An Organizational Theory of Unionization*

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Abstract

Motivated by the recent wave of collective action, we explore the determinants of successful unionization. An employee who aims to unionize her workplace must first build an organizational team. In turn, the team convinces workers in the bargaining unit of the benefits of unionization. Unionization succeeds if and only if the organizer is sufficiently credible in the workplace. Credibility entails the team not being too biased towards unionization and/or incurring organizational costs. Our theory sheds light on why grassroots movements, rather than established unions, managed to organize their workplace. If a firm opposes unionization and targets organizers, unionization becomes more likely if organizational costs are low. However, unionization is thwarted if a firm's opposition is too strong, requiring legal and political protection.

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> If they lose,[...], it's because workers don't feel unions make a difference in their lives. "The UAW and other unions have to do a better job of selling themselves and letting workers see the benefits," [...] "They haven't been very good at that."[1]

1 Introduction

Endeavors to unionize workplaces have received increased attention in the United States. Unionization attempts at Amazon warehouses in Bessemer, Alabama, as well as Staten Island, have sparked renewed interest in the determinants of unionization success. While unionization efforts in Bessemer remained futile, an Amazon warehouse in Staten Island is now unionized.[2] On average, 50% of union representation petitions result in successful unionization. When is a unionization drive effective?

Our main contribution is to show that a grassroots movement originating within the workplace outperforms unionization attempts led by an established union, coming in from the outside.

Unionization starts with one worker, the leader. Her aim is to convince workers that unionization is beneficial for them. However, workers do not acquire information about the advantages and disadvantages of unionization. Rather, they make an inference about the value of unionization through the presence of union organizers. These can be professionals deployed by an existing union, in which case unionization follows a top down approach. Alternatively, the leader reaches out to co-workers and follows a bottom up approach. Organizers needs to be sufficiently credible, meaning their decision to organize conveys information about the value of unionization. We show that they are only credible if they are not too biased towards unionization and/or face sufficiently high organizational costs.

We argue that professional union organizers either favor unionization more strongly than regular workers or are required to participate in unionization efforts even if they do not agree with them. Moreover, organizing a union drive is a professional's job, limiting their organizational costs compared to a regular worker. Therefore, a professional organizer faces lower organizational costs and displays a stronger pro-union bias, reducing their credibility. Consequently, unionization is more likely to occur if the organizational team consists of co-workers due to their higher credibility –conditional on political, economic, and other environmental factors.

Moreover, management's attitude towards unionization matters. A firm opposed to

[1] https://www.cnbc.com/2014/02/05/volkswagen-union-vote-chattanooga-tenn-could-be-labor-rally-point.html

[2] For an in-depth discussion of the unionization efforts at the Amazon warehouse and examples of other unionization drives, see Section 7.

unionization can target organizers, raising their costs. If organizational costs are low, then management's opposition improves an organizer's credibility and in turn, the chances of successful organization. However, if management obstructs organizational activities aggressively or threatens the entire bargaining unit, then unionization can only succeed under sufficient political and legal protection.

Our result qualifies the established narrative that organizational activities fail due to management's obstruction. Some opposition may in fact help unionization as the leader's second-in-command within the organizational hierarchy must face costs for his endeavors in order to be credible and convincing to workers. Alternatively, he may be sufficiently moderate, highlighting the importance of the characteristics of the deputy.

In contrast to the hierarchy described here, collective action problems traditionally assume that the process of building an organization is decentralized. Such an approach ignores that the creation of a special interest group, or any other political structure, is determined by its institutional and legal framework. Unionization in particular is a heavily regulated process within the US. We provide an overview of the determinants of successful unionization as well as the unionization process itself in Section 2. We tailor our model to this framework. This allows us to confirm that temporary and blue collar workers lead to a lower probability of unionization. In contrast, higher economic uncertainty harms unionization.

We only require the leader to be sufficiently pro-unionization to make unionization worthwhile for her. In our setting, the leader merely draws a contact. In turn, the contact draws a signal about the value of unionization for the firm. This value can be positive or negative, meaning that unionization can be beneficial or not. The signal about the value is informative. Based on the signal, their own ideological preference for unionization, the environment they are facing as well as organizational costs, the contact then decides whether to become an organizer or not.

The decision of the contact to become an organizer or not provides information to workers. Workers do not draw signals themselves, but rely on the decision of the contact to provide them with information on whether unionization benefits them. Workers may not have the time to independently assess whether unionization is beneficial for them, but they can easily observe organizational activities and will note their absence.

While a worker knows the organizational cost, they do not see the signal nor the ideological bias of a contact. Therefore, the worker needs to disentangle whether the contact made his decision to become an organizer or not based on his signal or his ideological preference. Observing an organizer can mean that the contact is simply pro union and even a negative signal did not dissuade him from becoming an organizer. Alternatively, the contact may have become an organizer solely due to his positive signal.

The worker can make an inference about the signal as they know the set of biases that contains the ideological preference of the contact. A higher bias means a lower ideological preference for unionization or a higher preference for the status quo without unionization. Therefore, if the maximal bias of the contacts is low, then all contacts are reasonably pro-union. A higher maximal bias means that the contact can also be skeptical towards unionization.

We characterize the different equilibria depending on the maximal bias and the organizational cost. We distinguish between high, moderate and low organizational costs.

If organizational costs are high, then no contact becomes an organizer. Organizational costs comprise time costs, monetary costs, as well as the firm's retaliation against organizers. If a contact was required to incur a sufficiently large cost, then unionization efforts are not worthwhile, even if they are beneficial for the workplace.

For moderate organizational costs, a contact with a negative signal never becomes an organizer. A contact with a positive signal always becomes an organizer if the maximal bias is low. All contacts are sufficiently pro-union, and a positive signal induces all of them to become an organizer. In this instance, we obtain a fully informative equilibrium.[3] Even though the workers do not observe a signal, they perfectly learn the contact's signal through the contact's decision. If workers see an organizer, then they know that he drew a positive signal. If the contact declined to be an organizer, then workers know that his signal was negative.

With moderate costs and a high maximal bias, the contact with a positive signal conditions his choice on his bias. If he is more pro-union, he becomes an organizer; if he is more anti-union, he refrains from participating in organizational activities.

For low organizational costs, not only contacts with a positive signal but also those with a negative signal may opt to become organizers. The exact decision depends once again on the maximal bias. In general, costs and the maximal bias work as credibility 'substitutes': a higher maximal bias leads to more neutral or even anti-union contacts, while higher organizational costs make unionization more expensive. In both instances, only those who are sufficiently sure that unionization is beneficial choose to organize, lending credibility to their endeavors. However, if there is too strong an anti-union sentiment among contacts or organizational costs are too high, then unionization campaigns are curbed, as at best only the very pro-union contacts with a positive signal become organizers.

At the other extreme, with very low costs and only strong pro-union contacts, no organizer emerges due to a lack of credibility. If workers were to see an organizer, they would not be able to make an inference about the value of unionization, given that both contacts with a positive and a negative signal would prefer to become organizers. However,

[3]This corresponds to a separating equilibrium.

if workers cannot make an inference, then the probability of unionization is not affected by the organizational activities. At the same time organizers incur a cost. Therefore, in equilibrium, there cannot be an organizer present.

Having characterized the equilibria, we ask which maximal bias makes unionization most likely, taking organizational costs as given. In practice, these costs are heavily influenced by the firm. Management can make organizational activities time-consuming and risky, if it targets organizers. The leader has little influence on these costs, beyond choosing whether to bring in a union from the outside or organizing the union drive with the help of co-workers. Therefore, we focus on the optimal maximal bias given costs. We then rank the equilibria that emerge for the different maximal biases according to the probability of unionization they achieve.

From an ex-ante perspective, the probability of unionization is the same across all maximal biases and costs. The change in the probability of unionization due to organizational activities depends on the informativeness of the equilibrium. Higher informativeness means that the worker is more likely to learn about the true value. If unionization is beneficial, then better informativeness increases the unionization probability. However, higher informativeness also decreases the unionization probability if the true value of unionization is negative. Ex ante, the upside and the downside cancel out. This finding implies that a leader merely interested in unionization does equally well across all equilibrium outcomes.

Given that the leader is also an employee of the firm, she may start a unionization drive only if she believes that the value of unionization is beneficial. We find that the probability of unionization, conditional on a positive value, is increasing in the informativeness of the contacts' decisions. With moderate costs, any maximal bias that leads to the fully informative equilibrium maximizes informativeness. This means a low to moderate maximal bias makes unionization most likely. With low costs, there exists a unique maximal bias, that maximizes informativeness and therefore the probability of unionization. In order to convey information, it is optimal to discourage organizers with a negative signal, while encouraging organizers with a positive signal. However, discouraging organizers with a negative signal can also discourage organizers with a positive signal. The optimal maximal bias is such that it limits the organizers with a negative signal, while every contact with a positive signal becomes an organizers. A lower maximal bias would only increase the organizers with a negative signal, leading to a lower informativeness and in turn lower probability of unionization. A higher maximal bias, on the other hand, induces both contacts with a positive signal and those with a negative signal to not become organizers. It turns out that to achieve better informativeness, it is more important to retain the contacts with a positive signal as organizers, instead of limiting the organizers with a negative signal. This is achieved at the optimal maximal bias.

Our results shed light on why a bottom up approach tends to be more successful than a top down approach. A top down approach is characterized by low costs and a low maximal bias. This implies that at the extreme, no information is gained by the presence of organizers and therefore, the probability of unionization is unaffected. But even if professional organizers are to convey some information, this is significantly less than what co-workers achieve, given that the latter are less biased in favor of unionization and face higher organizational costs.

A bottom up approach when unionization costs are low allows for the possibility of moderate organizers. With low costs, a higher maximal bias increases the informativeness, which in turn makes unionization more likely if workers benefit from it. Additionally, moderate costs are plausible only when unionization is bottom up. In this case a fully informative equilibrium can be attained, which maximizes the probability of unionization if the value is positive.

We link our framework to real-world unionization campaigns in the US, evaluating their outcomes through the lens of our model. Due to the lack of available data on unionization, we discuss some anecdotal evidence. Specifically, we examine the unionization efforts at two Amazon Warehouses - one in Staten Island and the other in Alabama. Despite facing fierce resistance from Amazon in both cases, the grassroots approach in Staten Island proved successful, leading to unionization, while the top-down strategy in Alabama fell short.

This example underscores that it's not solely management's opposition that dictates the success of a union drive. We substantiate our claim by citing instances where unionization efforts floundered even in companies supportive of unionization. In these cases, workers weren't persuaded of the benefits of unionization, emphasizing the importance of credible organizers, in line with our model.

Nevertheless, management can influence the chances of unionization. First, firms can affect organizational costs. If management is opposed to unionization, then it can make the organizational costs so high as to never allow for unionization. If unionization is wanted then protecting union organizers is necessary– in line with the US legislation which forbids firms to target union organizers. In addition, if organizers are wrongfully mistreated or dismissed, then a federal agency, the National Labor Relations Board (NLRB) brings a case on the organizer's behalf, which reduces the costs of organization. In addition, management can threaten the entity that strives for unionization, in the most extreme case with closure. Such an approach affects both organizers as well as workers and unambiguously lowers the odds of unionization. This response is easier to implement in entities that do not display high levels of fixed costs. Therefore, we would expect unionization to be less prevalent in such firms.

We additionally consider the workforce characteristics and how they affect unionization as well its economic, political and legal determinants. This allows us derive various policy implications on how unionization can be supported or hindered.

Related Literature We contribute to the literature on the determinants of the success of social movements. Olson (1965) postulates that collective action suffers from free-rider problems, and unions are established if they manage to overcome them. One solution to this coordination failure are early participants in the social movement, whose presence induces others to join as well. This has been explored by numerous papers in the context of protests and revolutions, see Shadmehr (2015), Shadmehr and Bernhardt (2019), Tarrow (2022). One channel of why early participants, or leaders, help a social movement is due to them having better information (Hermalin 1998, Ginkel and Smith 1999, Loeper, Steiner, and Stewart 2014). Another feature of these models is that these early participants tend to be more extreme (Kuran 1991, Lohmann 1994a,b, Kricheli, Livne, and Magaloni 2011). In contrast, we focus on unionization, which is governed by a legal framework. This impacts incentives and determines the unionization process. In line with the protest literature, we also assume that organizers, which can be interpreted as early participants possess better information. However, in a stark contrast to the protest literature, we find that moderate organizers, rather than extreme ones are crucial for successful information transmission.[4] Crucially, we are not aware of any theoretical work on union formation.

Traditionally, unions have been simply assumed to exist. For instance, Galbraith (1954) views unions as a countervailing force to management power. This notion has been reflected in theoretical work on wage bargaining and strikes as in Ashenfelter and Johnson (1969). The role of unions on wage setting, but also giving workers a voice has been widely explored since the seminal work by Freeman and Medoff (1984), most recently by Harju, Jäger, and Schoefer (2021). Our study, which explores the selection process for worker representation, complements research focused on the selection into union membership as explored in Naylor and Cripps (1993). Even though they also take the union as given, they discuss the conditions for which unions unravel. This notion of de-unionization has been established as an empirically relevant phenomenon by Acemoglu, Aghion, and Violante (2001). Naylor and Cripps (1993) state that once a union has ceased to exist it will not recover easily: our model shows how a union can be (re-)established.

Understanding this is particularly relevant for the US where private-sector bargaining

[4]Our result also differs from the findings derived in cheap talk models which highlight that it is beneficial to first convince agents with more aligned interests. In turn these agents persuade those further away from the original sender. In this case it is again optimal to reach out to the most extreme agents, not moderate ones as in our costly signaling model (Caillaud and Tirole (2007), Awad (2020), Schnakenberg (2017)).

coverage has been eroded (Farber, Herbst, Kuziemko, and Naidu 2021). This is despite US workers wanting union representation (Kochan, Yang, Kimball, and Kelly 2019, Hertel-Fernandez, Kimball, and Kochan 2022). Even though unionization is sought, successful unionization is tied to lower profits and establishment closures, especially when management opposed unionization (Lee and Mas 2012, Frandsen 2021, Wang and Young 2022). One reason for lower profits is provided by the theory of Levine, Mattozzi, and Modica (2023). They distinguish between workers and shirkers and provide conditions under which labor associations protect shirkers.

The idea of different types of workers touches on the characteristics of union members, organizers and leaders. Boudreau, Macchiavello, Minni, and Tanaka (2021) investigate empirically the role of union organizers in Myanmar's garment sector. Union organization in these workshops is pursued by employees and corresponds to our bottom up approach. They show that convincing workers is instrumental for mobilization– in line with our theory.

Moreover, our work introduces a novel concept of leadership. Existing work explores leading by example (Hermalin 1998), leader's judgment and their ability to communicate clearly (Dewan and Myatt 2007, 2008), the role of overconfidence (Bolton, Brunnermeier, and Veldkamp 2013), and the competence-loyalty trade-off (Egorov and Sonin 2011). We highlight that leadership success can be determined by the leader's connections, echoing Machiavelli (1532) Chapter 22. Our model echoes this perspective, as the leader requires organizers that lend her credibility. Strikingly, the leader's characteristics are found to be of secondary importance; instead, it is the attributes of the second-in-command that determine the success of unionization.

Finally, our work aims to improve our understanding of organizational structures of entities beyond the firm. While there is a vast literature on the organization of firms starting with Coase (1937), how other economic and political structures develop and organize has yet to receive further scrutiny. We consider our approach a first stab at this important question.

The remainder of our paper proceeds as follows. We provide an overview of the determinants of unionization as well as the process these campaigns follow in Section 2. Our model is presented in Section 3. We analyze the workers' and contacts' decisions in Sections 4 and 5, respectively. The latter section provides an overview of the equilibria, and we rank the unionization probability across different outcomes in Section 6. We connect our model to unionization endeavors in Section 7, provide comparative statics in Section 8, and conclude in Section 9.

2 Unionization Determinants and Process

The success of unionization depends on various political and economic factors as well as the legal framework that governs the unionization process.

2.1 Determinants of Unionization

Value Of Unionization In general, there is uncertainty among workers about the value of unionization. The key benefits of unionization evolve around higher pay (Blanchflower and Bryson (2004)) as well as having a voice, that is being able to communicate concerns and problems to management (Freeman and Medoff (1984)). How important each of these factors is depends on how fairly management already behaves towards workers, but also on the quality of union representation. Unions charge member fees, which vary across union. Therefore, the wage gains generated by the union should ideally outweigh union fees. Unions are also required to push for the best possible deal for their workers, which has not always been the case. For instance, one factor that contributed to the demise of unions in the 1980ies was corruption by union bosses: they were paid off by companies to prevent meaningful wage increases, resulting in the harm of the workers they were meant to represent. Therefore, it is not obvious for workers whether unionization is beneficial in their firm, but rather the unionization campaign needs to make a case for why unionization is beneficial.

Response of Bargaining Unit A second factor for unionization success is potential retaliation by the bargaining unit. A bargaining unit is either a firm or a section within the firm, which can set wages. For example, every Amazon warehouse is its own bargaining unit, so is every Starbucks shop. In general, management tries to prevent unionization and has various means to achieve this. Management can hire union busters which come in and explain to workers the potential disadvantages of unionization in mandatory meetings. They can also threaten to close the bargaining unit if unionization takes place or try to fire employees who engage in unionization activities. There may also be promises made if unionization does not take place. While the latter is illegal, it is often difficult for the fired employee to hold management accountable for their violation of the law.

Legal Environment If a worker believes his dismissal is due to his unionization efforts, then to contest the firm's decision he can file a complaint with the National Labor Relations Board (NLRB). How aggressively the NLRB fights for the worker depends on the state. Some states have stronger NLRB's, others weaker organizations. The NLRB can sue employers if they violate the law around union organization, but they have discretion in what cases they choose to bring. The NLRB may also condition their decision on which case to pursue on the legal environment: for instance, if the courts in a given state have an established history to find against workers, then it may not even be worth it to bring a case. One indicator of how friendly a state is towards firms is whether it is a Right to Work state or not.[5] In a Right to Work state, union membership is not mandatory. This means that even if a bargaining unit is unionized, any employee does not have to be a union member, even though negotiated bargaining agreements still apply to them. If a state is not a Right to Work State, then every employee in a unionized bargaining unit is required to join the union and pay membership dues. Right to Work states encourage free riding, and this is reflected in unions unraveling (Fortin, Lemieux, and Lloyd (2023)). However, overall, Right-to-Work and non-Right to Work states do not seem to differ significantly in terms of their unionization rates (Farber et al. 2021).

Economic Environment The economic environment is also generally assumed to contribute to unionization success, although it is not obvious in what way. If it is easy for workers to find a new job, then instead of pursuing unionization, a costly and time-intensive process, many workers will simply leave a company that does not pay and/or treat workers well. On the other hand, under these circumstances unionization efforts are also less risky: if the firm retaliates or fires a worker, it is easy for the worker to move on. Similarly, if economic conditions are bad, then it is more challenging to leave a job, but simultaneously riskier to undertake unionization efforts. It is therefore not obvious whether good or bad economic conditions lead to more or less unionization.

Workforce Composition Another factor that affects unionization success if whether the jobs are temporary in nature or not. Temporary workers have less of an incentive to engage in a costly and drawn out unionization process. By the time they could reap benefits, they have already moved on. It further matters whether the job is a white collar job versus a blue collar job: blue collar workers have on average lower unionization rates compared to white collar workers.

2.2 Unionization Process

The unionization process is governed by regulations that leaders, union organizers, but also management are required to follow.[6] These rules are enforced by the NLRB.

[5] For instance, Farber (1984) argues that the differences between Right to Work states and non-Right to Works states are due to differences in attitudes towards unionization.

[6] The legal possibilities for unionization are broader than described here, we focus on how unionization commonly proceeds. For instance, there are solidarity and minority unions, which do not engage in wage bargaining, but still lend voice to employees. These unions are not registered with the NLRB.

The unionization process usually starts with a disgruntled employee, who is unhappy with the working conditions. She reaches out to an established union and files, with their help, a unionization petition with the NLRB. The leader then can either hand over the running of the unionization campaign to an established union, selecting a *top down* approach. Alternatively, she can contact colleagues and friends to form an organizational team, which we refer to as *bottom up* unionization campaign.

Independently of the whether the union campaign is run as a top down or bottom up approach, the following steps will be taken:

1. The leader as well as organizers try to convince as many workers as possible that unionization is beneficial for them, through a unionization campaign. The campaign consists of calling workings, producing leaflets, but also entails social events.[7]
2. In many instances, management hires union busters in order to prevent unionization. Management may also threaten with the closure of the bargaining unit and may retaliate against the organizational team.
3. Organizers require at least 30% of workers within the bargaining unit to sign cards.[8] Once they collected the necessary signatures, the organizer return to the NLRB, which holds a vote on unionization.
4. If a majority of employees in the bargaining unit vote in favor of unionization, then the workplace is unionized.

In a unionized bargaining unit, the union bargains with management about wages. The union also influences working conditions, for instance, it can influence scheduling or will flag workplace issues to management on behalf of workers. As already mentioned above, if a bargaining unit is unionized, then every employee at the workplace is required to become a union member in a state that does not follow a Right to Work legislation. In a Right to Work state, union membership is voluntary.

3 An Organizational Theory of Unionization

3.1 Agents, Actions, Types

Our model focuses on the unionization campaign. We take a leader as given, who then draws a contact. The contact can either be a co-worker or it can be a professional union organizer.

If the contact is a co-worker, then he decides whether to become an organizer or not.

[7]The unionization campaign resembles a political campaign in that it generates talking points, but it cannot inform workers exactly what will happen after unionization, as this is subject to considerable uncertainty.

[8]Workers need to show first that they are interested in unionization and they do so by signing union authorization cards.

Figure 1: Timing

leader draws contact	$\rightarrow$	contact draws signal	$\rightarrow$	contact becomes organizer or not	$\rightarrow$	shock realised	$\rightarrow$	workers decide on unionization

If the contact is a professional union organizer, then he can also either decide whether to become an organizer or he may simply be required to become a union organizer. Each worker decides for or against unionization. We denote the contact's decision by $x \in \{0, 1\}$, where $x = 1$ means that the contact opted to be an organizer.

Every agent has an ideological preference for or against unionization. We pin down the leader's preference at $\underline{b} < 0$ as a low bias implies a preference for unionization. A low bias means a bias more to the left, motivated by left ideologies being more favorable towards unionization.

The contact's ideological bias b is uniformly distributed between $\underline{b}$ and ω, $b \sim U[\underline{b}, \omega]$. Similarly, a worker's bias b_w is uniformly distributed between $\underline{b}$ and $\overline{b}$, $b_w \sim U[\underline{b}, \overline{b}]$, where $\omega \leq \overline{b}$ to capture that contacts may be more pro unionization than workers.

Finally, management decides on the degree to which it obstructs unionization, denoted by $d \in [\underline{d}, \overline{d}]$. We allow for management to be supportive of unionization, in which case $d < 0$, while for the usual case of management being hostile towards it, $d > 0$.

3.2 Timing

The timing of the unionization campaign is depicted in Figure 1.

1. The leader draws the contact from the continuum of workers.
2. The contact draws a signal $s \in \{0, 1\}$ about the value of unionization. The value of unionization can be positive or negative, with $v_1 > 0 > v_0$ with a priori probability $\frac{1}{2}$. The signal about the value of unionization is informative, with precision $p > \frac{1}{2}$. The contact conditions his choice to become an organizer his signal.
3. After the unionization decision of the contact, management decides on the level of obstruction d in case unionization occurs.
4. A shock δ is realized, which can be a political, economic or environmental shock (or a combination of all three), which is uniformly distributed between $\underline{\delta} < 0 < \overline{\delta}$, $\delta \sim U[\underline{\delta}, \overline{\delta}]$. Crucially, this shock affects everyone involved in the unionization process.
5. Workers decide for or against unionization.

3.3 Payoffs

The goal of the leader is to maximize the probability of unionization with respect to the maximal bias of the contact ω. If the leader knows that the value of unionization is positive, then he wants to maximize the probability of unionization conditional on the true value v_1:

$$\max_{\omega} \qquad P(u|v_1) \tag{1}$$

Contact If the contact becomes an organizer, his payoff is as follows:

$$\mathbb{E}[v|s] - d - \bar{c} \qquad \text{if unionization succeeds,} \tag{2}$$

$$b + \mathbb{E}[\delta] - \bar{c} \qquad \text{if unionization fails.} \tag{3}$$

An organizer's payoff if unionization succeeds depends on the expected value of unionization conditional on the signal $\mathbb{E}[v|s]$ and the level of obstruction imposed by management d in case of unionization. Finally, there is a cost of becoming an organizer, denoted by $\bar{c} > 0$. If unionization fails, then the payoff to the organizer is his ideological, status quo bias b. This is positive if the contact is anti-union, as he prefers the current status quo, and negative if the contact is pro-union. Moreover, the payoff if unionization fails depends on the overall economic and political environment. If the environment in expectation is favorable towards unionization then $\mathbb{E}[\delta]$ is negative, while a more hostile environment means a positive reward for failed unionization with $\mathbb{E}[\delta] > 0$. If the contact does not become an organizer, then the payoffs are given as

$$\mathbb{E}[v|s] - d \qquad \text{if unionization succeeds,} \tag{4}$$

$$b + \mathbb{E}[\delta] \qquad \text{if unionization fails.} \tag{5}$$

They key difference between the payoff after becoming an organizer versus not engaging in organizational activities is the organizational cost which only accrues if the contact becomes an organizer.

Worker We turn to the worker's payoff. The worker obtains a payoff $\mathbb{E}_w[v|x] - d$ if unionization occurs and $b_w + \delta$ if unionization does not occur. The key difference to the payoff of the contact is that workers do not draw a signal about the value of unionization, but merely observe the decision of the contact to become an organizer or not. Their expectation over the value of unionization, indexed with w, is then conditional on the contact's choice.

Unionization is successful if a majority of workers decide in favor of it. Denote by

$\pi_u(x)$ the share of workers in favor of unionization, conditional on the choice of the contact. Then unionization occurs with probability

$$P(u|x) = P\left(\pi_u(x) > \frac{1}{2}\right). \tag{6}$$

3.4 Solution Concept

We solve for weak perfect Bayesian equilibria as is commonly done.

3.5 Top Down vs Bottom Up

We capture the difference between a top down and a bottom up approach by the maximal bias of the contact, ω, as well as the organizational cost $\bar{c}$. First, we assume that the organizational cost is lower, if not negligible, for a professional union organizer. Organizational costs capture both how much time, effort and even money organizers dedicate to unionization as well as potential retaliation by management. A professional union organizer is paid for his duties, while organizers recruited among workers are required to use their free time on unionization activities. The latter may even spend their own money on unionization activities. In addition, management often targets organizers specifically. In case of their own employees, this can mean trying to fire them, which cannot happen to external, professional organizers. Therefore, if an employee becomes an organizer there is much more at stake, potentially a loss of livelihood if they become an organizer.

4 Worker's Decision

We solve by backward induction and first consider a worker's decision regarding unionization. A worker is in favor of unionization if and only if

$$\mathbb{E}[v|x] - d > b_w + \delta \qquad \Leftrightarrow \qquad \mathbb{E}[v|x] - d - b_w - \delta > 0 \tag{7}$$

Unlike the organizer, a worker does not obtain a signal about the value of unionization. Instead, he updates his beliefs about its value based on the organization decision of the contact. For a worker to prefer unionization, it must hold that the economic environment, characterized by d, the firms response to unionization, as well as δ, the shock, is not too hostile towards unionization. Only then does there exist a worker who prefers unionization. If there exists such a worker, then we also have a worker with ideological preference $\hat{b}_w$ who is indifferent between unionization and the status quo. Every worker with $b_w \leq \hat{b}_w$ prefers unionization, while every worker with $b_w > \hat{b}_w$ decides against unionization. If every worker opposes unionization, then we set $\hat{b}_w = \underline{b}$. If every worker is in favor of unionization, then $\hat{b}_w = \overline{b}$.

The share of workers who opt for unionization is then given by

$$\pi_u(x) = \frac{\hat{b}_w - \underline{b}}{\overline{b} - \underline{b}} = \begin{cases} 0 & \text{if } \hat{b}_w = \underline{b} \\ \frac{\mathbb{E}[v|x] - d - \delta - \underline{b}}{\overline{b} - \underline{b}} & \text{if } \hat{b}_w \in (\underline{b}, \overline{b}) \\ 1 & \text{if } \hat{b}_w = \overline{b} \end{cases} \tag{8}$$

which by our definition of $\hat{b}_w$ always lies between zero and one. Unionization is successful, if the share of workers in favor of it exceeds 50%. This yields the probability of successful unionization,

$$P(u|x) = P\left(\pi_u(x) > \frac{1}{2}\right) = \frac{\mathbb{E}[v|x] - d - \frac{1}{2}(\overline{b} - \underline{b}) - \underline{\delta}}{\overline{\delta} - \underline{\delta}}. \tag{9}$$

As we require this to be a probability, we ensure that $P(u|x)$ lies between zero and one, by setting the unionization probability to zero if $\frac{\mathbb{E}[v|x] - d - \frac{1}{2}(\overline{b} - \underline{b}) - \underline{\delta}}{\overline{\delta} - \underline{\delta}} < 0$. For $\frac{\mathbb{E}[v|x] - d - \frac{1}{2}(\overline{b} - \underline{b}) - \underline{\delta}}{\overline{\delta} - \underline{\delta}} > 1$, we cap it at one.[9]

In what follows, we require solely the probability of unionization from the worker's problem as this it is a sufficient statistic of the worker's decision.

5 Contact's Decision

At the heart of our problem is the decision of the contact on whether to become an organizer or not. The contact chooses to be an organizer if and only if

$$P(u|x = 1)\left(\mathbb{E}[v|s] - d - \overline{c}\right) + (1 - P(u|x = 1))\left(b + \mathbb{E}[\delta] - \overline{c}\right) \tag{10}$$

$$> P(u|x = 0)\left(\mathbb{E}[v|s] - d\right) + (1 - P(u|x = 0))\left(b + \mathbb{E}[\delta]\right) \tag{11}$$

This is equivalent to

$$\mathbb{E}[v|s] - d - b - \mathbb{E}[\delta] \geq \frac{\overline{c}}{P(u|x = 1) - P(u|x = 0)} \tag{12}$$

As the RHS of inequality (12) is constant, while the LHS is decreasing in b, it follows that the equilibrium must be a cut-off equilibrium. We therefore introduce a cut off b_s such that a contact with signal s and bias $b < b_s$ becomes an organizer, while a contact with bias $b > b_s$ refrains from becoming an organizer. Note that we write $b_s = \underline{b}$, if the contact never chooses to become an organizer, even if at $\underline{b}$ the contact strictly prefers to

[9] Alternatively, we can impose appropriate restrictions on $\underline{\delta}$, $\overline{\delta}$ and $\overline{b}$, for details see Appendix A.

not become an organizer. In the same spirit, $b_s = \omega$ simply means that every contact prefers to be an organizer.

It is useful to define the following two expressions:

$$k_0 \equiv \mathbb{E}[v|s=0] - d - \mathbb{E}[\delta] \tag{13}$$

$$k_1 \equiv \mathbb{E}[v|s=1] - d - \mathbb{E}[\delta] \tag{14}$$

Note further that the difference between k_1 and k_0 is given by

$$k_1 - k_0 = (2p-1)(v_1 - v_0) \equiv \tilde{v} \tag{15}$$

We then impose the following assumption

Assumption 1 (Restricted Punishment). *Let* $\overline{d} < \frac{v_0+v_1}{2} - \underline{b} - \mathbb{E}[\delta]$.

This assumption ensures that the most pro-union contact with an uninformative signal about the value of unionization prefers unionization to not unionizing. Under Assumption 1 it is feasible to observe an organizer even if his signal is zero. Otherwise, $k_0 - \underline{b}$ would be negative, meaning that a contact with zero signal would never attain a positive payoff from being an organizer, independently of the organizational costs and the probability of successful unionization.[10] However, this assumption does not imply that a contact with signal zero will become an organizer.

This assumption captures that there are limits to what management can do, given that unionization is legally protected. This does not only apply in terms of retaliation against union organizer, but also towards workers.

One observation that follows immediately from Assumption 1 is that a higher retaliation of the firm can ensure that only a contact with a positive signal becomes an organizer. If a contact with a positive signal obtains a sufficiently high expected value of unionization, then he will choose to become an organizer, while a contact with negative signal never does so as his expected value falls even further.[11]

Assumption 1 further ensures that at least the most pro-union contact with a positive signal finds unionization beneficial, with $k_1 - \underline{b} > 0$. Once again, this does not automatically imply that the contact becomes an organizer– a decision that also hinges on organizational costs and the change in unionization probabilities.

We demonstrate the importance of organizational costs in our first result. To establish it, we define $c \equiv \overline{c}(\overline{\delta} - \underline{\delta})$ and express it as a condition on c. We refer to c as the de-facto

[10]Technically speaking, not making this assumption would rule out certain equilibria.

[11]What this means is that for d above the specified threshold, there is never a contact with a zero signal who becomes an organizer. The problem then becomes a mere decision problem of the contact with signal one and whether he becomes an organizer. We capture such a situation in what follows.

or real costs of unionization, and to $\bar{c}$ as the nominal costs. Ultimately, what matters for the organization decision is the cost weighted by the uncertainty in the environment $\overline{\delta} - \underline{\delta}$.

Proposition 1 (High Organizational Costs). *No contact becomes an organizer if* $c > \frac{1}{2}\tilde{v}(k_1 - \underline{b})$.

If the cost of being an organizer is too high, then not even the most pro-union contact with signal one chooses to be an organizer. High costs imply that organizers are required to spend significant time on organizational efforts, which is costly to them and/ or that the firm strongly retaliates against union organizers which may entail a hostile work environment and at worst job loss. Our result implies that if management has sufficient tools to retaliate against union organizers, they can squash unionization endeavors in their entirety.

We turn to the case where organization costs are below $\frac{1}{2}\tilde{v}(k_1 - \underline{b})$. Generally, we are interested in informative equilibria. These are equilibria that allow workers to make an inference about the signal of the organizer.

Definition 1 (Informative Equilibrium). *An equilibrium is informative if and only if a worker can make an inference about the value of unionization based on the decision of the contact.*

We ask whether for organizational costs below $\frac{1}{2}\tilde{v}(k_1 - \underline{b})$, there always exists an informative equilibrium and if it exists, what it looks like. What type of equilibrium emerges depends on another cost threshold, $\tilde{v}(k_0 - \underline{b})$. It may be the case that $\frac{1}{2}\tilde{v}(k_1 - \underline{b}) > \tilde{v}(k_0 - \underline{b})$ or the inequality may be reversed. In what follows, we impose the following assumption without loss of generality.[12]

Assumption 2 (High $\underline{b}$). *Let* $\tilde{v} > k_0 - \underline{b}$.

It can be easily verified that this assumption guarantees that $\frac{1}{2}\tilde{v}(k_1 - \underline{b}) > \tilde{v}(k_0 - \underline{b})$. The assumption is always fulfilled if the most pro-union worker in the firm is sufficiently moderate.

Proposition 2 (Moderate Costs). *Let Assumptions* (1) *and* (2) *hold. Then,* $\frac{1}{2}\tilde{v}(k_1 - \underline{b}) > c > \tilde{v}(k_0 - \underline{b})$,

(1) $b_0 = \underline{b} < \omega = b_1$ *if and only if* $\omega < \hat{\omega}$

Contact with signal 0: no organizer

Contact with signal 1: organizer

[12] Without this assumption, the moderate cost equilibrium vanishes, and we are left with the low cost result. Therefore, the assumption is without loss of generality, as we also cover all results, if it does not hold.

(2) $b_0 = \underline{b} < b_1 < \omega$ *if* $\omega > \hat{\omega}$

Contact with signal 0: no organizer

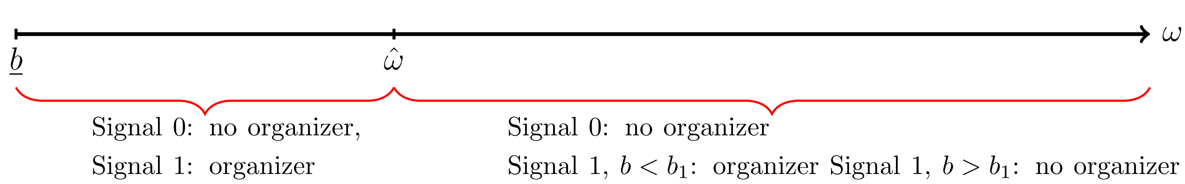
Contact with signal 1: $b < b_1$ *organizer,* $b > b_1$ *no organizer*

We provide an explicit characterization of $\hat{\omega}$ in the Appendix. With intermediate organizational costs, an informative equilibrium always exists. However, a contact with signal zero never becomes an organizer, independently of his bias. A contact with signal one may opt to become an organizer. His choice could depend on his ideological bias. If the maximal bias of the contact is low, then he always becomes an organizer, independently of the exact realization of the bias. He is sufficiently pro-union to want to be an organizer. If on the other hand, the maximal bias is high, meaning that some contacts are critical towards unions, then a contact only becomes an organizer for a low enough bias. For a high maximal bias, only the most pro union contacts become organizer, even though they obtained signal one. We provide an overview of the result in Figure 2.

This result highlights that for moderate costs, a fully informative equilibrium can emerge. Higher organizational costs can lead to better information. Even though workers cannot observe the signal, the organizational decision in the fully informative equilibrium provides the workers with the signal.

This result already sheds light on the advantages of the grass roots movement relative to professional union organizers. It is both reasonable to assume that regular employees at a firm are less ideological, meaning a more moderate $\underline{b}$, while at the same time organizational efforts are more costly to them. Instead of being paid to organize, ordinary workers are required to spend their free time on organizational efforts. Moreover, they face a retaliation threat from management, which is naturally limited for outsiders whose livelihood does not depend on a job at the firm. Therefore, we would expect such a fully informative equilibrium to be more likely to arise when organizational efforts are bottom up, driven by employees at the bargaining unit.

Figure 2: Moderate Costs



We then turn to the low cost case, with $\tilde{v}(k_0 - \underline{b}) > c$.[13] We first establish that for sufficiently low ω, no informative equilibrium exists.

[13]Without Assumption 2, and $\frac{1}{2}\tilde{v}(k_1 - \underline{b}) < \tilde{v}(k_0 - \underline{b})$, the condition for the low cost case would be $c < \min\{\tilde{v}(k_0 - \underline{b}), \frac{1}{2}\tilde{v}(k_1 - \underline{b})\}$.

Proposition 3 (No Informative Equilibrium)**.** *Let* $\frac{1}{2}\tilde{v}(k_0 - \underline{b}) > c$*. An informative equilibrium does not exist if* $\omega < \tilde{\omega}$*. No contact becomes an organizer and if workers, off the equilibrium path, observe an organizer, they do not make any inference about the signal he received.*

Proposition 3 establishes when an informative equilibrium does not exist. An informative equilibrium fails to emerge if the costs are minimal and all contacts are strongly pro union. In this case, every contact would like to become a union organizer, independently of the signal. However, a worker observing a union organizer cannot make an inference about the signal, meaning that the probability of unionization does not change upon seeing an organizer. Given that unionization efforts are not free, an organizer would incur a cost, which is not met with an increase of unionization probability. Therefore, this cannot be an equilibrium and it must hold that for low costs and a strong pro-union stance no contact will become an organizer. Upon seeing an organizer, off the equilibrium path, no worker makes an inference about the signal, as any contact would like to be an organizer. We restrict attention to a higher maximal bias and characterize the different equilibria that emerge.

Proposition 4 (Low Costs)**.** *Let* $\tilde{v}(k_0 - \underline{b}) > c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$*.*

(1) $\underline{b} < b_0 < \omega = b_1$ *if* $\omega < \tilde{\omega}_1$

Contact with signal 0: $b < b_0$ *organizer,* $b > b_0$ *no organizer*

Contact with signal 1: organizer

(2) $\underline{b} < b_0 < b_1 < \omega$ *if* $\tilde{\omega}_1 < \omega < \tilde{\omega}_0$

Contact with signal 0: $b < b_0$ *organizer,* $b > b_0$ *no organizer*

Contact with signal 1: $b < b_1$ *organizer,* $b > b_1$ *no organizer*

(3) $\underline{b} = b_0 < b_1 < \omega$ *if* $\omega > \tilde{\omega}_0$

Contact with signal 0: no organizer

Contact with signal 1: $b < b_1$ *organizer,* $b > b_1$ *no organizer*

For $c < \frac{1}{2}\tilde{v}(k_0 - \underline{b})$*,*

(1) $\underline{b} < b_0 < \omega = b_1$ *if* $\tilde{\omega} < \omega < \tilde{\omega}_1$

Contact with signal 0: $b < b_0$ *organizer,* $b > b_0$ *no organizer*

Contact with signal 1: organizer

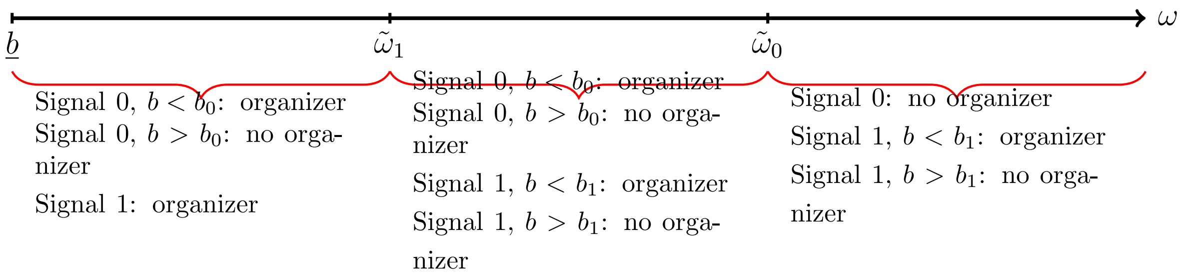
(2) $\underline{b} < b_0 < b_1 < \omega$ *if* $\tilde{\omega}_1 < \omega$

Contact with signal 0: $b < b_0$ *organizer,* $b > b_0$ *no organizer*

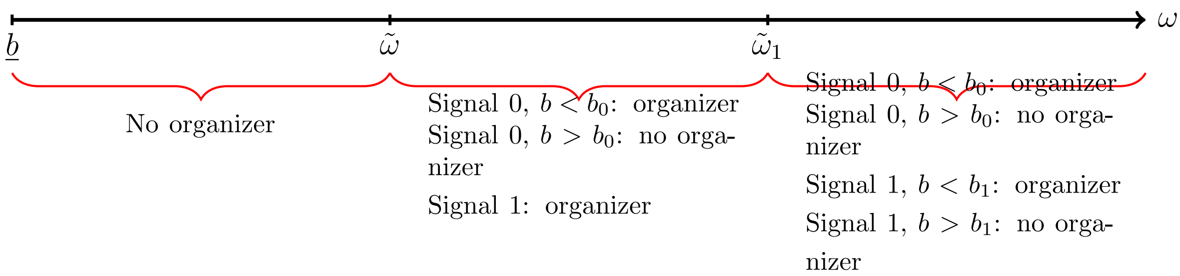
Contact with signal 1: $b < b_1$ *organizer,* $b > b_1$ *no organizer*

Propositions 3 and 4 are summarized in Figure 3. We need to distinguish between costs above and below $\frac{1}{2}\tilde{v}(k_0 - \underline{b})$. If costs are below this threshold, then the cutoff $\tilde{\omega}$ lies above the most pro union bias $\underline{b}$, meaning in this case there are maximal biases for which no informative equilibrium exists. In any informative equilibrium in this cost range, there are always some contacts who become organizers even though they drew a zero signal. Independently of the maximal bias, contacts with signal zero and ideological bias below the cutoff b_0 opt to become organizers. Less pro-union contacts, namely those with a bias above the cutoff b_0, do not become organizers after a signal zero. For contacts with a signal one, the maximal bias matters. If the maximal bias is low, then a contact always becomes an organizer. If the maximal bias is higher then only more pro-union contacts become organizers, while more moderate contacts refrain from organizational activities.

If costs are above $\frac{1}{2}\tilde{v}(k_0 - \underline{b})$, an informative equilibrium always exists and the two described equilibria still emerge. However, now, for a large bias, a new equilibrium emerges: one in which a contact with a zero signal never becomes an organizer, while only sufficiently pro-union contacts with a signal one organize.



(a) Case 1: $\tilde{v}(k_0 - \underline{b}) > c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$



(b) Case 2: $\frac{1}{2}\tilde{v}(k_0 - \underline{b}) > c$

Figure 3: Low Cost Thresholds

Figure 3 demonstrates that if costs and the maximal bias are low, no informative equilibrium emerges. Therefore, in these instances, no organizational efforts can succeed. The combination of low organizational costs and a strong pro union stance are more prevalent in a top down approach. Professional union organizers are more likely to be strongly pro-union. After all, it is their job to push for unionization. In addition, professional union organizers do not fear retaliation from management and are not required to spend their free time on unionization activities, reducing their cost relative to that of ordinary workers, who take on unionization endeavors in addition to their regular jobs. This means that with professional union organizers, unionization efforts may be entirely futile, in contrast to a top down approach.

However, above the threshold $\tilde{\omega}$, observing or not observing an organizer has an impact on unionization probability. The lower the maximal bias, the more likely it is to see an organizer. Initially, every contact with signal one and the pro-union contacts with signal zero turn to organizing. As the maximal bias increases, the probability of observing an organizer decreases: both contacts with a signal of zero and contacts with a signal of one are less likely to become organizer– at differential rates, depending on the exact cost.

6 Ranking Equilibria

Having characterized the different equilibria, we now consider which of these equilibria is more likely to lead to successful unionization. From an ex-ante perspective, the probability of unionization is the same across all maximal biases and costs, and overall informativeness does not matter. Informativeness means that the worker is more likely to learn about the true value. If the value is high, then better informativeness increases the unionization probability substantially. However, higher informativeness also decreases the unionization probability significantly if the true value of unionization is negative. Overall, we show that the upside and the downside cancel out. This finding implies that a leader merely interested in unionization does equally well across all different equilibria.

However, as the leader is also an employee at the firm, it seems reasonable to assume that they would only push for unionization if this is beneficial for all of their colleagues. After all, they still need to interact with them in the foreseeable future.

Therefore, we focus on the probability of unionization if its value is positive, formally $v = v_1$. If the value is positive, unionization is beneficial and therefore should occur.

We ask for which maximal bias it is most likely for unionization to succeed if the leader anticipates the value to be positive. This addresses from which pool a benevolent leader, who is interested in unionization if this truly benefits workers, should choose the contact.

Recall that the probability of unionization, as given in (9), depends on the workers expectation of the value of unionization. The workers do not know that the true value of unionization is given by v_1, while the leader does. Therefore, we need to distinguish between the expectation of the leader and those of the worker, $\mathbb{E}_w$. Then, the probability of unionization becomes a function of $\mathbb{E}\left[\mathbb{E}_w[v|x]|v_1\right]$. The probability of unionization is increasing in this expectation across the different equilibria and so we merely need to find the highest expected value. This depends on the costs, that is whether we are in the moderate or low cost case. Moreover, it depends on the type of equilibrium that emerges, which is a function of the maximal bias.

Proposition 5 (Unionization Probability)**.** *Suppose that the value of unionization is given by $v = v_1$.*

(1) ***Moderate Costs*** *With moderate costs, any ω that induces the fully informative equilibrium yields the same maximal unionization probability.*

(2) ***Low Costs*** *With low costs, $\omega = \tilde{\omega}_1$ induces the highest probability of unionization.*

If costs are moderate, then any maximal bias $\omega < \hat{\omega}$ is optimal. Any such maximal bias leads to a fully informative equilibrium and for all fully informative equilibria, the probability of unionization conditional of the value being positive is the same.

If costs are low, then there is a unique optimal maximal bias, that induces the highest probability of unionization. This occurs at $\omega = \tilde{\omega}_1$. In this case, the lower cut-off b_0 is admissible, meaning $b_0 \in (\underline{b}, \omega)$,while $b_1 = \omega$.

This implies that independently of the costs, in the optimal equilibrium, every contact with a positive signal becomes an organizer. At the same time, it is optimal for a contact with signal zero to not become an organizer. This makes the fully informative equilibrium in the moderate cost case optimal. For the low cost case, there are always some contacts who become organizers even if their signal equals zero. However, it is optimal to keep the share of those who become organizers with signal zero as low as possible. As this share is decreasing in ω it is best to increase ω, up until the point where the most anti-union contact with signal one is indifferent between becoming an organizer or not. This point is given by $\tilde{\omega}_1$. For a maximal bias higher than $\tilde{\omega}_1$, the share of contacts with signal zero who choose to be organizers decreases further. Only now, the share of contacts who opt out of organizing even though they have a signal one, increases. It turns out that the loss from losing signal one contacts outweighs the loss from losing signal zero contacts. This makes $b_1 = \omega$ optimal. Another way to interpret our finding is that it is always optimal to choose the maximal bias that increases the informativeness of the equilibrium. As the true value is positive, the leader would like workers to simply learn as much as possible, as this leads them to conclude that the benefit of unionization is positive.

We compare the unionization probability in the fully informative equilibrium with the maximal unionization probability in the low cost case.

Corollary 5.1 (Comparison Unionization Probability Moderate vs Low Costs)**.** *The unionization probability conditional on $v = v_1$ in the fully informative equilibrium is always higher than the unionization probability in any low cost equilibrium.*

This result highlights that with moderate costs, the maximal unionization probability exceeds the unionization probability in any of the low cost equilibria. A fully informative equilibrium provides workers with more information than any other equilibrium. As we have already argued that higher informativeness is beneficial if the true state of the world is high, no equilibrium can do better than the fully informative one.

Our result highlights, that for low costs a higher maximal bias generates more information, while for moderate costs, the optimal bias can be low or moderate. In this sense, the maximal bias and costs serve as credibility "substitutes". Only if organizers credible, can they credibly transmit information that unionization is beneficial to workers. This credibility is needed to increase the probability of unionization.

7 Application: Unionization Efforts in the US

We tie our model to a number of unionization campaigns that received widespread attention. Numerous bargaining units in the US have been striving to unionize. We highlight here some prominent cases and tie them to our model. In particular, we discuss why some unionization efforts failed, while others were successful through the lens of our model.

Amazon Warehouse BHM1 in Bessemer, Alabama One of the most widely-covered attempts to unionize was the union drive in an Amazon Warehouse in Bessemer, Alabama. This warehouse, named BHM1, employed approximately 5800 workers when the unionization efforts began. Jennifer Bates, who started working there in May 2020, and a few of her co-workers reached out to the Retail, Wholsesale and Department Store Union (RWDSU) in fall 2020 in order to unionize the workplace. In November 2020, RWDSU announced their intention to unionize the warehouse, which was met with widespread support of federal politicians.[14]

Jennifer Bates calling in RWDSU meant that the union ran the unionization campaign. In an interview, she describes the unionization process as follows:

> One of the things I can say is that we sought out the union organization, [the Retail, Wholesale and Department Store Union], [. . .]. A lot of us had already been in places that were already unionized. We had a group of people and a union that was strong and didn't just come to help, but stayed. [. . .], they gave us the materials that we needed and the information that we needed.[15]

The unionization campaign, in part due to Covid, was mostly run by phone. According to the union, their own employees as well as volunteers, which could be anyone with an interest in unionization, made hundreds of calls a day.[16]

[14] Even President Joe Biden spoke out in favor of the union. For a report on Jennifer Bates and her unionization efforts, see https://www.rollingstone.com/politics/politics-features/jennifer-bates-amazon-union-organizer-interview-jeff-bezos-1147426/.

[15] https://www.rollingstone.com/politics/politics-features/jennifer-bates-amazon-union-organizer-interview-jeff-bezos-1147426/

[16] https://www.newyorker.com/news/us-journal/the-alabama-workers-trying-to-unionize-an-amazon-fulfillment-center.

The widespread attention that the campaign received, meant that Jennifer Bates was thrust into the spotlight. She even testified in front of the US Budget Committee on March 17th 2021, which was at that point chaired by Bernie Sanders.[17] Speaking out as a union organizer comes at a cost, though, as explained by a commentator on CNN:

> "Anytime a worker gets involved in organizing with their coworkers, they're taking a risk and Jennifer Bates has been willing to take that risk on behalf of the people she works with, [...] She's been willing to talk to the media, to talk to Congress, to really fight very, very publicly."
> Bates knew this from the start. "I had to be very careful [of] how I moved, how I spoke and what I did," she recalled. "What good is it if I lose my job and the work that I started is not complete?"[18]

In fact, Jennifer Bates was fired in 2023, with Amazon subsequently being forced to reinstate her.[19]

In response to the unionization efforts, Amazon began a union-busting campaign, urging employees to vote against unionization. Amazon argues that both benefits packages and hourly pay are already generous. In fact, the warehouse pays more than double the minimum wage in Alabama. Amazon further created a web site which pushed workers to "Do It Without Dues". This is misleading as Alabama is a right to work state, meaning that no employee can be forced to become a union member–and pay dues. Amazon has held mandatory meetings for employees about how unions work and an Amazon spokesperson is quoted saying that

> it was important that all employees understand the facts of joining a union and the election process, and that the company hosted regular information sessions to answer their questions.[20]

In contrast, RWDSU claims that Amazon spread misinformation in these meetings.[21]

Ultimately, the unionization campaign failed, with a majority of workers voting against unionization. This vote had closed on March 29th 2021. RWDSU appealed the election result successfully with the NLRB. The NLRB found Amazon to have illegally interfered with the election. One of the main reasons given for the ruling was a mailbox installed on

[17] https://www.budget.senate.gov/imo/media/doc/Jennifer%20Bates%20-%20Testimony%20-%20U.S.%20Senate%20Budget%20Committee%20Hearing.pdf

[18] https://edition.cnn.com/2021/10/21/tech/amazon-jennifer-bates-risk-takers/index.html

[19] https://edition.cnn.com/2023/06/15/tech/amazon-warehouse-alabama-jennifer-bates/index.html

[20] https://www.newyorker.com/news/us-journal/the-alabama-workers-trying-to-unionize-an-amazon-fulfillment-center

[21] Other tactics to intimidate workers have been summarised in a policy brief by a think tankhttps://files.epi.org/page/-/pdf/bp235.pdf.

the premises, which indicated that the vote would not be anonymous. Amazon did not challenge the finding of the NLRB. The second vote was counted on March 28th 2022.[22] Unionization failed yet again.[23]

Amazon Warehouse JFK8 in Staten Island, New York In contrast to the failed union drive in Alabama, JFK8, an Amazon warehouse in Staten Island, successfully unionized. JFK8 is one of the biggest warehouses, with approximately 8000 employees, which substantially exceeds the number of employees at BHM1. unionization efforts at JFK8 started during Covid in March 2020, even before those at Bessemer, Alabama. Amazon required workers to come in even though they displayed symptoms of Covid and, in some instances, had tested positively for it. Many workers fell sick, leading to health and safety concerns.[24]

In response to the perceived lack of health and safety measures, Chris Smalls and Derrick Palmer, two employees in the warehouse, organized a protest.[25] Consequently, Amazon fired Chris Smalls arguing that his demonstration violated a quarantine-order as he had been in contact with a sick worker.[26] Upon Chris Smalls being fired, he turned to organizing a union drive full time, with the support of Derrick Palmer, who remained employed at the Amazon warehouse. Chris Smalls was widely perceived as leading the unionization efforts, also due to his "outspoken" personality.[27] In contrast, Mr Palmer is described as more "deliberate", managing to hang on to his job even though he supported Chris Smalls in his unionization endeavors.

Initially, unionization was a slow process, due to the numerous legal requirements. In order to gain information, Chris Smalls and Derrick Palmer visited Bessemer, Alabama in early 2021, to observe a union drive. At this point Bessemer had already received significant attention in the media, making it a natural point of interest.

In contrast to the organizational efforts at the warehouse in Staten Island, the union drive in Bessemer was organized by professional union organizers. The union employees were not particularly welcoming to the two friends and seemed like "outsiders who had

[22] For both campaigns, votes were collected over a two months window.

[23] https://thehill.com/policy/technology/592767-labor-legislation-failure-looms-over-amazon-union-vote/

[24] Albert Castillo working in the Amazon Staten Island Warehouse seems to have contracted Covid at work, ultimately passing away, https://www.nytimes.com/interactive/2021/06/15/us/amazon-workers.html.

[25] They were not the only ones with the perception that Amazon neglected health and safety procedures as New York sued Amazon for inadequately protecting workers during Covid, https://www.nytimes.com/2021/02/16/technology/amazon-new-york-lawsuit-covid.html

[26] Amazon's official narrative runs counter to internal emails, where an HR official wrote "Come on, Mr. Smalls was outside, peaceful and social-distancing." See https://www.nytimes.com/2022/04/02/business/amazon-union-christian-smalls.html

[27] The quote as well as the description of Derrick Palmer are taken fromhttps://www.nytimes.com/interactive/2021/06/15/us/amazon-workers.html

descended on the community".[28] Disillusioned, Chris Smalls and Derrick Palmer decided to embark on their own unionization campaign. They began by approaching workers at the bus stop, posted TikTok videos, made s'mores and sang songs. In an interview with Mr Palmer, he stated that between regular shifts and organizational activities, he had barely spent a day away from the warehouse in months.

The workers he tried to convince tended to be sceptical of unions in general, had doubts about unions due, were grateful for Amazon's health care and pay, or simply did not have the capacity to engage.

Amazon initially did not take the organizational efforts seriously, but soon began to counter. As in Bessemer, Alabama, they brought in professional union busters, with workers being forced to attend meetings on unions. Once again Amazon particularly targeted union organizers, monitoring their organizers' social media and claimed they were outsiders.[29] In response to Amazon's efforts to undermine unionization activities, the union organizers filed numerous complaints with the New York NLRB, which has pursued many of them in administrative court.[30]

Despite Amazon's tactics, unionization efforts were successful with workers opting to unionize JFK8 on April 1, 2022.

Comparing Unionization Campaigns We compare the two unionization campaigns through the lens of our model, highlighting how our model can help understand why unionization failed in Alabama, while it succeeded in New York. This outcomes took many by surprise and it raised questions about the correct unionization tactics, with unions re-thinking their approach, as documented in the following quote:

> organized labor has begun to ask itself an increasingly pressing question: Does the labor movement need to get more disorganized?[31]

Our paper unambiguously argues that the answer is yes, with a bottom up approach being more effective at increasing the chances of unionization relative to a top down campaign.

We compare here the two unionization campaigns, as they took place at almost the same time with the final votes closing only a few days apart. At JFK8, the vote closed on April 1st, 2022, while in BHM1 the final vote closed on March 28th 2022. Moreover, unionization efforts had started around the same time, in the spring and summer 2020.[32]

[28] The entire paragraph is based on a NYT article, with all quotes are taken from it, https://www.nytimes.com/2022/04/02/business/amazon-union-christian-smalls.html

[29] https://www.nytimes.com/2022/04/07/business/economy/amazon-union-labor.html

[30] See again https://www.nytimes.com/2022/04/02/business/amazon-union-christian-smalls.html

[31] https://www.nytimes.com/2022/04/07/business/economy/amazon-union-labor.html

[32] Even before Jennifer Bates and her co-workers reached out to RWDSU, there were discussions about unionization.

The unionization campaigns took place in two different bargaining units, but within the same company, Amazon, with workers employed in the same jobs. Namely, both attempts took place at Amazon warehouses.

At both warehouses, a leader emerged. In Alabama, this leader can be viewed as Jennifer Bates. She spoke out publicly and became the face of the campaign, as evidenced by the perception of the commentator at CNN.[33] In New York, the leader is Chris Smalls, who dedicated himself to work full time on the unionization drive. Both leaders had contacts and friends within the warehouse who were on board with the union drive. In Alabama, for instance Daryl Richardson, was filling out the forms to reach out to RWDSU. The contacts in Alabama were already quite pro-union, and had had experiences in unionized workplaces In addition, professional union organizer were essential to the union drive. In contrast, in New York, Derrick Palmer, was the key contact, with whom Chris Smalls discussed unionization, and even though they reached out to RWDSU as well, they refrained from involving them in the campaign. Both Chris Smalls and Derrick Palmer had had no previous involvement with unions. Derrick Palmer in particular, was concerned about health and safety, but also disappointed by a lack of advancement possibilities within the warehouse. He was frequently one of the top performers, and still did not progress. This means that the organizers at BHM1 were both pro-union employees and professional organizers, while the main organizer at JFK8, Derrick Palmer, had had no previous experience with unions, but is viewed as "deliberate".[34]

The difference in the composition of organizers lead to fundamentally different unionization campaigns. The unionization campaign in Alabama relied on material provided by the union and was run mostly by phone. In contrast, in New York, all material was produced by the local organizers, who organized numerous events in order to access workers.

This discrepancy in the composition of the organizational team, leads to two differences in terms of our model: (1) organizers at JFK8 face higher organizational cost, and (2) are simultaneously perceived to more moderate compared to those at BHM1.

In sum, our model indicates, that in Alabama, union organizers lacked credibility due to a lower cost of organization as well as a more pro-union bias among the organizer, while this credibility was a given in New York. Therefore, a more informative equilibrium is more likely to emerge at JFK 8, which in turn leads to a higher probability of unionization there.

More generally, we connect a top down approach with low organizational costs and pro-

[33]Interestingly, Jennifer Bates is also the only one with a wikipedia entry on her organizational activities in Bessemer Alabama.

[34]https://www.npr.org/2022/04/02/1090353185/amazon-union-chris-smalls-organizer-staten-island

union organizers. This implies that either no informative equilibrium exists and therefore unionization does not succeed. In contrast, with a bottom up approach, there can be moderate costs and/or moderate organizers. With moderate costs, a fully informative equilibrium is possible, which is best if unionization has a positive value. If cost are low, then moderate organizers are required in order to induce a higher probability of unionization.

We have therefore highlighted why a bottom up, grassroots movement tends to outperform the top down approach of established unions.

Naturally, there are further differences between the two unionization attempts. First, the quality of information may differ, as measured by the signal strength. It may also be the case that the value of unionization varies across the two warehouses. Moreover, the political environment is a different one in Alabama than New York. Therefore, in a next step we consider these discrepancies and how they can shed further light on the differences in unionization success.

Before turning to comparative statics, we provide additional examples of grass roots unionization success and motivate that it is really information, or a lack therefore, that can determine unionization outcomes.

Bottom Up unionization We provide additional examples highlighting that the differences in outcomes at the two Amazon warehouses, BHM1 and JFK8 are not merely an artefact, but are consistent with the unionization successes and failures across the US. Note however, that our examples omit by necessity cases where no union organizer was present. Therefore, if a contact chooses to not become an organizer, then this is an unionization attempt we do not observe. This can also not be remedied with more systematic unionization data, as workers file with the NLRB only once the organization phase started.

It is noteworthy, that Chris Smalls after his success at JFK8, attempted to unionize a second Amazon warehouse in Staten Island, LDJ5. Unionization efforts failed there.[35] In this case, the organizers, who were locals at JFK8, were outsiders at LDJ5 and workers were not convinced that unionization was beneficial for them. They were sceptical about promises made, and did not believe unionization would deliver value for them. This highlights that the unionization success at JFK8 was not a product of especially skilled organizers, but that it was indeed about credibility, about believing that unionization would deliver value.

Another company in the spotlight because of unionization attempts is Apple. There

[35] https://www.nytimes.com/2022/05/02/technology/amazon-union-staten-island.html

have been several unionization campaigns at Apple stores. The first one to successfully unionize was a shop in Towson, Maryland, and employees formed the Apple Coalition of Organized Retail Employees, which then joined the International Association of Machinists and Aerospace Workers (IAM).[36] In their statement, IAM states that

> This campaign was an employee-driven campaign from the start [...]

While there was some support by one professional union organizer, the almost 100 employees led the organizational effort.

The second Apple store to successfully unionize was a shop in Oklahoma City (located in a Right to Work state), which was once again driven by employees, with the support of an established union, in this case Communication Workers of America.

> Mr. Forsythe said the idea of unionizing first occurred to him late last year, [...] a store in Atlanta filed a petition for a union election, and Mr. Forsythe and other employees at the Oklahoma City store began to discuss unionization.[37]

However, some unionization petitions failed, for instance one in St. Louis.[38] There, employees blamed IAM, the union in charge of the organization efforts.

> we determined if we took on a union as a partner, the IAM would not be a good fit for our team. In their haste to represent us, the IAM disregarded the wishes of our organizing employees.

The reasons given for not wishing to unionize were summarized as follows:

> Points of bargaining were debated, but it was challenging for the team to agree on any that could be impacted positively by collective bargaining.[...] Some no longer felt the union would provide anything complimentary to Apple's culture and existing benefits, while others felt they had been misled [...]

These quotes highlight that the union failed to convince employees that unionization would be beneficial for them. Similarly, the first unionization petition to ever be filed at an Apple Store, the one in Atlanta, Georgia was withdrawn. This was again a union-led unionization campaign that failed.[39]

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[36] https://www.washingtonpost.com/technology/2022/05/03/apple-retail-towson-union-labor-machinists/,https://www.nytimes.com/2022/06/18/technology/apple-union-maryland.html

[37] https://www.nytimes.com/2022/10/14/business/economy/apple-store-union-oklahoma-city.html

[38] https://www.imore.com/apple/st-louis-apple-store-employees-blame-union-for-organizing-withdrawal

[39] The union in charge there cited Apple's illegal union busting techniques as a reason to withdraw, https://www.cnbc.com/2022/05/27/apple-union-push-faces-setback-as-atlanta-organizers-withdraw-bid-.html

Finally, unionization campaigns at Starbucks stores have been remarkably successful, with numerous stores unionized. These campaigns have been in organized in a decentralized fashion:

> at Starbucks [...] the campaign has largely expanded through worker-to-worker interactions over email, text and Zoom, even as it is being overseen by Workers United,[40]

emphasizing once again the value of a bottom approach.[41]

Alternative Explanation: Firm's Adversity Our model argues that it is crucial for workers to learn that the value of unionization is positive for them. A common alternative explanation for why unionization fails–one pushed by established unions–is that firms prevent unionization either by targeting organizers or threatening retaliation against all workers (for example, threatening to close the bargaining unit, to reduce wages and benefits).[42]

Note first, that in our setting, if organization costs are too high, then no contact will ever choose to become an organizer. If this was truly the issue, then sending a professional organizer or subsidizing local organizer can help unionization. A professional organizer is merely doing their job without fear of repercussion or great personal cost, a subsidy can help support local organizers. Nevertheless, as the previous examples have documented, top down approaches often fail, and they fail even in the absence of any threats by firms.

An example that illustrates this is that of the Volkswagen plant in Chattanooga, Tennessee.[43] Volkswagen established in virtually all of its factories a worker's council, following the German model of worker representation. To establish a worker's council, the factory needed to be unionized. This meant that when United Automobile Workers (UAW) in 2014 began a union drive, Volkswagen was encouraging towards unionization. For instance, Volkswagen urged third parties to not interfere, meaning politicians and business groups, all opposed to unionization. They also made statements jointly with UAW, emphasizing that they were looking forward to work together. However, third parties were not neutral, with the Governor of Tennessee promising that Volkswagen would add a new production line if the union vote was defeated. Volkswagen responded immediately, and stated there was no connection between a new production line and a

[40] https://www.nytimes.com/2022/04/07/business/economy/amazon-union-labor.html

[41] There have been additional successful bottom up unionization campaigns for instance at Verizon in Washington state,https://apnews.com/article/2022-midterm-elections-business-everett-austin-a65b2a310ebba2f1662b92fb7be3f1bf, overall too numerous to count.

[42] For an overview of common intimidation tactics, see https://files.epi.org/page/-/pdf/bp235.pdf.

[43] https://www.nytimes.com/2014/02/15/business/volkswagen-workers-reject-forming-a-union.html

unionization vote. Despite Volkswagen not interfering with the vote, unionization failed. The reasons given are for example that

> the majority had voted against U.A.W. because they were persuaded the union had hurt Detroit's automakers.

Moreover, there was skepticism about what a union could deliver, for instance

> a VW worker who led the anti-union drive, said many workers felt that they were paid well and treated well without having a union and thus saw no need to have one.

After the union drive was defeated, one of the opponents of the union drive, turned around and helped create a worker's council, The American Council of Employees.[44] He distrusted the union organization, stating

> I think [workers] became educated about their history," he says. "I saw mismanagement, I saw malfeasance, I saw cronyism, I saw nepotism. Just looking at their membership numbers, the way they've declined since 2002. Job security? Well, you can't give me that. And when I look at our wages compared with the big three, we're doing better, so you can't give me a raise."

Workers did not see the value of unions, even though Volkswagen encouraged them to unionize. This highlights once again that traditional unions may fail to generate credibility.

8 Comparative Statics

We consider here the effects of the different environments on the probability of unionization, conditional on the value of unionization being positive. The worker does not know about the true value of unionization, but forms an expectation about it. The expected value, from the worker's perspective, depends on whether he sees an organizer or not, but also on the equilibrium that emerges, which is determined by the maximal bias and the organizational costs. This implies that varying parameters has two effects. First, a change in parameters changes the unionization probability for a given equilibrium. Second, the change can affect which equilibrium emerges. We therefore first discuss how the cost thresholds respond to different environments, before fixing the equilibrium and discussing how the unionization probability changes in response to different environments.

[44] https://www.washingtonpost.com/news/storyline/wp/2014/11/19/the-strange-case-of-the-anti-union-union-at-volkswagens-plant-in-tennessee/

8.1 Cost Thresholds

The type of equilibrium to emerge depends on the organizational cost as well as the maximal bias. Note that we have defined the real organizational cost c as the product of the nominal organizational cost $\bar{c}$ and $(\bar{\delta} - \underline{\delta})$, which we interpret as the economic, political and environmental uncertainty in the economy. Recall that the realization of the global shock δ must lie within $[\underline{\delta}, \bar{\delta}]$. Therefore, if $\bar{\delta}$ is large, then it is possible to have very high anti-union shock, and for a small $\underline{\delta}$, there can be a large pro-union shock.

To make this connection between real and nominal organizational cost transparent, we express our cost thresholds in terms of nominal organization cost:

$$\frac{1}{2}\tilde{v}(k_1 - \underline{b}) > c \quad \Leftrightarrow \quad \frac{1}{2}\frac{\tilde{v}(k_1 - \underline{b})}{(\bar{\delta} - \underline{\delta})} > \bar{c}, \tag{16}$$

$$\tilde{v}(k_0 - \underline{b}) > c \quad \Leftrightarrow \quad \frac{\tilde{v}(k_1 - \underline{b})}{(\bar{\delta} - \underline{\delta})} > \bar{c}. \tag{17}$$

Therefore, an increase in uncertainty is beneficial in reducing nominal cost thresholds. An alternative interpretation is that real costs are higher if the uncertainty is higher, lending higher credibility. Starting from low nominal organizational costs, uncertainty is beneficial as credibility increases. However, eventually a higher uncertainty makes unionization endeavors prohibitively costly.

We then consider the effects of signal precision, a higher upside and a lower downside of unionization, contact's minimal bias as well as firm's retaliation and expected environmental support for unionization on the real cost thresholds, $\tilde{v}(k_0 - \underline{b})$ and $\frac{1}{2}\tilde{v}(k_1 - \underline{b})$. Our results are summarized in Proposition 6.

Proposition 6 (Comparative Statics: Cost Thresholds)**.** *Both cost thresholds are decreasing in d, $\mathbb{E}[\delta]$ and $\underline{b}$. They both increase in v_1 and respond differently to changes in v_0 and p.*

(1) Moderate Cost Threshold $\frac{1}{2}\tilde{v}(k_1 - \underline{b})$: The moderate cost threshold is increasing in p. It can be increasing or decreasing in v_0.

(2) Low Cost Threshold $\tilde{v}(k_0 - \underline{b})$: The low cost threshold is increasing in v_0. It can be increasing or decreasing in p.

Both cost thresholds respond in the same direction to a change in the expected shock, the firm's retaliation and the minimal bias. As each of these parameters increases, the cost thresholds decreases. This implies that if the minimal bias is higher, there is more expected anti-union sentiment as well as retaliation by the firm, the more likely we are in a moderate or high cost environment. For a low level of these parameters, an increase in adversity can lead to an equilibrium associated with higher probability of unionization. However, if unionization attempts are already facing significant opposition, then a more moderate leader, an increasingly hostile response by the firm and a challenging environment squash unionization endeavors.

In contrast, both thresholds are increasing in v_1. If unionization is more valuable in the high state, then contacts are more likely to become organizers. Interestingly, in equilibrium, a higher value of unionization will not necessarily lead to more unionization success if a switch from the moderate to the low cost setting occurs. Rather, it can induce contacts with a signal zero to disregard their signal and become organizers. Therefore, it is possible to have a less informative equilibrium and a lower success of unionization.

There is a pronounced difference in how cost thresholds respond to a change in the low value of unionization, as well as the signal precision.

While an increase in the lower value increases the low cost threshold, its effect on the moderate cost threshold is ambiguous. The low cost threshold depends on k_0, part of the payoff a contact receives after signal zero. A signal zero contact is more likely to become an organizer if v_0 is higher, making a low cost equilibrium more likely. This means that a decrease in the downside risk does not necessarily increase the chances of unionization, again, if the decrease leads to a switch to the low cost equilibrium. In contrast, for the moderate cost to high cost threshold, what matters is k_1. There are two scenarios. If $v_1 - v_0$ is high, then the moderate cost threshold increases in response to an increase in v_0. If $v_1 - v_0$ is low, then the moderate cost threshold decreases. If the discrepancy between the two values is high, then a signal one is meaningful and this is the case in the moderate cost case. If on the other hand there is little variation in the values, then a signal one is not particularly valuable. Given that a zero signal contact does not choose to turn out (as we are in the moderate cost setting) it means that it is also not valuable for the signal one contact to become an organizer. This makes the high cost setting more likely meaning the moderate threshold decreases.

Finally, we turn to a change in the signal precision. If p increases then the moderate cost threshold increases, meaning is more likely to be in a moderate cost setting. In this moderate cost setting, the signal one contacts become organizers. Their signal has just become more valuable. This makes a moderate cost setting more appealing relative to a high cost setting. In contrast, the effect on contacts with signal zero is ambiguous. On the one hand, they obtain a more precise signal, but it is the negative signal. This increases the downside risk. If $\tilde{v} > 2(k_0 - \underline{b})$, the low cost threshold decreases, otherwise it increases. If $\tilde{v}$ is large, then the high and the low value differ greatly. In this case, the moderate cost equilibrium is more likely to emerge, as contacts are interested in becoming organizers if the signal is positive. If $\tilde{v}$ is relatively small, then the threshold increases and a low cost equilibrium is more likely. For a small $\tilde{v}$ zero signal contacts are not discouraged from becoming organizers, but signal one contacts have better signals, implying that at least some of them are also turning out.

8.2 Probability and Equilibrium Changes

We consider how the unionization probabilities change for a given cost setting. The expected unionization probability conditional on $v = v_1$ is given by

$$\frac{\mathbb{E}[\mathbb{E}_w[v|x,c,\omega]|v_1] - d - \frac{1}{2}(\overline{b} - \underline{b}) - \underline{\delta}}{\overline{\delta} - \underline{\delta}}, \tag{18}$$

where $\mathbb{E}[\mathbb{E}_w[v|x,c,\omega]|v_1]$ captures that the value of unionization is positive, which the worker does not know. We therefore distinguish between the leader's expectation and the workers, by adding a subscript to the latter. The worker's expectation depends on whether he observes an organizer or not and the type of equilibrium that emerges which depends on the organizational costs and the maximal bias. A parameter now can have a direct impact on the unionization probability, such as d, $\overline{b}$, $\underline{b}$, $\overline{\delta}$ and $\underline{\delta}$. In addition, a parameter can have an impact by changing the expected value. It turns out that in the moderate cost case, the parameters that affect the expected value are different from those affecting the unionization probability directly. In the low cost case, the expected value also depends on d and $\underline{b}$ and so there, we need to take both the direct and indirect effect into account.

We first analyze for the moderate cost case how the unionization probability changes with the different parameters, before turning changes in $\hat{\omega}$, the threshold which determines whether the equilibrium is fully informative. We turn then to the low cost case, where we again first consider how the maximal unionization probability changes in response to different parameters, before considering how $\tilde{\omega}_1$ changes, namely the maximal bias for which the unionization probability is maximized in the low cost setting.

Moderate Costs In the fully informative equilibrium the expectation $\mathbb{E}[\mathbb{E}_w[v|x]|v_1]$ is given by[45]

$$(v_1 - v_0)(p^2 + (1-p)^2) + v_0. \tag{19}$$

The expectation depends on v_1, v_0 and p. In addition, parameters $\underline{b}$, $\overline{b}$, $\underline{\delta}$, $\overline{\delta}$ and d affect the unionization probability directly.
We find that the unionization probability increases in v_1, v_0 and p, as summarized in Proposition 7.

[45]We derive the expectations in the Proof of Proposition 5.

Proposition 7 (Comparative Statics Moderate Costs). *The unionization probability, conditional on the unionization value being positive, in the fully informative equilibrium increases in v_1, v_0 and p. The probability increases in $\underline{b}$ and decreases in $\overline{b}$, decreases in $\underline{\delta}$, $\overline{\delta}$ as well as d.*
The probability of a fully informative equilibrium increases in v_1 and p, decreases in c. It increases in v_0 if and only if $(1-p)(v_1 - v_0) > \frac{c}{\tilde{v}}$.

Turning to the parameters that affect the unionization probability directly, we find the following that the unionization probability is higher the more moderate the workers-both on the left and the right (higher $\underline{b}$ and lower $\underline{b}$). A more pro-union environment captured by lower $\underline{\delta}$ and $\overline{\delta}$ increases the unionization probability. Finally, a firm's opposition to unionization, d, reduces the unionization probability.

The fully informative equilibrium emerges for any $\omega < \hat{\omega}$. Proposition 7 further states how $\hat{\omega}$ changes in the parameters it depends on, namely v_1, v_0, p and c. The higher the threshold, the more likely it is to observe a fully informative equilibrium. A higher signal precision, a higher positive payoff as well as a lower real organizational cost increase the probability of a fully informative equilibrium, conditional on remaining in the moderate cost setting.

As we consider the moderate cost setting only contacts with signal one become organizers. Therefore, we can restrict attention to their response to the changes in parameters as the threshold delineates when some signal one contacts refrain from becoming organizers. These contacts are more likely to become organizers, if it is less costly for them, or the value they attain is higher. Moreover, if they can be more certain that their signal was correct, they are also more likely to turn out. The effect of a lower unionization downside is ambiguous on whether the threshold increases or decreases. On the one hand, less of a downside means that a contact with signal one has a reduced incentive to become an organizer to signal that unionization is valuable. On the other hand, unionization is more valuable. Which motive dominates depends on whether $(1-p)(v_1 - v_0)$ exceeds or not $\frac{c}{\tilde{v}}$. If $(v_1 - v_0)$ is sufficiently large, then the contact still becomes an organizer: it is still worthwhile to signal. If the difference between the values is low, then a signal is no longer needed and the contact is less likely to become an organizer.

Low Costs Turning to low costs, we analyze how the worker's expected value, and with it, the unionization probability varies in the different parameters. We focus on the maximal unionization probability, which emerges at $\tilde{\omega}_1$. A change in the different parameters also has an effect on this threshold $\tilde{\omega}$. It turns out that the expected value and the threshold move in the same direction, which is summarized in Proposition 8.

Proposition 8 (Comparative Statics Low Cost)**.** *Both the optimal bias $\tilde{\omega}_1$ and the unionization probability, conditional on $v = v_1$ increase in v_1, p, $\underline{b}$, and decrease in d and $\mathbb{E}[\delta]$. The effect of an increase in v_0 is ambiguous. In addition, the unionization probability decreases in $\underline{\delta}$, $\overline{\delta}$ and $\overline{b}$.*

The effects are similar to what we found in Proposition 7. We first consider changes in the threshold $\tilde{\omega}_1$ as well as the expected value, $\mathbb{E}[\mathbb{E}_w[v|x, c, \omega]|v_1]$ in response to the change in parameters. An increase in the positive value of unionization and the signal precision lead to a higher expected value as well as a higher threshold. With low costs, the effect of an increase in the negative unionization value is ambiguous both for the change in the optimal bias as well as in the expected value, with a similar logic as above. Note that also in this low cost case, the optimal ω ensures that every contact with signal one becomes an organizer. In the low cost case, we further need to consider the change in $\underline{b}$, d and $\mathbb{E}[\delta]$. If the most pro union contact is more moderate, then the optimal bias and the expected value of unionization are increasing. In contrast, greater retaliation and a more anti-union environment imply a lower threshold and ultimately, a lower expected value.

While some parameters only affect the expected value, others have in addition a direct effect on the probability of unionization. It turns that for both $\underline{b}$, d the direct effect on the unionization probability goes in the same direction as the effect on the expected value. Therefore, the unionization probability is increasing in $\underline{b}$ and decreasing in d. We have three more parameters that only have a direct effect on the probability, namely $\overline{b}$, $\underline{\delta}$ and $\overline{\delta}$. A higher maximal bias among worker, a higher maximal anti-union shock, as well as a higher minimal anti-union shock decrease the unionization probability.

8.3 Comparative Statics: Application

We connect our comparative statics results to our applications.

Value of Unionization In our setting, the value of unionization can be positive or negative. This is in line with the possibility that unions can deliver higher wages and lend voice to workers. However, there is also a risk that unions do not deliver but simply charge dues. One argument for a professional union might be that they are better at delivering value, they have more experience bargaining, and can support workers better in case of a strike (as this is funded by through other bargaining units). They are also a riskier choice, due to issues of corruption and potentially implementing policies that workers do not like. It seems therefore plausible that professional come with a higher v_1 but also a lower v_0, meaning their difference $v_1 - v_0$ is larger and consequently, so is $\tilde{v}$. An increase in v_1 makes both a low and moderate cost equilibrium more likely and increases the probability of unionization.

However, the decrease in v_0 makes a high cost setting more likely, for $v_1 - v_0$ sufficiently high, therefore countering the effect of an increase in v_1. A decrease in v_0 decreases the unionization probability in the moderate cast case, while the effect in the low cost case is ambiguous.

If professional unions are perceived to be more risky with higher v_1, but also lower v_0, then they face similar odds of unionization compared to bottom up organizer for given credibility. Therefore, professional unions being potentially more competent, but also being seen as less trustworthy delivers only certainly a higher unionization success compared local organization if the increase in the positive value outstrips the downside risk of union membership.

The value of unionization to the worker can also depend on his role within the firm. For instance, temporary workers tend to be more or less indifferent towards unionization. For them the difference between unionizing or not is small, meaning a low $v_1 - v_0$. In this case, an increase in v_0 is met with a decrease in in the moderate cost threshold, meaning a high cost setting is more likely.

More importantly, for temporary workers a unionization attempt may be connected to a lower v_1 than for full time workers, but with the same downside risk. For temporary workers, there are no gains from unionization, as they probably have left by the time the bargaining unit is unionized. However, if the temporary workers are seasonal, then unionization can mean that they will not get their job back when they return to a now unionized bargaining unit. A lower v_1 unambiguously means a lower unionization probability. This can shed light on why temporary workers are reluctant to unionize.

Signal Precision The signal precision refers to how accurately contacts can assess the value of unionization. It seems natural to assume that professional organizers have more precise signals, due to more experience. A better signal increases the moderate cost threshold and decreases the low cost threshold for $v_1 - v_0$ sufficiently high. This means a more precise signal helps organizers achieve unionization, giving an advantage to professional organizers. Moreover, for any given equilibrium a more precise signal improves the chances of unionization, conditional on the true value being positive.

Economic, Political and Legal Environment We capture the economic, political and legal environment by $\underline{\delta}$, $\overline{\delta}$ and $\mathbb{E}[\delta]$. The expected value captures the average pro- or anti-union stance the organizers face. This captures for instance whether the union drive takes place in a Right to Work state or not. In a Right to Work state we would expect a higher $\mathbb{E}[\delta]$. There is also a question how $\mathbb{E}[\delta]$ changes if the unionization drive receives significant attention. If business groups for instance try to prevent unionization, then this would lead to higher $\mathbb{E}[\delta]$. We argue that it is of limited importance whether federal politicians support unionization drives as legal decisions around the drives are taken at the state level. However, how aggressively the NLRB fights for workers rights can have an impact. In the Bessemer, Alabama, unionization drive, the NLRB voided the first election due to a monitored mailbox, but did not request for the mailbox to be removed for the second election. This is a less aggressive stance against Amazon than it could have taken, indicating a higher $\mathbb{E}[\delta]$. If increased attention pushed the NLRB to increase their support of workers, then this can also lower $\mathbb{E}[\delta]$. We find that the cost thresholds are decreasing in $\mathbb{E}[\delta]$, making a high cost setting, without any unionization drive more likely. $\mathbb{E}[\delta]$ does not affect the unionization probability in the moderate cost case, but decreases it in $\mathbb{E}[\delta]$. Therefore, a higher economic, political and legal average adversity reduces the likelihood of unionization. Not only the average adversity matters, but also the uncertainty of it, captured by $\overline{\delta}$ and $\underline{\delta}$. Higher uncertainty increases the real cost of unionization, reducing both cost thresholds. Note however, that an increase in $\underline{\delta}$ reduces uncertainty and leads to an increased cost threshold. Moreover, $\overline{\delta}$ and $\underline{\delta}$ affect the probability of unionization. In both the moderate and low cost case, unionization becomes less likely as $\underline{\delta}$ and $\overline{\delta}$ increase.

Worker's Characteristics Unionization success depends on the workers' preferences, captured here by $\underline{b}$ and $\overline{b}$. Cost thresholds decrease in $\underline{b}$, meaning that a higher minimal bias makes both the low and moderate cost outcome less likely. The thresholds do not depend on $\overline{b}$. The unionization probabilities, in contrast increase in $\underline{b}$. This highlights the ambiguous effect of less of a pro-union bias for the most extreme worker. As $\overline{b}$ increases, the unionization probabilities decrease. This implies that a more pro-union group of workers make unionization more likely. We would therefore expect more left-wing workers to be more likely to unionize. However, the work force should also not be too extreme: a more moderate workforce reduces unionization activities, as contacts recruited among the pool of workers are less likely to become organizers. However, once organizers have turned out then the unionization probability is higher with a moderate worker pool. This sheds light on why white collar jobs tend to have higher unionization rates compared to blue collar workers, with the latter being on average more anti-union.

Firm's Decision The firm can influence the unionization decision in two ways: (i) it can increase the organizational costs, by retaliating against union organizers and (ii) it can punish workers if unionization takes place/reward workers if they refrain from unionization. Having already analyzed the impact of organizational costs, we discuss here the punishment of the firm, d. Cost thresholds are decreasing in d, and so are the unionization probabilities. A firm keen to prevent unionization would set d as high as possible–and this is exactly what we are observing. Amazon spends lavish sums on preventing unionization, and so do most other firms. The fact that frequent complaints with the NLRB are part of any unionization campaign implies that firms will employ any means possible to prevent unionization.

9 Conclusion

We have demonstrated that a bottom up approach to unionization generally leads to better chances of unionization success compared to a top down approach, as implemented by established unions. We provide a novel channel of why a grassroots movement succeeds where traditional unions have failed: credibility. Local organizers who are part of a bottom up approach dedicated a significant amount of time to unionization efforts, and face significant threats of retaliation. In addition, local organizers recruited among regular workers are less ideological about unionization. Overall, they are more moderate. Given their costs as well as their more moderate stance on unionization, these workers are only willing to become organizers if they are convinced that unionizing is beneficial.

Our model also highlights that a firm's opposition towards unionization does not necessarily thwart unionization efforts. In fact, as long as the opposition is not too fierce it may be beneficial for unionization. In light of our model, the often brought forward argument by established unions that it is firm's behavior that prevents unionization may not speak to the whole truth.

We connect our model to numerous anecdotes about unionization, providing support for our mechanism of unionization. Moreover, we analyze the impact of unionization value, the economic, political and legal environment, signal precision, worker characteristics, and the firm's stance on unionization on unionization success. This allows us to draw conclusions about how unionization campaigns can be improved in order to make unionization more likely.

A Additional Steps

Worker's Decision

For there to be a worker who prefers unionization, we require

$$\overline{\delta} < v_0 - \overline{d} - \underline{b}. \tag{20}$$

Even if all workers know that the value of unionization is negative (v_0), the firm punishes workers as much as it can ($\overline{\delta}$), and the overall environment is anti-unionization ($\overline{\delta}$), there exists a worker who is sufficiently pro union to prefer unionization. We further must ensure that the probability of unionization, given in expression (9) lies between zero and one.
This means that both the following conditions must hold:

$$v_0 - \overline{d} - \frac{1}{2}(\overline{b} - \underline{b}) - \underline{\delta} > 0, \tag{21}$$

$$v_1 - \underline{d} - \frac{1}{2}(\overline{b} - \underline{b}) - \underline{\delta} < \overline{\delta} - \underline{\delta}. \tag{22}$$

Therefore, we require $\underline{\delta}$ to be sufficiently small, such that

$$v_0 - \overline{d} - \frac{1}{2}(\overline{b} - \underline{b}) > \underline{\delta}. \tag{23}$$

Moreover, we need the following condition, which takes into account expression (20).

$$v_1 - \underline{d} - \frac{1}{2}(\overline{b} - \underline{b}) < \overline{\delta} < v_0 - \overline{d} - \underline{b}. \tag{24}$$

These inequalities are only fulfilled if

$$v_1 - \underline{d} - \frac{1}{2}(\overline{b} - \underline{b}) < v_0 - \overline{d} - \underline{b} \tag{25}$$

$$\Leftrightarrow \qquad (v_1 - v_0) + (\overline{d} - \underline{d}) < \frac{1}{2}(\overline{b} - \underline{b}) - \underline{b}. \tag{26}$$

For this condition to hold, we merely require $\overline{b}$ to be sufficiently high.[46] This implies that we can ensure that workers choose unionization with some positive probability, for the appropriate $\underline{\delta}$, $\overline{\delta}$ and $\overline{b}$.

[46]We are emphasizing the condition on $\overline{b}$ here, as this parameter does not explicitly appear in the contact's decision problem, meaning we do not need to double check whether the specified conditions hold, when we turn to the contact's decision problem.

Characterization $\mathbb{E}[v|s]$

In what follows it is helpful to define $\Delta v = v - v_0$, as

$$\mathbb{E}[v|s] = v_0 + \mathbb{E}[\Delta v|s]. \tag{27}$$

Then, we can write

$$\mathbb{E}[\Delta v|s=0] = P(v=v_0|s=0)(v_0-v_0) + P(v=v_1|s=0)(v_1-v_0) \tag{28}$$

$$= (v_1-v_0)\frac{(1-p)}{(1-p)+p} = (v_1-v_0)(1-p) \tag{29}$$

$$\mathbb{E}[\Delta v|s_i=1] = P(v=v_0|s=1)(v_0-v_0) + P(v=v_1|s=1)(v_1-v_0) \tag{30}$$

$$= (v_1-v_0)\frac{p}{p+(1-p)} = (v_1-v_0)p, \tag{31}$$

which confirms that the expected value of unionization is lower after a low signal than after a high signal.

Characterization $\mathbb{E}[v|x]$

The difference in unionization probabilities, $P(u|x=1) - P(u|x=0)$ (see equation (12)) can be rewritten as

$$P(u|x=1) - P(u|x=0) = \frac{E[v|x=1] - E[v|x=0]}{\overline{\delta} - \underline{\delta}} \tag{32}$$

As $\mathbb{E}[v|x=1] - \mathbb{E}[v|x=0] = \mathbb{E}[\Delta v|x=1] - \mathbb{E}[\Delta v|x=0]$, we once again calculate the expectation of Δv conditional on the decision of the contact to become an organizer.

$$\mathbb{E}[\Delta v|x=0] = \frac{\omega - b_1 p - b_0(1-p)}{2\omega - b_1 - b_0}(v_1 - v_0) \tag{33}$$

$$\mathbb{E}[\Delta v|x=1] = \frac{b_1 p + b_0(1-p) - \underline{b}}{b_1 + b_0 - 2\underline{b}}(v_1 - v_0) \tag{34}$$

We then turn to the difference in expectations:

$$\mathbb{E}[\Delta v|x=1] - \mathbb{E}[\Delta v|x=0] = \frac{\tilde{v}(b_1 - b_0)(\omega - \underline{b})}{(b_1 + b_0 - 2\underline{b})(2\omega - b_1 - b_0)} \tag{35}$$

Contact's Simplified Payoffs

Given these simplifications, a contact with signal s then chooses to become an organizer if and only if

$$k_s - b \geq \frac{c(b_1 + b_0 - 2\underline{b})(2\omega - b_1 - b_0)}{\tilde{v}(b_1 - b_0)(\omega - \underline{b})} \tag{36}$$

To simplify notation, we define

$$g(b_0, b_1) \equiv \frac{c(b_1 + b_0 - 2\underline{b})(2\omega - b_1 - b_0)}{\tilde{v}(b_1 - b_0)(\omega - \underline{b})} \tag{37}$$

Equilibrium Candidates b_0 and b_1

There are the following candidates for an equilibrium:

1. Fully Informative Equilibrium: $b_0 = \underline{b}$, $b_1 = \omega$.

   For this to be an equilibrium, it must be the case that

   $$k_0 - \underline{b} < g(\underline{b}, \omega) < k_1 - \omega, \tag{38}$$

   where $g(\underline{b}, \omega) = \frac{c}{\tilde{v}}$. Note that for this to hold, $k_1 - \omega > k_0 - \underline{b}$. Therefore, a necessary condition for a fully informative equilibrium is $\tilde{v} > \omega - \underline{b}$.

2. Admissible Equilibrium: $\underline{b} < b_0 < b_1 < \omega$

   The contact is indifferent between being an organizer or not, after a zero signal if and only if

   $$k_0 - b_0 = \frac{c(b_1 + b_0 - 2\underline{b})(2\omega - b_1 - b_0)}{\tilde{v}(b_1 - b_0)(\omega - \underline{b})}. \tag{39}$$

   Similarly, the contact is indifferent between becoming an organizer after a signal of one if and only if

   $$k_1 - b_1 = \frac{c(b_1 + b_0 - 2\underline{b})(2\omega - b_1 - b_0)}{\tilde{v}(b_1 - b_0)(\omega - \underline{b})}. \tag{40}$$

   As the RHS of (39) and (40) is the same, it follows that the LHS must be identical as well:

   $$k_0 - b_0 = k_1 - b_1 \tag{41}$$

   $$\Leftrightarrow \qquad b_1(b_0) = \tilde{v} + b_0. \tag{42}$$

   Plugging $b_1(b_0)$ into expression (39) indirectly defines b_0. For this equilibrium to be feasible, it must hold that $\omega > b_0 + \tilde{v} > b_0 > \underline{b}$. A necessary condition for this to hold is $\omega - \underline{b} > \tilde{v}$.

3. Corner b_0: $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$
   For $b_0 = \underline{b}$, b_1 is implicitly defined by

$$k_1 - b_1 = \frac{c}{\tilde{v}(\omega - \underline{b})}(2\omega - b_1 - \underline{b}). \tag{43}$$

   Solving for b_1 yields

$$b_1 = \frac{k_1 \tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c}. \tag{44}$$

   Any contact with signal zero does not become an organizer, if and only if

$$k_0 - \underline{b} < \frac{c}{\tilde{v}(\omega - \underline{b})}\left(2\omega - \frac{k_1 \tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c} - \underline{b}\right) \tag{45}$$

$$\Leftrightarrow \qquad k_0 - \underline{b} < \frac{c(2\omega - k_1 - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c}. \tag{46}$$

4. Corner b_1: $b_0 \in (\underline{b}, \omega)$, $b_1 = \omega$
   If $b_1 = \omega$, then b_0 is implicitly defined by

$$k_0 - b_0 = \frac{c}{\tilde{v}(\omega - \underline{b})}(\omega + b_0 - 2\underline{b}). \tag{47}$$

   Solving for b_0 yields

$$b_0 = \frac{k_0 \tilde{v}(\omega - \underline{b}) - c(\omega - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c}. \tag{48}$$

   Any contact with signal one must then prefer to become an organizer, that is

$$k_1 - \omega > \frac{c}{\tilde{v}(\omega - \underline{b})}(\omega + \frac{k_0 \tilde{v}(\omega - \underline{b}) - c(\omega - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c} - 2\underline{b}) \tag{49}$$

$$\Leftrightarrow \qquad k_1 - \omega > \frac{c(\omega + k_0 - 2\underline{b})}{c + \tilde{v}(\omega - \underline{b})}. \tag{50}$$

5. No organizer $b_0 = b_1 = \underline{b}$.

6. All organizers $b_0 = b_1 = \omega$.

Not Everyone Becomes an organizer

We establish the it cannot be the case, that every contact becomes an organizer, independently of the signal received.

Lemma 1. *All organizers $b_0 = b_1 = \omega$ cannot be an equilibrium.*

Proof. In this case, the expected value of unionization for the worker is

$$\mathbb{E}[v|x = 1] = \frac{1}{2}(v_0 + v_1), \tag{51}$$

the same as if no contact became an organizer. This implies that becoming an organizer does not increase the probability of unionization, but comes at a cost. Any organizer's payoff is given by $-\bar{c}$, while he can guarantee himself a payoff of zero by not becoming an organizer, independently of the signal received. □

This lemma implies that we can omit from our analysis everyone becoming an organizer.

B Mathematical Proofs

Proof of Proposition 1: High Costs

We first consider the equilibrium candidate where $b_0 = b_1 = \underline{b}$ and we show that this occurs if organizational costs c are too high. In this case, no contact becomes an organizer. In order to establish that this is indeed an equilibrium, we must show that there is no profitable deviation, that is there exists no contact with signal s and bias b, who prefers to be an organizer. We first consider a deviation by a contact with signal 1. In this case, upon seeing an organizer, workers make the correct inference, namely that he has signal 1. Therefore, the change in the expected value of unionization is given by

$$\mathbb{E}[\Delta v|x = 1] - \mathbb{E}[\Delta v|x = 0] = p(v_1 - v_0) - \frac{1}{2}(v_1 - v_0) \tag{52}$$

$$= \frac{1}{2}(2p - 1)(v_1 - v_0) = \frac{\tilde{v}}{2}. \tag{53}$$

The probability weighted payoff of unionization is then at most

$$\frac{\tilde{v}}{2}(k_1 - \underline{b}) \tag{54}$$

while costs amount to c. Therefore, we do not have a profitable deviation by any contact with signal one, if and only if

$$\frac{\tilde{v}}{2}(k_1 - \underline{b}) < c. \tag{55}$$

Note that this condition also implies that there cannot be a profitable deviation by a contact with signal zero, even if workers believed that they were seeing a contact with signal 1 as $\frac{\tilde{v}}{2}(k_0 - \underline{b}) < \frac{\tilde{v}}{2}(k_1 - \underline{b})$, which is equivalent to $k_0 < k_1$. This holds by definition.

Proof of Proposition 2: Moderate Costs

We assume that $\tilde{v}(k_0 - \underline{b}) < c < \frac{1}{2}\tilde{v}(k_1 - \underline{b})$. We split our proof into two parts: Part 1 assumes that $\omega < \tilde{v} + \underline{b}$, while in Part 2, $\omega > \tilde{v} + \underline{b}$. Under the first condition, no admissible equilibrium is feasible (meaning $b_0, b_1 \in (\underline{b}, \omega)$), but a fully informative is ($b_0 = \underline{b}$, $b_1 = \omega$). Under the second condition the reverse holds true, see Appendix A, the discussion of equilibrium candidates.

Part 1: $\omega < \tilde{v} + \underline{b}$ As $\omega < \tilde{v} + \underline{b}$, we cannot have an admissible equilibrium. Given that $c < \frac{1}{2}\tilde{v}(k_1 - \underline{b})$, we can also rule out an equilibrium where $b_0 = b_1 = \underline{b}$. We are then left with the following equilibrium candidates:

1. $b_0 = \underline{b}$, $b_1 = \omega$
2. $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$
3. $b_0 \in (\underline{b}, \omega)$, $b_1 = \omega$

We first show that if $b_1 = \omega$, $b_0 = \underline{b}$. Note that $b_0 = \underline{b}$ if and only if

$$k_0 - \underline{b} < g(\underline{b}, \omega) = \frac{c}{\tilde{v}}. \tag{56}$$

As we assume that $\tilde{v}(k_0 - \underline{b}) < c$, this always holds. This rules out an equilibrium of the form $b_0 \in (\underline{b}, \omega)$, $b_1 = \omega$.

We are then left with two possible equilibria,

1. $b_0 = \underline{b}$, $b_1 = \omega$
2. $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$,

which we discuss in turn.

Fully Informative Equilibrium For a fully informative equilibrium, the following condition must hold:

$$k_0 - \underline{b} < \frac{c}{\tilde{v}} < k_1 - \omega. \tag{57}$$

We established above that the first inequality holds. We therefore turn to the second, which can be expressed as a condition on ω:

$$\frac{c}{\tilde{v}} < k_1 - \omega \qquad \Leftrightarrow \qquad \omega < k_1 - \frac{c}{\tilde{v}} \tag{58}$$

We assume that $\omega < \tilde{v} + \underline{b}$. Therefore, we need to establish the relationship between $k_1 - \frac{c}{\tilde{v}}$ and $\tilde{v} + \underline{b}$, which we do in the following lemma.

Lemma 2. *Let $\omega < \tilde{v} + \underline{b}$ and $\tilde{v}(k_0 - \underline{b}) < c$. Then, $k_1 - \frac{c}{\tilde{v}} < \tilde{v} + \underline{b}$.*

Proof. Note that $k_1 - \frac{c}{\tilde{v}} = k_0 + \tilde{v} - \frac{c}{\tilde{v}}$. It follows that

$$k_0 + \tilde{v} - \frac{c}{\tilde{v}} < \tilde{v} + \underline{b} \qquad \Leftrightarrow \qquad k_0 - \underline{b} < \frac{c}{\tilde{v}}, \tag{59}$$

where the last inequality holds by assumption. □

This establishes that we need to ensure that $\omega < k_1 - \frac{c}{\tilde{v}}$, in which case the fully informative equilibrium emerges, $b_0 = \underline{b}$ and $b_1 = \omega$.

Corner $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$ If $b_0 = \underline{b}$ and b_1 is admissible, then

$$b_1 = \frac{k_1 \tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c}. \tag{60}$$

Note that $\tilde{v}(\omega - \underline{b}) - c > 0$. To see this, assume by contradiction that $c > \tilde{v}(\omega - \underline{b})$. Then,

$$c > \tilde{v}(\omega - \underline{b}) > \tilde{v}(k_1 - \frac{c}{\tilde{v}} - \underline{b}) = \tilde{v}(k_1 - \underline{b}) - c, \tag{61}$$

where the second inequality follows from $\omega > k_1 - \frac{c}{\tilde{v}}$. Then,

$$c > \tilde{v}(k_1 - \underline{b}) - c \qquad \Leftrightarrow \qquad c > \frac{1}{2}\tilde{v}(k_1 - \underline{b}), \tag{62}$$

which yields the contradiction given our assumption on costs. We verify that (i) $b_1 < \omega$ and (ii) $b_1 > \underline{b}$. For the first point, we need to show that

$$\frac{k_1 \tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c} < \omega \qquad \Leftrightarrow \qquad (k_1 - \omega)\tilde{v} < c \qquad \Leftrightarrow \qquad k_1 - \frac{c}{\tilde{v}} < \omega, \tag{63}$$

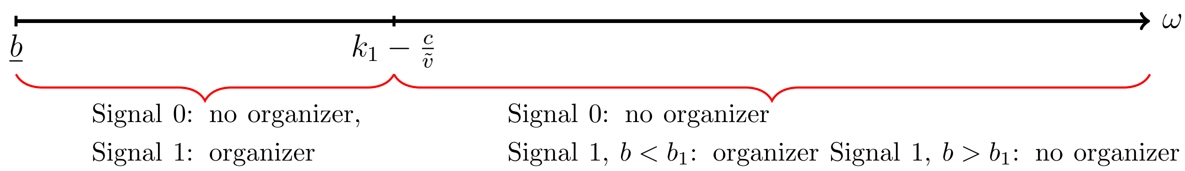
where the last inequality imposes a condition on ω. Recall that $\tilde{v} + \underline{b} > k_1 - \frac{c}{\tilde{v}}$. Therefore, $\tilde{v} + \underline{b} > \omega > k_1 - \frac{c}{\tilde{v}}$. Next, we show that $b_1 > \underline{b}$,

$$\frac{k_1 \tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c} > \underline{b}. \tag{64}$$

This is equivalent to $\frac{1}{2}\tilde{v}(k_1 - \underline{b}) > c$, which holds by assumption. We have therefore established, that $b_1 \in (\underline{b}, \omega)$ for $\tilde{v} + \underline{b} > \omega > k_1 - \frac{c}{\tilde{v}}$. As we have already ruled out an admissible equilibrium, this completes the proof.

Graphically, we can summarise the result for moderate costs and $\omega < \tilde{v} + \underline{b}$, as in Figure 4. We have therefore established that for intermediate costs, a contact with signal zero

Figure 4: Moderate Costs, $\omega < \tilde{v} + \underline{b}$



never becomes an organizer. A contact with signal one always becomes an organizer for $\omega < k_1 - \frac{c}{\tilde{v}}$. For $\omega > k_1 - \frac{c}{\tilde{v}}$, the contact becomes an organizer if $b < b_1$ and refrains from organizational activities if $b > b_1$.

Part 2: $\omega > \tilde{v} + \underline{b}$ In this case, a fully informative equilibrium is no longer feasible as $k_1 - k_0 = \tilde{v} < \omega - \underline{b}$. We now consider the following candidates for an equilibrium

1. $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$
2. $\underline{b} < b_0 < b_1 < \omega$
3. $b_0 \in (\underline{b}, \omega)$, $b_1 = \omega$

Corner $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$ By the same logic as above, for $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$ is a best response. We now need to show that for $b_1 \in (\underline{b}, \omega)$, $b_0 = \underline{b}$ is also a best response. For this to be a best response, it must be the case that

$$k_0 - \underline{b} < \frac{c(2\omega - k_1 - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c}. \tag{65}$$

Whether this holds, depends on ω. Note that $g(\underline{b}, b_1)$ is increasing in ω as

$$\frac{\partial \frac{c(2\omega - k_1 - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c}}{\partial \omega} = \frac{c((k_1 - \underline{b})\tilde{v} - 2c)}{(\tilde{v}(\omega - \underline{b}) - c)^2} > 0, \tag{66}$$

as $(k_1 - \underline{b})\tilde{v} > 2c$ by assumption. This means that if inequality (65) holds for some $\tilde{\omega}_0$ weakly, it also holds for any $\omega > \tilde{\omega}_0$ strictly,

$$k_0 - \underline{b} = \frac{c(2\tilde{\omega}_0 - k_1 - \underline{b})}{\tilde{v}(\tilde{\omega}_0 - \underline{b}) - c} \qquad \Leftrightarrow \qquad \tilde{\omega}_0 = -\frac{-\underline{b}\left(\tilde{v}(k_0 - \underline{b}) - 2c\right) + c\tilde{v}}{\tilde{v}(k_0 - \underline{b}) - 2c}. \tag{67}$$

Finally, we need to check whether $\tilde{\omega}_0 > \underline{b}$:

$$-\frac{-\underline{b}\left(\tilde{v}(k_0 - \underline{b}) - 2c\right) + c\tilde{v}}{\tilde{v}(k_0 - \underline{b}) - 2c} > \underline{b} \tag{68}$$

This is only possible for $\frac{1}{2}\tilde{v}(k_0 - \underline{b}) < c$. In this case, we obtain

$$\frac{-\underline{b}\left(\tilde{v}(k_0 - \underline{b}) - 2c\right) + c\tilde{v}}{-\tilde{v}(k_0 - \underline{b}) + 2c} > \underline{b} \tag{69}$$

$$\Leftrightarrow \qquad -\underline{b}\left(\tilde{v}(k_0 - \underline{b}) - 2c\right) + c\tilde{v} > (-\tilde{v}(k_0 - \underline{b}) + 2c)\underline{b} \qquad \Leftrightarrow \qquad c\tilde{v} > 0, \tag{70}$$

where the last inequality holds as both c and $\tilde{v}$ are strictly positive by assumption. As $\frac{1}{2}\tilde{v}(k_0 - \underline{b}) < \tilde{v}(k_0 - \underline{b}) < c$, by assumption $\tilde{\omega}_0 > \underline{b}$. Then, as $g(\underline{b}, b_1)$ is increasing in ω, it must hold that for all $\omega > \tilde{\omega}_0$, $b_0 = \underline{b}$.

Further, it must hold that $\omega > \tilde{v} + \underline{b}$. We therefore compare $\tilde{v} + \underline{b}$ and $\tilde{\omega}_0$ as for $\tilde{v} + \underline{b} > \tilde{\omega}_0$, implies that for any ω, $b_0 = \underline{b}$. Note first that $\tilde{v}(k_0 - \underline{b}) - 2c < 0$. This follows as

$$c > \tilde{v}(k_0 - \underline{b}) > \frac{1}{2}\tilde{v}(k_0 - \underline{b}), \tag{71}$$

where the first inequality is by assumption. Then, we establish that $\tilde{v} + \underline{b} > \tilde{\omega}_0$.

$$(\tilde{v} + \underline{b})(\tilde{v}(k_0 - \underline{b}) - 2c) < \underline{b}\left(\tilde{v}(k_0 - \underline{b}) - 2c\right) - c\tilde{v} \tag{72}$$

$$\Leftrightarrow \qquad \tilde{v}(k_0 - \underline{b}) < c. \tag{73}$$

We have therefore established that for any $\omega > \tilde{v} + \underline{b}$, $b_0 = \underline{b}$ and $b_1 = \frac{k_1\tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c} \in (\underline{b}, \omega)$. Note that this result rules out an admissible equilibrium. For an admissible equilibrium, there must be some ω for which $k_0 - \underline{b} = g(\underline{b}, b_1)$ due to continuity. This means that the most pro-union contact with zero signal must at least be indifferent, which we have shown to never hold.

It remains to be shown that $b_1 = \omega$ cannot be part of an equilibrium. If $b_1 = \omega$, then

$$b_0 = \frac{k_0\tilde{v}(\omega - \underline{b}) - c(\omega - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c}, \tag{74}$$

which must be greater than $\underline{b}$.

$$\frac{k_0\tilde{v}(\omega - \underline{b}) - c(\omega - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c} > \underline{b} \tag{75}$$

$$\Leftrightarrow \qquad \tilde{v}(k_0 - \underline{b}) > c, \tag{76}$$

a contradiction. This implies that for $b_1 = \omega$, $b_0 = \underline{b}$, which is a contradiction to $\omega > \tilde{v} + \underline{b}$, which rules out a fully informative equilibrium.

Therefore, we have ruled out the remaining two candidates for an equilibrium. This establishes that for $\omega > \tilde{v} + \underline{b}$, $b_0 = \underline{b}$ and $b_1 = \frac{k_1\tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c} \in (\underline{b}, \omega)$. Taking these two parts together we have that for $\omega < k_1 - \frac{c}{\tilde{v}}$, $b_0 = \underline{b}$, and $b_1 = \omega$, while for $\omega > k_1 - \frac{c}{\tilde{v}}$, $b_0 = \underline{b}$, and $b_1 = \frac{k_1 \tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c} \in (\underline{b}, \omega)$. Defining $\hat{\omega} \equiv k_1 - \frac{c}{\tilde{v}}$ yields the result. □

Proof of Propositions 3 and 4: Low Costs

We combine here the proofs of Propositions 3 and 4, which both assume that $\tilde{v}(k_0 - \underline{b}) > c$.[47] With low costs, we cannot have a fully informative equilibrium. To see this, recall that for a fully informative equilibrium, the following condition must hold:

$$k_0 - \underline{b} < \frac{c}{\tilde{v}}, \tag{77}$$

as outlined in Appendix A. This is ruled out by our assumption on costs, though.

We therefore are left with the following candidates for an equilibrium:[48]

1. $\underline{b} < b_0 < b_1 < \omega$
2. $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$
3. $b_0 \in (\underline{b}, \omega)$, $b_1 = \omega$

Corner $b_0 \in (\underline{b}, \omega)$, $b_1 = \omega$ Suppose first that $b_1 = \omega$. Then,

$$b_0 = \frac{k_0 \tilde{v}(\omega - \underline{b}) - c(\omega - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c}. \tag{78}$$

We require $b_0 > \underline{b}$, which is equivalent to

$$\frac{k_0 \tilde{v}(\omega - \underline{b}) - c(\omega - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c} > \underline{b} \tag{79}$$

$$\Leftrightarrow \qquad \tilde{v}(k_0 - \underline{b}) > c, \tag{80}$$

which always holds given our assumption on costs. Moreover, it must hold that $b_0 < \omega$, that is

$$\frac{k_0 \tilde{v}(\omega - \underline{b}) - c(\omega - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c} < \omega \tag{81}$$

$$\Leftrightarrow \qquad k_0 - \frac{2c}{\tilde{v}} < \omega. \tag{82}$$

Define $\tilde{\omega} \equiv k_0 - \frac{2c}{\tilde{v}}$. Then, for $b_1 = \omega$, we have an admissible $b_0 = \frac{k_0 \tilde{v}(\omega - \underline{b}) - c(\omega - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c} \in (\underline{b}, \omega)$ if and only if $\tilde{\omega} < \omega$. This always holds if $\tilde{\omega} < \underline{b}$, which is equivalent to

$$k_0 - \frac{2c}{\tilde{v}} < \underline{b} \qquad \Leftrightarrow \qquad \frac{1}{2}\tilde{v}(k_0 - \underline{b}) < c. \tag{83}$$

[47] Note that if $\tilde{v}(k_0 - \underline{b}) > \frac{1}{2}\tilde{v}(k_1 - \underline{b})$, then we merely require $\frac{1}{2}\tilde{v}(k_1 - \underline{b}) > c$.

[48] We already ruled out that $b_0 = b_1 = \underline{b}$.

Now, fix b_0. Then, a contact with signal one always wants to be an organizer if and only if

$$k_1 - \omega > \frac{c}{\tilde{v}(\omega - \underline{b})}(\omega + b_0 - 2\underline{b}) = g(b_0, \omega) \tag{84}$$

Plugging in b_0 as specified in (78) yields

$$g(b_0, \omega) = \frac{c(\omega + k_0 - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c} \tag{85}$$

We are then interested in the threshold $\tilde{\omega}_1$ for which

$$k_1 - \tilde{\omega}_1 = \frac{c(\tilde{\omega}_1 + k_0 - 2\underline{b})}{\tilde{v}(\tilde{\omega}_1 - \underline{b}) + c} \tag{86}$$

This is a quadratic equation in $\tilde{\omega}_1$, which yields two solutions, namely

$$\tilde{\omega}_1^{+/-} = -\frac{c}{\tilde{v}} + \frac{1}{2}(k_1 + \underline{b}) \pm \frac{1}{2\tilde{v}}\sqrt{4c^2 - 4c(k_0 - \underline{b})\tilde{v} + (k_1 - \underline{b})^2\tilde{v}^2}. \tag{87}$$

As $\tilde{\omega}_1^- < \underline{b}$,[49] the relevant threshold is given by

$$\tilde{\omega}_1 = -\frac{c}{\tilde{v}} + \frac{1}{2}(k_1 + \underline{b}) + \frac{1}{2\tilde{v}}\sqrt{4c^2 - 4c(k_0 - \underline{b})\tilde{v} + (k_1 - \underline{b})^2\tilde{v}^2}. \tag{88}$$

The final step is then to show that $k_1 - \omega > g(b_0, \omega)$ is equivalent to $\omega < \tilde{\omega}_1$. Put differently, if $\omega < \tilde{\omega}_1$ then a contact with signal one to always want to be an organizer. Note first that for $\omega \to \underline{b}$, $g(b_0, \omega)$ simplifies to $k_0 - \underline{b}$. Therefore, inequality (84) boils down to

$$k_1 - \underline{b} > k_0 - \underline{b} \qquad \Leftrightarrow \qquad k_1 > k_0, \tag{89}$$

which always holds. Note further that $k_1 - \omega$ is linearly decreasing in ω, while the RHS of (84) is a convex decreasing function in ω as

$$\frac{\partial\left(\frac{c(\omega + k_0 - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c}\right)}{\partial \omega} = -\frac{c(\tilde{v}(k_0 - \underline{b}) - c)}{(\tilde{v}(\omega - \underline{b}) + c)^2} < 0 \tag{90}$$

$$\frac{\partial^2\left(\frac{c(\omega + k_0 - 2\underline{b})}{\tilde{v}(\omega - \underline{b}) + c}\right)}{\partial \omega^2} = \frac{2c\tilde{v}(\tilde{v}(k_0 - \underline{b}) - c)}{(\tilde{v}(\omega - \underline{b}) + c)^3} > 0 \tag{91}$$

This means that for $\omega < \tilde{\omega}_1$, the LHS is larger than the RHS. For $\omega > \tilde{\omega}_1$, the reverse holds, that is the RHS is larger than the LHS. Therefore, if and only if $\omega < \tilde{\omega}_1$ does the

[49] See the accompanying Mathematica file.

contact always become an organizer when receiving signal one.

We then need to distinguish between two cases: (i) if $c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$, then for $\underline{b} < \omega < \tilde{\omega}_1$, $b_0 = \frac{k_0\tilde{v}(\omega-\underline{b})-c(\omega-2\underline{b})}{\tilde{v}(\omega-\underline{b})+c}$ and $b_1 = \omega$; (ii) if $c < \frac{1}{2}\tilde{v}(k_0 - \underline{b})$, we need to compare $\tilde{\omega}_1$ and $\tilde{\omega}$. We can show that $\tilde{\omega}_1 > \tilde{\omega}$.[50] It then holds that for $\tilde{\omega} < \omega < \tilde{\omega}_1$, $b_0 = \frac{k_0\tilde{v}(\omega-\underline{b})-c(\omega-2\underline{b})}{\tilde{v}(\omega-\underline{b})+c}$ and $b_1 = \omega$.

Corner $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$ If $b_0 = \underline{b}$, then

$$b_1 = \frac{k_1\tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c}. \tag{92}$$

We then must ensure that b_1 is indeed admissible. This means that (i) $b_1 > \underline{b}$ and (ii) $b_1 < \omega$. For $b_1 > \underline{b}$, we require

$$\frac{k_1\tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c} > \underline{b} \tag{93}$$

For this to hold, we must have $\tilde{v}(\omega - \underline{b}) - c > 0$. Then, the previous inequality can be simplified to $\frac{1}{2}\tilde{v}(k_1 - \underline{b}) > c$, which always holds. This also implies that for $\tilde{v}(\omega - \underline{b}) - c < 0$, $b_1 < \underline{b}$. We then establish when $b_1 < \omega$,

$$\frac{k_1\tilde{v}(\omega - \underline{b}) - c(2\omega - \underline{b})}{\tilde{v}(\omega - \underline{b}) - c} < \omega \qquad \Leftrightarrow \qquad k_1 - \frac{c}{\tilde{v}} < \omega \tag{94}$$

Note that

$$k_1 - \frac{c}{\tilde{v}} > \frac{c}{\tilde{v}} + \underline{b} \qquad \Leftrightarrow \qquad \frac{1}{2}\tilde{v}(k_1 - \underline{b}) > c \tag{95}$$

Therefore, for $\omega > k_1 - \frac{c}{\tilde{v}} > \frac{c}{\tilde{v}} + \underline{b}$, we have shown that $b_1 \in (\underline{b}, \omega)$ is indeed a best response to $b_0 = \underline{b}$. Given the specified b_1, we now provide a condition for which $b_0 = \underline{b}$. In this case, $g(\underline{b}, b_1)$ simplifies to

$$g(\underline{b}, b_1) = \frac{c(2\omega - \underline{b} - k_1)}{\tilde{v}(\omega - \underline{b}) - c} \tag{96}$$

Then, every contact with a signal zero prefers to not be an organizer if and only if

$$k_0 - \underline{b} < \frac{c(2\omega - \underline{b} - k_1)}{\tilde{v}(\omega - \underline{b}) - c} \tag{97}$$

We have already established in the proof of Proposition 2 that this holds for $\omega > \tilde{\omega}_0$, where we required that $c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$ for $\tilde{\omega}_0 > \underline{b}$. While in the Moderate Cost setting, this assumption was always fulfilled, this is no longer the case here. Suppose therefore

[50] See the accompanying Mathematica file.

that $c < \frac{1}{2}\tilde{v}(k_0 - \underline{b})$, which implies that $\tilde{\omega}_0 < \underline{b}$. In this case, we need to show whether (97) holds for all possible ω. Note that $g(\underline{b}, b_1)$ is increasing in ω:

$$\frac{\partial\left(\frac{c(2\omega-\underline{b}-k_1)}{\tilde{v}(\omega-\underline{b})-c}\right)}{\partial\omega} = \frac{c(\tilde{v}(k_1-\underline{b})-2c)}{(\tilde{v}(\omega-\underline{b})-c)^2} > 0 \tag{98}$$

Therefore, if we can show for the highest possible ω that

$$k_0 - \underline{b} > \frac{c(2\omega-\underline{b}-k_1)}{\tilde{v}(\omega-\underline{b})-c}, \tag{99}$$

then this must hold for any other ω. Letting $\omega \to \infty$, yields

$$\lim_{\omega\to\infty} \frac{c(2\omega-\underline{b}-k_1)}{\tilde{v}(\omega-\underline{b})-c} = \frac{2c}{\tilde{v}}. \tag{100}$$

For $k_0 - \underline{b} > \frac{2c}{\tilde{v}} > \frac{c(2\omega-\underline{b}-k_1)}{\tilde{v}(\omega-\underline{b})-c}$, we then have that the most pro-union contact with a zero signal always becomes an organizer. This rules out $b_0 = \underline{b}$ and the corner equilibrium, whenever $c < \frac{1}{2}\tilde{v}(k_0 - \underline{b})$.

We then have an equilibrium with $b_0 = \underline{b}$ and the specified interior b_1 for $\omega > \max\{k_1 - \frac{c}{\tilde{v}}, \tilde{\omega}_0\}$ and $\tilde{v}(k_0 - \underline{b}) > c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$.[51] We require

$$\omega > k_1 - \frac{c}{\tilde{v}} \qquad \Leftrightarrow \qquad c > \tilde{v}(k_1 - \omega) \tag{101}$$

Given that $c < \tilde{v}(k_0 - \underline{b})$, such an equilibrium is only feasible for

$$\tilde{v}(k_0 - \underline{b}) > \tilde{v}(k_1 - \omega) \qquad \Leftrightarrow \qquad \omega > \tilde{v} + \underline{b} \tag{102}$$

Note that

$$k_1 - \frac{c}{\tilde{v}} > \tilde{v} + \underline{b} \qquad \Leftrightarrow \qquad \tilde{v}(k_0 - \underline{b}) > c, \tag{103}$$

where we take into account that $k_1 = k_0 + \tilde{v}$.

Admissible Equilibrium $\underline{b} < b_0 < b_1 < \omega$ As specified in Appendix A, we can express b_1 as a function of b_0, namely

$$b_1(b_0) = \tilde{v} + b_0 \tag{104}$$

[51] Note that it is not possible to rank the two different thresholds at this point.

We then obtain

$$k_0 - b_0 = \frac{c(2b_0 - 2\underline{b} + \tilde{v})(2\omega - \tilde{v} - 2b_0)}{\tilde{v}^2(\omega - \underline{b})} \tag{105}$$

This is a quadratic expression in b_0 of the form

$$A_1 b_0^2 - A_2 b_0 + A_3 = 0, \tag{106}$$

where

$$A_1 = \frac{4c}{\tilde{v}^2(\omega - \underline{b})} \tag{107}$$

$$A_2 = 1 + \frac{4c(\omega + \underline{b} - \tilde{v})}{\tilde{v}^2(\omega - \underline{b})} \tag{108}$$

$$A_3 = k_0 - \frac{c(\tilde{v} - 2\underline{b})(2\omega - \tilde{v})}{\tilde{v}^2(\omega - \underline{b})}. \tag{109}$$

Existence To ensure a solution exists, we require

$$A_2^2 - 4A_1A_3 > 0 \qquad \Leftrightarrow A_2^2 > 4A_1A_3. \tag{110}$$

Our threshold $\hat{\omega}$ is then given by

$$\left(1 + \frac{4c(\hat{\omega} + \underline{b} - \tilde{v})}{\tilde{v}^2(\hat{\omega} - \underline{b})}\right)^2 = \frac{16c}{\tilde{v}^2(\hat{\omega} - \underline{b})}\left(k_0 - \frac{c(\tilde{v} - 2\underline{b})(2\hat{\omega} - \tilde{v})}{\tilde{v}^2(\hat{\omega} - \underline{b})}\right). \tag{111}$$

Rearranging and simplifying yields

$$\hat{\omega} = \frac{16\left(\frac{1}{2}(v_0 + v_1) - D\right)c\tilde{v}^2 + \underline{b}\left(\tilde{v}^2 - 4c\right)^2}{\left(\tilde{v}^2 + 4c\right)^2}. \tag{112}$$

Solution Given that we have a quadratic solution, we obtain two candidates for a solution for b_0,

$$\begin{aligned} b_0^{+/-} &= \frac{A_2 \pm \sqrt{A_2^2 - 4A_1A_3}}{2A_1} \\ &= \frac{\omega + \underline{b} - \tilde{v}}{2} + \frac{\tilde{v}^2(\omega - \underline{b})}{8c} \pm \frac{1}{8c}\sqrt{(\omega - \underline{b})\left(16c^2\omega + \tilde{v}^4\omega + 8c\tilde{v}^2(\omega - k_0 - k_1) - \underline{b}(\tilde{v}^2 - 4c)^2\right)} \end{aligned} \tag{113}$$

We need to establish two results: (1) we must determine whether the relevant solution is b_0^- or b_0^+, and (2) we require that becoming an organizer is associated with a positive probability of unionization, expressed by $g(b_0)$, where we drop the dependence on b_1:

$$g(b_0) = \frac{c(2b_0 - 2\underline{b} + \tilde{v})(2\omega - \tilde{v} - 2b_0)}{\tilde{v}^2(\omega - \underline{b})} > 0. \tag{114}$$

Put differently, becoming a union organizer must generate a positive profit for the contact. We proceed by first positing an ω threshold, such that for ω above this thresholds we have a positive unionization probability. This is useful in seeing whether b_0^- exceeds b_0^+ or vice versa. We then rank b_0^- and b_0^+ and show that b_0^- is the relevant threshold. Finally, we prove that for ω above the specified threshold unionization is indeed profitable.

We posit that for $\omega > \frac{v_1+v_0}{2} - D$ and the relevant b_0, $g(b_0) > 0$. To see this note that we can rewrite the third part of expression (113) as

$$\frac{\omega - \underline{b}}{8c}\sqrt{\frac{(16c^2\omega + \tilde{v}^4\omega + 8c\tilde{v}^2(\omega - k_0 - k_1) - \underline{b}(\tilde{v}^2 - 4c)^2)}{\omega - \underline{b}}}. \tag{115}$$

Plugging in $\omega = \frac{v_1+v_0}{2} - D$ yields

$$\frac{\omega - \underline{b}}{8c}\sqrt{(\tilde{v}^2 - 4c)^2}. \tag{116}$$

The expression under the root can be positive or negative depending on whether $\tilde{v}^2 - 4c$ is positive or negative. This has implications for whether b_0^+ is greater or smaller than b_0^-. It turns out that this does not only hold for this specific $\omega = \frac{v_1+v_0}{2} - D$, but for any ω. Namely, if $\tilde{v}^2 - 4c < 0$, then $b_0^+ < b_0^-$, for $\tilde{v}^2 - 4c > 0$, $b_0^+ > b_0^-$. We therefore express $\sqrt{(\tilde{v}^2 - 4c)^2}$ as $|\tilde{v}^2 - 4c|$, which ensures that $b_0^-(\omega) < b_0^+(\omega)$, while remaining agnostic about whether $\tilde{v}^2 - 4c > 0$ or not.[52]

We now return to general ω and establish which threshold is relevant for the organization decision. It turns that the relevant threshold is $b_0^-(\omega)$. To see this, note first that the function $g(b_0)$ is strictly concave as

$$g'(b_0) = \frac{4c\,(\omega + \underline{b} - \tilde{v} - 2b_0)}{\tilde{v}^2(\omega - \underline{b})}, \tag{117}$$

$$g''(b_0) = -\frac{8c}{\tilde{v}^2(\omega - \underline{b})} < 0. \tag{118}$$

We then proceed to show that $g(b_0^+) < 0$, meaning that a contact with bias b_0^+ does not find it beneficial to become an organizer, and therefore b_0^+ cannot be the relevant

[52]See also the accompanying Mathematica File.

threshold. Suppose $b_0 = \omega$. Then, we can show that $g(b_0 = \omega) < 0$ as

$$g(\omega) = \frac{c(2\omega - 2\underline{b} + \tilde{v})(2\omega - \tilde{v} - 2\omega)}{\tilde{v}^2(\omega - \underline{b})} = \frac{-c(2\omega - 2\underline{b} + \tilde{v})}{\tilde{v}(\omega - \underline{b})} < 0. \tag{119}$$

As $g(b_0)$ is a concave function it has two intersections with zero, with the higher value corresponding to $\hat{b}$:[53]

$$2\omega - \tilde{v} - 2\hat{b} = 0 \qquad \Leftrightarrow \qquad \hat{b} = \omega - \frac{1}{2}\tilde{v}. \tag{120}$$

Note that $\hat{b} < \omega$. For b_0^+ to be associated with a positive probability of unionization it must hold that $\hat{b} > b_0^+$ as for any $b_0 > \hat{b}$, $g(b_0) < 0$. However, the opposite is true as

$$\hat{b} < b_0^+ \tag{121}$$

$$\Leftrightarrow \qquad \omega - \frac{1}{2}\tilde{v} < \frac{\omega + \underline{b} - \tilde{v}}{2} + \frac{\tilde{v}^2(\omega - \underline{b})}{8c}\frac{\omega - \underline{b}}{8c}\sqrt{\frac{(16c^2\omega + \tilde{v}^4\omega + 8c\tilde{v}^2(\omega - k_0 - k_1) - \underline{b}(\tilde{v}^2 - 4c)^2)}{\omega - \underline{b}}} \tag{122}$$

$$\Leftrightarrow \qquad 1 < \frac{\tilde{v}^2}{4c}\left[1 + \frac{1}{\tilde{v}^2}\sqrt{\frac{16c^2\omega + \tilde{v}^4\omega + 8c\tilde{v}^2(\omega - 2k_1 - \tilde{v}) - \underline{b}(\tilde{v}^2 - 4c)^2}{\omega - \underline{b}}}\right] \tag{123}$$

The final inequality always holds for $|\tilde{v}^2 - 4c|$ meaning that at b_0^+ the payoff from unionization is never positive, independently of the exact value of ω. This establishes that b_0^- is the relevant cutoff.

In what follows, we drop the minus superscript and simply write b_0. Even though, we now have the relevant threshold, it is not clear, whether at this threshold, a contact has a positive value of unionization.

Therefore, we set $\omega = \frac{v_1+v_0}{2} - D$ once again. We obtain

$$b_0\left(\frac{v_1 + v_0}{2} - D\right) = k_0 - D, \tag{124}$$

which means that the benefit of becoming an organizer is zero, for $\omega = \frac{v_1+v_0}{2} - D$ as $k_0 - b_0\left(\frac{v_1+v_0}{2} - D\right) = 0$.
For any $b_0(\omega) < b_0\left(\frac{v_1+v_0}{2} - D\right)$, we have a positive payoff from unionization. We therefore need to establish how b_0 changes in ω. It turns out that b_0 is decreasing in ω. This means for $\omega > \frac{v_1+v_0}{2} - D$, we have a strictly positive payoff from unionization.

Lemma 3 ($b_0 \downarrow$ in ω). *The threshold b_0 is decreasing in ω.*

Proof. Defining $K \equiv 16c^2\omega + \tilde{v}^4\omega + 8c\tilde{v}^2(\omega - k_1 - k_0) - \underline{b}(\tilde{v}^2 - 4c)^2$ and taking the derivative

[53] It can either be that $(2b_0 - 2\underline{b} + \tilde{v}) = 0$ or $(2\omega - \tilde{v} - 2b_0) = 0$.

with respect to ω yields

$$\frac{\partial b_0}{\partial \omega} = \frac{1}{8c}\left[4c + \tilde{v}^2 - \frac{1}{2}\sqrt{\frac{\omega - \underline{b}}{K}}(4c + \tilde{v}^2)^2 - \frac{1}{2}\sqrt{\frac{K}{\omega - \underline{b}}}\right] \tag{125}$$

The derivative is negative if

$$-(4c + \tilde{v}^2) + \frac{1}{2}\sqrt{\frac{\omega - \underline{b}}{K}}(4c + \tilde{v}^2)^2 + \frac{1}{2}\sqrt{\frac{K}{\omega - \underline{b}}} > 0 \tag{126}$$

$$\Leftrightarrow \quad -2(4c + \tilde{v}^2) + \sqrt{\frac{\omega - \underline{b}}{K}}(4c + \tilde{v}^2)^2 + \sqrt{\frac{K}{\omega - \underline{b}}} > 0 \tag{127}$$

$$\Leftrightarrow \quad (4c + \tilde{v}^2)^2 - 2\sqrt{\frac{K}{\omega - \underline{b}}}(4c + \tilde{v}^2) + \frac{k_3}{\omega - \underline{b}} > 0 \tag{128}$$

$$\Leftrightarrow \quad \left((4c + \tilde{v}^2) - \sqrt{\frac{K}{\omega - \underline{b}}}\right)^2 > 0, \tag{129}$$

where the latter always holds.[54] □

This establishes that for $\omega > \frac{v_1+v_0}{2} - D$, we obtain $b_0 < k_0 - D$, meaning that the benefit of unionization is strictly positive at the cut off. Define $\omega^e \equiv \frac{v_1+v_0}{2} - D$. This can be interpreted as the expected payoff of unionization without any additional information.

We can then show that $\omega^e > \hat{\omega}$, meaning that whenever the payoff from becoming an organizer is positive, then the cut-off also exists.

$$\omega^e > \frac{16c\tilde{v}^2}{(\tilde{v}^2 + 4c)^2}\omega^e + \frac{\underline{b}\,(\tilde{v}^2 - 4c)^2}{(\tilde{v}^2 + 4c)^2} \tag{130}$$

$$\omega^e\left(1 - \frac{16c\tilde{v}^2}{(\tilde{v}^2 + 4c)^2})\right) > \frac{\underline{b}\,(\tilde{v}^2 - 4c)^2}{(\tilde{v}^2 + 4c)^2} \tag{131}$$

$$\omega^e\frac{(\tilde{v}^2 - 4c)^2}{(\tilde{v}^2 + 4c)^2} > \underline{b}\frac{(\tilde{v}^2 - 4c)^2}{(\tilde{v}^2 + 4c)^2}, \tag{132}$$

which always holds as $\omega^e - \underline{b} > k_0 - \underline{b} > k_0 - b_0 > 0$.

Having found b_0, we then need to make sure that $b_0 > \underline{b}$ and $b_1 = b_0 + \tilde{v} < \omega$.

Lemma 4 ($b_0 > \underline{b}$)**.** *The threshold b_0 is greater than $\underline{b}$, if and only if either of the following conditions holds*

(1) for $\tilde{\omega}_0 > \omega > \underline{b}$

(2) for $\tilde{\omega}_0 < \underline{b}$.

[54]Once again, see the accompanying Mathematica file.

Proof. Consider first the case where $\tilde{\omega}_0 > \underline{b}$, which is ensured by $c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$. The cutoff $b_0 = \underline{b}$ if and only if $\omega = \tilde{\omega}_0$. To see his note that the threshold then becomes

$$b_0(\tilde{\omega}_0) = \frac{\tilde{v}^2(\tilde{\omega}_0 - \underline{b})}{8c} + \frac{1}{2}(\tilde{\omega}_0 + \underline{b} - \tilde{v}) - \frac{\tilde{v}^2(\tilde{\omega}_0 - \underline{b})}{8c}\frac{\tilde{v}^2 + 4\tilde{v}(k_0 - \underline{b}) - 4c}{\tilde{v}^2} \tag{133}$$

$$= \frac{1}{2}(\tilde{\omega}_0 + \underline{b} - \tilde{v}) - \frac{\tilde{v}^2(\omega - \underline{b})}{8c}\frac{4\tilde{v}(k_0 - \underline{b}) - 4c}{\tilde{v}^2} \tag{134}$$

$$= \tilde{\omega}_0 - \frac{1}{2}\tilde{v} - \frac{(\tilde{\omega}_0 - \underline{b})\,\tilde{v}\,(k_0 - \underline{b})}{2c} \tag{135}$$

$$= -\tilde{\omega}_0\left[\frac{\tilde{v}(k_0 - \underline{b}) - 2c}{2c}\right] + \frac{\underline{b}\tilde{v}\,(k_0 - \underline{b})}{2c} \tag{136}$$

$$= \underline{b} + \frac{1}{2}\tilde{v} - \frac{1}{2}\tilde{v} = \underline{b} \tag{137}$$

Noting that b_0 is decreasing in ω yields the result. Suppose now that $\tilde{\omega}_0 < \underline{b}$. This holds for $c < \frac{1}{2}\tilde{v}(k_0 - \underline{b})$. Then, $b_0(\omega) > \underline{b}$ for any $\omega > \underline{b}$.[55] □

Lemma 5 ($b_1 < \omega$)**.** *The threshold b_1 is smaller than ω, if and only if $\omega > \tilde{\omega}_1$.*

Proof. We set $b_1 = b_0 + \tilde{v} = \omega$. Then it must hold that

$$k_1 - \omega = \frac{c}{\tilde{v}^2(\omega - \underline{b})}(2\omega - 2\underline{b} - \tilde{v})(2\omega + \tilde{v} - 2\omega) \tag{138}$$

$$\Leftrightarrow \qquad k_1 - \omega = \frac{c}{\tilde{v}(\omega - \underline{b})}(2\omega - 2\underline{b} - \tilde{v}) \tag{139}$$

$$\Leftrightarrow \qquad (k_1 - \omega)(\omega - \underline{b}) = \frac{2c}{\tilde{v}}(\omega - \underline{b}) - c \tag{140}$$

Rewrite $\tilde{\omega}_1$ as

$$\tilde{\omega}_1 = -\frac{c}{\tilde{v}} + \frac{1}{2}(k_1 + \underline{b}) + \frac{1}{2\tilde{v}}\sqrt{4c^2 - 4c(k_0 - \underline{b})\tilde{v} + (k_1 - \underline{b})^2\tilde{v}^2} \tag{141}$$

$$= \frac{1}{2}\left[k_1 + \underline{b} - \frac{2c}{\tilde{v}} + \hat{K}\right], \tag{142}$$

where

$$\hat{K} = \frac{1}{\tilde{v}}\sqrt{4c^2 - 4c(k_0 - \underline{b})\tilde{v} + (k_1 - \underline{b})^2\tilde{v}^2}. \tag{143}$$

Plugging $\tilde{\omega}_1$ into (140) yields

$$-c + \frac{c}{\tilde{v}}\left[k_1 - \underline{b} - \frac{2c}{\tilde{v}} + \hat{K}\right] = -c + \frac{c}{\tilde{v}}\left[k_1 - \underline{b} - \frac{2c}{\tilde{v}} + \hat{K}\right], \tag{144}$$

which establishes that if $\omega = \tilde{\omega}_1$, then $b_1 = \omega$. Recall that $b_1 = b_0 + \tilde{v}$ and that b_0 is decreasing in ω. This establishes that for any $\omega > \tilde{\omega}_1$, b_1 is below ω. □

[55] See that accompanying Mathematica file.

As we have established that an admissible equilibrium is only feasible for $\omega > \underline{b} + \tilde{v}$, it is worth noting that $\tilde{\omega}_1 > \underline{b} + \tilde{v}$. Moreover, $\tilde{\omega}_1 > \omega^e$. Therefore, for an admissible equilibrium, it is sufficient to ensure that $\omega > \tilde{\omega}_1$.[56]

Our results so far establish that we need to distinguish between (1) $c < \frac{1}{2}\tilde{v}(k_0 - \underline{b})$ and (2) $c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$. For $c < \frac{1}{2}\tilde{v}(k_0 - \underline{b})$, there are only two equilibria possible:

(1) $b_0 \in (\underline{b}, \omega)$, $b_1 = \omega$: $\tilde{\omega} < \omega < \tilde{\omega}_1$

(2) $\underline{b} < b_0 < b_1 < \omega$: $\tilde{\omega}_1 < \omega$.

For $c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$, we also need to consider $\tilde{\omega}_0$. Note that for $\tilde{\omega}_0 > \underline{b}$, $\tilde{\omega}_1 < \tilde{\omega}_0$. In turn, $\tilde{\omega}_1 < \tilde{\omega}_0$ implies $\tilde{\omega}_0 > k_1 - \frac{c}{\tilde{v}}$.[57] Based on this, we can then summarise the different thresholds if $c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$

(1) $b_0 \in (\underline{b}, \omega)$, $b_1 = \omega$: $\underline{b} < \omega < \tilde{\omega}_1$

(2) $\underline{b} < b_0 < b_1 < \omega$: $\tilde{\omega}_1 < \omega < \tilde{\omega}_0$.

(3) $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$:$\tilde{\omega}_0 < \omega$.

Finally, for $\omega < \tilde{\omega}$, no informative equilibrium exists as none of the conditions required for the informative equilibria apply. However, as $\tilde{\omega} < \underline{b}$ for $c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$, an informative equilibrium always exists in this cost range. This concludes the proof.

Proof of Proposition 5: Probability of unionization $v = v_1$

We assume that the value of unionization is v_1, which the worker does not. From the workers perspective, the expected value of unionization is $\mathbb{E}_w[v|x]$. The probability of unionization conditioning on v_1 and taking into account the worker's expected value is then

$$\frac{\mathbb{E}[\mathbb{E}_w[v|x]|v_1] - d - \frac{1}{2}(\overline{b} - \underline{b}) - \underline{\delta}}{\overline{\delta} - \underline{\delta}}. \tag{145}$$

This probability is increasing in $\mathbb{E}[\mathbb{E}_w[v|x]|v_1]$ and therefore to find the highest unionization probability, it is sufficient to find the equilibrium that generates the highest $\mathbb{E}[\mathbb{E}_w[v|x]|v_1]$. This expectation can be expressed as follows:

$$\mathbb{E}[\mathbb{E}_w[v|x]|v_1] = \mathbb{E}[\mathbb{E}_w[\Delta v|x]|v_1] + v_0 \tag{146}$$

$$= \mathbb{E}_w[\Delta v|x = 0]P_w(x = 0|v_1) + \mathbb{E}_w[\Delta v|x = 1]P_w(x = 1|v_1) + v_0, \tag{147}$$

[56] See that accompanying Mathematica file.

[57] See that accompanying Mathematica file.

where

$$\mathbb{E}_w[\Delta v|x] = P_w\left(v = v_1|x\right)(v_1 - v_0) \tag{148}$$

$$= \frac{P_w\left(x|v_1\right)}{P_w\left(x|v_0\right) + P_w\left(x|v_1\right)}\left(v_1 - v_0\right). \tag{149}$$

The expected value simplifies to

$$\mathbb{E}[\mathbb{E}_w[\Delta v|x]|v_1] = (v_1 - v_0)\left[\frac{P_w\left(x=0|v_1\right)^2}{P_w\left(x=0|v_0\right) + P_w\left(x=0|v_1\right)} + \frac{P_w\left(x=1|v_1\right)^2}{P_w\left(x=1|v_0\right) + P_w\left(x=1|v_1\right)}\right] + v_0. \tag{150}$$

We then need to compare two expressions, namely (1) $P_w\left(x|v_0\right) + P_w\left(x|v_1\right) = 2$, the probability of becoming an organizer/not becoming an organizer times two and (2) $P_w\left(x|v_1\right)$, the probability of becoming an organizer, conditional on $v = v_1$.[58] We relate these probabilities across the different cost structures and maximal biases.

Moderate Costs In the moderate cost case, we compare the fully informative equilibrium with the corner equilibrium $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$.

Fully Informative Equilibrium In the fully informative equilibrium, the worker knows that if he observes an organizer, the organizer had signal one. A signal one can occur if either the true state of the world is high and the signal is correct or if the state is low and the signal is wrong.

$$P_w\left(x=1|v_1\right) = P_w\left(s=1|v_1\right) = p, \tag{151}$$

$$P_w\left(x=0|v_1\right) = P_w\left(s=0|v_1\right) = 1-p, \tag{152}$$

$$P_w\left(x=1\right) = P_w\left(x=0\right) = \left(p + (1-p)\right) = 1. \tag{153}$$

Then, the relevant expectations becomes

$$\mathbb{E}[\mathbb{E}_w[\Delta v|x]|v_1] = (v_1 - v_0)[p^2 + (1-p)^2] + v_0. \tag{154}$$

Corner $b_0 = \underline{b}$, $b_1 \in (\underline{b}, \omega)$ In this case, the worker knows that if he observes an organizer, the organizer had signal one. A signal one can occur if either the true state of the world is high and the signal is correct or if the state is low and the signal is wrong. However, if the worker does not observe an organizer, then this is either due to the worker having

[58]We can ignore prior probabilities as we fixed them at $\frac{1}{2}$.

signal zero or because he had a signal one, but his bias was too high.

$$P_w(x=1|v_1) = p\frac{b_1-\underline{b}}{\omega-\underline{b}}, \tag{155}$$

$$P_w(x=0|v_1) = p\frac{\omega-b_1}{\omega-\underline{b}}+1-p, \tag{156}$$

$$P_w(x=1) = p\frac{b_1-\underline{b}}{\omega-\underline{b}}+(1-p)\frac{b_1-\underline{b}}{\omega-\underline{b}} = \frac{b_1-\underline{b}}{\omega-\underline{b}}, \tag{157}$$

$$P_w(x=0) = p\frac{\omega-b_1}{\omega-\underline{b}}+1-p+p+(1-p)\frac{\omega-b_1}{\omega-\underline{b}} = 1+\frac{\omega-b_1}{\omega-\underline{b}}. \tag{158}$$

Then,

$$\frac{P_w(x=1|v_1)^2}{P_w(x=1|v_0)+P_w(x=1|v_1)} = \left(p\frac{b_1-\underline{b}}{\omega-\underline{b}}\right)^2\frac{\omega-\underline{b}}{b_1-\underline{b}} = p^2\frac{b_1-\underline{b}}{\omega-\underline{b}}, \tag{159}$$

$$\frac{P_w(x=0|v_1)^2}{P_w(x=0|v_0)+P_w(x=0|v_1)} = \frac{(\omega-pb_1-(1-p)\underline{b})^2}{(\omega-\underline{b})(2\omega-\underline{b}-b_1)}. \tag{160}$$

The relevant expectation in this corner case becomes

$$\mathbb{E}[\mathbb{E}_w[\Delta v|x]|v_1] = (v_1-v_0)\left[p^2\frac{b_1-\underline{b}}{\omega-\underline{b}}+\frac{(\omega-pb_1-(1-p)\underline{b})^2}{(\omega-\underline{b})(2\omega-\underline{b}-b_1)}\right]+v_0. \tag{161}$$

Comparison of Equilibria If $b_0=\underline{b}$ and b_1 is admissible, then

$$b_1 = \frac{k_1\tilde{v}(\omega-\underline{b})-c(2\omega-\underline{b})}{\tilde{v}(\omega-\underline{b})-c}. \tag{162}$$

The fully informative equilibrium then leads to a higher probability of unionization if and only if

$$p^2+(1-p)^2 > p^2\frac{b_1-\underline{b}}{\omega-\underline{b}}+\frac{(\omega-pb_1-(1-p)\underline{b})^2}{(\omega-\underline{b})(2\omega-\underline{b}-b_1)} \tag{163}$$

Plugging in b_1 into the RHS of (163) yields

$$p^2\frac{\tilde{v}(k_1-\underline{b})-2c}{\tilde{v}(\omega-\underline{b})-c}+\frac{(c(2p-1)+\tilde{v}(\omega-pk_1-(1-p)\underline{b}))^2}{\tilde{v}(\tilde{v}(\omega-\underline{b})-c)(2\omega-k_1-\underline{b})} \tag{164}$$

For $\omega = k_1-\frac{c}{\tilde{v}}$, the threshold at which the equilibria switch, expression (164) becomes

$$p^2\frac{\tilde{v}(k_1-\underline{b})-2c}{\tilde{v}(k_1-\underline{b})-2c}+\frac{(1-p)^2(\tilde{v}(k_1-\underline{b})-2c)^2}{(\tilde{v}(k_1-\underline{b})-2c)^2} = p^2+(1-p)^2. \tag{165}$$

Moreover, (164) is decreasing in ω:

$$\frac{\partial\left(p^2\frac{\tilde{v}(k_1-\underline{b})-2c}{\tilde{v}(\omega-\underline{b})-c}+\frac{(c(2p-1)+\tilde{v}(\omega-pk_1-(1-p)\underline{b}))^2}{\tilde{v}(\tilde{v}(\omega-\underline{b})-c)(2\omega-k_1-\underline{b})}\right)}{\partial\omega}=-\frac{(2p-1)^2[\tilde{v}(k_1-\underline{b})-2c]}{\tilde{v}(2\omega-\underline{b}-k_1)^2}<0 \tag{166}$$

due to the conditions on costs. This establishes that the fully informative equilibrium leads to a higher probability of unionization. Therefore, if the value of unionization is positive, then choosing a maximal bias below $\hat{\omega}$ is optimal for successful unionization. Any ω that induces the fully informative equilibrium yields the same unionization probability.

Low Costs We begin with a probability comparison of the corner $b_0 \in (\underline{b}, \omega), b_1 = \omega$ and the admissible equilibrium, before turning to the corner $b_0\underline{b}, b_1 \in (\underline{b}, \omega)$.

Corner $b_0 \in (\underline{b}, \omega),\ b_1 = \omega$ The different probabilities are given by

$$P_w(x=1|v_1) = p + (1-p)\frac{b_0-\underline{b}}{\omega-\underline{b}}, \tag{167}$$

$$P_w(x=0|v_1) = (1-p)\frac{\omega-b_0}{\omega-\underline{b}}, \tag{168}$$

$$P_w(x=1) = p + (1-p)\frac{b_0-\underline{b}}{\omega-\underline{b}} + (1-p) + p\frac{b_0-\underline{b}}{\omega-\underline{b}} = 1 + \frac{b_0-\underline{b}}{\omega-\underline{b}}, \tag{169}$$

$$P_w(x=0) = (1-p)\frac{\omega-b_0}{\omega-\underline{b}} + p\frac{\omega-b_0}{\omega-\underline{b}} = \frac{\omega-b_0}{\omega-\underline{b}}. \tag{170}$$

Then,

$$\frac{P_w(x=1|v_1)^2}{P_w(x=1|v_0)+P_w(x=1|v_1)} = \frac{(p\omega+(1-p)b_0-\underline{b})^2}{(\omega-\underline{b})(\omega+b_0-2\underline{b})}, \tag{171}$$

$$\frac{P_w(x=0|v_1)^2}{P_w(x=0|v_0)+P_w(x=0|v_1)} = (1-p)^2\frac{\omega-b_0}{\omega-\underline{b}}. \tag{172}$$

Admissible Equilibrium $b_0, b_1 \in (\underline{b}, \omega)$ The different probabilities are given by

$$P_w(x=1|v_1) = p\frac{b_1-\underline{b}}{\omega-\underline{b}} + (1-p)\frac{b_0-\underline{b}}{\omega-\underline{b}} \tag{173}$$

$$P_w(x=0|v_1) = p\frac{\omega-b_1}{\omega-\underline{b}} + (1-p)\frac{\omega-b_0}{\omega-\underline{b}} \tag{174}$$

$$P_w(x=1) = p\frac{b_1-\underline{b}}{\omega-\underline{b}} + (1-p)\frac{b_0-\underline{b}}{\omega-\underline{b}} + (1-p)\frac{b_1-\underline{b}}{\omega-\underline{b}} + p\frac{b_0-\underline{b}}{\omega-\underline{b}} = \frac{b_1+b_0-2\underline{b}}{\omega-\underline{b}} \tag{175}$$

$$P_w(x=0) = p\frac{\omega-b_1}{\omega-\underline{b}} + (1-p)\frac{\omega-b_0}{\omega-\underline{b}} + (1-p)\frac{\omega-b_1}{\omega-\underline{b}} + p\frac{\omega-b_0}{\omega-\underline{b}} = \frac{2\omega-b_1-b_0}{\omega-\underline{b}} \tag{176}$$

It follows that

$$\frac{P_w\left(x=1|v_1\right)^2}{P_w\left(x=1|v_0\right)+P_w\left(x=1|v_1\right)}=\frac{(pb_1+(1-p)b_0-\underline{b})^2}{(\omega-\underline{b})(b_1+b_0-2\underline{b})} \tag{177}$$

$$\frac{P_w\left(x=0|v_1\right)^2}{P_w\left(x=0|v_0\right)+P_w\left(x=0|v_1\right)}=\frac{(\omega-(1-p)b_0-pb_1)^2}{(\omega-\underline{b})(2\omega-b_0-b_1)} \tag{178}$$

Comparison Corner $b_0 \in (\underline{b}, \omega)$, $b_1 = \omega$ and Admissible Equilibrium The corner equilibrium, where every contact with signal one becomes an organizer, leads to a higher probability of unionization if and only if

$$\frac{(p\omega+(1-p)b_0-\underline{b})^2}{(\omega-\underline{b})(\omega+b_0-2\underline{b})}+(1-p)^2\frac{\omega-b_0}{\omega-\underline{b}}>\frac{(pb_1+(1-p)b_0-\underline{b})^2}{(\omega-\underline{b})(b_1+b_0-2\underline{b})}+\frac{(\omega-(1-p)b_0-pb_1)^2}{(\omega-\underline{b})(2\omega-b_0-b_1)} \tag{179}$$

Note that the corner equilibrium with $b_1 = \omega$ and the admissible equilibrium lead to the same probability of unionization at $\tilde{\omega}_1$. To see this note that, by definition, $b_1^A = \omega = \tilde{\omega}_1$, where the superscript denotes the admissible equilibrium. Then, $b_0^A = b_0^{C\omega}$, with $C\omega$ denoting the corner ω equilibrium, as

$$b_0^{C\omega}=\frac{k_0\tilde{v}(\omega-\underline{b})-c(\omega-2\underline{b})}{\tilde{v}(\omega-\underline{b})+c}, \tag{180}$$

$$b_0^A=\omega-\tilde{v}. \tag{181}$$

It then holds that

$$b_0^{C\omega}=b_0^A \quad \Leftrightarrow \quad (\tilde{\omega}_1-\tilde{v})(\tilde{v}(\tilde{\omega}_1-\underline{b})+c)=k_0\tilde{v}(\tilde{\omega}_1-\underline{b})-c(\tilde{\omega}_1-2\underline{b}), \tag{182}$$

see the accompanying Mathematica File. We can then simplify expression (179) and we obtain

$$\frac{(p\tilde{\omega}_1+(1-p)b_0-\underline{b})^2}{(\tilde{\omega}_1-\underline{b})(\tilde{\omega}_1+b_0-2\underline{b})}+(1-p)^2\frac{\tilde{\omega}_1-b_0}{\tilde{\omega}_1-\underline{b}}=\frac{(p\tilde{\omega}_1+(1-p)b_0-\underline{b})^2}{(\tilde{\omega}_1-\underline{b})(\tilde{\omega}_1+b_0-2\underline{b})}+\frac{(\tilde{\omega}_1-(1-p)b_0-p\tilde{\omega}_1)^2}{(\tilde{\omega}_1-\underline{b})(2\tilde{\omega}_1-b_0-b_1)} \tag{183}$$

$$\Leftrightarrow \quad (1-p)^2\frac{\tilde{\omega}_1-b_0}{\tilde{\omega}_1-\underline{b}}=\frac{(\tilde{\omega}_1-(1-p)b_0-p\tilde{\omega}_1)^2}{(\tilde{\omega}_1-\underline{b})(\tilde{\omega}_1-b_0)} \tag{184}$$

$$\Leftrightarrow \quad (1-p)^2\frac{\tilde{\omega}_1-b_0}{\tilde{\omega}_1-\underline{b}}=(1-p)^2\frac{(\tilde{\omega}_1-b_0)^2}{(\tilde{\omega}_1-\underline{b})(\tilde{\omega}_1-b_0)}, \tag{185}$$

establishing that at $\tilde{\omega}_1$ the unionization probability is the same across the admissible equilibrium and the corner solution with $b_1 = \omega$. Further, the probability of unionization for the corner solution is increasing in ω. To see this, we plug $b_0^{C\omega}$ into the LHS of (179) and take the derivative with respect to ω. This derivative is given by

$$\frac{(2p-1)^2(\tilde{v}(k_0-\underline{b})-c)}{\tilde{v}(\omega+k_0-2\underline{b})^2} > 0, \tag{186}$$

as we are in the low cost case with $\tilde{v}(k_0-\underline{b}) > c$. This establishes that the unionization probability is increasing in ω as long as we are in the Corner $b_1 = \omega$ equilibrium.
We then turn to the unionization probability in the admissible case. Taking into account that $b_1 = b_0 + \tilde{v}$ yields

$$\mathbb{E}[\mathbb{E}_w[\Delta v|x]|v_1] = (v_1 - v_0)\left(\frac{(p(b_0+\tilde{v})+(1-p)b_0-\underline{b})^2}{(\omega-\underline{b})(b_0+\tilde{v}+b_0-2\underline{b})} + \frac{(\omega-(1-p)b_0-p(b_0+\tilde{v}))^2}{(\omega-\underline{b})(2\omega-b_0-b_0-\tilde{v})}\right) + v_0 \tag{187}$$

$$\equiv h(b_0(w), \omega \tag{188}$$

Define F as

$$F(b_0,\omega) = (v_1 - v_0)\left(\frac{(p(b_0+\tilde{v})+(1-p)b_0-\underline{b})^2}{(\omega-\underline{b})(b_0+\tilde{v}+b_0-2\underline{b})} + \frac{(\omega-(1-p)b_0-p(b_0+\tilde{v}))^2}{(\omega-\underline{b})(2\omega-b_0-b_0-\tilde{v})}\right) + v_0 - h = 0. \tag{189}$$

Applying the implicit function theorem yields

$$\frac{\partial F(b_0,\omega)}{\partial \omega} = -\frac{\partial F(b_0,\omega)}{\partial b_0}\frac{\partial b_0}{\partial \omega} \tag{190}$$

Lemma 3 establishes that $\frac{\partial b_0}{\partial \omega} < 0$. Taking the derivative with respect to b_0 yields

$$\frac{\partial F(b_0,\omega)}{\partial b_0} = -\frac{\tilde{v}^3(2p-1)}{(2b_0+\tilde{v}-2\underline{b})(2\omega-2b_0-\tilde{v})^2} < 0. \tag{191}$$

It follows that $\frac{\partial F(b_0,\omega)}{\partial \omega} < 0$.

Therefore, the probability of unionization is maximal at $\omega = \tilde{\omega}_1$ for $c < \frac{1}{2}\tilde{v}(k_0-\underline{b})$. For $c > \frac{1}{2}\tilde{v}(k_0-\underline{b})$, we still need to take into account the corner equilibrium with $b_0 = \underline{b}$. It holds again that at $\tilde{\omega}_0$, the admissible unionization probability equals the corner $b_0 = \underline{b}$. By definition, in both types of equilibria $b_0 = \underline{b}$. Then, the weighted sum of unionization probabilities in the admissible case is as follows:

$$\frac{(p\tilde{v})^2}{(\omega-\underline{b})\tilde{v}} + \frac{(\omega-\underline{b}-p\tilde{v})^2}{(\omega-\underline{b})(2\omega-2\underline{b}-\tilde{v})} \tag{192}$$

For the corner $b_0 = \underline{b}$ equilibrium, the relevant expression taking into account b_1 is

$$p^2 \frac{\tilde{v}(k_1 - \underline{b}) - 2c}{\tilde{v}(\omega - \underline{b}) - c} + \frac{(c(2p-1) + \tilde{v}(\omega - pk_1 - (1-p)\underline{b}))^2}{\tilde{v}(\tilde{v}(\omega - \underline{b}) - c)(2\omega - k_1 - \underline{b})}, \tag{193}$$

see also the Moderate Cost case, expression (164). Plugging in $\tilde{\omega}_0$, and setting the expressions equal yields the result.[59] We have already established that the unionization probability in the corner $b_=\underline{b}$ equilibrium is decreasing in ω. Therefore, also for $c > \frac{1}{2}\tilde{v}(k_0 - \underline{b})$, the unionization probability is maximal at $\tilde{\omega}_1$.

We have established that in the low cost case, the optimal ω, the maximal bias that maximises the unionization probability equals $\tilde{\omega}_1$, conditional on the true value of unionization being positive.

Proof of Corollary 5.1: Comparison unionization Probability Moderate vs Low Costs

We compare here the unionization probability for the fully informative equilibrium with the maximal unionization probability in the low cost case. The unionization probability in the fully informative equilibrium depends on

$$p^2 + (1-p)^2, \tag{194}$$

which we need to compare to the equivalent probabilities in the $b_1 = \omega$ equilibrium, given by

$$\frac{(p\tilde{\omega}_1 + (1-p)b_0 - \underline{b})^2}{(\tilde{\omega}_1 - \underline{b})(\tilde{\omega}_1 + b_0 - 2\underline{b})} + (1-p)^2 \frac{\tilde{\omega}_1 - b_0}{\tilde{\omega}_1 - \underline{b}} \tag{195}$$

$$= \frac{(p\tilde{\omega}_1 + (1-p)(\tilde{\omega}_1 - \tilde{v}) - \underline{b})^2}{(\tilde{\omega}_1 - \underline{b})(\tilde{\omega}_1 + (\tilde{\omega}_1 - \tilde{v}) - 2\underline{b})} + (1-p)^2 \frac{\tilde{\omega}_1 - (\tilde{\omega}_1 - \tilde{v})}{\tilde{\omega}_1 - \underline{b}} \tag{196}$$

$$= \frac{(\tilde{\omega}_1 - (1-p)\tilde{v} - \underline{b})^2}{(\tilde{\omega}_1 - \underline{b})(2\tilde{\omega}_1 - \tilde{v} - 2\underline{b})} + (1-p)^2 \frac{\tilde{v}}{\tilde{\omega}_1 - \underline{b}}. \tag{197}$$

It holds that

$$p^2 + (1-p)^2 > \frac{(\tilde{\omega}_1 - (1-p)\tilde{v} - \underline{b})^2}{(\tilde{\omega}_1 - \underline{b})(2\tilde{\omega}_1 - \tilde{v} - 2\underline{b})} + (1-p)^2 \frac{\tilde{v}}{\tilde{\omega}_1 - \underline{b}}, \tag{198}$$

see the accompanying Mathematica File.

[59] See the accompanying Mathematica file.

Proof of Proposition 6: Comparative Statics Cost Thresholds

We consider how the cost thresholds $\tilde{v}(k_0 - \underline{b})$ and $\frac{1}{2}\tilde{v}(k_1 - \underline{b})$ respond to changes in the parameters d, $\mathbb{E}[\delta]$, $\underline{b}$ as well as v_0, v_1, and p. As the sign of the derivative of $\frac{1}{2}\tilde{v}(k_1 - \underline{b})$ equals the the sign of the derivative of $\tilde{v}(k_1 - \underline{b})$, we omit the $\frac{1}{2}$ in what follows. The parameters d and $\mathbb{E}[\delta]$ only affect k_s with

$$\frac{\partial \tilde{v}(k_s - \underline{b})}{\partial d} = \frac{\partial \tilde{v}(k_s - \underline{b})}{\partial \mathbb{E}[\delta]} = \tilde{v}\frac{\partial k_s}{\partial d} = -\tilde{v}. \tag{199}$$

Therefore both thresholds are decreasing in d and $\mathbb{E}[\delta]$. Similarly, the change in the thresholds in response to an increase in $\underline{b}$ is given by

$$\frac{\partial \tilde{v}(k_s - \underline{b})}{\partial \underline{b}} = -\tilde{v}. \tag{200}$$

A change in v_0, v_1, and p does not only affect k_s, but also $\tilde{v}$. Moreover, the effect is different for the two thresholds.

Moderate Cost Threshold We begin with the effect of v_1 on $\tilde{v}(k_1 - \underline{b})$,

$$\frac{\partial \tilde{v}(k_1 - \underline{b})}{\partial v_1} = \frac{\partial \tilde{v}}{\partial v_1}(k_1 - \underline{b}) + \tilde{v}\frac{\partial k_1}{\partial v_1} = (2p-1)(k_1 - \underline{b}) + \tilde{v}p > 0, \tag{201}$$

which establishes that the threshold increases in v_1. In contrast, the effect of v_0 is ambiguous,

$$\frac{\partial \tilde{v}(k_1 - \underline{b})}{\partial v_0} = \frac{\partial \tilde{v}}{\partial v_0}(k_1 - \underline{b}) + \tilde{v}\frac{\partial k_1}{\partial v_0} = -(2p-1)(k_1 - \underline{b}) + \tilde{v}(1-p) \gtrless 0. \tag{202}$$

Note that the threshold is concave in v_0

$$\frac{\partial^2 \tilde{v}(k_1 - \underline{b})}{\partial v_0^2} = -(2p-1)(1-p) < 0, \tag{203}$$

meaning that for small v_0 the first derivative is increasing, while for those close to zero, it can be decreasing. Finally, we turn to the effect of p,

$$\frac{\partial \tilde{v}(k_1 - \underline{b})}{\partial p} = 2(v_1 - v_0)(k_1 - \underline{b}) + \tilde{v}(v_1 - v_0) > 0, \tag{204}$$

which is also positive.

Low Cost Threshold We turn to the effect of v_1 on $\tilde{v}(k_0 - \underline{b})$,

$$\frac{\partial \tilde{v}(k_0 - \underline{b})}{\partial v_1} = \frac{\partial \tilde{v}}{\partial v_1}(k_0 - \underline{b}) + \tilde{v}\frac{\partial k_0}{\partial v_1} = (2p-1)(k_0 - \underline{b}) + \tilde{v}(1-p) > 0, \tag{205}$$

which establishes that the threshold increases in v_1. Similarly, an increase in v_0 has a positive effect on the low cost threshold

$$\frac{\partial \tilde{v}(k_0 - \underline{b})}{\partial v_0} = \frac{\partial \tilde{v}}{\partial v_0}(k_0 - \underline{b}) + \tilde{v}\frac{\partial k_0}{\partial v_0} = -(2p-1)(k_0 - \underline{b}) + \tilde{v}p > -(2p-1)\tilde{v} + \tilde{v}p = (1-p)\tilde{v} > 0, \tag{206}$$

where the first inequality follows from Assumption 2. Finally, we turn to the effect of p,

$$\frac{\partial \tilde{v}(k_0 - \underline{b})}{\partial p} = 2(v_1 - v_0)(k_0 - \underline{b}) - \tilde{v}(v_1 - v_0) \gtrless 0, \tag{207}$$

which is ambiguous. If $\tilde{v} > 2(k_0 - \underline{b})$, then the derivative is negative, otherwise it is positive.

Proof of Proposition 7: Comparative Statics Moderate Costs

Comparative Statics Expected Value The expected value of unionization for the worker, conditional on $v = v_1$ is

$$(v_1 - v_0)(p^2 + (1-p)^2) + v_0. \tag{208}$$

Taking the derivative with respect to the three parameters yields

$$\frac{\partial((v_1 - v_0)(p^2 + (1-p)^2) + v_0)}{\partial v_1} = (p^2 + (1-p)^2) > 0, \tag{209}$$

$$\frac{\partial((v_1 - v_0)(p^2 + (1-p)^2) + v_0)}{\partial v_0} = 2p(1-p) > 0, \tag{210}$$

$$\frac{\partial((v_1 - v_0)(p^2 + (1-p)^2) + v_0)}{\partial p} = 2\tilde{v} > 0. \tag{211}$$

Comparative Statics Threshold The threshold $\hat{\omega}$ is defined as $k_1 - \frac{c}{\tilde{v}}$. The derivatives with respect to its parameters is given by

$$\frac{\partial \hat{\omega}}{\partial c} = -\frac{1}{\tilde{v}} < 0, \tag{212}$$

$$\frac{\partial \hat{\omega}}{\partial v_0} = (1-p) - \frac{c}{\tilde{v}(v_1 - v_0)} \gtrless 0, \tag{213}$$

$$\frac{\partial \hat{\omega}}{\partial v_1} = p + \frac{c}{(2p-1)(v_1 - v_0)^2} > 0, \tag{214}$$

$$\frac{\partial \hat{\omega}}{\partial p} = (v_1 - v_0) + \frac{2c}{(2p-1)^2(v_1 - v_0)} > 0. \tag{215}$$

Proof of Proposition 8: Comparative Statics Low Costs

The relevant expected value at $\tilde{\omega}_1$ equals

$$(v_1 - v_0)\left(\frac{(p\tilde{\omega}_1 + (1-p)(\tilde{\omega}_1 - \tilde{v}) - \underline{b})^2}{(\tilde{\omega}_1 - \underline{b})(\tilde{\omega}_1 + (\tilde{\omega}_1 - \tilde{v}) - 2\underline{b})} + (1-p)^2 \frac{\tilde{\omega}_1 - (\tilde{\omega}_1 - \tilde{v})}{\tilde{\omega}_1 - \underline{b}}\right) + v_0 \tag{216}$$

$$= (v_1 - v_0)\left(\frac{(\tilde{\omega}_1 - (1-p)\tilde{v} - \underline{b})^2}{(\tilde{\omega}_1 - \underline{b})(2\tilde{\omega}_1 - \tilde{v} - 2\underline{b})} + (1-p)^2 \frac{\tilde{v}}{\tilde{\omega}_1 - \underline{b}}\right) + v_0 \tag{217}$$

We first consider how $\tilde{\omega}_1$ changes as the different parameters increase,

$$\frac{\partial \tilde{\omega}_1}{\partial v_1} > 0, \quad \frac{\partial \tilde{\omega}_1}{\partial v_0} \gtrless 0, \quad \frac{\partial \tilde{\omega}_1}{\partial p} > 0, \quad \frac{\partial \tilde{\omega}_1}{\partial \underline{b}} > 0, \quad \frac{\partial \tilde{\omega}_1}{\partial d} = \frac{\partial \tilde{\omega}_1}{\partial \mathbb{E}[\delta]} < 0, \tag{218}$$

see the accompanying Mathematica file. We then turn to the change in the expected value in $\tilde{\omega}_1$:

$$\frac{\partial \mathbb{E}[\mathbb{E}_w[\Delta v | x, \omega, c] | v_1]}{\partial \tilde{\omega}_1} < 0 \tag{219}$$

By the implicit function theorem, the sign of the derivative of $\mathbb{E}[\mathbb{E}_w[\Delta v|x, \omega, c]|v_1]$ with respect to any parameter is then given by

$$-sign\left(\frac{\partial \tilde{\omega}_1}{\partial y} \frac{\partial \mathbb{E}[\mathbb{E}_w[\Delta v | x, \omega, c] | v_1]}{\partial \tilde{\omega}_1}\right), \tag{220}$$

where y denotes the parameter of interest. Given that the derivative of the expectation is negative, the sign of the derivative equals the sign of $\frac{\partial \tilde{\omega}_1}{\partial y}$, as specified above. This means that the optimal ω moves in the same direction as the probability of unionization.

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