LONG-RUN IMPACTS OF UNIONS ON FIRMS: NEW EVIDENCE FROM FINANCIAL MARKETS, 1961-1999

Supplemental Online Appendix

David S. Lee Alexandre Mas

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A.I The Event-Study Method: Calendar Time Portfolio

A commonly used approach in long-run event-studies is the calendar time portfolio (CTP) approach developed by Jaffe (1974) and Mandelker (1974) and advocated by Fama (1998). For each calendar month we compute the return of an equally-weighted portfolio of companies that unionized in the last T months, where T is either 18 or 24 in our study. The return of this "unionization portfolio" is denoted R_{ut}, where u indicates that the portfolio consists of companies where workers voted for unionization and t denotes the calendar month. The unionization portfolio is rolling, because companies with new unionization events are added in any given month, while firms without a unionization event within the last T months are dropped. The Fama-French three factor model (Fama and French, 1993) is used to compute the abnormal return of this portfolio:

$$R_{ut} - R_{ft} = \alpha_u + b_u(R_{Mt} - R_{ft}) + s_u SMB_t + h_u HML_t + \varepsilon_{ut}, \quad (1)$$

where R_{ft} is the one-month treasury bill rate, $R_{Mt}$is the monthly return on a value-weight market portfolio of NYSE, AMEX, and NASDAQ stocks, *SMB* is the difference in the returns on portfolios of small and big stocks (below or above the NYSE median), and *HML* is the difference in the returns of portfolios of high- and low-BE/ME stocks.[1] In practice, Equation 1 is estimated by weighting the number of equities in

[1]The three factors, R_{Mt}, *SMB*, and *HML*, were taken from Kenneth French's web page (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The web page contains additional information on the construction of these series.

the R_{Mt} portfolio at time t, as suggested by Fama (1998). Assuming that the broad-market return and the Fama-French factors adequately describe average returns, the parameter of interest, α_u, can be interpreted as the average abnormal return associated with holding this simulated portfolio.

The CTP methodology has been used in many long-run event-studies, for example Loughran and Ritter (1995), Brav and Gompers (1997), Mitchell and Stafford (2000), and Greenstone et al. (2006). This approach is thought by some, including Fama (1998) and Mitchell and Stafford (2000), to have better statistical properties than leading alternatives. For example, firms clustered in event-time can lead to over-stated test statistics in the matched-portfolio approach described above.[2] Since the CTP methodology uses a time-series of portfolio returns, cross-correlations of firm abnormal returns are incorporated in the portfolio variance. Additionally, this approach allows for classical statistical inference because the distribution of the estimator is well-approximated by the normal distribution (Mitchell and Stafford, 2000). A disadvantage to this approach is that the market-model parameters of the portfolio are assumed constant. But, because the model is estimated over a long time-period (1961-1999) and because the firms in the portfolio are changing, that assumption is unrealistic.

Appendix Table I presents the estimates from the calendar time event-study methodology. The portfolio of stocks consisting of all firms with a unionization win in the previous 24 months has a precisely estimated alpha of -0.005 (t-ratio=-3.6). In the second row we consider a hypothetical portfolio of firms that are purchased two years prior to case closure and are sold four months prior to case closure (-24 to -4 months relative to closure). This portfolio corresponds to a small and statistically insignificant alpha. Likewise, we do not observe an economically or statistically significant alpha for portfolios of firms recently experiencing union losses (Appendix Table I, Panel B), nor for portfolios consisting of firms with small elections relative to the size of the company (Appendix Table I, Panels C and D). These results give us confidence in our finding: negative alphas are only present when the union wins, and even then, only when the electorate is a large fraction of the firm's total workforce. Moreover, the results are robust to the use of two standard methodologies for long-run event studies.

[2]Though, it should be noted, we will allow for such correlations in computing standard errors by clustering on election and calendar month, using the formula from Cameron et al. (2006).

A.II Compustat Analysis

In addition to the event study analysis using the CRSP data, we also use data available in the CRSP/Compustat Industrial Quarterly Merged Database to examine the effect of the representation election on various accounting variables. Summary statistics of these variables are shown in Appendix Table II. Companies in the Compustat database have larger market values on average than those those in the CRSP database (Table I in the main paper), implying that small firms are underrepresented in the Compustat database. In addition to the mean and standard deviation, we report in braces the average percentile rank of that variable relative to all other firms in the Compustat database for the year and quarter of election. The average percentile rank is convenient for assessing how the firms in our sample compare to companies in the Compustat universe, and is advantageous as a statistic that is "robust" to outliers. From the percentile rankings it can be seen that firms in the $< 5\%$ sample tend to be around the 75th percentile in the size distribution of all Compustat companies, whereas firms in the $\geq 5\%$ sample are, on average, in the 35th percentile. In both samples, firms tend to be fairly representative with respect to profit margins, return on assets, Tobin's Q, and the dividend ratio. At the time of the election, UL and UV firms appear to be similar in most measures, including employment, market value, profit margin, profit per employee, Tobin's average Q, and industry composition.

For this analysis, we are interested in the effect of unionization on the following accounting variables: shareholder equity, assets, total liabilities/total assets (a measure of leverage), plant, property and equipment, sales, the dividend ratio, Tobin's average Q, profit margins, and the returns on assets. We compute the average value of these variables (logged when appropriate) over the twelve quarters before and after the event date, comparing UV and UL firms.[3] We acknowledge that the data is less complete than the CRSP data used in the main study, but the analysis is nonetheless informative.

Unfortunately, the early part of the sample period is unusable in the Compustat analysis because many of these variables were not reported until the late 1960s, and not universally until the early 1970s. Moreover, the fraction of missing observations is substantially higher in the Compustat dataset than in the CRSP dataset. As a result, for this analysis we will only consider elections over the 1973-1999 period. To mitigate composition bias to due to unbalanced panels we de-mean the variables, but do not drop elections with missing values.

In the nine panels of Appendix Figure II we plot averages of the de-meaned variables over event-time, in each case comparing elections where the union won to those where the union lost. Note that in the graphs,

[3] All variables in 1998 dollars, when appropriate.

the pre-event window is three years rather than two years from the event-study analysis. The figures show that the time pattern of variables proxying for "size" are consistent with the pattern in equity value. UV firms display a downward break in trend in total assets (Panel A), shareholder equity (Panel B), and sales (Panel C) near or just before certification. The reduction in asset growth is, in large part, due to reduced growth in plant, property, and equipment (Panel D).[4] The smaller sample sizes mean these series are not as well-behaved as those for equity values, though they have a similar pattern. We see little effect of union victories on the measure of leverage, defined as long-term debt divided by total assets (Panel E). This last finding can be viewed as circumstantial evidence that companies are not using leverage strategically to influence bargaining negotiations (conditional on unionization), at least in this sample. It should be noted that this does not contradict the findings of Bronars and Deere (1991) and Matsa (2006), who show a positive association of leverage and union threat, because firms may be in a better position to adopt leverage strategically *before* the union is certified, as noted by Bronars and Deere (1991).

The marked reduction in the growth rate of assets is notable because if unionization increases the price of labor, there should be substitution from labor to capital (though, as seen in Panel F, Tobin's average Q appears stable). The fact that assets are actually declining implies that the "scale" effect from reduced reinvestment dominates the possible substitution effect.[5] The time pattern of these variables also sheds light on the seemingly slow reaction of investors to unionization events that we see in Figure III. The pattern of abnormal returns mirrors the time-pattern we observe in shareholder equity, assets, sales, and pre-tax income. The evidence is consistent with the stock market pricing the effect of unionization only after changes in these variables become known.

While the reduced relative size of the UV firms is associated with lower pretax income (Panel G), variables that proxy for operating performance, for example return on assets and profit margins, appear stable.[6] The finding that companies that undergo unionization experience lower growth rates but stable returns on assets and profit margins seems puzzling. One possibility is that firms only select projects that are sufficiently profitable and unionization reduces the number of these high net present value (NPV) projects, then it is possible for the company's growth rate to decline in spite of experiencing no change in its operating

[4]We have also examined the corresponding figures using a balanced panel. The overall patterns are the same as when using the unbalanced sample, but because we lose so many elections the confidence intervals are substantially wider.

[5]An alternative interpretation is that increases in union bargaining power lead to unions capturing a larger proportion of the quasi-rents from returns to capital. This "tax" on capital induces companies to reduce capital investment. This approach is adopted and documented in Grout (1984), Baldwin (1983) and Hirsch (1991).

[6]The profit margin in UV firms appears to decline a bit relative to UL firms, but not until about seven quarters after the election (Panel I).

performance. That said, any potential explanation should be tempered with the fact that the estimates for profit margins are somewhat noisy.

In Appendix Table III we present difference-in-difference estimates for the effect of a union victory relative to a union loss on each of the six aforementioned variables. The sample consists of election $\times$ event-time observations. We regress each of the (non-demeaned) variables on election fixed-effects, an indicator for whether the NLRB closed the election on or after the given quarter ("post"), and the interaction of "post" with an indicator for whether the union won the election ("post $\times$ union victory"). The point estimates suggest that assets, shareholder equity, and sales fall by approximately 10 percent in UV firms after the election, relative to UL firms. Pre-tax profits of UV firms are approximately 17 percent lower in the post-election period relative to the pre-election period (relative to UL firms). These statistically significant estimates are consistent with the 10 to 14 percent negative abnormal returns we observe in equities.

A.III Interpretation and Policy Implications

In this section, we provide a detailed discussion of what our empirical results could imply about the potential effect of a policy that makes it easier for workers to unionize. An example of such a policy shift can be seen in the Employee Free Choice Act, recently proposed legislation that is meant to amend the National Labor Relations Act. Specifically, one of the provisions of the legislation would allow employees to authorize a union via "card check," a showing that the majority of the workers signed cards to authorize a union, without having to win certification via a secret-ballot election process. It is widely believed that the legislation, supported by the AFL-CIO, would make it much easier for workers to unionize, if it were to become law.

In essence, we view such a policy change as a *ceteris paribus* marginal increase in the probability of unionization. One way to conceive of such an exogenous increase, would be to consider the thought experiment of lowering the necessary vote share threshold for certification. After all, the card check process is not unlike the petitioning that constitutes the first step in the NLRB election process.

As a thought experiment, consider lowering the threshold from 50 percent to say, 45 percent. One conjecture is that such a policy change would only effect those firms with vote shares between 45 and 50 percent, and that the effect could be approximated by the RD estimate. The shortcoming of this conjecture is that it assumes that unions, firms, and workers do not respond to the increased ease of unionization. As we noted in the introduction, Friedman (1950) suggested that unions might be forced to moderate promises

to raise wages when seeking the support of their workers. In a representation election, this might mean moderating wage expectations to increase their chance of winning. With these forces at work, an exogenous increase in the probability of a union victory could very well lead unions to be more aggressive, resulting in increased negative impacts on profitability – not just for those firms near the 50 percent threshold, but also for those where the union won by a wider margin. Exogenously easing the unionization process might also affect the outcome for firms that eventually do not unionize, through union threat.

Thus, to make quantitative predictions regarding the impacts of making unionization easier – predictions that both use the magnitudes we estimate, and allow for behavioral responses to a change in policy – it is necessary to adopt assumptions about the behavior of unions and firms and how profitability is affected by changes in the probability of unionization. We consider a "median voter"-type model of endogenous union determination. The basic idea of the model is that in anticipation of the representation election, the firm and the union each propose an outcome (e.g. a wage level), and voters, recognizing that wages can be both too low or "too high" (if it poses too large a risk of job loss), vote on the two choices in the election. Both the union and the firm face similar trade-offs: the union (firm) would benefit from higher (lower) wages, but proposing those wages loses votes among those workers who have more moderate preferences.

We present a parsimonious parameterization for the model, and then calibrate it by choosing parameters such that the model produces both an equilibrium vote share distribution and event-study estimates that most closely match that which we observe in the data (shown in Appendix Figure V).

This calibrated model yields a distribution of voter preferences, and also allows us to simulate the effects of lowering the vote share threshold, a policy which exogenously increases the probability of unionization. We also assess the model's predictions for the impact on equity value of two sub-populations, a marginal group (the firms that are not currently unionized, but would be in the new regime), and two inframarginal groups (firms that are either already unionized or not unionized, and whose status does not shift after the policy change).

A.III.A Endogenous Voting Model

There are surely an unlimited number of distinct ways to model the interaction between unions, workers, and firms in an election context. Arguably, an obvious starting point is to adopt a "textbook" model of electoral competition.[7] Indeed, median voter-type models have previously been considered in the theoretical literature

[7] See Persson and Tabellini (2000) for a guide to models of this sort.

on unions (see Atherton, 1973; Farber, 1978; and Booth, 1995).[8]

We assume there are three optimizing entities involved in a representation election, the workers, the union, and the management.[9]

Workers: Each worker is assumed to maximize his/her own individual utility, and faces the decision to either vote for or against union recognition. In doing so, each forward-looking worker compares the anticipated outcome if the union wins to the expected outcome if the union loses. For example, the main issue could be wages, where the anticipated wage level is higher if the union prevails in the election than if it fails. Workers will not always vote for higher wages, because it may also carry a higher risk of job loss as the firm must respond to those higher wages. So for each worker, there is an "ideal wage" or a "bliss point".

It is most natural to discuss workers' (and unions') preferences over wages, benefits and other working conditions. But as long as improved (inferior) compensation and conditions lead to lower (higher) profits for the firm, we can equivalently consider workers' and unions' preferences over profit levels, by applying an appropriate monotonic transformation from wages, for example, to profits. In the discussion below, we use this equivalent formulation, focusing our attention on "profit levels" (strictly speaking, the change in stock market value of the firm).

Thus, the actions of the workers are summarized by the probability of the firm winning the election

$$P(\pi_M, \pi_U)$$

where π_M is the resulting anticipated profit level if the firm wins, and π_U is the anticipated level if the union wins. $\frac{\partial P}{\partial \pi_M}$ and $\frac{\partial P}{\partial \pi_U}$ are both negative: as the outcome under a firm victory becomes more "extreme" and more profitable to the firm, fewer workers find that outcome attractive, lowering the chance of an electoral victory for the firm. Conversely, if the anticipated profit level is more moderate, the "middle" of the electorate gravitates towards voting for the firm. The same is true for the union: the firm has a lower chance of winning if the outcome under a union victory π_U (which will always be less than π_M) is higher (and hence more moderate).

Note that we assume a probabilistic voting model (e.g. workers, the firm, and the union cannot perfectly

[8]Interestingly, this model has many parallels to the model of final offer arbitration developed in Farber (1980). The two bargaining parties face the same trade-offs as the union and firm do here, and the role of arbitrator is played by the median voter in this context.

[9]The setup is similar to Ashenfelter and Johnson (1969) who also consider management, workers, and unions as separate maximizing entities.

predict the outcome) as is common in many electoral competition models. It will be clear that without some uncertainty, there can be no equilibrium where $\pi_M \neq \pi_U$. Thus, introducing some uncertainty as to the exact location of the median voter expands the range of possible equilibria.

Management: We assume that the management's objective is to maximize shareholder value by maximizing profits. The firm influences the anticipated result of a firm electoral victory. Essentially, they propose a profit level π_M to maximize expected profits

$$\pi_M \cdot P(\pi_M, \pi_U) + \pi_U \cdot (1 - P(\pi_M, \pi_U))$$

taking the union's proposal as given. The management faces a clear trade-off: higher profits are desired, but proposing an outcome that leads to higher profits raises the chance that the workers will vote to unionize, which would lead to lower profits.

In this sense the model captures the possibility of "union threat", where the presence of unions can compel firms to offer above-market wages, even if the workers ultimately do not unionize.

Union: The union faces a similar problem with similar trade-offs. It controls anticipated outcome π_U under a union victory. Essentially, they make a proposal π_U to maximize the objective function

$$\overline{U} \cdot P(\pi_{M,} \pi_U) + U(\pi_U)(1 - P(\pi_{M,} \pi_U))$$

taking π_M as given. $\overline{U}$ is the level of utility the union obtains if it loses the election, and $U(\pi_U)$, which is decreasing in π_U, is obtained if the union prevails. We assume that for all the feasible π_U, $\overline{U} \leq U(\pi_U)$, so that the union would never prefer to lose the election. Again, the union benefits from a lower-profit outcome *if it prevails in the election*. But it must also take into account that the further away their proposal is from the median worker, the more likely the less desirable outcome π_M will occur.

Equilibrium: We consider the Nash Equilibrium, which is characterized by the first order conditions

$$\begin{aligned} P(\pi_M, \pi_U) + \frac{\partial P(\pi_M, \pi_U)}{\partial \pi_M}(\pi_M - \pi_U) &= 0 \\ \frac{\partial U(\pi_U)}{\partial \pi_U}(1 - P(\pi_M, \pi_U)) + \frac{\partial P(\pi_M, \pi_U)}{\partial \pi_U}\left(\overline{U} - U(\pi_U)\right) &= 0 \end{aligned} \tag{2}$$

The solution to this system yields equilibrium proposals for π_U and π_M as well as the equilibrium probability $P(\pi_M, \pi_U)$.

Finally, we introduce two elements of heterogeneity to make it possible for the model to generate a relationship between the vote share and the observed profit level. First, we allow for heterogeneity across workplaces in the preferences of the workers (i.e. the median voter): heterogeneity in $P(\pi_M, \pi_U)$. Second, we allow for heterogeneity in preferences among workers *within* each workplace. It is possible to include this kind of heterogeneity without affecting the specification of $P(\pi_M, \pi_U)$ and hence the equilibrium π_M and π_U, but without some heterogeneity, realized vote shares could only equal 1 or 0.[10]

A.III.B Parameterization and Estimation

Our policy extrapolation exercise requires us to parameterize the model. We choose the following functional forms.

1. In bargaining over wages, profits are bounded. We let $\overline{\pi}$ be the maximum feasible profits, given the constraints of the market. For example, $\overline{\pi}$ could be the profit level if the post-election wage equaled the competitive market wage. If firms are price takers in the labor market, then any wage below that level would mean that they could not hire any workers and would be forced to shut down.

2. We let $U(\pi_U) = -\left(\frac{\pi_U}{c} - 1\right)^2$, which is representative of the entire class of concave quadratic functions in π_U.[11] c is the union's "ideal" profit level. We also set $\overline{U} = U(\overline{\pi})$ so that the union gains exactly nothing if it wins the election but achieves a wage level no different than the market competitive wage.

3. Voters ideal profit levels ("bliss points") are uniformly distributed over the interval $[\mu - \varepsilon - \sigma, \mu - \varepsilon]$, where μ varies across workplaces and σ quantifies the degree of heterogeneity of voter preferences within the workplace. ε is a stochastic component, uniformly distributed on $[0, \lambda_\varepsilon]$, reflecting the uncertainty that both union and firm face regarding the exact location of the workers. If individual workers' utility over π are symmetric around their bliss point, this implies that the vote share for the union will be $VS = \frac{1}{\sigma}\left\{\frac{\pi_M + \pi_U}{2} - (\mu - \varepsilon - \sigma)\right\}$, and that $P(\pi_M, \pi_U) = \Pr\left[VS < \frac{1}{2}\right] = \frac{1}{\lambda_\varepsilon}\left[\mu - \frac{\sigma}{2} - \left(\frac{\pi_M + \pi_U}{2}\right)\right]$.[12] This specification satisfies the above assumption that as the firm or union raises its proposal, the probability of a firm victory declines.

[10] If all voters had the same ideal profit level as the median, then either all workers will vote for or against the union.

[11] A quadratic function has three parameters, but the expected utility is invariant to affine transformations, so that it is innocuous to rescale and shift the function so that the peak of the function equals zero, and that the function equals -1 when $\pi_U = 0$. This is therefore a one-parameter function.

[12] Additionally, VS and $P(\pi_M, \pi_U)$ must be between 0 and 1.

4. μ is distributed across workplaces, such that $-\mu$ follows an exponential, $F\left(x;\lambda_\mu,\overline{\mu}\right)=1-\exp(-\lambda_\mu\cdot(x-\overline{\mu}))$ for $x-\overline{\mu}\geq 0$, and 0 otherwise. The distribution of μ thus has a long left tail, and a maximum at $\overline{\mu}$.

To summarize, the model contains 6 parameters in total, $\overline{\mu},\lambda_\mu,\lambda_\varepsilon,\sigma,\overline{\pi},c$. $\overline{\mu},\lambda_\mu$ characterize how worker preferences are approximately distributed across workplaces, λ_ε quantifies the degree of uncertainty of the precise location of the voters' preferences, and σ quantifies heterogeneity in workers' preferences within a firm. $\overline{\pi}$ represents the limit on how low the firms' wages can be, and c is the union's "ideal" profit level.

These six parameters are sufficient for generating a joint distribution of π^{obs} (an event-study estimate of the impact of the union on the firm) and the vote share in favor of the union, the two variables that we observe in the data. Specifically, a μ is drawn from the distribution given by the parameters $\overline{\mu},\lambda_\mu$. Conditional on this value of μ, and the remaining 4 parameters ($\lambda_\varepsilon,\sigma,\overline{\pi},c$), the firm and the union make optimal proposals according to the marginal conditions in 2. Subsequent to these optimal choices π_M^* and π_U^*, an ε is drawn and the VS is determined as above, and the observed profit level is given by $\pi^{obs}=\pi_U^*\cdot 1\left[VS>.5\right]+\pi_M^*\cdot 1\left[VS<.5\right]$.

At the same time, the model has a minimal number of parameters. There is one parameter for the union's objective function (c), one for the firm ($\overline{\pi}$), and two parameters for the distribution of worker preferences across firms ($\overline{\mu},\lambda_\mu$). Without allowing for λ_ε, there would be no uncertainty in the precise location of voters' preferences, which would imply that the firm's and union's proposals could never be different in equilibrium. Finally, without σ, a vote share would never be anything except 0 or 1.

To calibrate this model, we choose parameters that most closely generate 1) the pattern of event-study estimates in Figure VII, and II) the distribution of vote shares. Specifically, we minimize the quadratic form

$$f(\theta)'\hat{V}^{-1}f(\theta),\ \text{where}\ f(\theta)=\begin{pmatrix}\hat{\alpha}_1-E\left[\pi^{obs}|VS>.5\right]\\ \hat{\alpha}_2-E\left[\pi^{obs}|VS<.5\right]\\ \hat{\alpha}_3-\lim_{\Delta\to 0^+}E\left[\pi^{obs}|VS=.5+\Delta\right]\\ \hat{\alpha}_4-\lim_{\Delta\to 0^+}E\left[\pi^{obs}|VS=.5-\Delta\right]\\ \hat{\alpha}_5-E\left[VS\right]\\ \hat{\alpha}_6-E\left[VS^2\right]\end{pmatrix}$$

and θ is the vector of parameters from the model, the expectations are the moments predicted by the model given θ, and the $\hat{\alpha}$s are the corresponding observed moments. $\hat{\alpha}_1$ is the event-study estimate for all union victories, $\hat{\alpha}_2$ is the event-study estimate for all union losses, $\hat{\alpha}_3$ and $\hat{\alpha}_4$ are the event study estimates close to, and on either side of, the 50 percent union vote share threshold, and $\hat{\alpha}_5$ and $\hat{\alpha}_6$ are the first and second moments of the vote share.[13] π^{obs} is the change in market value predicted by the model and VS is the predicted vote share for the union. $\hat{V}$ is the estimated variance-covariance matrix of these 6 estimators.

Although our model is parsimonious and we chose simple functional forms (e.g. uniform distributions for ε, the distribution of voter preferences, and quadratic utility), it leads to somewhat complicated (and not particularly illuminating) analytic expressions for the theoretical moments in $f(\theta)$. Therefore, we estimate the parameters via Monte Carlo simulation. For each set of parameter values, we take 50000 Monte Carlo draws of μ and ε, and for each of those draws compute π^{obs} and VS as described above. We then use that simulated data to compute the theoretical moments in the same way the observed moments are calculated.

Before reporting the results, we provide some intuition as to how various parameters would affect the theoretical moments. First, as the distribution of μ (given by the parameters $\overline{\mu}$ and λ_μ) shifts in the negative direction, one can expect π^{obs} to become more negative, as both firm and union proposals respond to the location of μ. Second, $\overline{\pi}$ is essentially an upper bound to the union and firm proposals, so decreases will generally lead to lower π^{obs} as well. Third, a very small σ implies that workers within a firm have very similar preferences, and therefore will vote similarly, implying that the only observed vote shares would be close to either 0 or 1. If σ is very large, then vote shares would be clustered around an intermediate value. Fourth, a very small λ_ε, which would represent very little uncertainty in the distribution of voters, would lead union and firm offers to converge towards each other. If the proposals are virtually identical, then we would expect no discontinuity in the event-study estimate with respect to the vote share.

Finally, we recognize that the observed data on π^{obs} and VS does not reveal the magnitude of c in any obvious way. For example, given the first order condition in 2 and a quadratic utility function, a less negative c would raise the marginal gain to the union of lowering an offer, but at the same time it would increase the potential penalty of losing the election; this suggests an ambiguous impact of c on π^{obs}.[14] For this reason, we investigate the extent to which our qualitative results are sensitive to the value of c by estimating the

[13] Specifically, $\hat{\alpha}_3$ and $\hat{\alpha}_4$ are the values of the regression prediction on either side of the 50 percent threshold, from a regression of π^{obs} on a quartic in the vote share and a dummy variable for the vote share being greater than 50 percent.

[14] Adding to the ambiguity of how c might affect the equilibrium offers is the fact that c is a lower bound on both union and firm offers.

remaining 5 parameters, conditional on varying values of c.

A.III.C Results and Policy Extrapolation

We estimate the model by minimizing the quadratic form described above. In doing so, we discovered that the objective function was virtually flat with respect to the parameter c, and that the estimated five parameters were not sensitive to the magnitude of c. For example, estimating the full six-parameter model gave estimates of $c = -17.20$, $\overline{\pi} = 0.042$, $\overline{\mu} = 0.339$, $\lambda_\mu = 7.80$, $\sigma = 0.311$, $\lambda_\varepsilon = 0.101$, whereas estimating the remaining 5 parameters conditional on fixing the value of c at -2.29 yielded $\overline{\pi} = 0.043$, $\overline{\mu} = 0.343$, $\lambda_\mu = 7.90$, $\sigma = 0.314$, $\lambda_\varepsilon = 0.102$. We concluded that c was not well-identified, and therefore we report the results from fixing c at -2.29.[15]

To illustrate the fit of the model, we generated simulated data according to the estimated parameters. Appendix Figure IV shows a histogram of simulated equilibrium vote shares. Overall, the distribution shares a similar shape to the actual distribution of vote shares in Appendix Figure III. As expected – since the estimation procedure only used the first two moments – there are some notable discrepancies. First, the simulated data yields a ratio of union losses to victories is about 2 to 1, compared to the actual ratio of about 2.5 to 1. Second, the simulated data produced no observations with vote shares above 83 percent, whereas Appendix Figure III shows a small number of cases in that upper tail.

The fit of the model can also be seen in Appendix Figure V, which provides the predicted change in market value, as a function of the observed vote share, using the simulated data. The figure gives the same overall shape as that in Figure VII, with the union effects flat and near zero to the left of the 50 percent vote share threshold, and a negative slope to the right of the threshold. In our judgment, while this five-parameter model certainly does not capture every feature of the observed data, it does seem to provide a reasonable approximation.

Importantly, our modest "calibration" exercise of this electoral competition framework suggests that unions are responding to workers' preferences. Using the simulated data, the regression of the union offers on the expected median position ($\mu - \frac{\sigma}{2} - \frac{\lambda_\varepsilon}{2}$) yields a coefficient of 0.734. Furthermore, our model suggests that firm and union offers are generally more "moderate" than the positions of the median voter. Appendix

[15] -2.29 seems to be the lower bound on the change in market value (relative to the broad market index): historically, over an 18 month period, the most the broad market index has ever increased has been 129 percent. Since an individual firm's stock price cannot lose more than 100 percent of its initial value, we take as the most negative excess returns to be -229 percent. Fixing c to be half of that value (-1.15) has almost no effect on the magnitude of the remaining parameters.

Figure V plots the average realized position of the median ($\mu - \frac{\sigma}{2} - \varepsilon$) worker by the realized vote share using the simulated data. It shows that when the union loses, the median worker's ideal profit is higher than the firm's offer, while the worker's ideal level is more negative than what the union offers, when the union prevails in the election.

The simulation results also provide insights into worker preferences. The simulations imply that the distribution of worker (implicit) preferences for profitability is highly skewed left. The 50th percentile of the median voter distribution (across firms) has a median voter with a preference for the change in equity value of *positive* 4.6%. At the same time, 25 percent of median voters have preferences that are more negative than -4.3%, while 5% have preferences for the change in equity value of less than -24%. This distribution suggests that the taste for large compensation packages amongst workers considering unionization is present in only a small number of establishments. We can think of these preferences as related to the establishment's elasticity of labor demand in the sense that workers are willing to accept larger compensation packages when demand is more inelastic and when their jobs are not at risk. From this perspective these simulations imply that the great majority of establishments undergoing elections have fairly elastic labor demand.

For the policy simulation we hold all of the parameters fixed at their estimated values, and *c* at -2.29, and then vary the threshold for a union election win. Changing the threshold alters the probability $P(\pi_M, \pi_U)$ in our model. For example, if the threshold is 25% of affirmative votes required to unionize, then the probability of a firm victory becomes $P(\pi_M, \pi_U) = \Pr\left[VS < \frac{1}{4}\right] = \frac{1}{\lambda_\varepsilon}\left[\mu - \frac{3}{4}\sigma - \left(\frac{\pi_M + \pi_U}{2}\right)\right]$. We then conduct a Monte Carlo simulation with 50,000 draws to compute the equilibrium union and management offers, and the union vote share distribution. We view this analysis as applicable to proposals that would make it easier for unions to organize workers, such as EFCA. Under the EFCA scenario there would no longer be elections, but it is arguably still true that we can view workers as deciding between two options (sign card or not), which is not unlike an election with a low union vote threshold. As in our model, firms and unions would try to influence that decision. Our policy simulation yields predicted effects of making it marginally easier to unionize (as indexed by the fraction that would win certification).

In Appendix Table IV we present the results from the policy simulations. The columns represent different scenarios according to the union vote share threshold for certification. The population is split into five mutually exclusive groups, represented by the rows. Each sub-group will either be all unionized or not, depending on the scenario, as indicated by the labels "YES" and "NO". In the "Proportion" column, it is seen that as the threshold decreases, more and more elections result in a union victory. For example, a 25

percent threshold corresponds to a (33+37+15=) 85 percent union victory rate while a 50 percent threshold corresponds to a 33 union victory rate.

The first row shows the predicted average percentage change in market value for the entire population for the different scenarios. Note that here we include both sets of establishments (winners and losers) because the model allows for management to vary their offers in response to a union threat and because lowering the threshold changes the composition of establishment in each category, as more establishments are unionizing. We find that a more than doubling of the union victory rate (from 33 to 70 percent, as we move from the 50 percent to the 33 percent vote share threshold), leads to an overall decrease in equity value of about 4 percent. If the union vote share threshold were lowered to 10 percent, it would increase the proportion unionized to 0.99, and the simulation predicts a further 6.6 percent decline (from -0.058 to -0.124) in equity value.

Our fully specified model allows us to examine the main sources of these changes. We are able to examine the changes for the sub-groups defined in the second through sixth rows of Appendix Table IV. We point to three general patterns. First, as we lower the vote share threshold, the market value change of the group of firms that would continue to lose under the new scenario remains fairly stable. Indeed the group in the second row ("Inframarginal Loss") experiences no change in market value. This pattern is consistent with management not being highly responsive to increased union threat as a result of the policy change. By contrast, we do see important changes in equity value among "inframarginal" unions who are already victorious with the higher threshold. This can be seen most clearly in the "Inframarginal win" row of Appendix Table IV, where the union effect drops from -0.117 to -0.153, moving from the 50 percent to the 33 percent threshold. This negative equity effect falls to -0.205 when the threshold falls to 10 percent, which according to the simulation would mean nearly the entire population would be unionized. Finally, we observe that when a marginal group shifts from the union losing the election to it winning the election there is a significant reduction in the market value of the firm. We note that each time this occurs, the change in the marginal group (ranging from -0.08 to -0.10) is reasonably approximated by the the estimated RD estimate using the simulated data (also is in the -0.08 to -0.10 range), which is shown in the last row of Appendix Table IV. Thus, one reason to be cautious about the simulated overall effect is that it is to some extent being driven by the simulated RD estimate, which is somewhat larger than the point estimates we obtain from the actual data.

There are other reasons for caution in making these policy predictions, particularly because of our choice of model. For example, we are not modeling which establishments hold union representation elections in the

first place. It is possible that lowering the threshold for unionization will change the composition of which establishments hold elections. We speculate that the marginal firms induced to hold an election by the policy change would be ones where wage demands are relatively weak in the first place, since one could argue that the cost of holding an election outweighed the potential benefits to the union.

A perhaps more fundamental concern is that our conclusions are made through the lens of a model of electoral competition. But it is possible that workers are not voting on compensation packages, and hence that unions and management are not acting strategically to influence the vote. In this case, we might expect to see the observed relationship between the vote share and the change in the market value because unions require widespread support to be effective, for example to impose a credible strike threat. Distinguishing this model from the one we propose would involve examining the employment changes following representation elections. One prediction of a model of electoral competition is that there should be limited employment effects from new unionization, something that we view as plausible given the results in DiNardo and Lee (2004). Exploring this further would be a fruitful avenue for future research.

We are not aware of any other attempt to estimate the impact of policies that ease unionization. Thus, in spite of the above caveats, we believe that our modeling and simulation exercise, which is disciplined by the magnitudes we find in our event-study and RD analyses, provides a useful benchmark for policy predictions.

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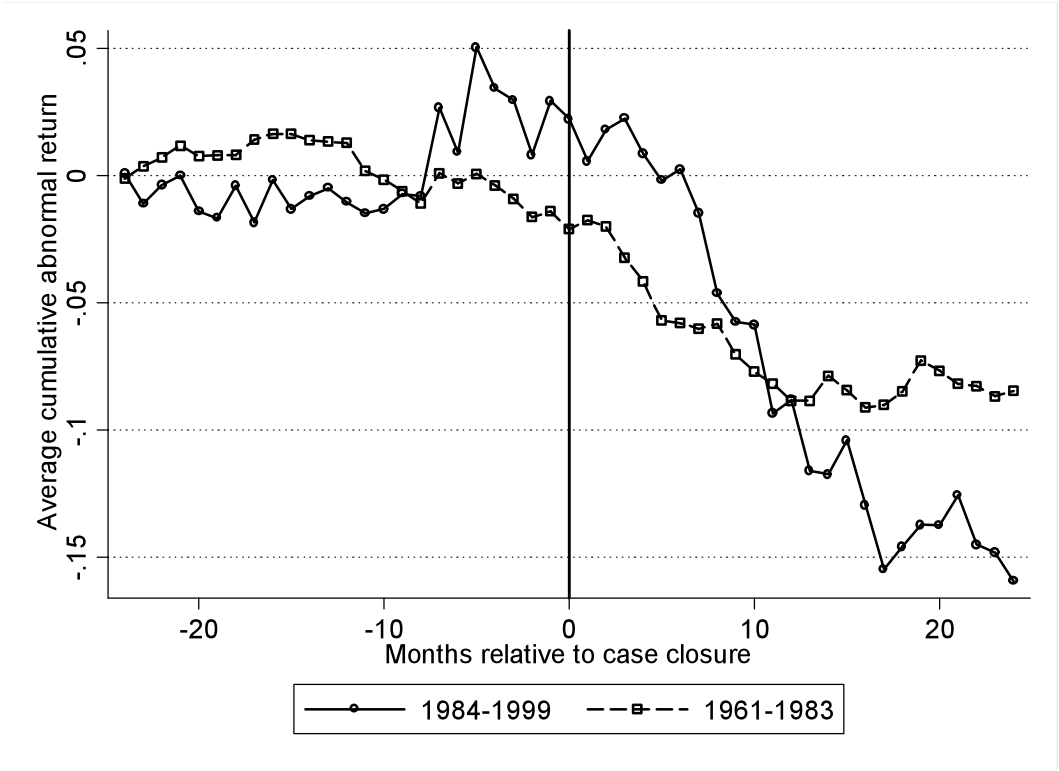
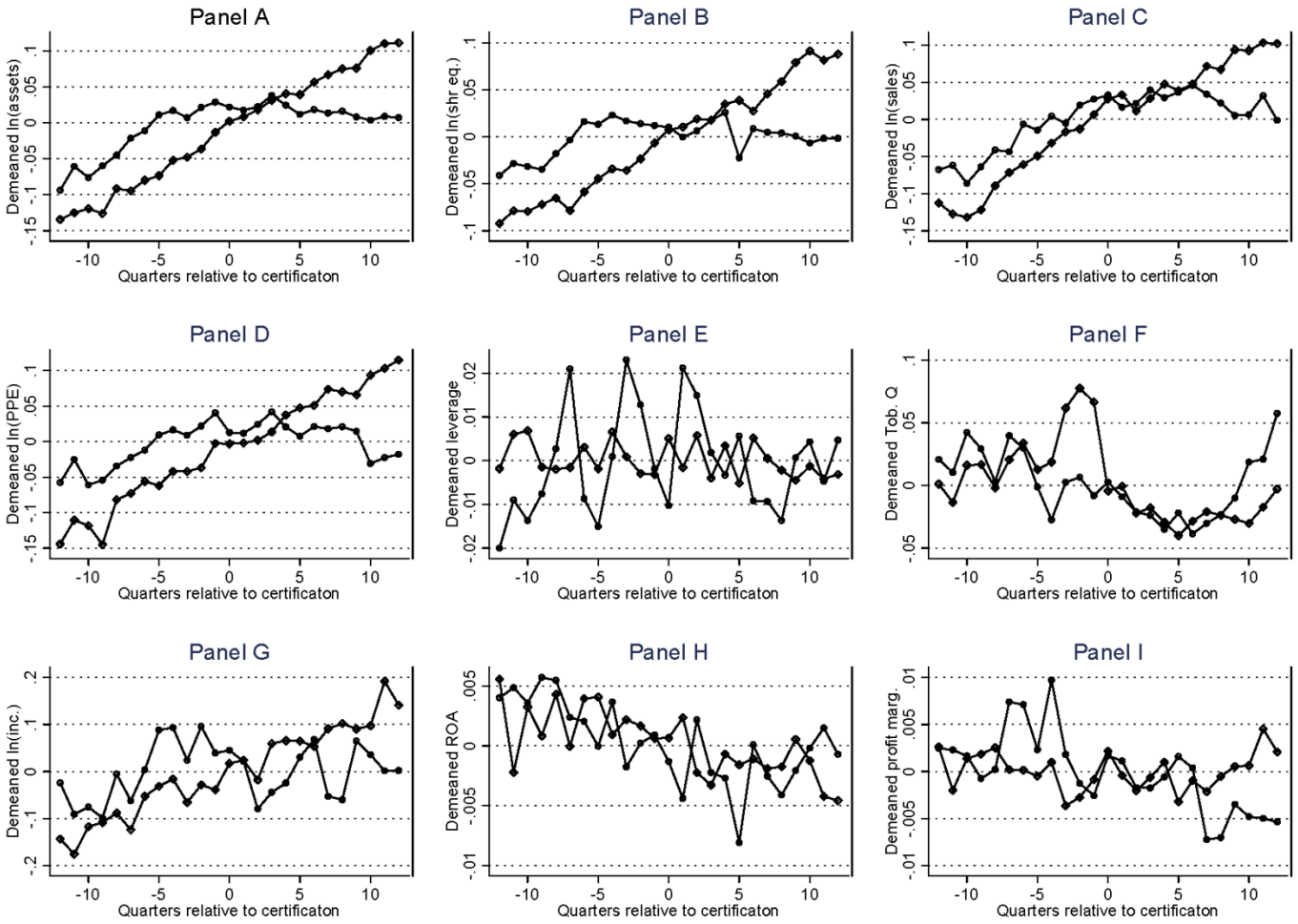
Appendix Figure I

Average cumulative abnormal return, by time period of election

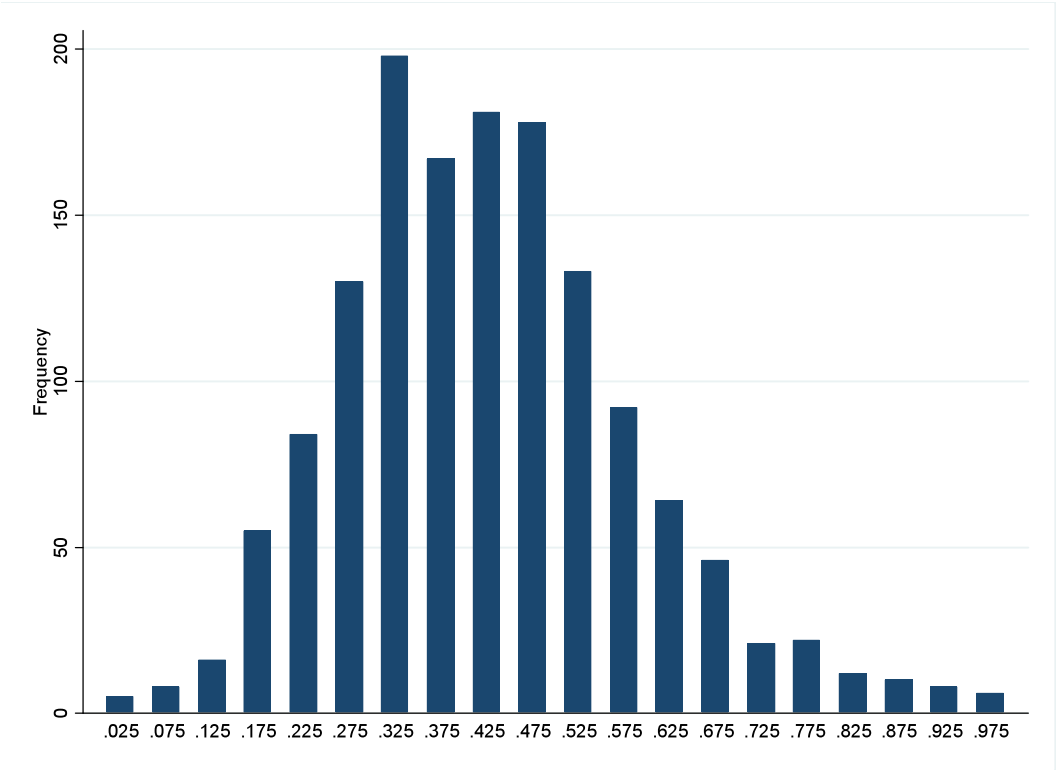


Appendix Figure II
Compustat variables; Union victory/loss comparisons

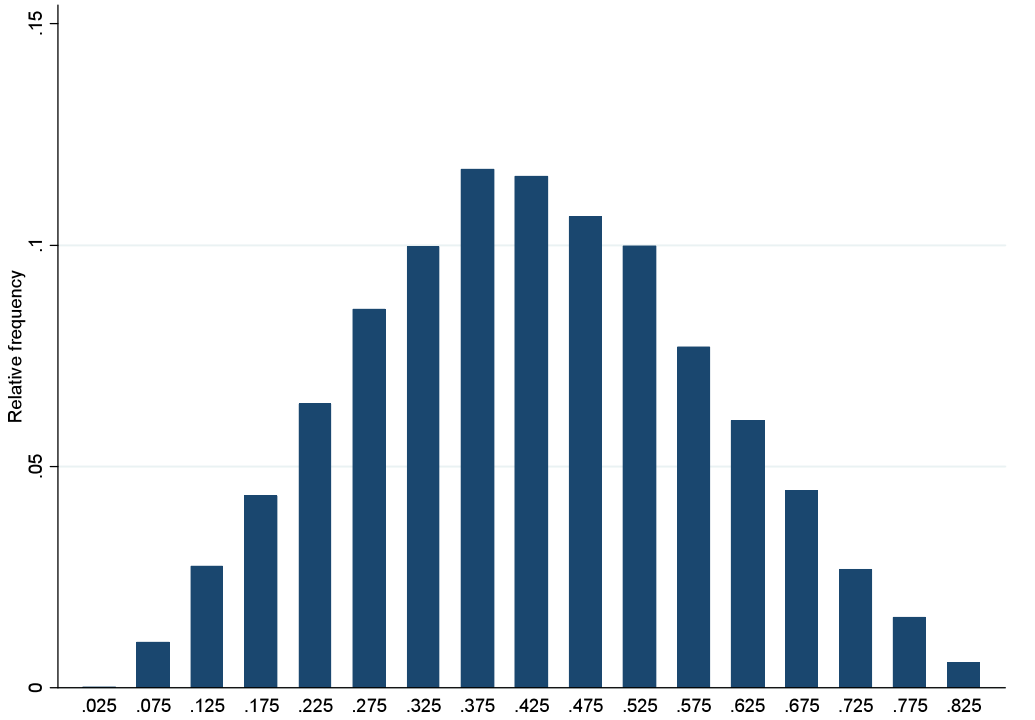


Notes: The sample consists of publicly traded companies with elections taking place between 1973-1999 where at least 5% of the workforce voted. Lines with circles correspond to union victory companies. Lines with diamonds correspond to union loss companies. All variables are drawn from the Compustat quarterly database. Each variable is demeaned, where the mean is taken within each election panel. Note that here we are using a longer pre-event window (three years) than that used in the event-study analysis (two years).

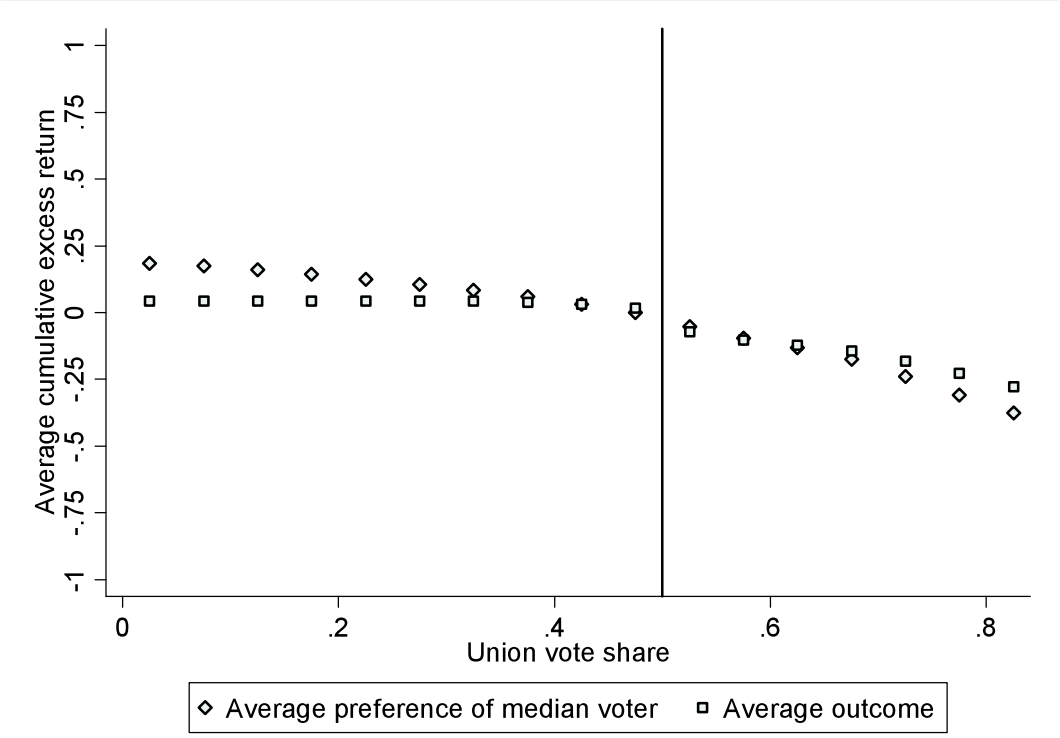
Appendix Figure III
Histogram of the union vote share



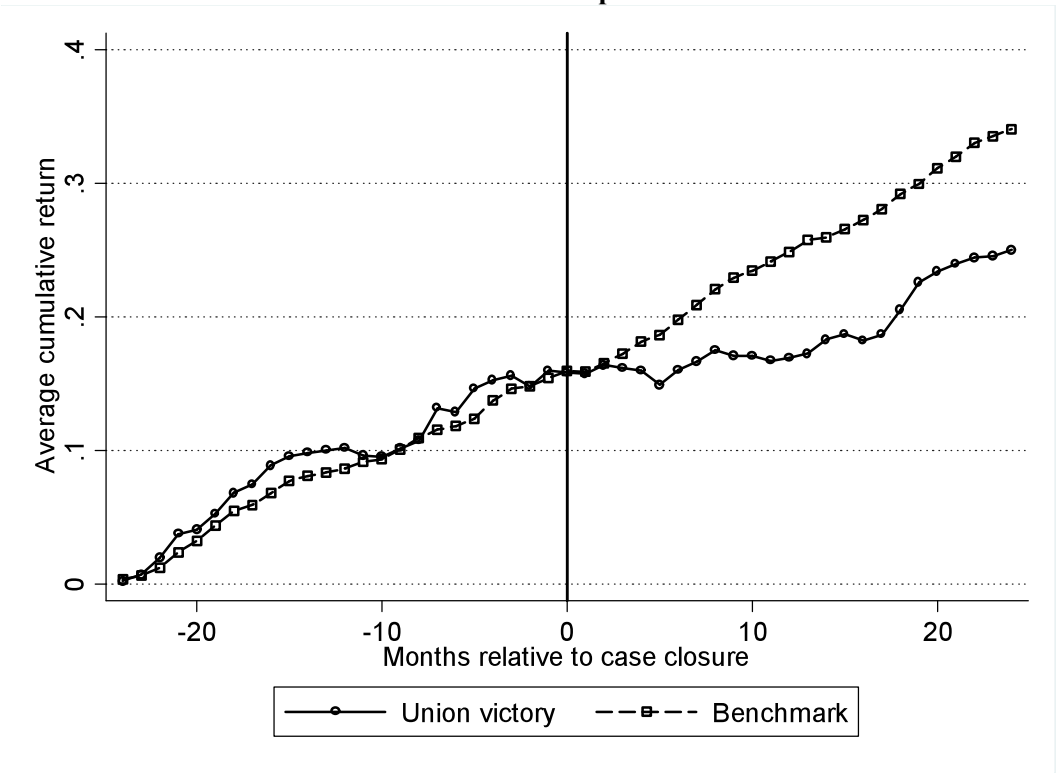
Appendix Figure IV
Histogram of simulated equilibrium vote shares



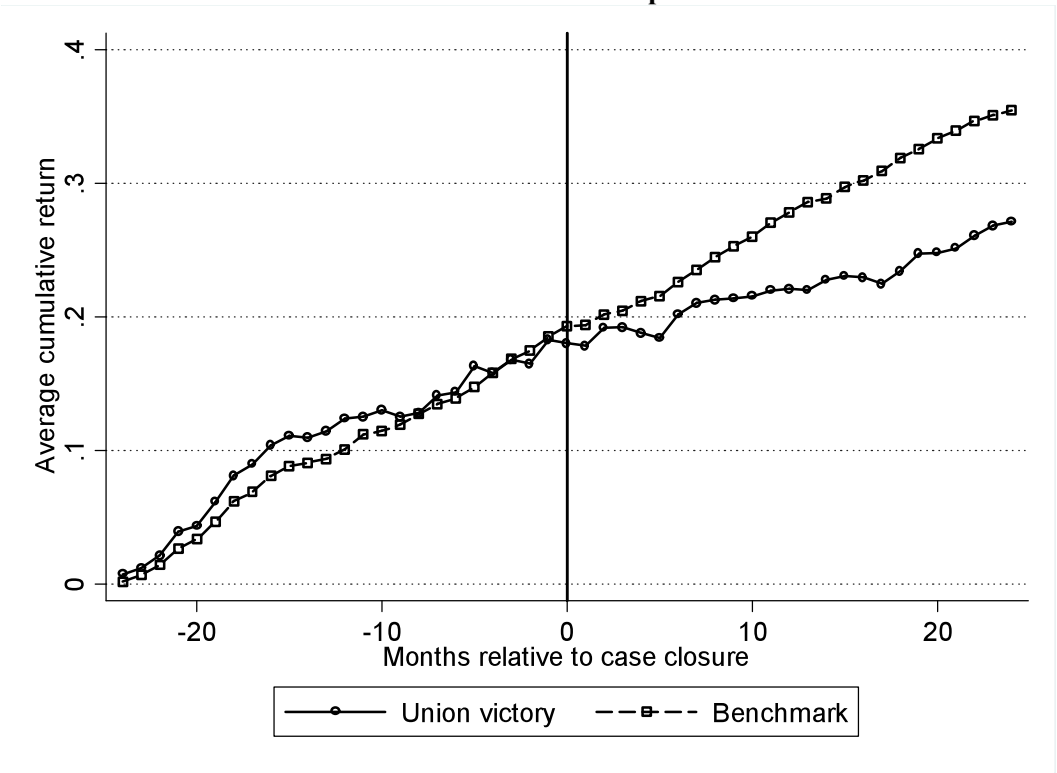
Appendix Figure V
Predicted change in market value, as a function of the observed vote share, using the simulated data



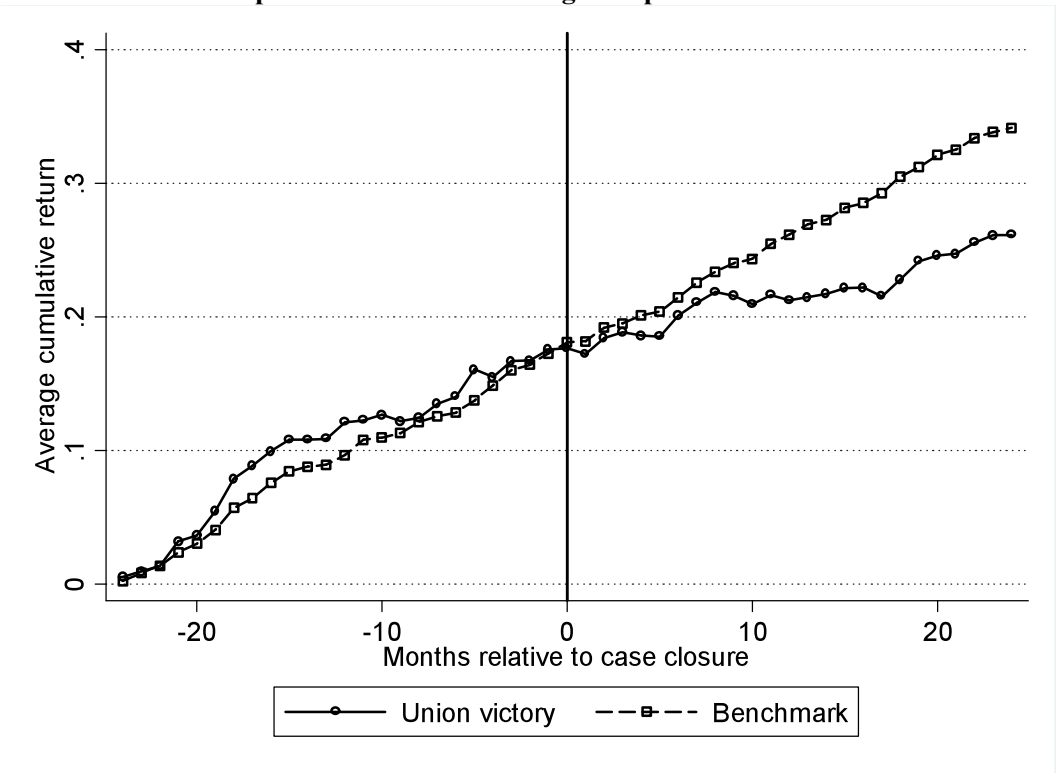
Appendix Figure VI
Average cumulative returns of union victory firms and of the sized-matched benchmark; non-imputed data



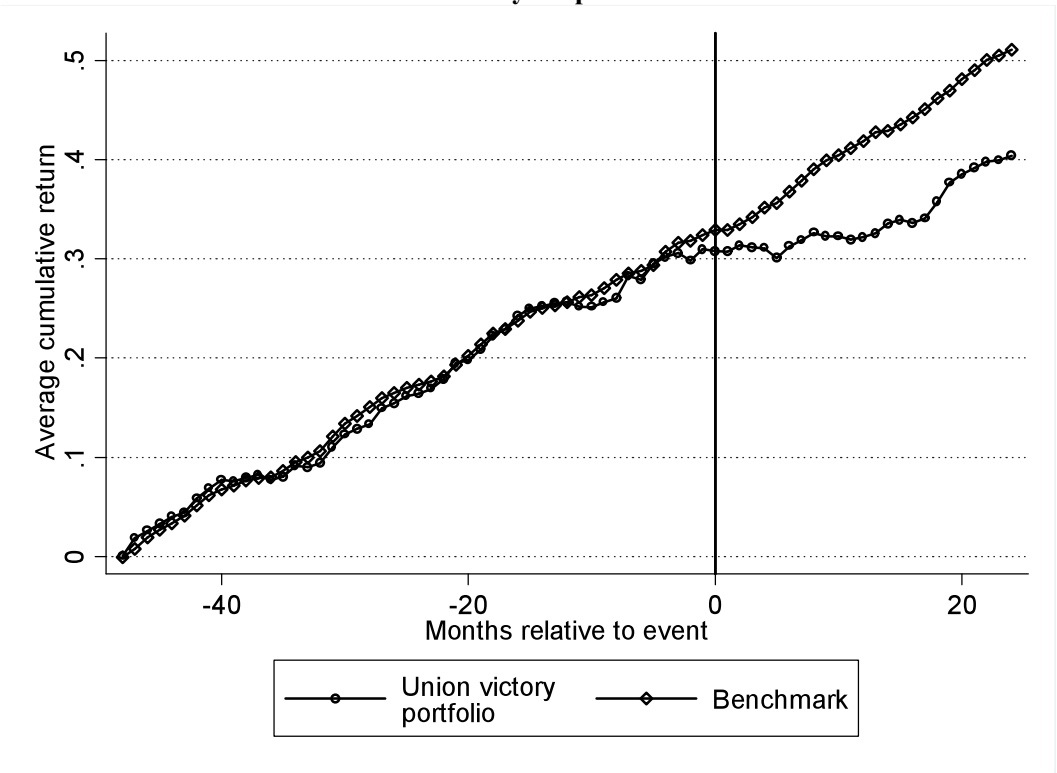
Appendix Figure VII
Average cumulative returns of union victory firms and of the sized-matched benchmark; Balanced panel



Appendix Figure VIII
Average cumulative returns of union victory firms and of the sized-matched benchmark; eliminate 5% most positive and 5% most negative post-event abnormal return elections

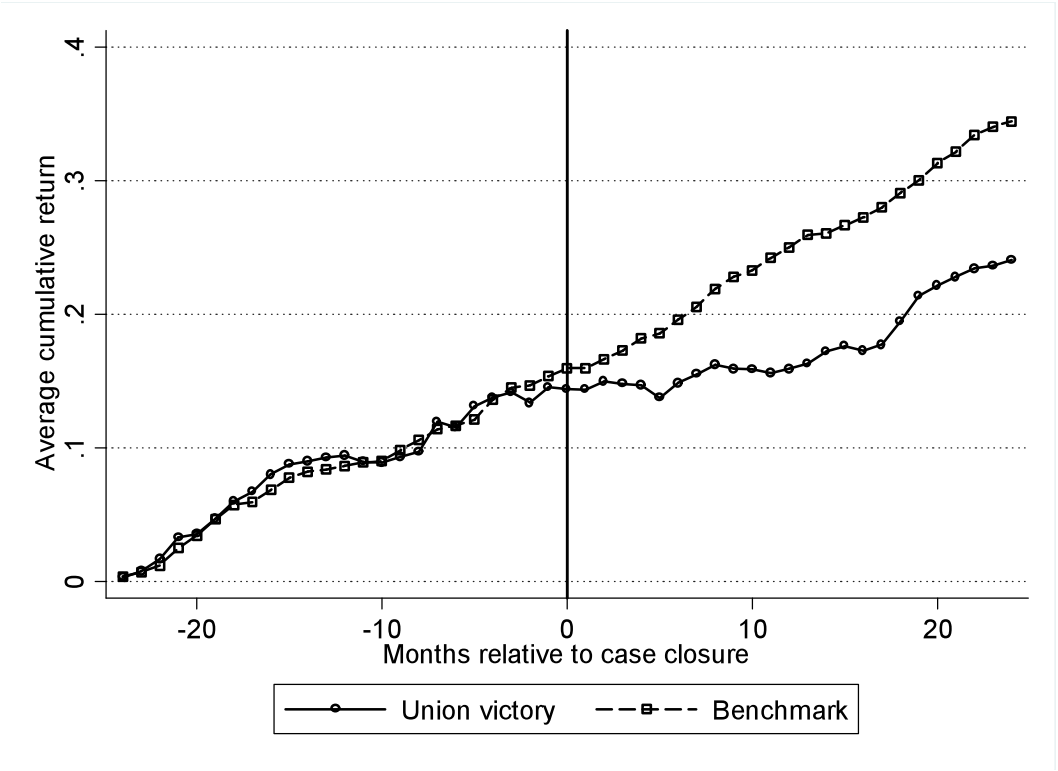


Appendix Figure IX
Average cumulative returns of union victory firms and of the sized-matched benchmark; Four year pre-event window

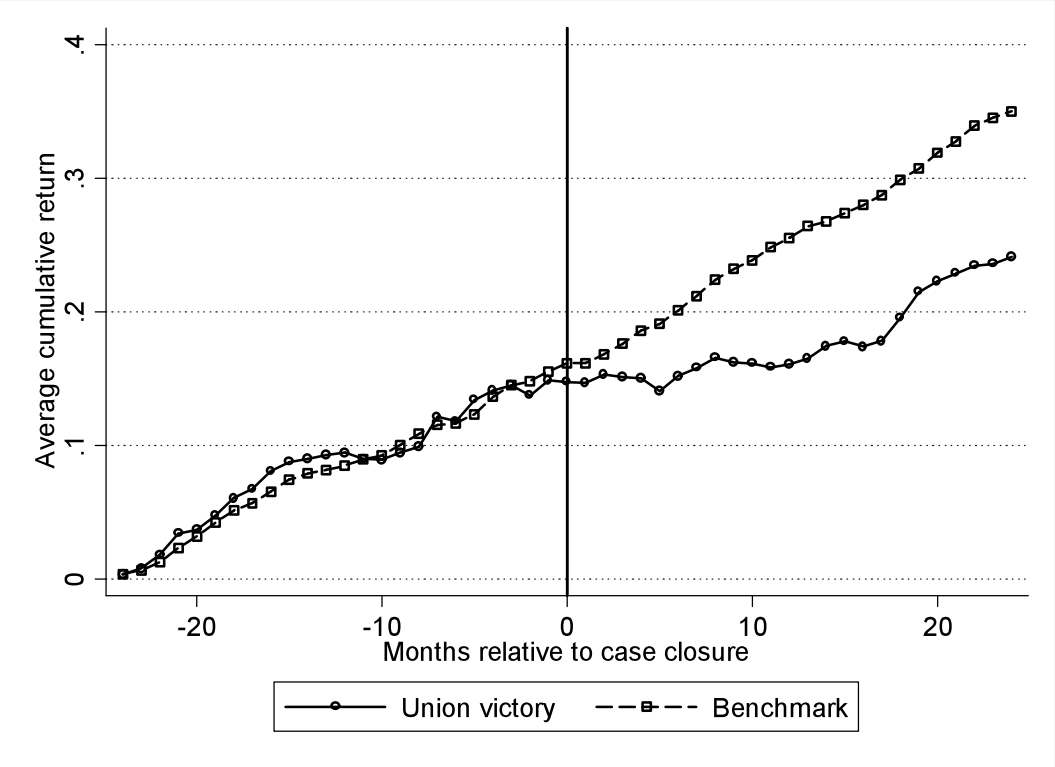


Appendix Figure X

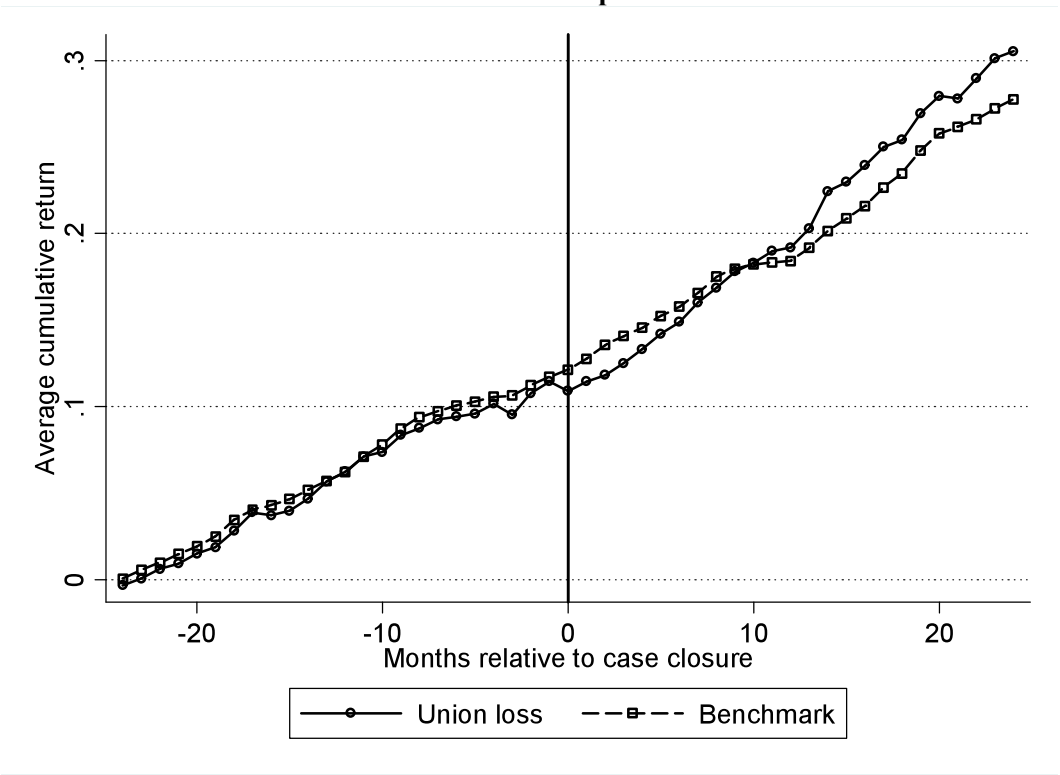
Average cumulative returns of union victory firms and of the industry×sized-matched benchmark



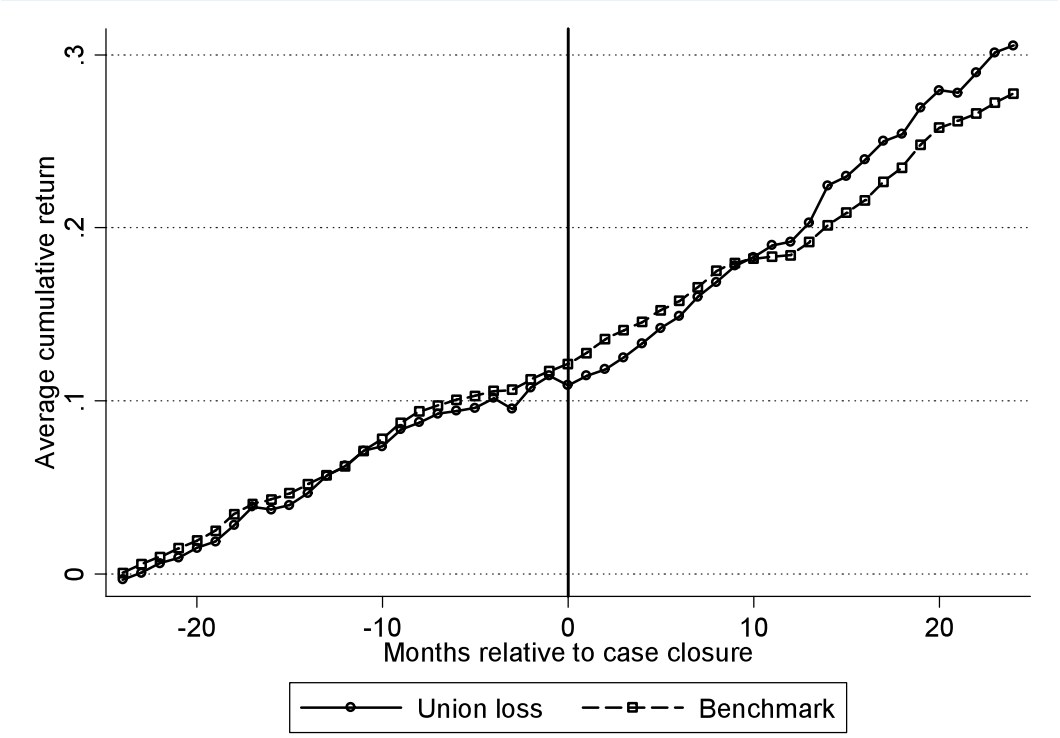
Appendix Figure XI
Average cumulative returns of union victory firms and of the CRSP equally-weighted index benchmark



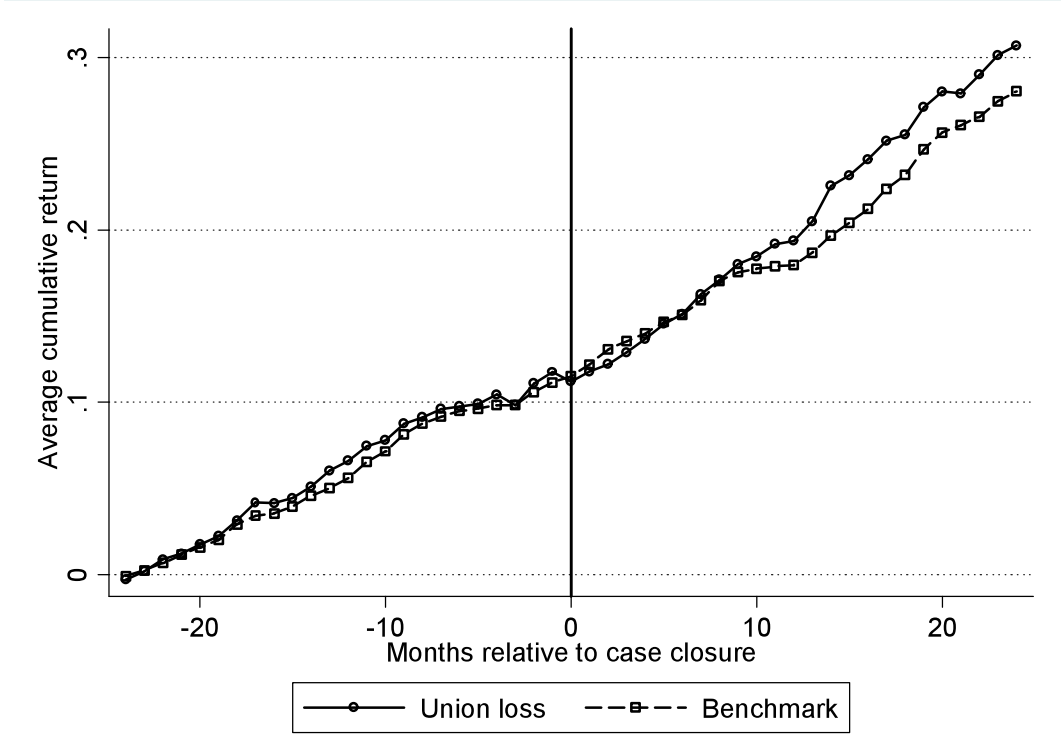
Appendix Figure XII
Average cumulative returns of union loss firms and of the sized-matched benchmark; non-imputed data



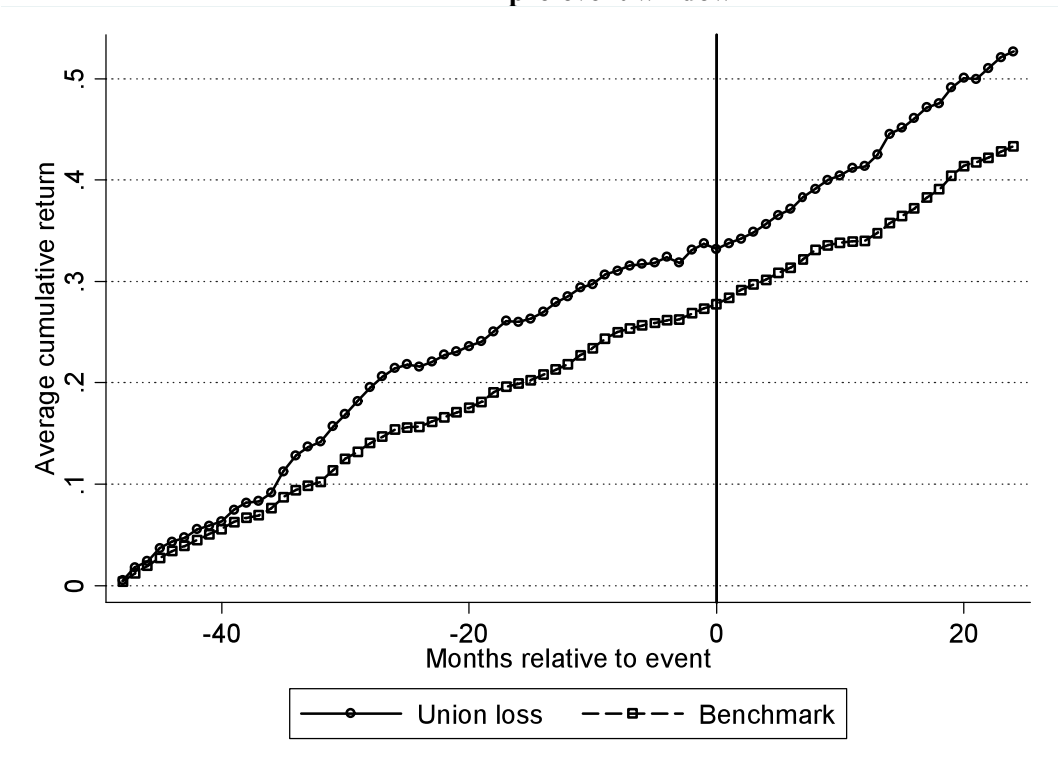
Appendix Figure XIII
Average cumulative returns of union loss firms and of the sized-matched benchmark; Balanced panel



Appendix Figure XIV
Average cumulative returns of union loss firms and of the sized-matched benchmark; eliminate 5% most positive and 5% most negative post-event abnormal return elections

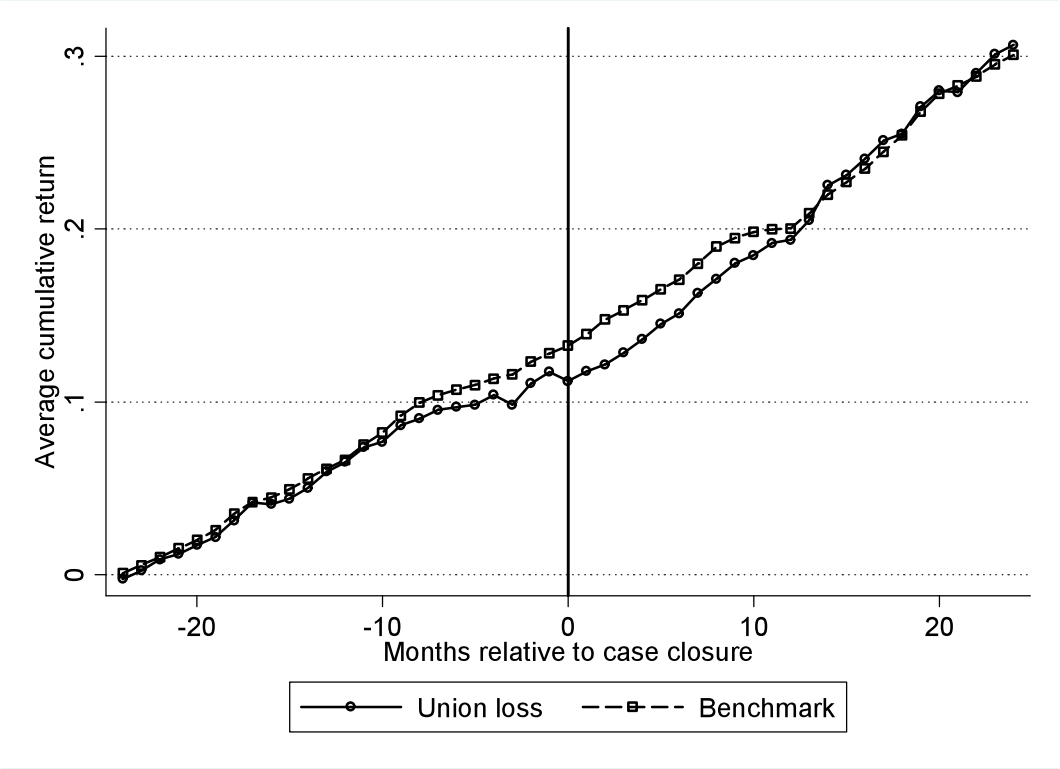


Appendix Figure XV
Average cumulative returns of union loss firms and of the sized-matched benchmark; Four year pre-event window

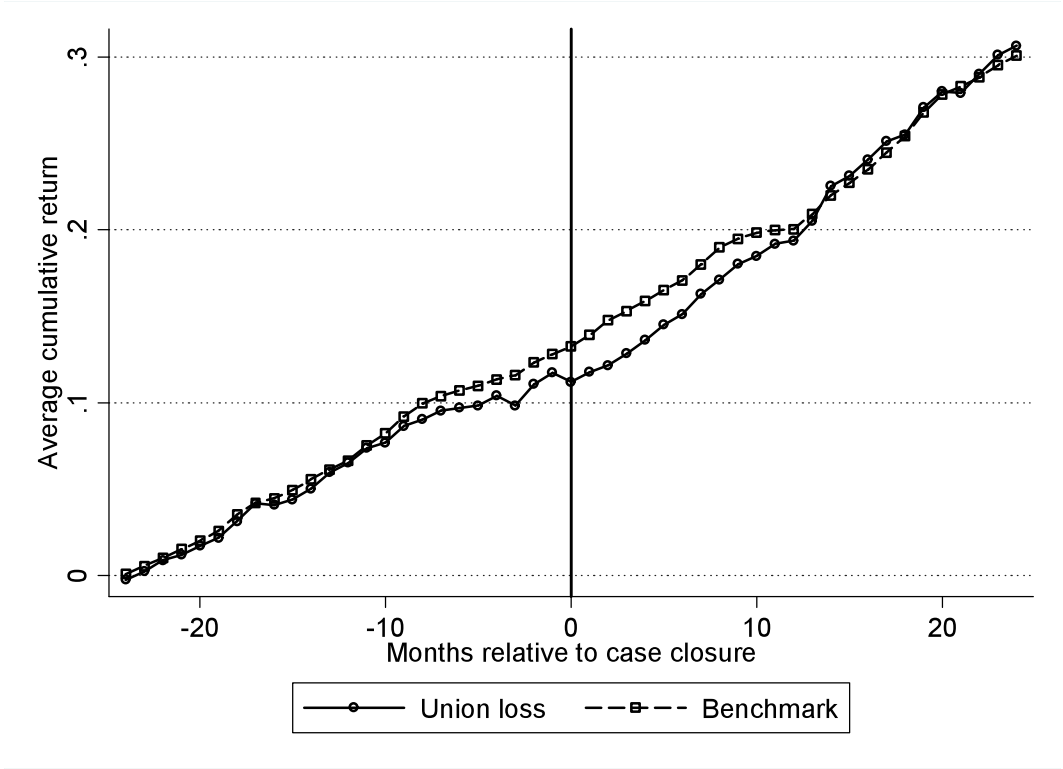


Appendix Figure XVI

Average cumulative returns of union loss firms and of the industry×sized-matched benchmark

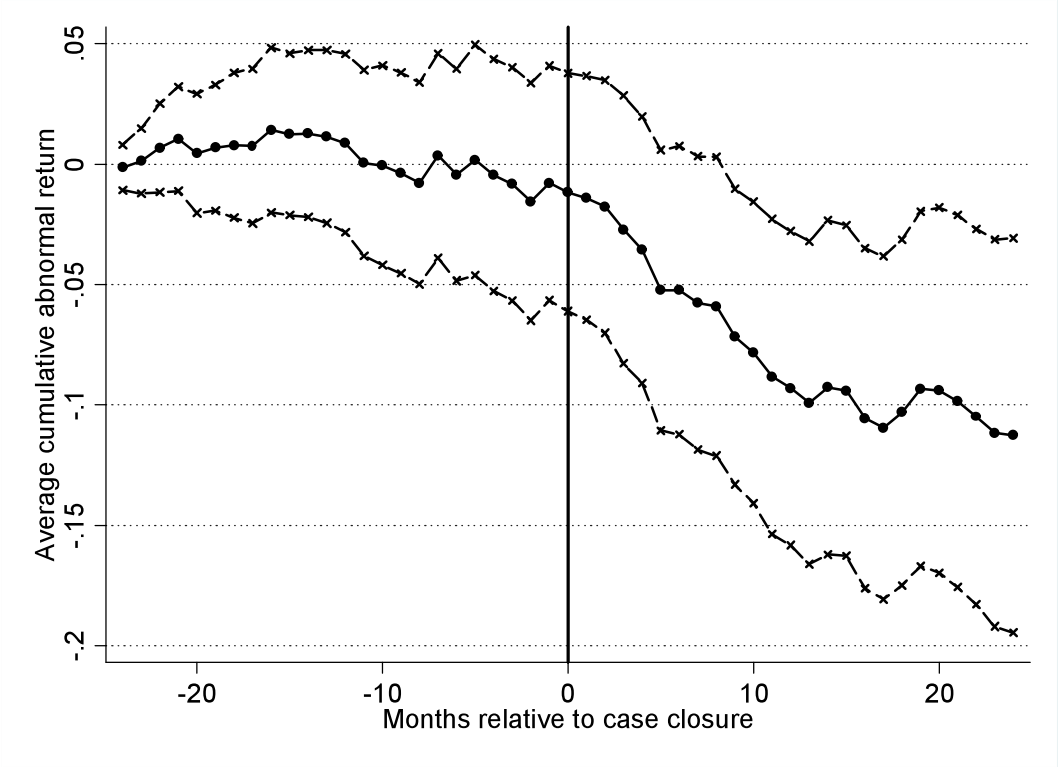


Appendix Figure XVII
Average cumulative returns of union loss firms and of the CRSP equally-weighted index benchmark

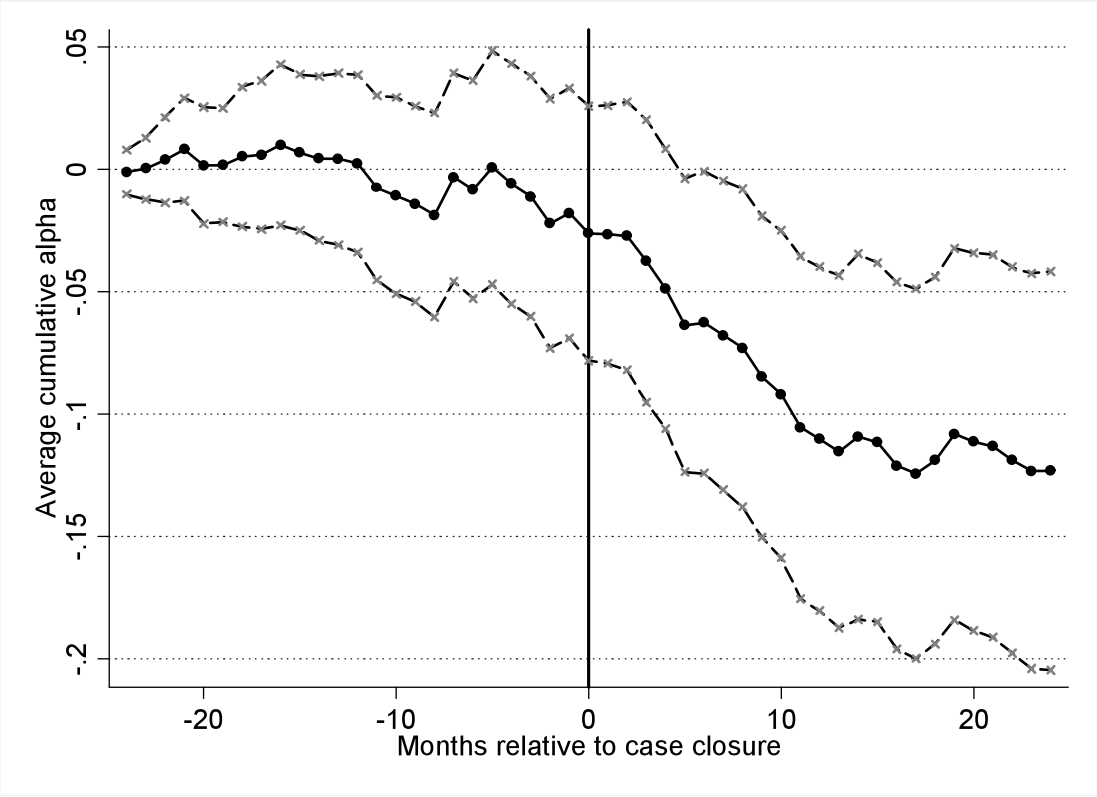


Appendix Figure XVIII

Average cumulative abnormal returns of union victory firms, by month relative to NLRB case closure; accounting for multiple elections with the same company



Appendix Figure XIX
Average cumulative abnormal return of union victory firms, by month relative to NLRB case closure, allowing for changing Betas



Notes: This figure shows the running sum of the coefficients on dummies for month relative to case closure in a regression of firm stock return minus the T-rate on the month dummies and the benchmark return minus the T-rate, allowing the coefficient on the benchmark return to change in event months -18, -12, -6, 0, 7, 13, and 19. It corresponds to the average cumulative abnormal risk adjusted return computed beginning 24 months prior to case closure. The dashed lines represent the 95% confidence intervals, which are computed using standard errors clustered on elections and calendar months. We use the formula in Cameron, Gelbach, and Miller (2006) to compute standard errors with multi-way clustering.

Appendix Table I
Fama-French Calendar Time Portfolio Estimates

Panel A: Union Victory Portfolio (≥5% sample)

Event-window:	Alpha	MKTRF	HML	SMB
(0,24)	-0.0051	0.909	0.421	1.12
	(0.0014)	(0.035)	(0.054)	(0.048)
(-24,-4)	-0.0015	0.996	0.487	1.14
	(0.0015)	(0.038)	(0.062)	(0.054)

Panel B: Union Loss Portfolio (≥5% sample)

Event-window:	Alpha	MKTRF	HML	SMB
(0,24)	-0.0001	1.04	0.469	1.01
	(0.0017)	(0.031)	(0.048)	(0.043)
(-24,-4)	-0.0005	0.970	0.264	1.04
	(0.0011)	(0.020)	(0.040)	(0.035)

Panel C: Union Victory Portfolio (<5% sample)

Event-window:	Alpha	MKTRF	HML	SMB
(0,24)	0.0010	1.10	0.395	0.222
	(0.0014)	(0.037)	(0.055)	(0.048)
(-24,-4)	-0.0009	1.10	0.283	0.373
	(0.001)	(0.026)	(0.042)	(0.037)

Panel D: Union Loss Portfolio (<5% sample)

Event-window:	Alpha	MKTRF	HML	SMB
(0,24)	-0.0015	1.14	0.509	0.212
	(0.0007)	(0.023)	(0.035)	(0.030)
(-24,-4)	-0.0009	1.10	0.220	0.335
	(0.0008)	(0.017)	(0.031)	(0.027)

Note: The "≥5% sample" consists of elections where at least 5% of the firm's workforce voted. The "<5% sample" corresponds to elections where less than 5% of the firm's workforce voted. MKTRF is the monthly return of the CRSP value-weighted NYSE/AMEX/NASDAQ broad market index, SMB is the monthly return on the zero investment portfolio for the common size factor in stock returns, and HML is the monthly return on the zero investment portfolio for the common book-to-market equity factor in stock returns. The unit of observation is the calendar month. Observations are weighted by the number of firms in the event-window.

Appendix Table II
Summary Statistics from Compustat Data, 1973-1999

	At least 5% of workforce voting		Less than 5% of workforce voting	
	Union victory (UV firms)	Union loss (UL firms)	Union victory (UV firms)	Union loss (UL firms)
Market Value	308.7	329.80	6334.1	7580.9
	[614.9]	[799.0]	[13372.0]	[16,343.1]
	{0.34}	{0.33}	{0.76}	{0.78}
Shareholder equity	242.6	233.2	4991.7	4479.8
	[433.0]	[497.7]	[13859.3]	[9432.4]
	{0.34}	{0.31}	{0.77}	{0.77}
Total Assets	588.4	683.8	13974.4	14164.9
	[1243.3]	[1876.5]	[36396.5]	[33308.0]
	{0.37}	{0.31}	{0.78}	{0.79}
Total Liabilities/Total Assets	0.060	0.068	0.062	0.071
	[0.118]	[0.162]	[0.112]	[0.183]
	{0.58}	{0.44}	{0.55}	{0.60}
Pretax income	15.11	9.76	249.3	276.3
	[46.97]	[41.9]	[731.7]	[731.1]
	{0.35}	{0.36}	{0.74}	{0.74}
Sales	160.7	144.2	2693.5	3041.2
	[238.7]	[225.1]	[5306.3]	[5534.1]
	{0.33}	{0.31}	{0.80)	{0.80}
Tobin's Q	1.17	1.30	1.29	1.31
	[0.658]	[0.694]	[0.642]	[0.625]
	{0.44}	{0.50}	{0.48}	{0.56}
Profit margin	0.069	0.060	0.084	0.084
	[0.119]	[0.167]	[0.073]	[0.074]
	{0.44}	{0.50}	{0.46}	{0.52}
Income/Employees	0.004	0.003	0.004	0.004
	[0.023]	[0.008]	[0.006]	[0.007]
	{0.41}	{0.49}	{0.48}	{0.51}
Return on Assets	0.013	0.022	0.026	0.027
	[0.051]	[0.037]	[0.023]	[0.027]
	{0.48}	{0.53}	{0.47}	{0.25}
Dividend Ratio	0.633	0.259	1.15	0.941
	[3.42]	[1.100]	[6.99]	[11.02]
	{0.44}	{0.50}	{0.58}	{0.59}

Notes: Standard deviations are in brackets. The average percentile rank, relative to all Compustat companies in the year and quarter of the election, are in braces. Market value, shareholder equity, total assets, pretax income, and sales are in millions of dollars. Summary statistics for market value differ from the CRSP measures in Table 1 of

the main paper because there are more missing values in the Compustat database. Profit margin = pre-tax income/sales. Dividend ratio = dividends/pre-tax income.

Appendix Table III
Relationship Between Changes in Firm Outcomes and Union Representation: Accounting Variables from Compustat, 1973-1999

	(1) ln(Assets)	(2) ln(Shareholder Equity)	(3) ln(PPE)	(4) ln(Sales)	(5) ln(Pretax Income)	(6) Dividend Ratio	(7) Profit Margin	(8) ROA	(9) Tobin's Q	(10) Liabilities/ Assets
post	0.1500	0.1060	0.1370	0.1320	0.1680	-0.197	0.0001	-0.004	-0.054	-0.001
	(0.024)	(0.022)	(0.030)	(0.022)	(0.035)	(0.128)	(0.002)	(0.001)	(0.026)	(0.005)
post x union victory	-0.110	-0.098	-0.113	-0.077	-0.168	0.045	-0.005	-0.001	0.031	0.003
	(0.038)	(0.039)	(0.049)	(0.035)	(0.063)	(0.272)	(0.003)	(0.002)	(0.039)	(0.008)
Observations	14,319	16,220	14,223	17,028	14,042	6,127	14,585	13,960	14,035	5,791
R-squared	0.97	0.95	0.96	0.94	0.75	0.08	0.64	0.32	0.66	0.28

Notes: Variables are derived from Compustat data; 1973-1999. Each column corresponds to a different model estimated using OLS. Standard errors clustered by firm are in parentheses. Observations are event quarter × firm cells. Sample sizes vary due to the presence of missing values. PPE stands for plant, property, and equipment. ROA stands for return on assets.

Appendix Table IV
Simulated Market Value Changes Under Different Vote Threshold Scenarios

Group	Proportion	Threshold=0.50		Threshold=0.33		Threshold=0.25		Threshold=0.10	
		Effect	Win?	Effect	Win?	Effect	Win?	Effect	Win?
Overall	1.00	-0.015		-0.058		-0.083		-0.124	
Inframarginal Union Loss	0.01	0.042	NO	0.042	NO	0.042	NO	0.042	NO
Marginal Group 1	0.13	0.042	NO	0.042	NO	0.042	NO	-0.062	YES
Marginal Group 2	0.15	0.042	NO	0.040	NO	-0.041	YES	-0.074	YES
Marginal Group 3	0.37	0.031	NO	-0.050	YES	-0.069	YES	-0.098	YES
Inframaringal union win	0.33	-0.117	YES	-0.153	YES	-0.171	YES	-0.205	YES
Simulated Discontinuity		-0.080		-0.081		-0.082		-0.108	

Note: Each column represents a different scenario for the union vote share necessary for certification. The population is split into five groups (represented by rows). "Inframarginal loss" denotes firms that would not be unionized under any scenario. "Inframarginal win" denotes firms that would be unionized under all scenarios. "Marginal Groups" denote firms in which unions would lose under one or more scenarios, but would win with a lower threshold (as indicated under the sub-column "Win?"). e.g. Marginal Group 3 comprises of firms where the union vote is marginally below the 50 percent when the threshold is 0.50; they would become unionized in any of the other scenarios. "Simulated Discontinuity" is the RD estimate - via a 4th order polynomial regression -- using the simulated data.