0) on the mean vote probability declines in magnitude from -0.1030 to -0.0823 when controlling for

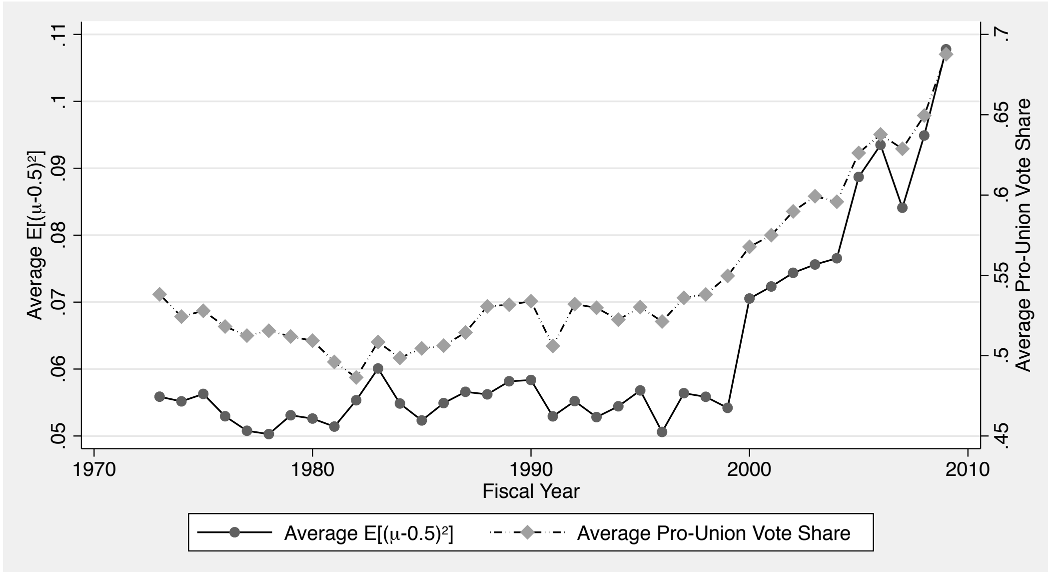

Figure 14: Average Inverse Measure of Closeness ($E((\mu - 0.5)^2|s)$) and Fraction of Vote Pro-Union, by Fiscal Year.

expected election closeness (compare columns 4 and 5 of table 1). Thus, the decline in expected election closeness accounts for fully 2.07 percentage points (about 20 percent) of the remaining 10.3 percentage point decline in the average vote probability since 1999.

As with election size, an alternative explanation for the finding that turnout is negatively related to election size is based on social pressure. If there is more social pressure to vote in close elections, the effect of closeness on the probability of voting should be lower in mail elections (where the act of voting is not directly observable) relative to on-site elections. Again, I estimate the simple relationship between the turnout rate and closeness separately for on-site and mail elections. In fact, the marginal effect of closeness turnout is larger for mail elections than for on-site elections. I use equation 22 and the assumption that the election has more than a handful of voters get an idea of the difference in the marginal effect of closeness by type of election. The estimates imply that the difference in the expected turnout rate between an election where the expected pro-union vote share is 0.5 and an election with an expected pro-union vote share of 0.7 (or 0.3) is 2 percentage points in on-site elections and 3.5 percentage points in mail elections. This suggests strongly that social pressure is not an explanation for the positive relationship between turnout and expected closeness.

6.5 The Combination of Larger and Less Close Elections

The second-order prediction of the model (prediction 5) is that the marginal effect of closeness on turnout will increase as elections become larger. This implies that an interaction of election size with my inverse measure of closeness will have a negative effect on turnout. In other words, as elections become larger, the negative marginal effect on turnout of the reduction in closeness will increase. I re-estimated the beta-binomial model of turnout adding the interaction of inverse closeness measure with the two variables measuring election size, and the resulting estimates are contained in column 6 of table 1. The estimates are strongly consistent with the model's prediction.[35] The interaction terms are both negative and imply that the marginal effect of decreasing closeness is more strongly negative in larger elections. This finding provides further support for the view that workers on the margin of voting consider whether they will be pivotal in deciding whether or not to vote.

As I noted above, the average value of $E((\mu-0.5)^2|s)$ increased from 0.054 in 1999 to 0.108 in 2009. Using the point estimates in column 6 of table 1, this reduction in average closeness implies a decrease in average voter turnout between 1999 and 2009 of 2.89 percentage points (s.e. = 0.06) for an election of average size over this period (71 eligible voters). Adding the interaction terms between expected closeness and election size does not change the result that the reduction in election closeness between 1999 and 2009 accounts for a substantial fraction of the decline in turnout since 1999. Specifically, the change in the 2009 year effect (1999=0) on the mean vote probability declines in magnitude from -0.1030 to -0.0826 when controlling for expected election closeness and its interaction with election size (compare columns 4 and 6 of table 1). This decline of 2.04 percentage points (about 20 percent) is comparable in magnitude to the effect when ignoring the interaction terms (compare colums 5 and 6 of table 1).

7 Final Remarks

In order to summarize my analysis of the decline in voter turnout, figure 15 presents the estimated year effects on the mean vote probability (m) from 1990-2009 (differenced from 1999) from three versions of the beta-binomial model of the vote probability.[36] The "unadjusted" set are the year effects from the model without other control variables for the mean (column 1 of table 1). This shows the 11.7 percentage point decline in the mean vote

[35] The main effect of inverse closeness measure is positive in this specification, but the magnitude is such that, given the negative coefficient on the closeness-size interaction, the marginal effect on turnout of an election becoming less close is negative for elections with four or more eligible voters.

[36] The estimated year effects prior to 1990 do not vary substantially over time.

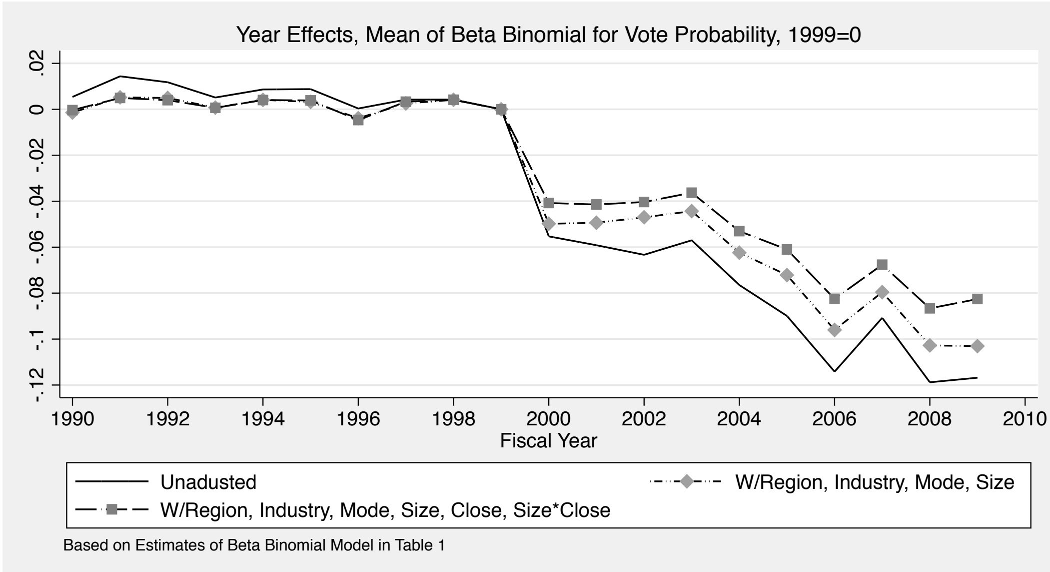

Figure 15: Adjusted and Unadjusted Mean Vote Probabilities, by year.

probability between 1999 and 2009. The second set shows year effects from the model with controls for region, industry, election mode, and election size (column 4 of table 1). These controls account for 1.4 percentage points (12.0 percent) of the decline in the mean vote probability. Finally, the third set shows year effects from the model with an additional control for expected election closeness and its interaction with election size (column 6 of table 1). The closeness measure and its interaction alone accounts for another 2.04 percentage points (17.4 percent) of the 11.7 point decline between 1999 and 2009 in the mean vote probability (compare columns 1 and 6 of table 1). The remaining 8.3 percentage point decline in the mean probability of voting is not accounted for by observed election characteristics.

In conclusion, the continuing deterioration the union organizing environment has made organizing through the NLRB representation election process more costly. The first-order consequence of this deterioration is that there are many fewer representation elections, but it has also made unions more selective in choosing targets for organization. Unions now undertake organization in potential bargaining units that are larger, where they have a higher probability of victory, and where the resulting elections are less close. The result is an increase in the union win rate and a decline in voter turnout in elections held.

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Appendix I – Derivation of the Inverse Measure of Closeness using the Beta-Binomial Distribution

I assume that μ, the probability of a voter casting his vote in favor of union representation in a given election, is distributed as beta such that

$$g(\mu;\theta,\nu) = \frac{\Gamma(\nu)}{\Gamma(\theta\nu)\Gamma((1-\theta)\nu)}\mu^{\theta\nu-1}(1-\mu)^{(1-\theta)\nu-1}, \tag{23}$$

where θ and ν are positive parameters and $\Gamma(\cdot)$ is the gamma function defined as

$$\Gamma(x) = \int_0^\infty exp(-z)z^{x-1}dz. \tag{24}$$

By the Bayes theorem, the distribution of μ conditional on observing s pro-union votes among n total votes cast is

$$f(\mu|s) = \frac{h(s|\mu)g(\mu)}{f(s)}. \tag{25}$$

Assuming a binomial distribution for pro-union votes in a given election, the probability of observing s pro-union votes cast among n total votes cast conditional on μ is

$$h(s|\mu) = \binom{s}{n}\mu^s(1-\mu)^{n-s}. \tag{26}$$

The unconditional distribution of the number of pro-union votes cast in an election with n total votes cast is

$$f(s) = \binom{n}{s}\frac{\Gamma(\nu)\Gamma(\theta\nu+s)\Gamma((1-\theta)\nu+n-s)}{\Gamma(\theta\nu)\Gamma((1-\theta)\nu)\Gamma(n+\nu)}. \tag{27}$$

Substitution from equations 23, 26, and 27 into equation 25 yields the posterior distribution of μ given s pro-union votes among n votes cast:

$$f(\mu|s) = \frac{\Gamma(n+\nu)}{\Gamma(s^*)\Gamma(n+\nu-s^*)}\mu^{s^*-1}(1-\mu)^{n-s^*+\nu-1}, \tag{28}$$

where $s^* = s + \theta\nu$. The posterior mean of μ given s is

$$E(\mu|s) = \frac{\Gamma(n+\nu)}{\Gamma(s^*)\Gamma(n+\nu-s^*)}\int_0^1 \mu^{s^*}(1-\mu)^{n-s^*+\nu-1}d\mu. \tag{29}$$

Noting that $\int_0^1 \mu^{s^*}(1-\mu)^{n-s^*+\nu-1}d\mu$ is the Beta function with parameters s^*+1 and $n+\nu-s^*$, it is straightforward to show that

$$E(\mu|s) = \left[\frac{n}{n+\nu}\right]\left(\frac{s}{n}\right) + \left[\frac{\nu}{n+\nu}\right]\theta. \tag{30}$$

Thus, the posterior mean of the pro-union share in the workplace given the pro-union share of votes in the election is a weighted average of the observed vote share and the prior mean.[37] Using the beta-binomial distribution and after some algebra, the inverse measure of closeness is

$$E((\mu - 0.5)^2|s) = 0.25 - \left[\frac{n+\nu}{n+\nu+1}\right] E(\mu|s)(1 - E(\mu|s)), \tag{31}$$

where $E(\mu|s)$ is defined in equation 30.

[37] Derivation of this relationship relies on the definition of the Beta function as

$$B(a,b) = \int_0^1 \mu^{a-1}(1-\mu)^{b-1} d\mu = \frac{\Gamma(a)\Gamma(b)}{\Gamma(a+b)}$$

and the property of Gamma functions that $\Gamma(Z+1) = Z\Gamma(Z)$.