# Labor Unions and Social Insurance*

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**Abstract**

We study the labor market impacts of unions by accounting for their effects on employers' insurance provisions, and explore the implications for the design of social insurance programs. We first provide descriptive evidence that social insurance expansions may crowd out unionization in the United States. We then develop and estimate an equilibrium labor search model where unionization, wages, insurance provisions, and job security are endogenously determined. We demonstrate that unionization, along with the threat of unionization, increases employer-sponsored insurance provisions in both unionized and nonunionized firms. We find that social insurance expansions can affect inequality through (de)unionization, and inequality may increase or decrease depending on how social insurance is targeted. Social insurance expansions, along with technological changes, contribute to the long-term decline of unions in the U.S. Despite their role in deunionization, social insurance expansions enhance welfare by mitigating the loss of employer-provided benefits resulting from union declines induced by technological change. Subsidizing unions raises low-skilled workers' welfare, but the welfare gain from increased unionization is smaller in the presence of more generous social insurance.

**Keywords:** Labor unions; Social insurance; Employer-provided insurance; Technological change

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# 1 Introduction

Labor unions in the United States have steadily declined over the past few decades. In 1955, about 36% of the private sector workers were unionized; today, it is less than 10%. This trend has sparked increased interest in unions' roles in the labor market and potential policy interventions. Although unions' impacts on wages and wage inequality, as well as their effects on firms' labor demand and production, have received the most attention, unions also influence workers by increasing employers' provisions of insurance benefits and job security (Freeman and Medoff, 1984). Indeed, unions' insurance effect is raised as one of the primary reasons to promote unions and collective bargaining in the recent Executive Order on April 26, 2021 (E.O. 14025) by the Biden administration.

However, the insurance role of unions is deeply intertwined with the design of social insurance systems. On the one hand, generous social insurance systems (e.g., generous unemployment insurance or strict employment protection) can offset the loss of various employer-provided insurance benefits due to union decline; on the other hand, the expansions of social insurance programs might diminish the perceived value of unions, potentially exacerbating labor market inequality. If union-provided insurance benefits are a primary reason workers join unions, the availability of affordable insurance options outside unions, through the government or other sources, can reduce the attractiveness of union membership. Consequently, expansions of social insurance can reduce the unionization rate and affect labor market equilibrium.[1] This channel is particularly relevant in the U.S., where, unlike in many European countries, employers determine access to many essential insurance benefits, and union formation is decided at the employer level. Thus, understanding the equilibrium labor market and welfare impacts of labor unions requires a detailed examination of the mechanisms through which unions interact with social insurance systems.

In this paper, we present a framework to study labor unions that accounts for unions' roles in wage compression and insurance provisions, and use it to explore several key questions regarding the aggregate impact of labor unions and their interactions with social insurance. First, we examine the mechanisms underlying unions' influence on insurance provisions, shedding light on the complex interplay between unionization, social insurance provision, employer-provided insurance benefits, and other labor market outcomes. Second, we quantitatively assess the effects of various social insurance policies, emphasizing their impacts

[1] The connection between social insurance and the labor movement is well known. Otto von Bismarck, the German Chancellor in the late 19th century, tried to undermine socialist organizations and trade unions. In 1889, he introduced the world's first old age social insurance program to "promote the well-being of workers, and to stave off calls for more radical socialist alternatives." See US Social Security Administration.

on labor unions. Lastly, we investigate the welfare and labor market implications of labor unions, highlighting their interaction with the design of social insurance programs.

To motivate our focus on the interaction between labor unions and social insurance, we first empirically document the impacts of social insurance on labor unions by exploiting the variations across time and space in various social insurance programs. We utilize several micro-level datasets, including household-level data such as the Current Population Survey (CPS), the Health and Retirement Study (HRS), the Survey of Income and Program Participation (SIPP), as well as establishment-level data from the Robert Wood Johnson Foundation Employer Health Insurance Survey, and the datasets on long-run trends in union density and elections. To begin with, we document that unionized firms tend to be larger and more likely to provide employer-sponsored health insurance (ESHI) and job security, consistent with the findings in Freeman and Medoff (1984). Then, by exploiting the introduction of Medicare and Medicaid in the 1960s, we find that both public health insurance programs lowered the unionization rates and the number of union elections. Moreover, we also find that expansions of social insurance programs in recent years further lowered the unionization rates by exploiting the variations across states and time in the Medicaid expansion under the Affordable Care Act (ACA) and the generosity of the state unemployment insurance (UI) benefits.

We then develop a model of labor unions, building upon the standard search and matching model (Diamond-Mortensen-Pissarides model, Pissarides, 2000), which inherently yields firms' monopsony power in the labor market, thereby creating a potential role for unions as a countervailing force. A novel feature of our model is that it *jointly* incorporates the following two ingredients. First, following Taschereau-Dumouchel (2020), we incorporate endogenous firm size and union formation where unionization at each firm is endogenously determined to reflect their employees' endogenous "preferences" for unionization. In unionized firms, wages are *collectively* bargained, whereas non-unionized firms engage in *individual* bargaining with each employee. Second, non-wage benefits and job security are endogenously determined in the model. Firms endogenously decide the provision of non-wage benefits to attract workers, in line with the models in Hwang et al. (1998) and Aizawa and Fang (2020). We demonstrate that unions increase the provisions of non-wage benefits through more efficient sharing of the costs of non-wage benefits, including the fixed costs, between the workers and the firm. In addition, while unions may enhance job security by reducing job destruction, this retention may lead to profit losses for the firms as less profitable matches are inefficiently retained.

Our model generates rich equilibrium predictions where employers' provision of non-wage benefits, firms' unionization status, firm sizes, the skill composition of their workforce, and wage inequality are all endogenously determined. By incorporating the provision of non-wage benefits, our model captures the dual roles of unions in wage compression and insurance provisions. This framework enables us to analyze the impact of social insurance policies and quantify how technological changes and union policies may affect workers' access to insurance.

We quantitatively extend our model and estimate it with micro-level data on individual union status, labor market outcomes, demographics, and non-wage benefits. Motivated by our empirical evidence and the fact that health care consists of a sizable part of the U.S. economy (Hall and Jones, 2007), we consider health insurance as the main non-wage benefit in our empirical specification and model various health insurance programs. The estimated model successfully accounts for the relationship among unionization status, insurance provisions, skill premiums, and firm sizes.

Importantly, our estimates indicate that the threat of union formation significantly increases employers' insurance provisions, even among nonunionized firms. In our model, union formation is influenced by the endogenous preferences of workers for unionization. Low-skilled workers tend to favor unionization, which leads nonunionized firms to curtail the number of low-skilled workers in their workforce to economize on the union threat cost. This insight is revealed through a counterfactual experiment in which union threat costs are removed–that is, firms are not constrained by workers' preferences regarding unionization–and nonunionized firms increase their hiring of low-skilled workers. Interestingly, this shift in the workforce composition toward low-skilled workers results in a substantial decline in the insurance offerings of nonunionized firms. The reason is as follows: Nonunionized workers and firms engage in individual bargaining, where the firm splits surplus with each individual worker separately; individual bargaining makes it difficult to share insurance costs efficiently among heterogeneous workers, thus lowering the insurance offering in nonunionized firms as they hire more low-skilled workers in the counterfactual.

Using the estimated model, we analyze how government-provided social insurance policies (e.g., public health insurance provisions) affect labor unions and labor market outcomes. Government-provided social insurance may lower the value of unions by reducing worker's incentives to take jobs to gain insurance access. Importantly, if social insurance expansion lowers the unionization rate, it can also impact wage inequality in equilibrium. For example, we find that if the existing ESHI system is replaced by a tax-funded universal health insurance system, the union membership density will drop by 3.4 percentage points (p.p.); moreover, the decline in unions is associated with, on average, a 1.5% lower wages and an increase in the wage inequality between high- and low-skilled workers by 3.4 log points.

Interestingly, the impact of social insurance policies on the labor market outcomes depends on their targeting strategy. We find that if government-provided health insurance is expanded to low-skilled unemployed workers only, equivalent to a significant expansion of Medicaid, the unionization rate will decrease by 1.8 p.p., but the average wage will rise by 0.6%, and the wage inequality will decline by 2.2 log points; however, the decline in unionization rate also reduces the insurance coverage for high-skilled workers.

Other forms of social insurance policies, such as subsidizing or mandating employers' provisions of insurance benefits and job security, also have significant implications for unionization and the labor market. We find that subsidies for providing non-wage benefits, such as tax exemption status for ESHI premiums, lead to a decrease in the unionization rate.[2] This occurs as nonunionized firms increase their insurance provisions while unionized firms lose their competitive edge in attracting workers through insurance coverage. In particular, the policy change increases wage inequality through the decline in unions. Thus, the tax treatment of ESHI health insurance becomes an additional source of wage inequality due to its negative influence on the unionization rate.

Given our findings that the expansion of social insurance programs lowers unionization, we also examine how much this channel helps us account for the long-run decline in labor unions in the U.S. The decline in labor unions in the U.S. is unique in that it started in the mid-1950s. The existing explanations of union decline in the U.S. tend to focus on skill-biased technological changes (Acemoglu et al., 2001), which shift labor demand away from low-skilled workers who tend to favor unionization, and the implementation of right-to-work (RTW) laws (Farber, 2005), which makes union less sustainable by making it optional for workers to pay union dues. We extend our model to incorporate these factors as well as the expansion of various social insurance programs, and re-estimate our model to fit the key statistics of the U.S. economy in the 1950s. Through simulations, we find that technological change and the implementation of RTW laws account for about 32% and 7% of the observed union decline between 1955 and 2019, respectively; interestingly, we also find that social insurance expansions through the provisions and expansions of multiple health insurance programs contributed to about 15% of the overall decline in that time period.

Then, we move on to analyze the welfare impact of labor unions. We begin by examining the welfare implications of declining labor unions due to skill-biased technological changes, emphasizing the interplay between union strength and social insurance programs. Techno-

[2]Coincidentally, the year 1954 when the U.S. Congress enacted legislation that exempted employer-sponsored health insurance from federal income taxation was the year with the highest union density, at almost 36%, among American workers.

logical changes increase workers' exposure to job displacement while simultaneously reducing access to health insurance as union coverage declines. However, these adverse effects can be mitigated by more generous unemployment insurance (UI) and public health insurance programs. Our analysis shows that such programs alleviate the welfare losses experienced by less skilled workers as the unions weaken. Furthermore, we find that overall welfare under skill-biased technological change is higher in economies with more generous social insurance systems, underscoring the importance of these programs in moderating the effects of union decline.

Finally, we assess the welfare impact of subsidizing unionization. From a utilitarian government perspective, it slightly increases the overall worker welfare while it reduces the total social welfare once taking into account the firms' profits and the cost of subsidies. Interestingly, the worker's welfare gain tends to be smaller with more generous social insurance programs because the union's insurance role is much more limited when social insurance is more generous.

Because union formation and social insurance systems vary substantially across countries, our findings are specific to the U.S. economy. Nevertheless, a broader lesson from our analysis is that unions play dual roles–wage compression and insurance provision–shaping both wage inequality and access to insurance. This underscores the importance of jointly examining labor unions and the design of social insurance programs to fully understand their welfare implications. We conclude by outlining several potential avenues for future research to further explore these interactions and their broader impacts on labor market institutions and social welfare.

**Related Literature.** This paper contributes to several strands of literature. First, it is related to the literature on unions and labor markets. Our study is most related to a growing number of macro-labor studies that assess the impact of unions on labor market equilibrium.[3] For instance, Acemoglu et al. (2001) develop a model of how unions affect redistribution, wage insurance, and investment, arguing that (skill-biased) technological changes determine the size of labor unions. Recent studies also evaluate the macroeconomic impacts of unions (e.g., Açıkgöz and Kaymak, 2014, Dinlersoz and Greenwood, 2016, Krusell and Rudanko, 2016, Taschereau-Dumouchel, 2020, Alder et al., 2023, and Pickens, 2023). However, none of the studies examine the effect of unions on non-wage benefits. We contribute to this liter-

[3]There are a large number of empirical studies estimating the effect of unions on wages and wage inequality (e.g., DiNardo et al., 1996, DiNardo and Lee, 2004 and Farber et al., 2021). A small number of empirical studies examine unions' effects on non-wage benefits (e.g., Freeman and Medoff, 1984, Buchmueller et al., 2002, Knepper, 2020, and Lagos, 2021). See Jäger et al. (2024) for the most comprehensive recent survey.

ature by studying the equilibrium implications of unions' influence on employers' insurance provisions and highlighting the interactions between unions and social insurance systems.

Second, by focusing on the role of non-wage benefits, this paper is related to the literature studying equilibrium labor market impacts of non-wage benefits. Recent studies have emphasized the allocative function of non-wage benefits and their heterogeneity across firms (e.g., Sorkin, 2018, Taber and Vejlin, 2020, Lamadon et al., 2024, and Morchio and Moser, 2024). We add to this literature by showing how unions interact with firms in determining the provisions of non-wage benefits.

Third, our paper also contributes to the growing literature that studies the labor market and the welfare impact of social insurance using structural models. Many studies evaluate the welfare impacts of social insurance programs in structural life-cycle models (e.g., French and Jones, 2011, De Nardi et al., 2010, and Low and Pistaferri, 2015). A smaller number of studies evaluate social insurance programs using equilibrium labor market models. For example, Dey and Flinn (2005), Aizawa (2019), and Aizawa and Fang (2020) study health insurance; Mitman and Rabinovich (2015) and Chodorow-Reich et al. (2019) study unemployment insurance; and Cole et al. (2019), Aizawa et al. (2024), and Lise et al. (2024) study disability policies.[4] We contribute to this literature by examining the interactions among labor market institutions, labor markets, and social insurance.

## 2 Background

This paper focuses on the private sector labor unions in the United States. In this section, we summarize the key features of unions and insurance in the U.S.

In the U.S., workers can form a union to collectively bargain with their employers over compensation and benefits under the National Labor Relations Act (NLRA). To organize a union, workers first need to gather union authorization cards or petitions from at least 30% of their co-workers. Then, the workers can file a petition for a union election with the National Labor Relations Board (NLRB), and a union is formed if more than 50% of workers are in favor of unionization.[5]

Once a union is formed, collective bargaining covers all workers in the bargaining unit. The NLRA stipulates that an appropriate bargaining unit is a group of two or more employees who share a community of interest, and the determination of a bargaining unit is left to the discretion of the NLRB. In practice, most of the bargaining takes place at the enterprise

[4] See Fang and Krueger (2022) which surveys recent macroeconomic studies on health policies.

[5] For more details, see an NLRB web page https://www.nlrb.gov/about-nlrb/rights-we-protect/the-law/employees/your-right-to-form-a-union

level.[6] Once a union is organized, all workers at the same workplace are covered by collective bargaining even if they are not union members. Operating a union incurs costs, and typically, union dues are automatically withheld from the payrolls of all covered workers. However, some states have approved RTW laws, allowing non-members to avoid paying union dues while still being covered by collective bargaining agreements.

In theory, forming a union is up to the employees in the firm, but in practice, firms play a crucial role. Firms often use anti-union tactics to dissuade workers from unionizing (Dickens 1983, Bronfenbrenner 2009).[7] Consequently, unionization is determined not only by workers' preferences for unions but also by how costly it is for firms to prevent unionization through various tactics.

In addition, employers play an important role in insurance provisions in the U.S. For example, ESHI is a dominant source of insurance coverage for working adults, covering more than 60% of them (Aizawa and Fang, 2020). The government provides public insurance through Medicaid and Medicare, but only low-income adults and the elderly are eligible. Moreover, since the U.S. employment protection is weaker than that of European countries, employers directly determine layoff risks (Cahuc and Postel-Vinay, 2002).

These features are substantially different from many European countries, where unions are organized and collective bargaining takes place at the *sectoral* level (Jäger et al., 2024).[8] For example, while union density and collective bargaining coverage are roughly equivalent in the U.S., France exhibits a stark contrast, with union density below 20% despite nearly universal collective bargaining coverage. In addition, the government provides various insurance benefits, often through sectoral labor unions. Thus, employers in Europe play a limited role in both union formation and insurance provisions at the firm level. In the United States, employers play an essential role in the interactions between labor unions and social insurance.

# 3 Empirical Evidence

To motivate our focus on the relationship among employer-provided insurance benefits, unions, and social insurance, this section provides a variety of empirical evidence. First, we document that unionized firms are more likely to provide a variety of employer-provided insurance benefits, as well as job security. Then, we provide new evidence on the effects of social insurance on the unionization rate.

[6] According to the OECD/AIAS ICTWSS database, collective bargaining in the U.S. occurs at the company or enterprise level for more than two-thirds of union coverage.

[7] These tactics include both lawful actions (e.g., hiring anti-union consultants) and unlawful actions (e.g., threats, interrogations, and harassment). See Bronfenbrenner (2009) for more details.

[8] See OECD/AIAS ICTWSS Database (https://www.oecd.org/employment/ictwss-database.htm) for the level at which collective bargaining takes place in various OECD countries.

## 3.1 Unionization and Insurance Provisions by Employers

### 3.1.1 Data and Sample Selection

We use household survey data from the Health and Retirement Study (HRS, 1992-2019) to examine the relationship between insurance status and union status, and use the Survey of Income and Program Participation (SIPP, 1996-2008 panels) to study the relationship between union status and job security. The HRS contains rich measures of various non-wage benefits, while the SIPP allows us to more accurately measure job turnovers. On the employer side, we use establishment-level data from the 1997 Robert Wood Johnson Foundation Employer Health Insurance Survey, which provides detailed information on establishment characteristics, ESHI offerings, and unionization. We also use the data on the state-level union density since 1963, produced by Hirsch et al. (2001), to study the impact of social insurance policies on state-level union density.[9] Additionally, we use the data from the Current Population Survey (CPS) and information on state-level political environments from KlarnerPolitics and the National Conference of State Legislatures in some analysis.[10] We restrict our sample to private-sector workers aged 22-65 who reported their union status, and exclude individuals who were out of the labor force at the time of the survey. For the HRS, individuals aged 50 or older and their spouses, regardless of their age, are included in the survey.

### 3.1.2 Empirical Patterns

**Employer-Provided Insurance Benefits.** First, we describe how union workers are different from nonunion workers in terms of employer-provided insurance benefits. We use the HRS sample to regress indicators for various insurance coverages on union membership and several demographic variables. Specifically, we look into (i) ESHI coverage, (ii) pension from the current job, (iii) life insurance coverage, and (iv) long-term care (LTC) insurance coverage. We estimate the following regression equation:

$$y_{it} = \beta \cdot Union_{it} + x_{it}'\gamma + \alpha_i + \lambda_t + \epsilon_{it}, \tag{1}$$

where $i$ is the individual, $t$ is the year, $y_{it}$ is an indicator for insurance coverage for $i$ at $t$, $Union_{it}$ is an indicator that takes 1 if $i$ is a union member at $t$, $x_{it}$ is a vector of time-variant

[9] Although we cannot distinguish between the public and the private sectors in the state-level data by Hirsch et al. (2001), we supplement our analysis by using the election data from NLRB, which oversees private-sector union elections.

[10] We obtained the data on partisan balance in early years at https://www.klarnerpolitics.org/datasets-1 (Last accessed March 11, 2024) which is based on Klarner (2003), and we obtained the data in recent years from the National Conference of State Legislatures.

Table 1: Union Membership and Insurance Coverage

| | ESHI | Pension | Life Ins. | LTC Ins. |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Union | 0.056*** | 0.186*** | 0.039*** | 0.008 |
| | (0.018) | (0.018) | (0.013) | (0.015) |
| Mean outcome | 0.719 | 0.678 | 0.838 | 0.102 |
| Observations | 32,787 | 32,950 | 32,907 | 32,439 |
| $R^2$ | 0.7618 | 0.7622 | 0.7019 | 0.5925 |

*Note*: This table reports the estimation result of equation (1). The sample consists of workers aged 65 or younger in the HRS 1992-2019. The time-variant covariates include quadratic polynomials of age, the log of the number of people in the same workplace, the log of earnings, dummies for occupations, industries, and four census regions. Year fixed effects and individual fixed effects are also controlled. Person-level analysis weights are used. Standard errors are clustered at the individual level. $^{*}p < 0.1$;$^{**}p < 0.05$;$^{***}p < 0.01$.

covariates, $\alpha_i$ is individual fixed effects, $\lambda_t$ is time fixed effects, and $\varepsilon_{it}$ is an error term. The coefficient $\beta$ represents how much insurance coverage is related to union status. Since we control for individual fixed effects, we exploit changes in union membership of the same individuals over time to identify the coefficient $\beta$.

Table 1 shows that union membership is associated with better access to health insurance, pension, and life insurance. Access to LTC insurance is weakly correlated with union membership, although the coefficient is not statistically significant.

**Job Security.** Unions can also provide workers with insurance in the form of better protection against layoffs. We investigate how union membership is related to subsequent job loss using SIPP data. Here, we summarize the main findings and relegate the details to Appendix B. First, we find that the monthly job losing probability is smaller for union workers than non-union workers. Second, the decline in job loss probability from unionization is much larger for lower-skilled workers.

**Firm Heterogeneity in Unionization.** Another important observation is that some firms are more likely to be unionized than others. Table A.3 in Appendix K provides summary statistics of the establishment-level outcomes from the Robert Wood Johnson Foundation Employer Health Insurance Survey. Here, we summarize key robust establishment-level patterns from the data. First, unionized establishments tend to be larger, provide higher wages, and are 25% more likely to provide health insurance to their workers. Second, unionized establishments are larger and more likely to provide health insurance within *any* industry, although wages are not necessarily higher in unionized establishments within industries. For example, unionized establishments are 11%–38% more likely to provide health insurance to their workers, conditional on the industry. Although union wages are much higher in the construction sector, they are similar to nonunion wages in other industries and even lower than nonunion wages in the manufacturing industry. Third, some industries are more likely to be unionized; specifically, the construction and manufacturing industries have more unionized establishments than the service industries. These patterns suggest that unionization across establishments reflects firm-side heterogeneity beyond productivity differences. In the model, we aim to endogenously capture the relationships among unionization, firm size, and ESHI offerings through firm-side heterogeneity.

## 3.2 Effects of Social Insurance Expansions on Unionization

Next, we establish evidence of the effect of the expansion of social insurance programs on unions. To begin with, we introduce some aggregated data patterns. First, Figure A.1a in the Online Appendix displays the national union membership density for private sector workers from 1948 onward, based on Farber et al. (2021). The union density was around 35% during the 1950s, began to decrease around the mid-1950s, and stood at less than 10% after 2010.[11] Interestingly, the union decline occurred in all of the four census regions from 1964 onward (Figure A.1b). Second, Figure A.1c shows the government spending on the three major social insurance programs, namely, Medicaid, Medicare, and Social Security, as a percentage of the US GDP. In contrast to the trend in union density, government spending on social insurance programs has constantly increased over the same time periods. Before 1965, neither Medicare nor Medicaid existed; however, spending on each program has escalated to around three percent of GDP in recent years.

Although aggregate trends suggest that social insurance policies may crowd out labor unions, they alone cannot establish causality.[12] As emphasized in the literature (Acemoglu et al., 2001; Farber et al., 2021), union decline has also been driven by factors such as technological changes (particularly since the 1980s) and the adoption of state-level RTW laws. Political factors play a role as well; for example, union density is lower in the South, where social insurance programs are generally less generous (Figure A.1b). Furthermore, several mechanisms could potentially lead to a positive correlation between unions and social insurance expansion.[13]

[11] Union density is highly heterogeneous across sectors, and large sectoral mobility happened over the second half of the twentieth century (Lee and Wolpin, 2006), but we confirm in the Online Appendix A that such sectoral mobility is not a major factor behind the decline in unions.

[12] Early studies, such as Neumann and Rissman (1984) and Moore et al. (1989), documented a time-series association between government welfare expenditures and union density, concluding that higher social program spending correlated with lower union density in the late 20th century.

[13] For example, unions may encourage workers to utilize unemployment insurance, as shown by recent

In the following, we exploit plausibly exogenous variations across time and space in social insurance programs to estimate the impacts of these social insurance programs on unionization. First, we look into the introductions of two of the largest social insurance programs in the U.S., Medicare and Medicaid, during the 1960s. We then study the more recent policy changes, including the Medicaid expansion under the ACA and the state-level changes in unemployment insurance generosity.

#### 3.2.1 Introduction of Medicare

Medicare, which was enacted into law on July 1, 1965, and implemented on July 1, 1966, is a large public social insurance program that provides almost universal health insurance coverage mainly for elderly Americans who are 65 or older. It can impact the union density for the following reasons. Before the implementation of Medicare, individuals had to rely on private insurance to cover the health risks associated with old age. Due to the lack of well-functioning individual markets, workers needed to rely on ESHI, which often included post-retirement coverage. As such, unions played a crucial role in providing retiree health insurance coverage, which could have incentivized workers to seek union jobs to secure access to insurance. The implementation of Medicare delinked the retiree insurance coverage from unions. Indeed, employer-provided retiree health insurance has largely disappeared: while more than 90% of large firms offer employer-sponsored health insurance (ESHI), fewer than 20% of those firms provide retiree health insurance benefits today (Kaiser Family Foundation and Health Research and Educational Trust, 2023). Thus, by lowering the demand for union-provided insurance, Medicare may contribute to crowding out unions.

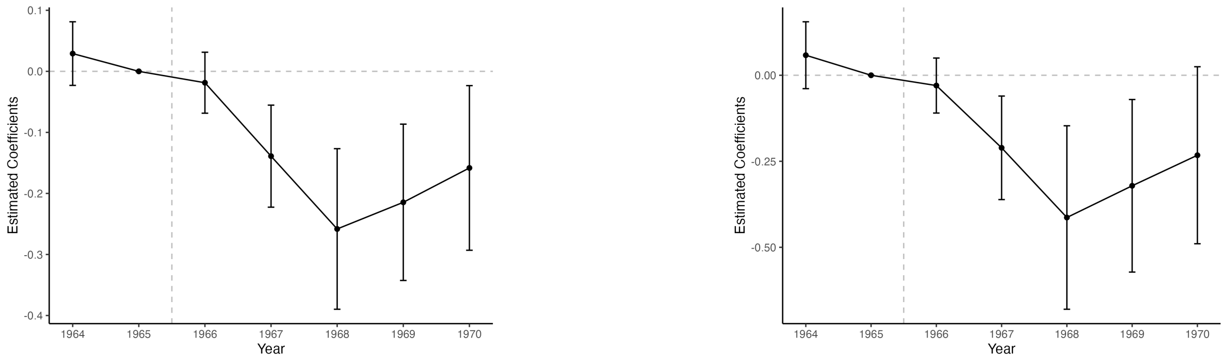
To identify the effect of Medicare on unions, we follow the empirical strategy of Finkelstein (2007) and exploit geographic variations in the pre-1965 health insurance coverage for the elderly. Prior to the introduction of Medicare, the private health insurance coverage rates for the elderly differed across regions, and Medicare introduction increased the coverage to, almost uniformly, 100%. A region with a higher pre-reform coverage rate is affected (or exposed) more by the introduction of Medicare because access to Medicare substantially lowers the need for workers to rely on private coverage to gain retiree health insurance.[14]

We first look at the raw trends in union density among the group of high pre-reform insurance coverage (i.e., high policy exposure) states and the group of low coverage (i.e., low policy

evidence from Lachowska et al. (2022), suggesting that social insurance spending could be endogenous to union density.

[14] Figure A.3 in the Online Appendix also shows that the pre-reform coverage rate is positively correlated with the state-level union density prior to the introduction of Medicare. In Appendix C, we provide further details about the role of unions in retirement coverage after age 65 of employer-sponsored health insurance plans.

Figure 1: Estimated Impact of Medicare Introduction on Unions




(a) Blue Cross Coverage

(b) Any Insurance Coverage

*Note*: This figure displays the estimated coefficients of equation (2). Panel (a): *Coverage* is BlueCross insurance coverage in 1963. Panel (b): *Coverage* is any insurance coverage in 1963. The error bars represent the 95% confidence intervals based on standard errors clustered at the state level.

exposure) states over the years. As shown in Figure A.4 in the Online Appendix, both groups move in parallel before 1966, but then the union density decreases since 1966 only for the high exposure group. Given this finding, we estimate the following event-study specification:

$$\log\left(union_{st}\right) = \sum_{\tau=-1,\tau\neq 0}^{5} \beta_\tau \times \left(Coverage_{s,1963}\right) \times \mathbb{1}\{t = \tau + 1965\} + x_{st}'\gamma + \alpha_s + \lambda_t + \epsilon_{st} \quad (2)$$

where the outcome variable $\log\left(union_{st}\right)$ is the log of union membership density in state $s$ at year $t$, and the treatment variable $Coverage_{s,1963}$ is the fraction of the elderly in state $s$ covered by private retiree insurance in 1963 (prior to the introduction of Medicare); $x_{st}$ is a vector of time-varying state-level covariates; and $\alpha_s$ and $\lambda_t$ are the state and year fixed effects. We impose a normalization by excluding $\mathbb{1}\{t = 1965\}$. We use the state population in 1960 as weights. Standard errors are clustered at the state level. We follow Finkelstein (2007) in making a distinction between Blue Cross insurance coverage, which had more comprehensive coverage than most others, and any insurance coverage.

As discussed in Callaway et al. (2024), the parameter $\beta_\tau$ identifies a weighted average of the average causal responses, under a strong parallel trend assumption.[15] Specifically, it assumes that the average evolution of outcomes for the entire population if all states experienced $Coverage = c$ is equal to the actual evolution of outcomes for states with

[15] Furthermore, even if $\beta_\tau$ identifies a weighted average of the average causal responses, the underlying weights do not necessarily align with the sampling distribution. Following Callaway et al. (2024), we also estimate a non-parametric specification that allows flexible interactions between exposure and time dummies and construct average causal responses weighted by the sampling distribution.

*Coverage* $= c$.[16] Essentially, this assumption requires that the differential effect of Medicare implementation across states arise only from state-level differences in pre-Medicare retiree health insurance coverage levels *Coverage*, and it does not arise from other time-varying unobserved factors in each state that may be correlated with the policy effect of interest $(Coverage_{s,1963} \times \mathbb{1}\{t = \tau + 1965\})$. To address the plausibility of this identifying assumption, we conduct several diagnoses. First, as discussed above, the outcomes evolved in parallel ways across states before 1966. Second, we control for many possible time-varying confounding factors, including employment composition across industries over time, demographic factors such as the share of workers with some college education, the share of female workers, and the share of old workers aged 40 or more, and state political environments by including an indicator for a Democratic governor, the third-order polynomials of the proportion of state legislative seats, separately for the state Senate and House, held by the Democratic Party.

Figure 1 graphically displays the estimates of coefficient $\beta_\tau$ in equation (2). The coefficient is normalized to 0 in the year 1965. In line with our expectations, the estimated coefficients after the year 1965 suggest that, during the first five years after the introduction of Medicare, regions with larger retiree insurance coverage prior to Medicare — where unions would have played a more important role in negotiating such insurance — experienced larger declines in union density compared to regions with smaller insurance coverage.[17] Although data availability limits our ability to examine long-term pre-trends, we confirm that there is no significant pre-trend over the short term.[18]

In the Online Appendix, we confirm that the result here is robust to controlling state-level Medicaid implementation that occurred mostly between 1966 and 1972 (Figure A.5). We also provide additional supporting evidence using the data on NLRB elections in Online Appendix D.1.

[16] Formally, in the language of the potential outcomes framework, if all states experienced the coverage level of $c$, their average change in outcomes $Y_s$ from pre- to post-policy periods must satisfy:

$$\mathbb{E}[Y_{s,post}(c) - Y_{s,pre}(c)] = \mathbb{E}[Y_{s,post}(c) - Y_{s,pre}(c) | Coverage = c]$$

where $Y_{s,t}(c)$ is an outcome for state $s$ in period $t$ if it experienced the coverage level of $c$. The left-hand side is the average evolution of the outcomes if all states experienced the coverage level $c$ and the right-hand side is the average for states that actually experienced the coverage $c$.

[17] The average estimate of the post-reform coefficient is -0.152. We also estimate a non-parametric specification that allows flexible interactions between exposure and the time dummy and calculate the average causal response that weights these estimates based on the distribution of exposure. Our estimate is -0.206, which is even greater. This estimate implies that the state with the highest private retirement coverage (0.51) would have experienced an 8% greater decline in union density compared to the state with the lowest private coverage (0.12).

[18] See also Online Appendix D.1 for our analysis of union election, which allows us to observe union information a few more years before the Medicare reform.

### 3.2.2 Introduction of Medicaid

In the previous analysis of the Medicare introduction, we controlled for the timing of Medicaid implementation. We can also leverage this variation to estimate the impact of Medicaid implementation on unions. Specifically, although Medicaid was signed into law in July 1965, the timing of its implementation was up to each individual state. As a result, some states implemented the program earlier than other states.[19]

There are both labor supply and demand mechanisms through which Medicaid may reduce the union density. First, without Medicaid, individuals may strongly prefer to work (Garthwaite et al., 2014) and to join a union to gain access to ESHI. Second, to the extent that Medicaid increases the value of unemployment for less skilled workers, the introduction of Medicaid makes it more costly for firms to hire less skilled workers. By lowering labor demand to the less skilled, Medicaid may shift the worker composition away from less skilled to more skilled, who tend to be less favorable toward unions.

One complication of staggered treatment timing is that it makes the standard difference-in-differences estimates hard to interpret. Furthermore, most states quickly implemented the program within a few years, and there is only a small group of states belonging to "not-yet-treated" states if we aim to estimate dynamic effects over a long period of time. As a compromise, we take a short time window.

We begin with the following standard event study specification

$$\log\left(union_{st}\right) = \sum_{\tau=-3,\tau\neq-1}^{1} \beta_\tau \mathbb{1}\{t - E_s = \tau\} + x'_{st}\gamma + \alpha_s + \lambda_t + \epsilon_{st} \tag{3}$$

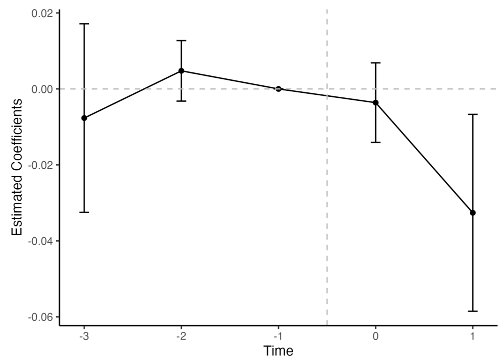
using the sample until $t = 1967$. $E_s$ is the year when state $s$ implements Medicaid; $x_{st}$ is a vector of time-variant covariates; $\alpha_s$ and $\lambda_t$ are the state and year fixed effects, respectively. We control for the same set of variables that represent the political environments of the state as in the previous regression equation (2) for Medicare. We use the state population in 1960 as weights. We cluster standard errors at the state level.

Figure 2 displays the estimated coefficients of equation (3). The estimate suggests that the union density is reduced by 3% one year after the implementation. We do not detect significant pre-trends.

Given the impact of the introduction of Medicare, one concern is that some of the effects of Medicaid could be confounded by the introduction of Medicare. We deal with this issue by controlling for Medicare exposure. Specifically, we include $\mathbb{1}\{t > 1965\} \times \textit{High Exposure}_s$

[19] See Gruber (2003) for the timing of the implementation by each state.

Figure 2: Estimated Impact of Medicaid Implementation on Union Density




*Note*: This figure displays the estimated coefficients of equation (3). The error bars represent the 95% confidence intervals based on standard errors clustered at the state level.

where $High\ Exposure_s$ is an indicator that takes the value 1 if the BlueCross coverage rate among retirees in state $s$ is greater than the national median prior to 1965. Figure A.9 confirms that the result here is robust to controlling Medicare exposure. Furthermore, we provide additional evidence using the data on NLRB elections in Appendix D.1.

### 3.2.3 Expansions of Social Insurance Programs in Recent Years

We next examine the effect of a more recent expansion of social insurance programs on unions. Here, we summarize the main findings and relegate all the details to Appendix D. We consider policy changes in health insurance and unemployment insurance (UI). First, we examine the effect of insurance expansions under the 2010 Affordable Care Act (ACA). One of the key provisions of the ACA is a state-based expansion of Medicaid, which provides Medicaid coverage to anyone whose income is below 138% of the Federal Poverty Line (FPL). We utilize the variation in the timing of the ACA Medicaid expansion across states by a difference-in-differences approach and find that the ACA Medicaid expansion slightly lowers the union membership on average, but it lowers the unionization rate much more significantly for less-educated workers, as one would expect from the fact that Medicaid is targeted toward low-income individuals.

Second, we consider the effect of more generous UI benefits. The UI provides temporary benefits to individuals who lost their jobs, which possibly substitutes the union's role of job protection. Importantly, each state can adjust the UI generosity including the amount of benefits. We use variations in UI replacement rates across states and over time to estimate the impact of UI generosity on union membership. We find that more generous UI replacement lowers the individual unionization rate.

# 4 The Model

The previous section highlights the relationship between union status and the provision of employment-based insurance benefits. Moreover, our finding that social insurance expansions decrease labor union membership suggests the importance of interactions between labor unions and social insurance. To illuminate the mechanisms underlying these observations and to explore the long-term impacts and welfare consequences of social insurance expansions, we build an equilibrium labor market model with endogenous unionization and amenity provision.

## 4.1 Environment

We consider a discrete-time, infinite horizon model. There is a unit mass of risk-averse workers with skill types indexed by $x \in \mathcal{X} = \{1, \ldots, X\}$, with $N_x$ denoting the fraction of each type. Workers consume wages $w$ and amenities (or non-wage benefits, including insurance products) $a \in \mathcal{A}$, where $\mathcal{A}$ is a finite set; each element of $\mathcal{A}$ represents a particular bundle of amenities, and $a = 0$ denotes no benefits.[20] Wages can vary across employees within a firm, but amenities cannot.[21]

Firms are risk-neutral and heterogeneous in their production technologies indexed by $y \in \mathcal{Y} = \{1, \ldots, Y\}$. We denote by $k \in \{u, n\}$ the union status of a firm. A firm is either unionized ($k = u$) or nonunionized ($k = n$). Each firm uses only labor inputs $\boldsymbol{g} = (g_1, \ldots, g_X)$, where $g_x$ denotes the measure of type-$x$ workers it hires, to produce consumption goods according to the production function $F_y(\boldsymbol{g})$ (see equation (8) for details). The measure of type-$y$ firms is given by $M_y$, and the total measure of firms is $M = \sum_{y \in \mathcal{Y}} M_y$.[22]

Both workers and firms discount future values at a rate $\gamma \in (0, 1)$. We assume that workers cannot save or borrow and they have no individual insurance option to highlight the interaction of insurance provided by employers and social insurance.[23] In what follows, we

[20] Although amenities here are only for employed workers, we later extend the model by introducing retirement and amenities for retired individuals to study Medicare. See Appendix J.1 for details.

[21] Some amenities, such as workplace safety, are inherently determined uniformly at the firm level, while for other amenities, such as health insurance and workplace accommodation, anti-discrimination laws prohibit firms from providing different levels to different workers.

[22] Although we have a fixed number of firms rather than free entry, changes in firms' profitability still affect the labor market through endogenous responses in vacancy creation. Acemoglu and Hawkins (2014), for example, show that the response of unemployment to productivity shocks is quantitatively similar between the case of the fixed number of firms and that of free entry.

[23] It is conceptually straightforward to add these factors, although it may greatly complicate the model and the computation. The absence of saving technology could be a simplifying approximation given that self-insurance among workers without employer-provided insurance is very limited: The median asset value among working-age individuals without health insurance is only \$619 in the 2013 Consumer Finance Survey (Aizawa and Fang, 2020). However, to avoid overestimating the value of insurance, we impose a lower level

focus on a steady state.

**Labor Market.** There is a frictional labor market for each skill type $x$. Firms can post multiple vacancies. In the sub-market for skill type $x$, matches are created according to a matching function $m(s_x, v_x)$ where $s_x$ is the measure of unemployed job seekers of type $x$, and $v_x$ is the measure of vacancies for type-$x$ workers. We assume that $m(\cdot,\cdot)$ is strictly concave and strictly increasing in each argument and homogeneous of degree one. We define the labor market tightness as $\theta_x = v_x/s_x$. Since $m(\cdot,\cdot)$ is homogeneous of degree one, the firm's vacancy-filling probability is given by $q(\theta_x) = \frac{m(s_x,v_x)}{v_x} = m\left(\frac{1}{\theta_x}, 1\right)$ and the probability of finding a job for the unemployed worker is given by $p(\theta_x) = \frac{m(s_x,v_x)}{s_x} = m(1, \theta_x)$. Matches are destroyed at the end of each period with probability $\delta_{x,k}$, which depends on worker skill type $x \in \mathcal{X}$ and firm union status $k \in \{u, n\}$. There is no on-the-job search.

**Timing.** The timing of events in each period is as follows: (i) Firms' union status is endogenously determined; (ii) Firms decide how many vacancies to post in each market and decide on firm-level amenity provisions; (iii) Vacancies and unemployed workers are randomly matched in each labor market; (iv) Production and wage bargaining take place, and then wages and amenities are provided; (v) A fraction $\delta_{x,k}$ of jobs are destroyed for each $x$ and $k$.

## 4.2 Worker's Problem

**Preference.** If a type-$x$ worker gets wage $w$ and amenity $a$, then the worker obtains utility $u_x(w, a)$ where preferences depend on type $x$ and $u_x$ is concave in the first argument. An unemployed individual obtains $u_x(b_x, 0)$ where $b_x$ is unemployment benefits (and/or home production).

**Value Function.** The value for a type-$x$ worker employed by a type-$y$ firm with union status $k$ that offers a compensation package $(w, a)$ this period is given by

$$V^E_{x,y,k}(w, a) = u_x(w, a) + \gamma\Big[\delta_{x,k} V^U_x + (1 - \delta_{x,k}) V^E_{x,y,k}(w_{x,y,k}, a_{x,y,k})\Big]. \tag{4}$$

The value of employment consists of a flow utility from the package $(w, a)$ plus the discounted expected future value. With probability $\delta_{x,k}$, the job is destroyed and the worker gets the unemployment value $V^U_x$ described below. The equilibrium future wages and amenities $(w_{x,y,k}, a_{x,y,k})$ are taken as given in the bargaining for the current wages.

of risk aversion in the subsequent quantitative analysis compared to the literature.

The value from unemployment for a type-$x$ worker is given by

$$V_x^U = p(\theta_x)\mathbb{E}\left[\max\{V_{x,y,k}^E(w_{x,y,k}, a), u_x(b_x, 0) + \gamma V_x^U\}\right] + (1 - p(\theta_x))[u_x(b_x, 0) + \gamma V_x^U]. \quad (5)$$

With probability $p(\theta_x)$, the worker meets a firm and with the remaining probability, the worker remains unmatched. The expectation is taken over the equilibrium distribution of vacancies posted in the sub-market for type-$x$ workers, distinguished by the firm type $y \in \mathcal{Y}$ that post the vacancy, as well as the wage, amenity and the union status associated with the vacancy.[24]

## 4.3 Cost of Unionization and Union Prevention

While, in theory, a firm is expected to unionize if a majority of workers favor it, the reality is nuanced. As discussed in Section 2, firms often resort to various strategies to prevent unionization. To fully capture both the costs of preventing and promoting unionization, we assume that firms determine their unionization status, but the costs of doing so are influenced by the collective endogenous "preferences" of their workers for or against unionization.[25] Consequently, while the option to remain non-unionized always exists for a firm, union prevention may not be profitable if its workers exhibit a strong collective preference for unionization.

To derive the endogenous preference for unionization, we denote by $\mathcal{W}_{x,y,n}(\boldsymbol{g}, a) \in \mathbb{R}$ the *willingness to pay for unionization* of a type-$x$ worker in a type-$y$ nonunionized firm employing a composition of workers $\boldsymbol{g}$ with amenity $a$. It represents how strongly a worker favors unions in terms of consumption goods and tends to be positive for low-skill workers and negative for high-skill workers. We derive it by using (4) and relegate its formal derivation to Appendix F.2 (see equation (A7)), but $\mathcal{W}_{x,y,n}(\boldsymbol{g}, a)$ represents the amount of consumption a type-$x$ worker needs to be compensated for staying nonunionized in a firm. To define the firm-level cost of unionization, we aggregate them in each firm of type $y$, denoted by $\mathcal{W}_{y,n}(\boldsymbol{g}, a)$ (see equation (A8) for its derivation). Then, a firm's cost of preventing

[24]The precise expression is given by equation (A6) in Online Appendix F.1.

[25]In Appendix F.3, we explicitly consider the voting decisions of workers and argue that, with some additional assumptions, the specification above is equivalent to the case where the cost depends on the outcome of the majority voting.

unionization, which we term the *union threat cost*, is given by:[26]

$$C_{y,n}(\boldsymbol{g}, a) = c_0 \max\{0, \mathcal{W}_{y,n}(\boldsymbol{g}, a)\} \tag{6}$$

where $c_0 > 0$ reflects the cost of the various ways a firm may deploy to counteract unionization. If the employees' aggregate willingness to pay for unionization is positive, a firm needs to incur the cost to suppress unionization, and the more "eager" workers are to form a union, the more costly it is for the firm to prevent unionization. The importance of such union threat cost is governed by the parameter $c_0$, which captures the firm's role in the eventual unionization outcome. The union threat cost also implies that if the willingness to pay for unionization varies across workers, firms may distort the composition of workers to reduce the union threat cost (see also Taschereau-Dumouchel, 2020).

We define a similar cost function when a firm prefers unionization but its workers oppose it.[27] Given the employees' aggregate *willingness to accept de-unionization*, $\mathcal{W}_{y,u}(\boldsymbol{g}, a)$, formally derived in Appendix F.2, the total cost of a type-$y$ unionized firm to maintain unionization of all of its workers $\boldsymbol{g}$ is given by:

$$C_{y,u}(\boldsymbol{g}, a) = FC_{union} + c_0 \max\{0, \mathcal{W}_{y,u}(\boldsymbol{g}, a)\} \tag{7}$$

where $FC_{union} > 0$ is the fixed cost of union that a firm needs to pay regardless of whether workers agree on unionization;[28] and $c_0 > 0$ represents the marginal cost of counteracting de-unionization.

## 4.4 Firm's Problem

Firms produce consumption goods using only labor inputs. The production function of a type-$y$ firm is a function of worker composition $\boldsymbol{g} = (g_1, \dots, g_X)$ and is given by

$$F_y(\boldsymbol{g}) = A_y \left( \sum_{x \in \mathcal{X}} z_x g_x^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}\alpha_y}, \tag{8}$$

[26]An advantage of using the flexible cost function as a penalty function rather than imposing a hard constraint with $c_0 \to \infty$ (e.g., Taschereau-Dumouchel 2020) is numerical tractability. With a hard constraint, there is a cutoff for $\hat{\alpha}$ such that there cannot be a solution to the hiring problem of nonunionized firms with $\alpha < \hat{\alpha}$, while some firms find it optimal to prevent unionization if $\alpha \geq \hat{\alpha}$. As a result, we encounter a discontinuity in the union probability at $\hat{\alpha}$, which hampers the convergence of an iterative algorithm. This also generates a counterfactual pattern where smaller firms (with smaller $\alpha$) all become unionized.

[27]Although workers are likely to prefer union on average in the quantitative model we use later, we define the cost function of unionized firms for completeness.

[28]See Section 4.7 for an interpretation of $FC_{union}$.

where $A_y$ is the firm-specific total factor productivity (TFP), $\alpha_y$ is the returns to scale, $\sigma$ is the elasticity of substitution between different skills, $z_x$ is the relative skill intensity satisfying $\sum_{x \in \mathcal{X}} z_x = 1$. We assume decreasing returns to scale $\alpha_y < 1$ for all firms. We assume that in the population of firms $\alpha_y$ is drawn from a CDF $G_\alpha$.

The current-period profit function of a type-$y$ firm with union status $k$ is given by

$$\pi_{y,k}(\boldsymbol{g}, a) = F_y(\boldsymbol{g}) - \sum_{x \in \mathcal{X}} \left[w_{x,y,k}(\boldsymbol{g}, a) + c_x(a)\right] g_x - FC_a(a) - C_{y,k}(\boldsymbol{g}, a). \tag{9}$$

The first term is revenue from the output; the second term is the compensation costs of hiring its workers: $w_{x,y,k}(\boldsymbol{g}, a)$ is a wage schedule and $c_x(a)$ is the type-specific expected cost per worker of the amenities $a$. The third term, $FC_a(a)$, represents the fixed cost per period of providing the level of amenity $a$, where $FC_a(a) > 0$ if $a > 0$, and $FC_a(0) = 0$.[29] The fourth term, $C_{y,k}(\boldsymbol{g}, a)$, is the union cost function defined in Section 4.3 above.

Given $\boldsymbol{g}$ and $a$, a type-$y$ firm posts, in each sub-market for skill type $x$, vacancies $\nu_x$ at a cost of $\kappa > 0$ per vacancy, to maximize the discounted sum of profits:

$$J_{y,k}(\boldsymbol{g}, a) = \max_{\{\nu_1, \ldots, \nu_X\}} \pi_{y,k}(\boldsymbol{g}', a) - \kappa \sum_{x \in \mathcal{X}} \nu_x + \gamma J_{y,k}(\boldsymbol{g}', a), \tag{10}$$

$$\text{subject to} \quad g'_x = (1 - \delta_{x,k}) g_x + \nu_x q(\theta_x) e_{x,y,k,a}, \quad x = 1, \ldots, X, \tag{11}$$

where $q(\theta_x)$ is the vacancy-filling probability defined in Section 4.1 and $e_{x,y,k,a}$ is worker's decision of whether to accept a job offer from this firm.[30] The first term in the law of motion for the firm's worker composition (11) is the number of workers who are not hit with the exogenous separation shock from the firm, while the second term is the number of new hires.[31] Note that $\delta_{x,k}$ differ by $x$ and $k$, which can capture two relevant forces: first, workers of different skills can subject to different rates of job separation; second, unions can affect job security and the impact can potentially differ by workers' skill type. We let the fixed cost of unionization $FC_{union}$ include the cost of offering different degrees of job security.

[29] The fixed cost $FC_a(a)$ encapsulates various costs associated with amenity provisions that remain invariant with respect to the size of the firm. For example, it includes the costs to operate a benefits office to offer amenities or the transaction costs for making contracts with insurance providers. In the case of health insurance, insurance companies often impose an administrative service over the anticipated claims costs. As reported in Karaca-Mandic et al. (2011), firms of up to 100 employees face loading fees of approximately 34%, while the load is 4% for firms with more than 10,000 employees. This type of cost can be attributed to the fixed cost in our model.

[30] Recall that $\theta_x = \nu_x / s_x = \sum_{y' \in \mathcal{Y}} \nu_{x,y'} / s_x$. We assume that each type-$y$ firm is infinitesimally small so its choice of $\nu_{x,y}$ does not impact $\theta_x$.

[31] Although each vacancy is filled randomly, due to the law of large numbers, the number of new hires is deterministic.

In a steady state, the objective function for type-$y$ firms is given as follows:[32]

$$\hat{\pi}_{y,k}(\boldsymbol{g}, a) = \pi_{y,k}(\boldsymbol{g}, a) - \psi_{y,k}(\boldsymbol{g}, a), \tag{12}$$

$$\text{where} \quad \psi_{y,k}(\boldsymbol{g}, a) = \kappa \sum_{x \in \mathcal{X}} \frac{g_x}{q(\theta_x)} - \kappa\gamma \sum_{x \in \mathcal{X}} (1 - \delta_{x,k}) \frac{g_x}{q(\theta_x)}. \tag{13}$$

The objective function (12) consists of the current-period profit (9), the union threat or maintenance cost, and $\psi_{y,k}(\boldsymbol{g}, a)$, which is the cost of posting a vacancy net of the gain from lowering future hiring costs.

**Hiring, Amenity Provision and Unionization.** Firms draw choice-specific shocks for amenities $\boldsymbol{\epsilon} = \{\epsilon_a\}_{a \in \boldsymbol{\mathcal{A}}}$ and union formation $\boldsymbol{\varepsilon} = \{\varepsilon_k\}_{k \in \{u,n\}}$ that are independent across firms but fixed over time, implying that each firm exhibits the same union status and amenity provision over time in a steady state. We assume these shocks are unobservable to workers and cannot be bargained over, hence they will not affect wage functions.

Given firm type $y$, amenity provision $a$ and union status $k$, a firm chooses its hiring profile $\boldsymbol{g}_{y,k}(a)$ to maximize its steady state profit flow (12):

$$\boldsymbol{g}_{y,k}(a) = \arg\max_{\boldsymbol{g}} \hat{\pi}_{y,k}(\boldsymbol{g}, a). \tag{14}$$

Given the optimal hiring choices above, a firm's value of choosing amenity level $a$ is given by the discounted sum of steady-state profits $\hat{J}_{y,k}(a) = \hat{\pi}_{y,k}(\boldsymbol{g}(a), a)/(1-\gamma)$. For each $y$ and $k$, a firm's amenity choice problem is given by $J_{y,k}(\boldsymbol{\epsilon}) = \max_{a \in \boldsymbol{\mathcal{A}}} \left\{ \hat{J}_{y,k}(a) + \epsilon_a \right\}$. Then the probability that a type-$y$ firm provides amenity $a$ conditional on the union status $k \in \{u, n\}$, which we denote by $P_{y,k}(a)$, and the probability that a type-$y$ firm unionizes, which we denote by $\mathcal{Q}_y$, are given by:[33]

$$P_{y,k}(a) = \Pr(\hat{J}_{y,k}(a) + \epsilon_a = \max_{a' \in \mathcal{A}} \hat{J}_{y,k}(a') + \epsilon_{a'}) \tag{15}$$

$$\mathcal{Q}_y = \Pr(J_{y,u}(\boldsymbol{\epsilon}) + \varepsilon_u \geq J_{y,n}(\boldsymbol{\epsilon}) + \varepsilon_n). \tag{16}$$

Equation (15) shows that forming a union is up to firms, but they cannot ignore workers' preferences. The reduced-form union threat cost (6) implies that if workers have strong preferences for unionization, firms cannot profitably prevent unionization and likely end up with unionized workers; likewise, the union maintenance cost (7) implies that if workers have strong preferences for non-unionization, firms cannot profitably unionize the workers

[32] See Lemma 1 of Taschereau-Dumouchel (2020).

[33] Both (15) and (16) appear in Eq. (A6) in Online Appendix F.1.

and therefore likely end up with non-unionized workers.

## 4.5 Wage Bargaining

Wages are determined by Nash bargaining between an employer and its workers. The bargaining protocol differs between unionized and nonunionized firms as described below. These problems are solved given the hiring profile $\boldsymbol{g}$ and amenity provision $a$.

**Individual Bargaining in Nonunionized Firms.** In individual bargaining, the firm bargains with each worker separately. Due to decreasing returns, the surplus for the firm from reaching an agreement with a worker depends on whether the worker is treated as a marginal worker or an infra-marginal one. We follow Stole and Zwiebel (1996), treating every worker as a marginal worker.[34]

Since bargaining takes place after the hiring decision, it does not take into account the vacancy posting cost needed to hire the worker in the bargaining. In addition, because bargaining takes place after union status has been determined and the firm has already paid the union threat cost to remain nonunion, that cost is sunk at the time of nonunion bargaining.[35] Accordingly, the marginal gain for the firm from an extra worker of type $x$ considered in the bargaining is obtained by differentiating equation (12) ignoring the first term of (13) and the union threat cost (6):

$$\Delta_{x,y,n}(\boldsymbol{w}, \boldsymbol{g}, a) = \frac{\partial F_y(\boldsymbol{g})}{\partial g_x} - w_{x,y,n}(\boldsymbol{g}, a) - c_x(a) - \sum_{x' \in \mathcal{X}} \frac{\partial w_{y,x',n}(\boldsymbol{g})}{\partial g_x} g_{x'} + \frac{\gamma \kappa (1 - \delta_{x,n})}{q(\theta_x)}. \quad (17)$$

The individual bargaining problem is then given by, for each $x \in \mathcal{X}$:

$$\max_{w(\boldsymbol{g},a)} \quad [V^E_{x,y,k}(w(\boldsymbol{g}, a), a) - u_x(b_x, 0) - \gamma V^U_x]^{\beta_n} \left[\Delta_{x,y,n}(\boldsymbol{w}, \boldsymbol{g}, a)\right]^{(1-\beta_n)}, \quad (18)$$

where $\beta_n \in (0, 1)$ is the bargaining power of a nonunion worker. The first bracket captures the individual worker's net surplus, while the second term captures the net surplus from hiring a marginal worker of type $x$. The bargaining problems in (18) need to be solved simultaneously for all $x \in \mathcal{X}$.

**Collective Bargaining in Unionized Firms.** Following Taschereau-Dumouchel (2020), we consider a collective bargaining problem as an $n$-player Nash bargaining problem between

[34] The same approach is taken by, for example, Elsby and Michaels (2013), Acemoglu and Hawkins (2014), and Taschereau-Dumouchel (2020).

[35] As directly implied by bargaining, firms cannot commit to future transfers at the time when union status is determined. This rules out the possibility of side payments from firms to workers in the promise of nonunionization.

a firm and all its workers represented by their union. Especially, the vector of wage functions $\boldsymbol{w}(\boldsymbol{g}, a) = \{w_x(\boldsymbol{g}, a)\}_{x=1}^{x=X}$ is simultaneously determined by

$$\max_{\boldsymbol{w}(\boldsymbol{g},a)} \left[\prod_x \left(V^E_{x,y,k}(w_x(\boldsymbol{g}, a), a) - u_x(b_x, 0) - \gamma V^U_x\right)^{\frac{g_x}{n_y}}\right]^{\beta_u} \\ \times \left[F_y(\boldsymbol{g}) - \sum_{x \in \mathcal{X}} (w_x(\boldsymbol{g}, a) + c_x(a)) g_x - FC_a(a) + \kappa\gamma \sum_{x \in \mathcal{X}} \frac{(1-\delta_{x,u}) g_x}{q(\theta_x)}\right]^{(1-\beta_u)}, \tag{19}$$

where $n_y = \sum_{x \in \mathcal{X}} g_x$ is the total size of type-$y$ firm, and $\beta_u$ is the union's bargaining power. The first bracket captures the collective net surplus of the workers while the second term captures the net surplus of the firm. The latter does not include the union maintenance cost because it has already been paid to achieve unionization and sunk at the time of bargaining. An important contrast between collective and individual bargaining is that the fixed cost of amenities $FC_a(a)$ shows up only in the collective bargaining problem since it is part of the firm's *overall* profit but it is not part of each worker's *marginal* contribution. As we discuss later in Section 4.7, this difference could provide unionized firms stronger incentives to offer amenities than the nonunionized firms.

## 4.6 Equilibrium

We pin down the vector of market tightness $\theta = (\theta_1, \cdots, \theta_X)$ by equalizing two steady-state relationships between unemployment and market tightness. On the firm side, firms' hiring decisions determine unemployment for each skill type $\mathcal{U}^{JC}_x(\theta)$ given $\theta$. On the worker side, equalizing the flow into and out of unemployment also determines the unemployment for each skill type $\mathcal{U}^{BC}_x(\theta)$ given $\theta$. We pin down $\theta$ so that

$$\mathcal{U}^{BC}_x(\theta) = \mathcal{U}^{JC}_x(\theta) \quad \text{for all } x \in \mathcal{X}. \tag{20}$$

See Appendix F.4 for the derivations of $\mathcal{U}^{JC}_x(\theta)$ and $\mathcal{U}^{BC}_x(\theta)$.

A *steady-state equilibrium* consists of a set of value functions $\{V^E_{x,y,k}, V^U_x\}$, hiring functions $\{\boldsymbol{g}_{y,k}\}$, wage schedules $\{w_{x,y,k}\}$, amenity provision functions $\{P_{y,k}\}$, unionization probability $\{Q_y\}$, market tightness $\{\theta_x\}$ such that: (i) the value functions solve the Bellman equations (4) and (5); (ii) the employment functions solve the optimal hiring problem (14); (iii) the wage schedules solve the bargaining problems (18) and (19); (iv) the amenity provision functions are determined by (15); and (v) the unionization is determined by (16); and (iv) the market tightness satisfies (20).

Our equilibrium is richer than the existing ones: amenity provisions, job security, wage distribution, union formation, firm size, and employment are all jointly determined. In addition, we introduce risk-averse workers to study social insurance and insurance provisions. However, it is at the cost of analytical tractability.[36] However, it is still numerically tractable, and through extensive searches across parameters, our numerical algorithm finds an equilibrium quickly and leads to a unique equilibrium. We relegate the details to Appendix G.

### 4.7 Incentive to Unionize and Provide Amenities

We highlight four mechanisms that affect the incentives of the firms to unionize and to provide amenities to their workers. First, the incentive to unionize is manifested through the union threat cost (equation 6) and the bargaining problems (18-19). Recall that nonunionized workers engage in individual bargaining with the firm where their *marginal* contribution to the firm's surplus appears in the Nash bargaining objective function (18), while unionized workers engage in collective bargaining where their *average* contribution to the firm's surplus appear in the Nash bargaining objective function (19). With decreasing returns production functions (see equation 8), the sum of the marginal contributions is less than the total output; as a result, in the absence of the union threat cost, firms, therefore, prefer individual bargaining to extract more surplus.[37] However, the union threat cost forces firms to take into account workers' endogenous "preferences" for unions, which can be heterogeneous across skill types; in particular, the less skilled workers have a stronger preference toward unions because they benefit more from the collective bargaining in which the average contribution exceeds the marginal contribution of the less skilled worker. Of course, nonunionized firms may respond to the threat by changing their workers' skill mix away from the optimal, but this can lead to production losses.

If the union threat cost or the production loss from the distorted worker skill mix is too high, some firms can be incentivized to choose unionization instead. In particular, firms with larger returns to scale, that is, firms with $\alpha_y$ in their production function, are more likely to unionize since the smaller concavity of the production function means a smaller gain from individual bargaining vis-à-vis collective bargaining. Since firms with larger $\alpha_y$ are larger, our model generates a positive correlation between firm size and unionization, as in the data. It should be noted that heterogeneity in TFP $A_y$ would not be helpful in generating such a pattern between unionization and firm sizes: although different TFPs generate different

[36] For example, a closed-form solution for wage functions cannot be obtained due to the concavity of the utility function.

[37] In a simple case with risk-neutral workers, $\beta_u = \beta_n$, no amenity provision, no union effect on job security, and no union threat cost, firms always choose nonunionization (Taschereau-Dumouchel, 2020).

production scales, they do not affect how much surplus a firm can extract in individual bargaining relative to collective bargaining.

Second, there is an inherent hold-up problem in individual bargaining, which makes it costly for nonunionized firms to provide amenities. In particular, nonunionized firms incur the fixed cost $FC_a$ of providing amenities as they are sunk costs that are not reflected in the individual bargaining, whereas unionized firms can pass some of them onto workers in collective bargaining as the fixed cost of providing amenities $FC_a$ appears as part of the total firm surplus from reaching an agreement with its union. This gives firms that provide amenities to their workers an extra incentive to unionize. This channel is especially relevant in our quantitative analysis because we consider health insurance as a non-wage benefit, which is known for its sizable fixed costs (Karaca-Mandic et al., 2011 and Aizawa and Fang, 2020).

Third, collective bargaining allows amenity costs to be shared among heterogeneous workers through wage adjustments. This could give rise to a union's advantage in providing amenities. An incentive to provide amenities depends on how much additional surplus from amenities the firm can extract by cutting wages. If only a small group of workers values amenities due to preference heterogeneity, the firm in individual bargaining can extract surplus only by cutting *their* wages.[38] In contrast, collective bargaining allows the firms to adjust the wages of *all* workers. Given the concavity of the utility function, it is less costly, in terms of utility, for high-skilled (i.e., high income) workers to bear a larger share of the amenity costs than low-skilled (i.e., low income) workers, which could allow the firm to extract larger surplus in collective bargaining. This channel, incidentally, is also the driving force for why unionization tends to result in more wage compression, and thus lower wage inequality among workers with different skills.

Finally, with a lower rate of job destruction for union firms ($\delta_{x,u} < \delta_{x,n}$), as empirically documented in Section 3.1.2, firms can provide better job security to workers through unionization. Better job security increases the duration of a match, generating a larger surplus for the firm by reducing the future hiring cost needed to maintain the same number of workers. This provides another incentive to unionize. However, better job security should come with some costs. In particular, it could result in costly labor hoarding when a firm is hit by a negative productivity shock and wants to scale down. Although we abstract away productivity shocks in the model, the fixed cost $FC_{union}$ would capture such a cost in a reduced-form

[38] In the context of health insurance, a consumption floor can lead low-income workers to have a smaller willingness to pay for employer-sponsored health insurance.

way.[39, 40]

# 5 Estimation

This section extends our model to a more quantitative setting, which we use to assess the impacts of social insurance policies on unionization and other labor market outcomes for the current economy.

## 5.1 Quantitative Extension and Estimation

### 5.1.1 Empirical Specification

Although our model considers general non-wage benefits, given our empirical evidence in Section 3 and the fact that healthcare consists of a sizable part of the U.S. economy (Hall and Jones, 2007), we now focus on health insurance as the amenity; as such, $a$ is now binary: $a = 1$ if a worker is insured and $a = 0$ otherwise. We consider that each risk-averse worker faces a medical expenditure shock and specify the utility function as

$$u_x(w, a) = \int \log C(w, a) dH_x(m_x), \tag{21}$$

where $C(w, a)$ is the consumption level given wage $w$ and insurance $a$ provided by the firm, and $H_x$ is the medical cost distribution for type-$x$ workers.[41] The consumption level is given by $C(w, a) = \max\{w - OOP(m_x; a), \underline{c}\}$ where $\underline{c}$ is the consumption floor, and $OOP(m_x; a)$ is the out-of-pocket medical expenditure that depends on a worker's health insurance status.

Given our interests in social insurance, we model the public health insurance system more realistically. Specifically, we model Medicaid as follows:[42] The fraction $p_x^{Med}$ of type-$x$ workers become eligible for Medicaid upon unemployment, and stay eligible until they get employed. The ex-ante unemployment value is now given by $V_x^U = p_x^{Med} V_x^U(1) + (1 - p_x^{Med}) V_x^U(0)$ where $V_x^U(1)$ is the unemployment value with Medicaid coverage and $V_x^U(0)$ is the one without. They are respectively given by $V_x^U(i) = p(\theta_x)V_x^M + (1 - p(\theta_x))[u_x(b_x, i) + \gamma V_x^U(i)]$ for $i \in \{0, 1\}$.

[39]Since firms are risk-neutral, whether $FC_{union}$ is a one-shot cost or a lump-sum cost does not matter for this interpretation.

[40]It is worth noting that the discussions above hold conditional on the hiring profile $\boldsymbol{g}$; therefore, they are not the result from the over-hiring inefficiency implied by Stole and Zwiebel (1996) bargaining.

[41]We adopt a log utility specification to impose relatively lower risk aversion compared to estimates or calibrated values in the literature, e.g., French and Jones (2011). The reason is that our model abstracts away from a self-saving technology, thus we would like to avoid overstating the value of the insurance channel permitted in the model by restricting ourselves to the log utility function.

[42]It is possible to model the other components of the ACA, following the spirit of Aizawa (2019) and Aizawa and Fang (2020). However, it involves significant complications, such as modeling health insurance exchanges and employer mandates. However, we believe that these features do not change the fundamental forces in this paper and, therefore, abstract in this paper.

We also impose additional assumptions on the firm side. Motivated by our theoretical discussion regarding the firm size and unionization rate in Section 4.7, the benchmark specification assumes that firms are different in their returns-to-scale parameters $\alpha_y$ but not in TFP $A_y$: In Appendix H, we also show that our main findings are robust to the extended model with TFP heterogeneity. We assume that $\alpha_y$ is drawn from a Beta distribution, $Beta(a, b)$, on the support $[0.5, 0.9]$. The cost shocks for amenities $\boldsymbol{\epsilon} = \{\epsilon_a\}_{a\in\{0,1\}}$ and for unionization $\boldsymbol{\varepsilon} = \{\varepsilon_k\}_{k\in\{u,n\}}$ are drawn from the type-I extreme value distributions with scale parameters $\sigma_a$ and $\sigma_{union}$.

#### 5.1.2 Externally Set or Estimated Parameters

We target the 2007 U.S. economy. We mainly use data from the CPS and the Census Business Dynamics Statistics (BDS) for the firm size information. Several model parameters are taken directly from the literature or estimated outside the model.

The list of parameters set or estimated externally is summarized in Table A.6 in the Online Appendix. We set the number of skill types to be $X = 2$. Low-skill workers ($x = 1$) are those who are either high school graduates or have less education, and high-skill workers ($x = 2$) have at least some college education. Each period of the model is a quarter. The discount rate is set to $\gamma = \frac{1}{1+r}$ where $r = 1.05^{1/4} - 1$ to reflect an annual interest rate of 5%. We set the measure of firms to $M = 0.042$ so that the average firm size in the model is about 22.56, as derived from the Census BDS.[43] The elasticity of substitution between skill types in production function (8) is set to $\sigma = 1.5$ (Johnson, 1997). The consumption floor per quarter $\underline{c}$ is set to \$1,000 (French and Jones, 2011). We specify the matching function as $m(s, v) = sv/(s + v)$, following Den Haan et al. (2000). The matching efficiency is normalized to 1 as this parameter and the vacancy creation cost $\kappa$ cannot be separately identified using the unemployment rate. $b_x$ includes both unemployment insurance benefits and other sources of non-labor income. Following Hall (2009) and Taschereau-Dumouchel (2020), we set $b_x$ to 85% of the average wage for each skill type. We set the bargaining powers for unionized and nonunionized workers to $\beta_u = \beta_n = 0.5$.[44]

Job destruction rates are allowed to depend on both skill type and union status. We estimate the impact of union status on the subsequent probability of job loss in the SIPP

[43] The average firm size in the model $\frac{1-\mathcal{U}}{M}$ also depends on the endogenous unemployment rate $\mathcal{U}$. We plug in the targeted unemployment rate from the estimation to calculate this number.

[44] We can also identify and estimate the bargaining power parameters within the model, for example, by targeting a union wage premium. However, the literature has not reached a consensus on the actual magnitude of a union wage premium. Therefore, we instead externally set these parameters and then compare the predicted union wage premium with the range of estimates reported in the literature. See Section 5.1.4 for further discussion.

data and use the estimation result to adjust the probability of job loss in the CPS sample. For unionized workers, we set the job destruction rates for $\delta_{1,u} = 0.0549$ and $\delta_{2,u} = 0.0276$, while for nonunionized workers, $\delta_{1,n} = 0.0639$, and $\delta_{2,n} = 0.0313$.

The distribution of medical expenditure $H_x(m_x)$ is parameterized by a mixture of a log-normal distribution $LN(\mu_{H,x}, \sigma^2_{H,x})$, and a mass point at zero $p_{0,x}$; and it is estimated using data from the 2007 Medical Expenditure Panel Survey (MEPS). Note that $OOP(m_x; a)$ depends on the characteristics of an insurance contract. Following Aizawa (2019), we refer to the characteristics of representative employer-sponsored plans reported by Sommers and Crimmel (2008) and assume that the annual deductible is \$714 and the coinsurance rate is 18%. We calculate the average insurance costs for a firm $c_x(\cdot)$ using the estimated medical expenditure distribution $H_x(m_x)$ and these contract characteristics.

We calibrate Medicaid eligibility $p^{Med}_x$ using the fraction of workers of each type covered by Medicaid in the CPS. We obtain $p^{Med}_1 = 0.16$ and $p^{Med}_2 = 0.09$.

### 5.1.3 Internally Estimated Parameters

We identify and estimate the rest of the parameters within the model. The cost associated with unions $FC_{union}$; the marginal cost parameter in the union threat and union maintenance cost functions, $c_0$; the fixed cost of insurance $FC_a$; the scale parameters for the choice-specific Type-I extreme value shocks for amenities, $\sigma_a$, and for union status $\sigma_{union}$; TFP $A$ and the parameters of the Beta distribution for returns to scale $\alpha_y$; and the vacancy posting cost $\kappa$. We first heuristically discuss how we separately identify these parameters by exploiting variations in union density, firm size, compensation packages, and employment. Then, we show the sensitivity of moments to parameter changes.

The first set of key parameters relates to unionization. As we discussed in Section 4.7, if there is no union threat and no gain from passing the insurance fixed costs onto the worker side, firms have no incentive to unionize. With $c_0 > 0$, some firms optimally unionize to avoid incurring the cost $C_{y,n}(\boldsymbol{g}, a)$. Since this cost is increasing in the firm size, the parameter $c_0$ helps the model fit the unionization of large firms. In contrast, the fixed costs $FC_{union}$ help the model explain the unionization of small firms. The parameter $\sigma_{union}$ smooths the relationship between firm sizes and unionization. We identify these parameters by the joint distribution of unionization and firm sizes.

The second set of key parameters is related to insurance provision. The fixed cost of providing insurance, $FC_a$, is identified by the overall insurance rate. The model predicts that unionized firms are more likely to provide insurance for two reasons. First, given the firm size, unionized firms are more likely to provide insurance due to the fixed cost channel discussed in Section 4.7. Second, unionized firms tend to be larger, and the fixed cost of insurance is less burdensome for large firms. Attenuating these effects, a larger scale parameter for the shock shrinks the difference between the insured rate of unionized and nonunionized workers. Hence, the relative insured rates conditional on union status identify $\sigma_a$ separately from $FC_a$.

The rest of the parameters are identified as follows. Since $\alpha_y$ directly affects the firm size, the distribution of firm sizes is informative about the parameters of the distribution of $\alpha_y$ ($a$ and $b$). TFP $A$ is identified by the average wage. Skill-specific productivity $z_1$ and $z_2$ are normalized to sum to one and are identified by the relative wages across skill types. Finally, we identify the vacancy posting cost $\kappa$ by targeting the unemployment rate in the data.

We estimate these parameters via the Generalized Method of Moments. The targeted moments are chosen based on our identification arguments and are listed in Table 3. We minimize the objective function $Q(\vartheta) = [\hat{\boldsymbol{m}} - \boldsymbol{m}(\vartheta)]'\boldsymbol{W}[\hat{\boldsymbol{m}} - \boldsymbol{m}(\vartheta)]$, where $\vartheta$ is a vector of parameters to be estimated (listed in Table 2), $\boldsymbol{m}(\vartheta)$ is a vector of model moments based on $\vartheta$, and $\hat{\boldsymbol{m}}$ is a vector of empirical moments. $\boldsymbol{W}$ is a weighting matrix where the diagonal elements are the diagonal elements of the inverse of the covariance matrix of the data moments. We compute standard errors based on the asymptotic variance.

To supplement the identification arguments above, we conduct a sensitivity analysis in the spirit of Andrews et al. (2017). Specifically, following Einav et al. (2018), we perturb each model parameter around the estimated values in the next subsection and then examine its impact on each moment. The results in Online Appendix I are consistent with our identification argument. For example, parameters related to the cost of unionization ($FC_{union}, \sigma_{union}, c_0$) greatly influence union density and firm size moments while they do not have much influence on others.

#### 5.1.4 Estimation Results

**Parameter Estimates.** Table 2 reports the estimated parameters within the model. We estimate the TFP $A$ to be 41.3, which implies that the per-quarter output of a firm hiring one low-skill worker and one high-skill worker will be \$41,300 based on our production function (8). The Beta distribution parameters of $\alpha_y$ are 1.16 and 1.00. This translates to the average returns to scale of about 0.71. This is in line with the estimated values in the literature (e.g., Elsby and Michaels 2013, Cooper et al. 2015), although they estimate it in a different model using other moments. The relative productivity of low-skill workers is 0.3. The fixed cost of insurance $FC_a$ is \$15,790 per quarter while the standard deviation of the cost shock $\sigma_a$ is

Table 2: List of Internally Estimated Parameters

| Parameter | Description | Estimate | Std. Err. |
|---|---|---|---|
| $A$ | TFP | 41.30 | 0.023 |
| $Beta(a,b):a$ | Production curvature distribution | 1.16 | 0.006 |
| $Beta(a,b):b$ | Production curvature distribution | 1.00 | 0.001 |
| $z_1$ | Low-skill worker relative productivity | 0.30 | 0.0003 |
| $FC_a$ (in \$1,000) | Fixed cost of insurance provision | 15.79 | 0.084 |
| $\sigma_a$ (in \$1,000) | Std. dev. of insurance cost shock | 0.88 | 0.269 |
| $FC_{union}$ (in \$1,000) | Fixed cost of unionization | 21.56 | 0.239 |
| $\sigma_{union}$ (in \$1,000) | Std. dev. of union cost shock | 5.58 | 0.513 |
| $c_0$ | Marginal cost of union threat | 0.15 | 0.006 |
| $\kappa$ (in \$1,000) | Vacancy posting cost | 1.89 | 0.021 |

*Note*: This table reports the estimated model parameters and standard errors. Monetary values are 2007 USD.

Table 3: Model Fit

| Moments | Data | Model |
|---|---|---|
| Union density | 0.09 | 0.09 |
| ESHI coverage: union | 0.83 | 0.81 |
| ESHI coverage: nonunion | 0.59 | 0.58 |
| ESHI coverage: low skill | 0.53 | 0.57 |
| ESHI coverage: high skill | 0.66 | 0.62 |
| Unemployment rate | 0.05 | 0.05 |
| Average wage: low skill (\$1K) | 8.19 | 8.21 |
| Average wage: high skill (\$1K) | 14.12 | 14.33 |
| Employment share of firms with $\geq 10$ workers: union | 0.94 | 0.96 |
| Employment share of firms with $\geq 10$ workers: nonunion | 0.83 | 0.88 |
| Employment share of firms with $\geq 100$ workers: union | 0.80 | 0.80 |
| Employment share of firms with $\geq 100$ workers: nonunion | 0.56 | 0.55 |

*Note*: This table reports the targeted data moments and their simulated counterparts. "Employment share of firms with $\geq x$ workers: (non)union" is defined as the fraction of (non)unionized firms that employ workers of size greater than or equal to $x$.

estimated to be \$880. The fixed cost of unionization $FC_{union}$ is about \$21,560 per quarter and the standard deviation of the cost shock is \$5,580. The marginal cost of the union threat is estimated to be $c_0 = 0.15$; that is, for every \$1 of the workers' aggregate willingness to pay for unionization, firms need to incur \$0.15 to suppress unionization. Finally, the vacancy posting cost is estimated to be \$1,890.

**Model Fit.** Table 3 shows the fit of the estimated model. As shown, the model is able to account for various important patterns in the data, including the positive relationships between union status and insurance coverage, as well as between firm size and union status.

It is also worthwhile to point out that our model generates a reasonable union wage premium, which is untargeted in our estimation. Note that directly comparing the average

Table 4: Impact of Removing the Union Threat Cost

| | Baseline | No Threat |
|---|---|---|
| ESHI coverage (%) | | |
| Overall | 60.35 | 55.55 |
| Union | 81.32 | 80.23 |
| Nonunion | 58.37 | 53.40 |
| Low skill | 57.17 | 51.97 |
| High skill | 62.40 | 57.88 |
| Unemployment rate (%) | | |
| Overall | 4.82 | 4.36 |
| Low skill | 8.70 | 7.66 |
| High skill | 2.14 | 2.08 |
| Output per capita (% change) | 0.00 | 0.35 |
| Labor productivity (% change) | 0.00 | -0.13 |
| Average wage (% change) | 0.00 | 0.46 |
| Skill wage gap (log points) | 55.65 | 55.24 |
| Average firm size | | |
| Overall | 22.50 | 22.64 |
| Union | 56.47 | 52.65 |
| Nonunion | 21.29 | 21.57 |

*Note*: This table reports the impact of removing the union threat cost. The union status of each firm is fixed at the baseline.

wages of unionized and non-unionized firms would confound the direct impact of the union on wages with that of the different skill compositions between unionized and nonunionized firms. To isolate the direct impact of unionization, we compare the average wage of the unionized firms with that of the nonunionized firms, evaluated at the hiring decisions of unionized firms. We find that the union wage premium ranges between 0.3% and 3.3%, depending on the firm type. These magnitudes fall within the range of estimates reported in the literature, where some find positive effects (e.g., Card, 1996, Farber et al., 2021) while others find null effects (e.g., DiNardo and Lee, 2004, Frandsen, 2021).

## 5.2 Equilibrium Effects of the Union Threat

We use the estimated model to explore the impact of the union threat cost for nonunionized firms, $C_{y,n}(\boldsymbol{g}, a)$ as in equation (6), by setting it to zero. To isolate the impact of how the union threat cost affects the behavior of firms *conditional on* their union status, we fix the union status of each firm at the baseline level in line with Taschereau-Dumouchel (2020).

Table 4 shows the results from this counterfactual experiment. Without the cost of union threat, nonunionized firms no longer hesitate to hire low-skilled workers for fear of unionization. The impact of the expansion of nonunionized firms in the number of low-skilled workers they hire is also manifested in the skill-specific unemployment, where the unemployment rate for the low-skilled workers decreased significantly.

A notable impact of removing the union threat cost appears in the ESHI coverage. Without the cost of union threat, the overall ESHI coverage decreases by about 5 percentage points; interestingly and surprisingly, this decrease is primarily driven by the lower ESHI offerings from nonunionized firms. This results from how the change in skill composition of workers in nonunionized firms towards low-skilled workers interacts with the bargaining protocol. As discussed in 4.7, individual bargaining in nonunionized firms prevents the possibility of efficiently sharing the insurance cost among heterogeneous workers. It is particularly costly for nonunionized firms to offer insurance to low-skilled workers because they cannot pass some of the cost on to high-skilled workers, whose marginal utility of income is lower than that of low-skilled workers. The expansion of nonunionized firms in hiring low-skilled workers, interacted with individual bargaining, reduces the ESHI access for all workers in nonunionized firms.

Note that the increase in low-skill employment translates into lower labor productivity due to the compositional change among employed workers. However, the average wage increases in the counterfactual experiment, partially because workers are compensated for reduced ESHI coverage, and partially because removing the union threat cost raises firms' profitability, which is then passed on to workers through higher wages. The increased demand for low-skilled labor also pushes up wages for low-skilled workers, contributing to a slightly smaller skill wage gap in the counterfactual.

# 6 Counterfactual Policy Experiments

In this section, we conduct various counterfactual experiments to understand the equilibrium impacts of social insurance policies on unionization rates and other labor market outcomes. Then, we also use our model to illustrate that social insurance expansions in the U.S. could be an important factor in understanding union declines.

## 6.1 Social Insurance

We first consider a social insurance policy in which the government provides universal health insurance coverage financed by a uniform payroll tax on firms. Note that firms no longer pay the fixed cost of insurance, as the government provides insurance.[45]

Column (2) in Table 5 shows the equilibrium impact of the policy. All workers get health insurance from the government, which removes the cost advantage of unionized firms in in-

[45] Alternatively, we can examine the effect of mandating all employers to provide ESHI. We find qualitatively similar effects. The result is available upon request.

Table 5: Counterfactual Policy Simulation: Insurance Policies

| | (1) Baseline | (2) SI for all | (3) Targeted SI | (4) Insurance subsidy | (5) Job security | (6) Insurance quality |
|---|---|---|---|---|---|---|
| Union density (%) | 8.62 | 5.22 | 6.78 | 6.86 | 6.81 | 3.34 |
| ESHI coverage (%) | | | | | | |
| Overall | 60.35 | 0.00 | 58.95 | 68.23 | 59.94 | 68.49 |
| Union | 81.32 | 0.00 | 73.42 | 83.24 | 74.42 | 60.19 |
| Nonunion | 58.37 | 0.00 | 57.90 | 67.12 | 58.88 | 68.77 |
| Low skill | 57.17 | 0.00 | 55.53 | 65.36 | 56.65 | 65.48 |
| High skill | 62.40 | 0.00 | 61.08 | 70.06 | 62.06 | 70.41 |
| Unemployment rate (%) | | | | | | |
| Overall | 4.82 | 7.65 | 6.14 | 4.86 | 4.54 | 4.90 |
| Low skill | 8.70 | 14.79 | 11.80 | 8.93 | 8.21 | 9.06 |
| High skill | 2.14 | 2.72 | 2.24 | 2.05 | 2.01 | 2.03 |
| Output per capita (% change) | 0.00 | -1.88 | -0.81 | 0.03 | 0.20 | 0.00 |
| Labor productivity (% change) | 0.00 | 1.13 | 0.59 | 0.07 | -0.10 | 0.09 |
| Average wage (% change) | 0.00 | -1.52 | 0.56 | -0.59 | -0.04 | -0.60 |
| Skill wage gap (log points) | 55.65 | 59.05 | 53.47 | 56.25 | 55.85 | 56.56 |
| Average firm size | | | | | | |
| Overall | 22.50 | 21.83 | 22.20 | 22.49 | 22.57 | 22.48 |
| Union | 56.47 | 41.24 | 45.17 | 47.92 | 41.61 | 27.10 |
| Nonunion | 21.29 | 21.28 | 21.41 | 21.64 | 21.84 | 22.34 |

*Note*: This table reports the general equilibrium impacts of each policy change. Column (2) is the economy with free public health insurance for all workers regardless of their employment status. Column (3) is the economy with free public health insurance only for low-skill unemployed workers. In column (5), firms receive subsidies for offering insurance to their workers. Column (5) is the economy in which nonunionized firms are forced to provide better job security than the baseline. In column (6), nonunion firms incur smaller costs for offering insurance.

surance provision. It results in a decline of union density by 3.4 p.p. from the baseline rate of 8.62%. The improvement in worker outside option increases the marginal hiring cost, increasing the unemployment rate by 2.83 p.p. and reducing the output by 1.88%.

The union decline affects the low-skill and the high-skill workers differently, both in employment rates and in wages. Since unionized firms tend to rely more on low-skill workers, the decline in unions results in a large increase in the unemployment of low-skill workers while it has a small effect on high-skill workers. Furthermore, the union decline increases the wage inequality between the skill types by 3.40 log points due to the different bargaining protocols between unionized and nonunionized firms.

## 6.2 Targeted Social Insurance Policies

We next examine the effect of social insurance provision targeted only at low-skilled unemployed workers financed by a uniform payroll tax on firms. Unlike universally provided social insurance in the previous subsection, firms that privately provide health insurance here still need to pay the fixed costs of insurance.

Column (3) in Table 5 shows the equilibrium impact of the above targeted social insurance for low-skilled workers. By providing public insurance outside their jobs, this policy reduces the low-skilled workers' incentives to obtain health insurance through unions, reducing the union density by 1.86 p.p. The higher marginal hiring cost increases the unemployment rate by 1.32 p.p., reducing the total output by 0.81%. Again, the decline in unions comes with a slight improvement in labor productivity of 0.59% due to the compositional change in the skills of employed workers.

The decline in unions is also damaging to high-skilled workers in terms of their ESHI coverage, reducing their coverage by 1.32 p.p. Although low-skilled workers see a similar decline in ESHI, 11.80% of them are unemployed and hence get free public insurance under the targeted social insurance provision.

Although the union decline reduces the coverage of collective bargaining, the policy change directly increases the wages of low-skilled workers by improving their outside options, suppressing wage inequality. In total, the effect of improved outside options dominates the impact of the union decline, reducing the skill wage gap by 2.18 log points.

Our results highlight the difference between the untargeted social insurance provision and the one targeting low-skilled unemployed workers only. Although both reduce the union density, they have different impacts on wages. Social insurance for all reduces the average wage and increases wage inequality through the decline of unions, while targeted social insurance reduces wage inequality. However, the decline of unions due to the targeted social insurance reduces insurance coverage for high-skilled workers.

## 6.3 Other Social Insurance Policies

**Insurance Subsidy.** In the U.S., many employer-sponsored insurance benefits are tax deductible, incentivizing firms to provide those benefits. To examine their equilibrium effects on unionization, we study the effect of subsidies for insurance provisions. Specifically, we reduce insurance fixed costs by one-third, or by $5,300 per quarter.

Column (4) in Table 5 shows the outcomes under the subsidy for the fixed cost of the firm's provision of insurance for their workers. Recall that the insurance fixed cost provides a firm with an incentive to unionize (see Section 4.7). By alleviating the fixed cost channel, the insurance subsidy reduces the union density by 1.76 p.p. As a result, the insurance subsidy, which may be intended to help workers, has unintended consequences. By reducing the coverage of collective bargaining, the subsidy widens the wage inequality as the skill wage gap increases by 0.60 log points. The decline in unionized firms reduces the relative demand for low-skilled workers, pushing up their unemployment rate by 0.23 p.p. while reducing that of high-skilled workers by 0.09 p.p. This results in a slight increase in output and labor productivity. Since the fixed cost of the insurance matters more for nonunionized firms, the subsidy increases the ESHI coverage of nonunionized workers more than that of unionized workers, shrinking the difference in ESHI coverage between unionized and nonunionized workers.

This finding has several implications. First, policies such as the tax deductibility of employer-sponsored insurance benefits can lower unionization by weakening a union's advantage in insurance provisions. Second, subsidizing insurance provisions can also contribute to wage inequality. This result complements the existing arguments that the tax deductibility of these benefits has regressive effects when income tax is progressive, because our finding suggests that even *pre-tax* income could be affected, leading to further consumption inequality between the skilled and the less skilled workers.

**Social Insurance for Job Security.** We also study the regulations that improve job security for nonunionized firms. We set the job destruction rate of nonunionized firms to the value halfway between the baseline $\delta_{x,u}$ and $\delta_{x,n}$ where $\delta_{x,u} < \delta_{x,n}$.[46,47] This is intended to capture the stricter enforcement of workplace job safety (for example, Occupational Safety and Health Administration (OSHA) regulations) or stricter employment protection. Column (5) of Table 5 shows that the equilibrium impact of this policy change is similar to that of universal social insurance; it reduces the union density, thus reducing the average wage and increasing the wage inequality. Better job security lowers unemployment and increases output, but labor productivity decreases due to the larger reduction in the unemployment rate for low-skilled workers.

**Insurance Quality.** Finally, we consider the counterfactual in which nonunionized firms gain an advantage in providing insurance, assuming they are able to negotiate better terms with insurance companies. Indeed, nonunionized firms are increasingly offering benefits like defined contribution pensions. We implement this by reducing the fixed cost of insurance provision of only nonunionized firms by one-third.

Column (6) of Table 5 shows that firms find unionization less attractive, resulting in lower union density, which in turn leads to higher wage inequality. Nonunionized firms can offer cheaper insurance, increasing the insured rate among nonunionized workers. Since some unionized firms offering insurance gain an incentive to deunionize to save insurance costs,

[46] This is equivalent to about 7% reduction in the job destruction rate for nonunionized firms.

[47] To account for the potential cost of providing better job security for firms, we assume that nonunion firms incur 5% of the union fixed cost $FC_{union}$, or about \$1,000 per quarter, through reduced output. We confirmed that qualitative patterns are not sensitive to this adjustment.

the remaining unionized firms are less likely to offer insurance.

## 6.4 Long-run Implications

While our analysis so far shows the importance of social insurance expansions in the recent U.S. economy, to gain the quantitative relevance of social insurance on the determinants of the size of labor unions, we can also use our model to investigate the relative importance of the historical expansions of social insurance policies with other relevant factors leading to the decline in unions. Motivated by our empirical evidence, we focus on the implementation and expansion of Medicare and Medicaid.[48] Moreover, following the literature, we evaluate skill-biased technological changes that favor high-skill workers and the adoption of the Right-to-Work laws.

### 6.4.1 Model Extension and Estimation for the 1955 Economy

To understand the causes of the union decline over the past half century, we estimate our model targeting the 1955 economy similarly to Section 5 using the data from the early years. We introduce two extensions, with details provided in Appendix J. First, to explore the role of Medicare, we introduce retirement and allow firms to provide insurance after retirement. Specifically, we assume that workers retire with an exogenous probability and retired individuals die with an exogenous probability. Whenever a worker retires, the same type of worker newly enters the labor market as an unemployed worker. In the absence of Medicare, retired individuals get access to health insurance only if they get it from their employers before retirement. Second, we assume RTW laws make it easier to prevent unionization, capturing the idea that under RTW laws, workers can attempt to free-ride on others' unionization efforts.

### 6.4.2 Decomposition of the Union Decline in the U.S. During 1955-2019

We simulate technological changes, social insurance expansion, and RTW laws that occurred between 1955 and 2019 as discussed below.[49]

As detailed in Appendix J, we model skill-biased technological changes that change the relative productivity of the two skill types, $(z_l, z_h)$, together with the fraction of each skill type $(N_l, N_h)$ in the workforce. In our framework, it sets two counteracting forces in motion. From the firm's perspective, the relative decline in the productivity of low-skilled workers

[48]Note that we underestimate the effect of social insurance programs by ignoring many programs that were expanded in the last half century: these include, but are not limited to, the implementation of the OSHA in 1970 and various subsidies programs for employer-provided benefits.

[49]We choose 2019 instead of 2007 used in our estimation in Section 5 because various states implemented RTW laws and expanded Medicaid since 2007.

Table 6: Deunionization by Technological Change, Social Insurance, and RTW Laws

| | Tech Change | Social Insurance | RTW Laws |
|---|---|---|---|
| Contribution (%) | 32.1 | 14.8 | 6.8 |

*Note*: This table reports the fraction of the decline in union density between 1955 and 2019 explained by skill-biased technological changes (Tech change), social insurance, and RTW laws.

is costly for unionized firms, which more heavily employ low-skilled workers, leading to the decline in unions. From the workers' perspective, technological change exacerbates the wage disparity between skill types, making low-skill workers more desperate for unionization and increasing the union threat costs for firms that aim to prevent unionization.

Moreover, to simulate effects of social insurance expansions through Medicare and Medicaid, we assume that in the 1955 economy, unemployed workers had no access to public insurance, and retired workers had access to retiree health insurance only through previous employers. The introduction of Medicare provides insurance coverage to retired workers, while the introduction and expansion of Medicaid partially provide insurance coverage to the unemployed.

RTW laws undermine the sustainability of unions by allowing workers to be covered by collective bargaining without paying union dues. We capture their impact in a reduced-form fashion by introducing a cost parameter $c_{RTW}$ that reduces the probability of unionization as described in Appendix J.

We ask how much each of the three factors separately accounts for the observed decrease in union density from about 36% in 1955 to 6.6% in 2019. Table 6 shows that 32.1% of the observed decline in union density since 1955 can be attributed to skill-biased technological change, while the introduction and expansion of social insurance account for 14. 8% of the decline. Lastly, 6.8% of the decline can be explained by the implementation of RTW laws.

#### 6.4.3 Discussions

While the above finding is specific to the U.S. economy, several countries have also experienced a union decline.[50] Our finding of the role of social insurance expansions as a cause of union decline in the U.S. complements the existing arguments. For instance, both the United Kingdom and Australia saw significant declines in unionization despite implementing universal social insurance programs long before these declines began. Unlike the

[50] In contrast, many European countries maintain stable union density, especially in terms of collective bargaining coverage, even though they have experienced similar technological changes. This stability may reflect institutional differences, such as sectoral or national-level bargaining structures, all of which mitigate the interactions between union membership, social insurance, and technological change.

Table 7: Interaction of social insurance and technological changes

| | Impact of Technological Change | | | | |
|---|---|---|---|---|---|
| | Baseline | SI | Full SI | UI | Full SI + UI |
| Union density (p.p. change) | -8.66 | -5.19 | -3.07 | -5.39 | -8.14 |
| Worker welfare (% change) | | | | | |
| All workers (ex-ante) | 3.61 | 3.76 | 4.10 | 4.86 | 5.87 |
| Low-skill | -23.40 | -22.39 | -21.95 | -21.68 | -19.81 |
| High-skill | -1.38 | -1.67 | -1.62 | -1.40 | -0.74 |

*Note*: This table reports the impact of simulating skill-biased technological changes in the 1955 economy in the baseline economy, the economy with Medicare and Medicaid (SI), and universal health insurance (Full SI), the economy with 5% more income for the unemployed (UI), and the economy with universal health insurance and more generous UI (Full SI + UI).

U.S., their union decline primarily occurred after 1980, consistent with skill-biased technological change (Acemoglu and Autor, 2011). Canada provides another interesting case. Although the public-sector union in Canada has been highly stable, the private one has steadily declined since the mid-twentieth century.[51] In particular, as shown in Troy (1992), the private-sector union density declined relatively steeply from 34% in 1958, when the universal health care was introduced, to 31% in 1965, and further down to 26% in 1975, which is consistent with our argument about the deunionization effect of social insurance expansion. Additionally, in line with skill-biased technological change, the private-sector union density in Canada has been decreasing in recent years as well, although at a slower pace than in the U.S. (Morissette, 2022).

# 7 Welfare Implications

## 7.1 Effects of Technological Changes

Given the insurance role of unions we have demonstrated so far and the downward pressure of skill-biased technological changes on unions, we explore what social insurance can do to the economy in the process of technological changes. Specifically, we start from the baseline economy in 1955 used in Section 6.4 and the ones with social insurance of various generosity, simulate technological changes in each of these economies, and compare the impact on unionization and welfare across these economies.

Table 7 reports the results. The first column shows the impact of skill-biased technological changes in the baseline economy in 1955. As we demonstrated in the previous section, skill-biased technological changes induce a large decline in union density of 8.66 p.p. Low-skilled

[51] Morissette (2022) uses the Labor Force Survey and reports that, in 2022, the union density is 61.6% in the public sector while it is 15.2% in the private sector.

workers experience a sizable welfare loss, partly because they become less productive due to technological changes and partly because the decline of unions implies less protection in terms of both insurance and wages/employment. High-skilled workers become more productive, but they also experience a slight welfare loss due to the increase in the supply of high-skilled workers. Although worker welfare declines for each skill type, overall ex-ante worker welfare for the whole economy increases because the composition of workers shifts toward high-skill (high-wage) workers.[52]

The second column reports the impact of skill-biased technological changes in the economy with Medicare and Medicaid. In particular, by substituting the insurance role of unions, social insurance alleviates the response of unions to technological changes. Specifically, the union density decreases by 5.19 p.p. instead of 8.66 p.p. in the baseline. At the same time, the worker welfare gain from technological changes slightly increases by 0.15 p.p. overall. If we focus on low-skilled workers, who are particularly damaged by the decline of unions, the welfare loss from technological changes decreases by about 1 p.p.

As reported in the third column, we obtain further protection for low-skilled workers from even more generous social insurance that universally provides health insurance. In addition, the fourth column shows that a more generous UI, which increases the consumption of the unemployed by 5%, similarly protects low-skilled workers from technological changes and increases the gain from technological changes.

In the last column, we study the impact of skill-biased technological changes in the economy with universal health insurance and more generous UI, the combination of the previous two columns. Although the impact on union density is similar to the baseline, the generous social insurance makes the decline even less damaging to workers, further improving the gain from technological changes.

Overall, our analysis suggests that while technological changes reduce the access to health insurance due to the decline in unions, which harms workers, social insurance mitigates this effect, making technological changes more beneficial by compensating for the loss of union-provided insurance.

[52]Welfare is calculated as a consumption equivalent. Letting $V_{low}$ and $V_{high}$ be the expected value of low-skill and high-skill workers, respectively. For the ex-ante welfare impact, we consider the ex-ante value $V = pV_{low} + (1-p)V_{high}$, where $p$ is the probability of being a low-skill worker, and calculate the proportional change in consumption in the baseline economy that makes workers indifferent between the baseline and counterfactual economies in terms of the ex-ante value $V$. The simulation of technological changes increases the share of high-skill workers, which directly affects the ex-ante value through the weights put on the value of each worker type.

Table 8: Welfare Impact of Union Subsidies

| | Baseline | SI for all | Targeted SI | Job security | Insurance subsidy | Insurance quality |
|---|---|---|---|---|---|---|
| Union density (p.p. change) | 15.61 | 10.80 | 13.41 | 13.07 | 13.47 | 10.20 |
| Worker welfare (% change) | | | | | | |
| All workers (ex-ante) | 0.25 | 0.19 | 0.21 | 0.21 | 0.23 | 0.18 |
| Low-skill | 0.77 | 0.58 | 0.64 | 0.69 | 0.75 | 0.56 |
| High-skill | -0.11 | -0.09 | -0.09 | -0.11 | -0.12 | -0.09 |
| Social welfare (% change) | -0.43 | -0.36 | -0.44 | -0.43 | -0.41 | -0.42 |

*Note*: This table reports the impact of the union subsidy on union density, worker welfare, and social welfare in each counterfactual economy.

## 7.2 Subsidizing Labor Unions

Based on the above findings, we explore the impact of unionization on worker and social welfare. We provide a subsidy for unionization covering one-third of the union's fixed cost to enhance unions and simulate its impact in various model environments. The welfare effect on workers is measured by the percent change in consumption in the baseline economy that makes a worker indifferent between the baseline and a counterfactual economy. The effect on social welfare is measured by changes in worker's welfare while uniformly redistributing the change in firms' profits and government revenue to workers.

Table 8 reports the welfare impact of the union subsidy. The union density increases by about 10-16 p.p. Interestingly, union subsidies lead to limited welfare gains for workers when there are more generous social insurance programs. Because social insurance programs provide valuable insurance protection, even low-skilled workers benefit less from labor unions. Consequently, even if the government prioritizes low-skilled workers sufficiently, more active labor union policies are less effective, leading to limited welfare gain.

# 8 Conclusion

In this paper, we study the equilibrium implications of interactions between labor unions and social insurance. We provide evidence that the expansion of social insurance programs reduces unionization rates in the United States. Then, we develop and estimate an equilibrium model of labor unions, where employers' insurance provisions and union formation are both endogenously determined. We show that unionization, along with the possibility of unionization, significantly increases employer-provided insurance provisions both in unionized and nonunionized firms. Throughout counterfactual policy experiments, we find that social insurance policies can significantly impact unionization and labor market outcomes, such as ESHI provision and wage inequality. Interestingly, whether inequality increases or decreases depends on how social insurance is targeted. Subsidizing employer-based insurance provisions can also lower union density and consequently increase wage inequality. The historical expansion of social insurance programs can account for about 15% of union decline in the U.S. These programs still provide valuable protection to workers, especially in response to the decline in labor unions due to technological changes. From the perspective of a utilitarian government, subsidizing unions generates welfare gains for low-skilled workers, but the gain is much modest with the presence of generous social insurance programs.

We believe that the framework developed in this paper can be useful for studying a variety of other important issues associated with labor unions as well. First, unions also facilitate the provisions of other non-wage benefits (e.g., female friendly amenities, Corrandini et al., 2024). Our framework is useful to examine their labor market implications and interactions with labor market regulations. Second, regarding interactions with social insurance, while we focus on unions' role in shaping employer-provided insurance, unions may also influence access to public insurance. In some European countries, such as those with the Ghent system, unions administer unemployment insurance programs. In Sweden, there is an ongoing debate about whether reductions in social insurance benefits have contributed to lower unionization rates (Kjellberg, 2011). Even in the United States, unions may facilitate the take-up of unemployment insurance benefits (Lachowska et al., 2022). Enriching our framework along this dimension would allow for studying richer interaction patterns between unions and social insurance. Finally, one can also extend our framework to study other channels that unions may impact, such as firms' entry decisions and technology choices (e.g., Holmes, 1998).

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# Online Appendix (Not For Publication)

## A Sectoral Shifts and Union Declines

This section calculates how much sectoral changes can potentially account for the decline in unions. We calculate the following counterfactual union density given by $union_t^{CF} = \sum_{i \in \mathcal{I}} \omega_{i,1983} \times union_{i,t}$ where $\omega_{i,1983}$ is the share of sector $i$ (defined over one-digit industry) in 1983 and $union_{i,t}$ is the union membership density in sector $i$ in year $t$. $union_t^{CF}$ represents the counterfactual aggregate union density calculated as if the employment share of each sector had remained constant at its 1983 levels. We use workers in the private sector from the CPS 1983-2019.

Figure A.2 displays the actual and counterfactual union density over time. The counterfactual union density is higher, suggesting that the sectoral employment shifts indeed have contributed to the decline in unions. However, it also shows that the contribution is quantitatively small. For example, in 2019, the difference is just 0.4 p.p.

## B Labor Unions and Job Security

We study how the union membership of a worker is related to subsequent job loss using the sample of workers from the SIPP. We estimate the following regression equation:

$$Job\ loss_{it} = \beta \cdot Union_{it} + x_{it}'\gamma + \eta_{s(i)} + \mu_t + \epsilon_{it}, \tag{A1}$$

where the outcome variable $Job\ loss_{it}$ is an indicator that takes value 1 if worker $i$ loses a job from month $t$ to month $t+1$. We are interested in the coefficient $\beta$ of $Union_{it}$ that is an indicator for union membership in month $t$. Although we observe employment status in each month, union membership is asked only once at the end of each wage that consists of 4 months. A worker reports union status in a firm for which the worker worked for the longest hours during a wave. We control for demographic variables such as age, sex, race, and education. We also control for state fixed effects $\eta_{s(i)}$ and time fixed effects $\mu_t$. $\epsilon_{it}$ is an error term.

Table A.1 reports the estimated coefficients. The first two columns suggest that the monthly job-losing probability is smaller for union workers by 0.2 p.p., which is sizable given the overall monthly job-losing probability of 0.7%. Columns (3) and (4) suggest that the coefficient is much larger (in absolute value) for low-skill workers.

# C Health Insurance After Retirement

We use the HRS to examine the relationship between union membership and retirement coverage of an ESHI plan at the individual level in recent years. Using the sample of employed workers aged 65 or younger, we estimate the same linear probability model as in Section 3.1.2.

Table A.2 reports the estimated coefficients. 15.2% of workers in the sample have an ESHI plan that provides retirement coverage after age 65. Columns (1) and (2) show that union workers are 12.5 p.p. more likely to be covered by such a plan without covariates and 10 p.p. more likely with covariates. Column (3) shows that once we control for individual fixed effects, the coefficient is statistically insignificant. This might partly be due to the limited mobility of workers between union and nonunionized firms for relatively old workers in the HRS. Furthermore, since we rely only on variations in the union status of workers moving between union and nonunionized firms, once we control for individual fixed effects, there might be some selection issues. For example, union workers might be willing to move to nonunionized firms only if access to insurance is guaranteed. To further explore, we make a distinction between the move from unionized firms to nonunionized firms and from nonunionized firms to unionized firms. Column (4) indicates that the move from union to nonunionized firms is not necessarily associated with the loss of coverage, whereas the move from nonunion to unionized firms is associated with a statistically significant 7.9 p.p. increase in coverage. This result suggests that the decline of unions could reduce a worker's opportunities to get access to retirement coverage through switching to unionized employers, which is consistent with the decline in retirement coverage in recent years.

# D Additional Empirical Evidence

## D.1 Medicare and Medicaid: Results from Election Data

We provide additional evidence on the impact of Medicare and Medicaid using the data on NLRB elections obtained from Sojourner and Yang (2022).[1]

**Medicare.** We first use the same specification as the regression equation (2) but use the log of the number of elections as the outcome variable. The election data is available starting from 1962. Figure A.6 displays the estimated coefficients of equation (2) where the outcome

[1] Hirsch et al. (2001) provide the database at https://www.unionstats.com/MonthlyLaborReviewArticle.htm. (last accessed March 11, 2024)

variable is the log of the number of elections.[2] Panel (a) shows the results where the treatment is Blue Cross coverage in 1963, while panel (b) shows the case where the treatment is any insurance coverage in 1963. The figure confirms the previous result in the main text based on union density that regions with larger insurance coverage prior to the introduction of Medicare experienced a larger decline in union elections. However, we also find a significant pre-trend in 1962 and 1964.

To address potential confounding factors generating the pre-trend, we plot the same event study separately for the low-exposure group and the high-exposure group. The low-exposure group consists of states with Blue Cross coverage in 1963 below the median, while the remaining states are the high-exposure group. Figure A.7 shows that in each group, there are no significant pre-trends, and we also detect significant policy impacts among the low-exposure group.

**Medicaid.** Similarly, we revisit the event study analysis for Medicaid using the log of the number of elections as the outcome variable. Consistent with the finding in the main text, Figure A.8 shows that the implementation of Medicaid results in significantly fewer union elections. Furthermore, we do not find significant pre-trends.

## D.2 ACA Medicaid Expansion

We use the CPS sample and the variation in the ACA Medicaid expansion across states to estimate the impact of the expansion on union membership. We focus on states that expanded Medicaid in January 2014 or never expanded during the sample period. Our empirical specification is

$$Union_{ist} = \beta \cdot (ACA\ Medicaid)_{st} + x'_{ist}\gamma + \alpha_s + \lambda_t + \epsilon_{ist}, \quad \text{(A2)}$$

where $i$ is the individual, $s$ is the state, $t$ is the year, $Union_{ist}$ is an indicator that takes 1 if individual $i$ in state $s$ is a union member at $t$, $(ACA\ Medicaid)_{st}$ is an indicator that takes 1 if state $s$ has expanded Medicaid coverage in $t$. $x_{ist}$ is a vector of time-variant covariates, including age, education, gender, race, year-specific dummies for industries and occupations, the same set of political variables used in the analysis of Medicare and Medicaid introduction, and indicators for a time before/after the passage of the RTW laws. $\alpha_s$ and $\lambda_t$ are the state and time fixed effects. To focus on those who are likely to be affected by the expansion,

[2] In the regression using union density, we control the share of workers with college education from the CPS. Since education information is not available for the year 1963, we do not control it here. Other covariates are the same as in the regression for union density.

we split the sample into individuals with low education (high school or less), who are more likely to be eligible due to low income, and high education, who are less likely to be eligible.

Table A.4 reports the estimation result. In Column (1), we report the result where we used all individuals in the sample. 12% of individuals are union members, and the ACA Medicaid expansion decreased the union density by 0.3 percentage points, although the coefficient is not statistically significant. Column (2) shows that the expansion had a statistically significant impact on low-education individuals, decreasing union members among them by 0.5 p.p., which is about 5% decrease in union membership given that 10% of individuals in this sample were union members. In contrast, the expansion had almost no impact on high-education individuals, as indicated by the last column. Figure A.10 in Online Appendix shows an event study plot consistent with these results, which also shows there is no pre-trend.

## D.3 Unemployment Insurance

We use variations in UI generosity across states and over time to estimate the impact of UI generosity on union membership. We use the CPS 2000-2019 to estimate the following specification.

$$\mathit{Union}_{ist} = \beta \cdot (\mathit{Replacement\ rate})_{ist} + x'_{ist}\gamma + \eta_s + \mu_t + \varepsilon_{ist}, \tag{A3}$$

where $i$ is the individual, $s$ is the state, $t$ is the year, $\mathit{Union}_{ist}$ is an indicator that takes the value one if individual $i$ in state $s$ is a union member at $t$, $\mathit{Replacement\ rate}_{ist}$ is the UI replacement rate, calculated at the weekly benefit amount divided by the weekly wage, for worker $i$ in state $s$ at time $t$, $x_{ist}$ is a vector of time-variant covariates, $\eta_s$ is state fixed effects, $\mu_t$ is year fixed effects, and $\varepsilon_{ist}$ is an error term.

Table A.5 reports the estimation result of equation (A3). We find a statistically significant impact of the UI replacement rate on union membership. Specifically, if UI becomes generous in terms of replacement rate by 10 p.p., an individual is less likely to be a union member by 2.1 p.p. Columns (2)-(4) indicate that these patterns remain even after we control for UI maximum duration, the RTW laws, and political variables that we used for the analysis of Medicare introduction.

# E Impact of Right-to-Work Laws on Unionization

This section first presents the effect of RTW on union membership by following Fortin et al. (2022) and then presents its impact on union elections.

## E.1 Individual Union Membership

To examine the impact of RTW laws on union membership, we estimate the following event-study specification using the CPS data:

$$Union_{ist} = \sum_{\tau=-5,\neq-1}^{4} \beta_\tau \mathbb{1}_{\{t-E_s=\tau\}} + \beta_{-6} \mathbb{1}_{\{t-E_s \leq 6\}} + \beta_{+5} \mathbb{1}_{\{t-E_s \geq 5\}} + x'_{ist}\gamma + \alpha_s + \epsilon_{ist} \qquad \text{(A4)}$$

where $Union_{ist}$ is a union membership for individual $i$ at state $s$ in time $t$. $E_s$ represents the timing of events (i.e., passage of RTW laws) in state $s$. $x_{ist}$ is a vector of covariates, including ages, education, sex, race, year-by-industry dummies, year-by-occupation dummies, and month fixed effects. We control for an indicator for ACA Medicaid expansion in state $s$ and control for political variables, including an indicator for a Democratic governor, the cubic polynomial function for the share of state legislative seats held by the Democratic party, separately for state senate and house. $\alpha_s$ are state fixed effects. We cluster standard errors at the state level.

Panel (a) of Figure A.11 displays the estimated coefficients and the 95% confidence intervals. Overall, the RTW laws reduced union membership by 2 p.p., consistent with Fortin et al. (2022) although our specification is not exactly the same since we control for the ACA Medicaid expansion and variables capturing state political environment. We detect a slight indication of pre-trend in four years before the event.

## E.2 Union Elections

Next, we investigate the impact of RTW laws on union elections using the NLRB election data. Specifically, we estimate the following event-study specification:

$$y_{st} = \sum_{\tau=-5,\neq-1}^{4} \beta_\tau \mathbb{1}_{\{t-E_s=\tau\}} + \beta_{-6} \mathbb{1}_{\{t-E_s \leq 6\}} + \beta_{+5} \mathbb{1}_{\{t-E_s \geq 5\}} + x'_{st}\gamma + \alpha_s + \lambda_t + \epsilon_{st} \qquad \text{(A5)}$$

where $y_{st}$ is the outcome in state $s$ in time $t$. $E_s$ represents the timing of events. $x_{st}$ is a vector of state-level covariates, including an indicator for ACA Medicaid expansion and the political variables. $\alpha_s$ and $\lambda_t$ are state fixed effects and year fixed effects. We cluster standard errors at the state level. We use the inverse hyperbolic sine (IHS) transformation of the number of elections in state $s$ in time $t$ as an outcome $y_{st}$.[3]

Panel (b) of Figure A.11 displays the estimated coefficients and their 95% confidence intervals. The estimated coefficient at $\tau = 0$ suggests that RTW laws reduce the number of union elections by 25% upon the introduction, but the estimated coefficients are not significant after that. This result thus suggests that the negative effect on the union density may happen through the deunionization of unionized firms, instead of the reduction of union formation.

# F Model Appendix

## F.1 Expected Value of a Match for Workers

In the main text, we mentioned the expected value of a match depends on the equilibrium distribution of vacancies posted by different firms. Formally, the value of meeting a firm is given by

$$\begin{aligned}\mathbb{E}\left[\max\{V^E_{x,y,k}(w_{x,y,k},a),V^U_x\}\right] = \sum_{y\in\mathcal{Y}}\Omega_{x,y}\sum_{a\in\mathcal{A}}\Big[&\mathcal{Q}_y P_{y,u}(a)\max\{V^E_{x,y,u}(w_{x,y,u},a),V^U_x\}\\ &+(1-\mathcal{Q}_y)P_{y,n}(a)\max\{V^E_{x,y,n}(w_{x,y,n},a),V^U_x\}\Big],\end{aligned} \tag{A6}$$

where $\Omega_{x,y} = \nu_{x,y}M_y/\sum_{y'\in\mathcal{Y}} v_{x,y'}M_{y'}$ is the fraction of vacancies in sub-market $x$ posted by type-$y$ firms. A worker of type $x$ meets a vacancy posted by a firm of type $y$ with probability $\Omega_{x,y}$; and among them, the fraction $\mathcal{Q}_y$ given by equation (16) is unionized while the remainder $1-\mathcal{Q}_y$ is not unionized; $P_{y,k}(a)$ is the fraction of firms providing amenity $a$ among type-$y$ firms with union status $k$ given by equation (15).

## F.2 Aggregate Willingness to Pay for (Non)Unionization

This section provides formal definitions of the aggregate willingness to pay for (non)-unionization that matters for the cost functions (6) and (7) in the main text. We first define the willingness to pay for unionization or nonunionization for each worker type, and then we aggregate it to the firm level.

First, let $w_{x,y,u}(\boldsymbol{g},a)$ and $w_{x,y,n}(\boldsymbol{g},a)$ be the union and nonunion wage schedules for a type-$x$ worker in a type $y$ firm with amenity $a$, determined in the bargaining problems (18) and (19), respectively.

[3] In the analysis of the introduction of Medicare and Medicaid, we just used the log of the number of elections since there were no zeros in the data during that time period. Since the data for recent years have zeros for some states, we use the IHS transformation to handle zeros.

We now define each worker's *willingness to pay for unionization*. Let $\mathcal{W}_{x,y,n}(\boldsymbol{g}, a)$ denote the willingness of a type-$x$ worker in a type $y$ nonunionized firm with amenity $a$ to pay for unionization. It is implicitly determined by

$$V^E_{x,y,u}(w_{x,y,u}(\boldsymbol{g}, a), a) = V^E_{x,y,n}(w_{x,y,n}(\boldsymbol{g}, a) + \mathcal{W}_{x,y,n}(\boldsymbol{g}, a), a) \tag{A7}$$

where $V^E_{x,y,u}(\cdot, \cdot)$ is defined in (4). $\mathcal{W}_{x,y,n}(\boldsymbol{g}, a)$ can be either positive or negative, and it gives the amount of consumption a type-$x$ worker needs to be compensated for staying nonunionized in a type-$y$ firm with amenity $a$. The firm-level aggregate willingness to pay for union in a nonunionized firm is then given by

$$\mathcal{W}_{y,n}(\boldsymbol{g}, a) = \sum_x \mathcal{W}_{x,y,n}(\boldsymbol{g}, a) \times g_x. \tag{A8}$$

Similarly, let $\mathcal{W}_{x,y,u}(\boldsymbol{g}, a)$ denote the amount of consumption a type-$x$ worker in a unionized firm needs to be compensated if the union were to be disbanded, which we refer to as the *willingness to accept de-unionization*. It is defined implicitly by

$$V^E_{x,y,u}(w_{x,y,u}(\boldsymbol{g}, a) + \mathcal{W}_{x,y,u}(\boldsymbol{g}, a), a) = V^E_{x,y,n}(w_{x,y,n}(\boldsymbol{g}, a), a). \tag{A9}$$

Again, it can be either positive or negative. Then, we define the firm-level aggregate willingness to accept de-unionization for all the workers in a unionized firm as

$$\mathcal{W}_{y,u}(\boldsymbol{g}, a) = \sum_x \mathcal{W}_{x,y,u}(\boldsymbol{g}, a) \times g_x. \tag{A10}$$

## F.3 Alternative Formulation of the Union Cost Function

Given that a voting outcome, in reality, depends on whether a simple majority is in favor of a union, a natural alternative approach would be to let the cost function depend on the excess number of voters in favor of the union. We argue below that this approach yields the same cost function as the baseline case under some additional assumptions.

Suppose workers draw i.i.d. taste shocks $\upsilon$ for unionization from a CDF $H$. Let $\Delta_{x,y,n}(\boldsymbol{g}, a) = V^E_{x,y,u}(w_{x,y,u}(\boldsymbol{g}, a), a) - V^E_{x,y,n}(w_{x,y,n}(\boldsymbol{g}, a), a)$ be the value gain from unionization. Note that if the utility function is quasilinear in $w$, then $\Delta_{x,y,n}(\boldsymbol{g}, a)$ equals the willingness to pay for unionization $\mathcal{W}_{x,y,n}(\boldsymbol{g}, a)$. To see that, letting $u_x(w, a) = w + f_x(a)$

and using the expression (4), we can rewrite equation (A7) as

$$V^E_{x,y,u}(w_{x,y,u}(\boldsymbol{g},a),a) = w_{x,y,n}(\boldsymbol{g},a) + \mathcal{W}_{x,y,n}(\boldsymbol{g},a) + f_x(a) \\ + \gamma[\delta_{x,n}V^U_x + (1-\delta_{x,n})V^E_{x,y,u}(\tilde{w}_{x,y,n},\tilde{a}_{x,y,n})]. \tag{A11}$$

where the right-hand side is the value of nonunion employment and $(\tilde{w}_{x,y,n},\tilde{a}_{x,y,n})$ is the equilibrium future wages and amenities. This implies $\mathcal{W}_{x,y,n}(\boldsymbol{g},a) = \Delta_{x,y,n}(\boldsymbol{g},a)$.

A type-$x$ worker votes for unionization if $\Delta_{x,y,n}(\boldsymbol{g},a) - \upsilon > 0$. Then, the excess number of workers in favor of unionization is given by

$$N_{y,n}(\boldsymbol{g},a) = \sum_x g_x[H(\Delta_{x,y,n}(\boldsymbol{g},a)) - 0.5], \tag{A12}$$

where $H(\Delta_{x,y,n}(\boldsymbol{g},a))$ is the fraction of type-$x$ workers in favor of unionization. Note that $N_{y,n}(\boldsymbol{g},a) \geq 0$ means a majority of workers are in favor of unions. Given this, the alternative formulation of the union threat cost is $\tilde{C}_{y,n}(\boldsymbol{g},a) = \tilde{c}_0 \max\{0, N_{y,n}(\boldsymbol{g},a)\}$.

Note that the difference between this version and the baseline specification is the difference between $H(\Delta_{x,y,n}(\boldsymbol{g}),a) - 0.5$ and $\mathcal{W}_{x,y,n}(\boldsymbol{g},a)$. The two cases are equivalent if the utility function is quasilinear in $w$ and if we impose the following linear approximation to the CDF $H$: $H(x) = hx + 0.5$. With these assumptions, we have $H(\Delta_{x,y,n}(\boldsymbol{g}),a) = h\mathcal{W}_{x,y,n}(\boldsymbol{g},a)$, and then $\tilde{C}_{y,n}(\boldsymbol{g},a) = \tilde{c}_0 h \max\{0, \sum_x g_x \mathcal{W}_{x,y,n}(\boldsymbol{g},a)\}$. Letting $c_0 = \tilde{c}_0 h$, this is equivalent to the baseline formulation of the union threat cost. In other words, the baseline specification can be interpreted as a special case of the voting model above with an assumption on taste shocks for workers.

## F.4 Equilibrium Condition for Labor Market Tightness

This section describes how labor market tightness $\theta$ is determined in a steady-state equilibrium. First, note that, given tightness $\theta$, firms decide on the optimal hiring, which leads to the following total mass of workers hired by firms:

$$\bar{g}_x(\theta) = \sum_{y=1}^{Y} M_y \sum_{a \in \boldsymbol{\mathcal{A}}} [\mathcal{Q}_y P_{y,u}(a) g_{x,y,u}(a;\theta) + (1-\mathcal{Q}_y) P_{y,n}(a) g_{x,y,n}(a;\theta)],$$

where we now let $g_{x,y,k}$ explicitly depend on $\theta$. The optimal hiring decisions of firms give us a relationship between a mass of unemployed workers and market tightness: $\mathcal{U}^{JC}_x(\theta) = N_x - \bar{g}_x(\theta)$ for each $x$. We use the superscript $JC$ (shorthand for "job creation") to emphasize that $\mathcal{U}^{JC}_x(\theta)$ reflects the optimal job creation decisions.

On the labor supply side, let $s_x(\theta)$ be the steady-state mass of type-$x$ job seekers at the beginning of a period. For each $x$, we have $\sum_{k\in\{u,n\}} \delta_{x,k}\bar{g}_{x,k}(\theta) = s_x(\theta)p(\theta_x)$ where the left-hand side is the flow into unemployment and the right-hand side is the flow-out of unemployment.[4] $\bar{g}_{x,k}$ is the mass of workers hired by firms with union status $k$. They are given by $\bar{g}_{x,u}(\theta) = \sum_{y=1}^{Y} M_y \mathcal{Q}_y \sum_{a\in\mathcal{A}} P_{y,u}(a) g_{x,y,u}(a;\theta)$ and $\bar{g}_{x,n}(\theta) = \sum_{y=1}^{Y} M_y(1-\mathcal{Q}_y)\sum_{a\in\mathcal{A}} P_{y,n}(a)g_{x,y,n}(a;\theta)$. Given $s_x(\theta)$, we obtain the mass of unemployed workers (after firms make their hiring): $\mathcal{U}_x^{BC}(\theta) = (1-p(\theta_x))s_x(\theta) = \frac{1-p(\theta_x)}{p(\theta_x)}\sum_{k\in\{u,n\}}\delta_{x,k}\bar{g}_{x,k}(\theta)$. The function $\mathcal{U}_x^{BC}(\theta)$ represents the mass of unemployed workers of skill $x$ that equalizes flows into and out of unemployment given tightness $\theta$, and $BC$ is shorthand for "Beverage curve." Note that both $\mathcal{U}_x^{JC}(\theta)$ and $\mathcal{U}_x^{BC}(\theta)$ are the mass of unemployed workers after matches are formed in the frictional labor markets and before jobs are destructed at the end of a period. Equilibrium market tightness is pinned down by $\mathcal{U}_x^{BC}(\theta) = \mathcal{U}_x^{JC}(\theta) \quad \text{for all } x \in \mathcal{X}$.

# G Numerical Algorithm

In this section, we lay out our numerical algorithm to solve for the equilibrium.

1. Provide an initial guess of a vector of market tightness, $\theta$, wages $w_{x,y,k}(a)$ for each $x, y, k, a$, union probability $Q_y$, insurance provision probability given union status $P_{y,k}$.
2. Solve for worker value functions by the value function iteration.[5]
3. Solve firm problems for each firm type and get $(w^*_{x,y,k}(a), Q^*_y, P^*_{y,k}, g^*_{x,y,k}(a))$:

    a. Solve the bargaining problems. Discretize the space of $\boldsymbol{g}$ and approximate the partial derivatives by finite differences. Iterate the first-order conditions until wages converge. Obtain $w^*_{x,y,k}(\boldsymbol{g}, a)$ and $w^*_{x,y,k}(\boldsymbol{g}, a)$.
    b. Given the numerically solved wage functions, solve the firm hiring problem for each union status and insurance status. Obtain $g^*_{x,y,k}(a)$ and $w^*_{y,x,k}(a)$, which is the wage functions evaluated at the optimal hiring.
    c. Compute insurance provision probability and union probability $(Q^*_y, P^*_{y,k})$.

4. Update wages, union probability, and insurance provision based on the solution in 3 as follows: $w^{new}_{x,y,k}(a) = \omega_w w^*_{x,y,k}(a) + (1-\omega_w)w_{x,y,k}(a)$, $g^{new}_{y,x,k}(a) = \omega_g g^*_{x,y,k}(a) + (1-\omega_g)g_{x,y,k}(a)$, $Q^{new}_y = \omega_Q Q^*_y + (1-\omega_Q)Q_y$, and $P^{new}_{y,k} = \omega_P P^*_{y,k}(a) + (1-\omega_P)P_{y,k}(a)$, where $\omega_w, \omega_g, \omega_Q, \omega_P \in (0, 1]$ are weights for facilitating convergence.

[4] One can get this by imposing the steady state condition on $s'_x = (1-p(\theta))s_x + \sum_k \delta_{x,k}\bar{g}_{x,k}(\theta)$ where $s'_x$ is the mass of job seekers in the next period.

[5] In our estimated structural model, workers face medical expenditure shocks. We numerically integrate to calculate the worker's expected utility.

5. Compute $\mathcal{U}_x^{BC}(\theta)$ and $\mathcal{U}_x^{JC}(\theta)$ based on $(w_{x,y,k}^{new}(a), Q_y^{new}, P_{y,k}^{new}, g_{x,y,k}^{new}(a))$.
6. Update market tightness. Increase $\theta_x$ if $\mathcal{U}_x^{BC}(\theta) > \mathcal{U}_x^{JC}(\theta)$ and otherwise decrease $\theta_x$. Specifically, $\log \theta_x^{new} = \log \theta_x + \omega_\theta(\mathcal{U}_x^{BC}(\theta) - \mathcal{U}_x^{JC}(\theta))$ where $\omega_\theta > 0$ is a pre-specified constant chosen for facilitating convergence.

Importantly, the model incorporates sufficient shocks and heterogeneity. It helps us account for the observed heterogeneity in data and makes our algorithm very stable across different parameter configurations.

# H Model with TFP Heterogeneity

In this section, we introduce TFP heterogeneity. Specifically, we let $A_y$ take two values. We assume that one half of establishments are high productive ($A_y = A_H$) and the remaining one are low productive ($A_y = A_L$). Specifically, we let $\bar{A}$ be the average productivity to be estimated, and we calibrate the productivity dispersion by taking values from the literature. We let $A_H$ ($A_L$) is higher (lower) than the average TFP $\bar{A}$ by 14 log points to be consistent with the interquartile range reported by Blackwood et al. (2021). We let the distribution of returns to scale to be specific to each productivity to capture the correlation between productivity and returns to scale. This adds two parameters of the Beta distribution to be estimated. We additionally target employment shares of firms with 10+ and 100+ employees conditional on unionization and ESHI offerings. We show the estimated parameters in Table A.8 and the model fit in Table A.9.

Table A.10 reports the equilibrium impact of social insurance policies. The patterns are similar to the one we obtain for the model without TFP heterogeneity in Section 6. In particular, both the universal health insurance (SI for all) and the targeted social insurance (Targeted SI) reduces union density while the latter results in less ESHI coverage through union decline. Once again, we find that the universal health insurance leads to wage inequality through the decline of unions while the targeted SI shrinks wage inequality through its targeting property.

# I Sensitivity Analysis

We follow Einav et al. (2018) in providing a diagnostic analysis of the relationship between data moments and model parameters by conducting the following perturbation exercise. For each estimated parameter, $\hat{\theta}_n$, we add a perturbation, $\hat{\sigma}_n$, equal to the standard error of $\hat{\theta}_n$, and then simulate the model. We measure the impact of parameter changes by calculating the percentage change in each moment from the baseline value, taking absolute values.

Since we have 10 parameters and 12 moments, this procedure generates a $10 \times 12$ matrix where the $(n, m)$ element indicates the impact of a change in the $n$-th parameter on the $m$-th moment. To facilitate interpretation, we categorize the 12 moments into 5 groups, averaging the results within each group. These five groups are (i) union density (1 moment), (ii) unemployment rate (1 moment), (iii) wages (2 moments), (iv) insurance (4 moments), and (v) firm sizes (4 moments).

Table A.7 shows the result of the perturbation exercise. The first three rows suggest that the three parameters related to the cost of unionization significantly affect union density, and also influence firm sizes. In particular, $\sigma_{union}$ and $c_0$ matter for the firm size distribution of unionized firms. They also impact insurance moments since unionized firm sizes interact with fixed insurance costs, influencing insurance provision. The fourth and fifth rows confirm that the parameters related to insurance provision are crucial for insurance moments. The cost of vacancy posting particularly affects the unemployment rate. Finally, the set of parameters related to production function also matters for the firm size distribution, but due to the fixed cost of insurance, it inherently affects insurance provision as well. TFP, $A$, and relative productivity, $z_1$, impact wages, although other parameters also influence wages.

# J Quantitative Model for the 1955 Economy

## J.1 Quantitative Extension of the Model

To study the contributions of skill-biased technological changes and social insurance expansions to deunionization, we fit the model to the 1955 economy. We extend the baseline model in the main text in a few ways.

First, we incorporate retirement and health insurance after retirement so that we can take into account Medicare. To keep the model tractable, we assume that retirement and subsequent death are stochastic. At the end of each period, a worker is hit by a retirement shock with probability $p_R$, and the worker retires with her job destroyed. If a job destruction shock and a retirement shock hit a worker simultaneously, the worker's move to non-employment is retirement. After retirement, the worker becomes dead with probability $p_D$. The retirement value is given by

$$V_x^R(a) = u_x(c_x^R, a) + \gamma(1 - p_D)V_x^R(a) \tag{A13}$$

where $a$ denotes whether the firm offered ESHI right before retirement, $c_x^R$ is consumption of retired workers, and the value of death is normalized to 0. $c_x^R$ is $b_x$ for workers without ESHI coverage while it is $b_x - c_x$ for workers with ESHI coverage where $c_x$ is the variable cost of insurance provision for employers.[6] In the absence of Medicare, retired people's access to health insurance depends on the insurance provision by the previous employer. We model Medicare by giving all the retired people the access to health insurance.

Given the retirement value, the value of employment is now given by

$$V_{x,y,k}^E(w,a) = u_x(w,a) + \gamma[p_R V_x^R(a_{x,y,k}) + (1-p_R)\delta_{x,k}V_x^U + (1-p_R)(1-\delta_{x,k})V_{x,y,k}^E(w_{x,y,k}, a_{x,y,k})] \tag{A14}$$

and the value of unemployment is now

$$V_x^U = p_x^{Med} V_x^{U,I} + (1-p_x^{Med})V_x^{U,i} \tag{A15}$$

where

$$V_x^{U,I} = p(\theta_x)V_x^M + (1-p(\theta_x))\Big[u_x(b_x, a_i) + \gamma\Big\{p_R V_x^R(0) + (1-p_R)V_x^{U,i}\Big\}\Big] \tag{A16}$$

for $i = I, N$ with $a_I = 1$ and $a_N = 0$ for unemployed workers eligible for Medicaid ($i = I$) and those not eligible for Medicaid ($i = N$), respectively.

The firms' optimization problems and the wage bargaining problems need a slight modification as well. The job destruction rate $\delta_{x,k}$ in these problems is now replaced by $\delta_{x,k} + p_R - \delta_{x,k}p_R$ since retirement results in job destruction. The expressions for wage bargaining are unchanged from the main text, but worker values in bargaining now takes into account workers' future gain from insurance offering by firms.

Whenever a worker retires, the same type of worker newly enters the labor market as an unemployed worker. This slightly changes the Beverage-Curve relationship between market tightness and unemployed workers. Specifically, we have $\mathcal{U}_x^{BC}(\theta) = \frac{1-p(\theta_x)}{p(\theta_x)} \sum_{k=u,n}(p_R + \delta_{x,k} - \delta_{x,k}p_R)\bar{g}_{x,k}(\theta)$.

The second extension is about RTW laws. In practice, RTW laws reduce the sustainabil-

[6] Thus, we assume that employers only provide retirees with access to insurance. Although it is straightforward to modify this assumption so that employers fully cover the premiums, we make this choice because the premiums of retirees' health insurance benefits are paid by workers quite often in practice. For example, Fronstin (2000) reports that about 30-50% of the large employers in 1997-1999 required retirees to pay the full cost. By making this assumption, the model would provide a conservative evaluation of the impact of Medicare, which replaces the role of retirement coverage. Still, the future insurance cost affects the value of currently employed workers, and therefore it is partly shared by firms in wage bargaining.

ity of unions by allowing workers to be covered by union contracts without paying union dues. Importantly, this should not affect the behavior of firms conditional on union status. We introduce a parameter $c_{RTW}$ so that a type-$y$ firm unionizes if $J_{y,u}(\boldsymbol{\epsilon}) - c_{RTW} + \epsilon_u \geq J_{y,n}(\boldsymbol{\epsilon}) + \varepsilon_n$. We adjust the parameter $c_{RTW}$ so that RTW laws in the baseline estimated model targeting the 2007 economy induce a 2 p.p. decline in union density, which is the estimated impact of the recent approval of RTW laws in Fortin et al. (2022). We get $c_{RTW} = 1.2$. Since it is in monetary value in 2007, we adjust it using the change in CPI between 1955 and 2007.

## J.2 Estimation

We estimate the economies in 1955 with and without RTW laws. One challenge is that some variables are not available in the 1950s. We deal with data limitations as follows.

First, the following information is available in the 1950s: wages, employment status, and education at the individual level. More specifically, these variables are not available in 1955, but they are available in the 1950 and 1960 censuses. Using this information in the 1950 and 1960 censuses, we calculate average wages for each education, the overall unemployment rate, and the fraction of workers of each skill type in 1950 and 1960 and interpolate them. Aggregate union density at the national level is available in 1955 in Farber et al. (2021), but we need to obtain union density in states with and without RTW laws separately. To do that, we first calculate the relative union density between RTW states and no RTW states in 1963 using state-level union density in Hirsch et al. (2001), and combine it with national-level union density to calculate union density in RTW states and no RTW states separately, assuming that the relative density is similar between 1955 and 1963.

Second, the following information is not available in the 1950s: insurance status, union status, firm size, and medical expenditure at the individual level. We need those variables to construct the moments, such as ESHI rate by education/union status, firm size by union status, and the distribution of medical expenditure by education. We use the data in the CPS in 1980 onward to calculate those moments, and then extrapolate them to obtain the moments in 1955 except for ESHI rates.[7]

As for ESHI rates, there are a few sources on the overall ESHI rates in the early years. First, the figure in page 11 of Health Insurance Association of America (1965) shows that the insured rate in 1954 is slightly above 60% while that in 1954 is about 70%. Another

[7]Extrapolations are linear in year except for employment shares, and the fraction of zero medical costs. In these cases, we make sure the values are between 0 and 1 by regressing $\log\left(\frac{y}{1-y}\right)$ on years where $y$ is the variable of interest.

source is Cohen et al. (2009), which reports that 69.1% of people under age 65 were covered by hospital insurance from 1958 to 1960. From those numbers, we assume that 65% of employed workers were covered by ESHI in 1955. However, this number alone is not enough to obtain targeted moments for the ESHI rate, conditional on union status or skill types. To proceed, we assume that the relative ESHI rate between union workers and nonunion workers is similar over time. We also assume the relative ESHI rate between low-skill workers and high-skill workers is similar over time. We combine the relative ESHI rates in later years in the CPS and the aggregate ESHI rate of 65% in 1955 to calculate the ESHI rates conditional on either union status or skill types.

Table A.11 reports the externally set parameters in states with RTW laws and without, respectively, while Table A.12 reports the parameters internally estimated to match the extrapolated moments in states with and without RTW laws. The data moments and the simulated moments are reported in Table A.13.

## J.3 Simulation of Union Decline

We have two economies in 1955: One with RTW laws and the other without RTW laws. We aggregate them using a weight $p_{1955}^{RTW}$. We set $p_{1955}^{RTW} = 0.182$, which is the fraction of workers in states with RTW laws in 1955.

We simulate skill-biased technological change by adjusting the relative productivity of each skill $(z_l, z_h)$ by targeting the skill wage gap observed in 2019. We simultaneously adjust the fraction of each type $(N_l, N_h)$, which is directly observable. In the baseline estimation, we set $b_x$ to 85% of the observed average wages for each skill type. In the simulation, we also adjust the consumption of the unemployed $(b_l, b_h)$ so that the relative consumption $\log b_h - \log b_l$ also changes to the targeted wage premium while fixing the average $b_x$ across skill types. All the other parameters, including social insurance and RTW laws, are fixed at 1955 values.

In the 1955 economy, there is neither Medicare nor Medicaid. We simulate the introduction and expansion of social insurance as follows. First, once Medicare is introduced, all retired workers have access to public insurance, which is equivalent to insurance plans provided by employers. Second, we capture the introduction and ACA expansions of Medicaid in the following way. For high-skill workers, we use the same $p_x^{Med}$ as in the baseline estimation. For low-skill workers, we adjust $p_x^{Med}$ so that $p_x^{Med}$ is the fraction of low-skill workers living in states that expanded Medicaid before or in 2019. Using the CPS, we set $p_x^{Med} = 0.63$ for low-skill workers.

As for the implementation of RTW laws, we take the following steps. First, we know the union density in the model with RTW laws and without. Let each of them be $union_{1955}^{RTW}$ and $union_{1955}^{NoRTW}$. Second, we calculate the fraction of workers in states with RTW laws $p_{2019}^{RTW} = 0.426$. Third, we simulate RTW laws in the 1955 economy without RTW laws by setting $c_{RTW} = 1.2$ as described in Appendix J.1 and get the counterfactual union density $union_{CF}^{NoRTW}$ in the economy without RTW. We calculate the counterfactual aggregate union density by $p_{1955}^{RTW} \times union_{1955}^{RTW} + (p_{2019}^{RTW} - p_{1955}^{RTW}) \times union_{CF}^{NoRTW} + (1 - p_{2019}^{RTW}) \times union_{1955}^{NoRTW}$ where the first term captures union density in states that had RTW laws in 1955, the second term captures union density in states that did not have RTW laws in 1955 but implemented after, and the last term captures union density in states that never implemented RTW laws.

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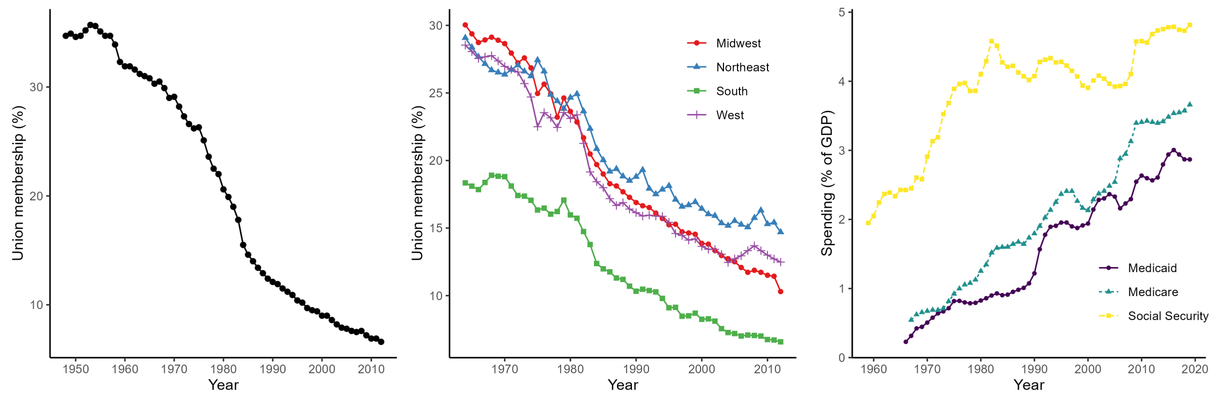
# K Additional Figures and Tables

Figure A.1: National / Regional Trend in Union Membership and Spending on Social Insurance

(a) Union Membership (b) Regional Union Membership (c) Spending on Social Insurance



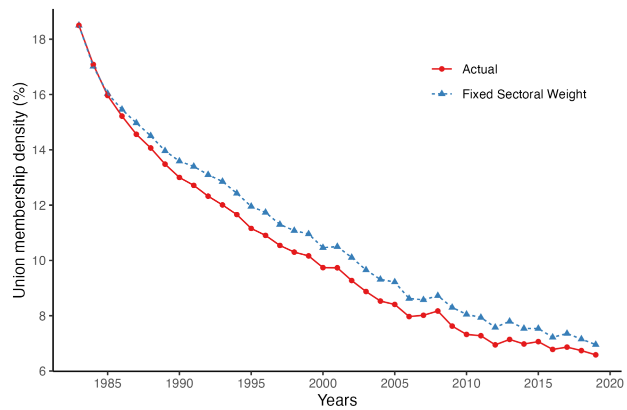

*Note*: Panel (a): Data is from Farber et al. (2021). The union density before 1983 are based on the survey conducted by the BLS while the data from 1983 onward is from the CPS. See Farber et al. (2021) for more detail. Panel (b): Data is from Hirsch et al. (2001). Panel (c): Data on the government spending on each social insurance program is from Federal Reserve Economic Data (FRED).

Table A.1: Union Membership and Job Losing

| | Job Losing | | | |
|---|---|---|---|---|
| | Pooled | | High school | College |
| | (1) | (2) | (3) | (4) |
| Union | -0.0020*** | -0.0020*** | -0.0028*** | -0.0012*** |
| | (0.0001) | (0.0001) | (0.0002) | (0.0002) |
| Demographics | | X | X | X |
| Mean outcome | 0.007 | 0.007 | 0.008 | 0.006 |
| Observations | 4,549,537 | 4,549,537 | 1,721,606 | 2,827,931 |
| $R^2$ | 5e-04 | 0.0019 | 0.0025 | 0.0012 |

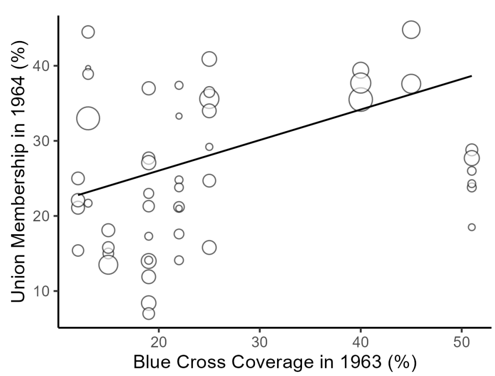
*Note*: Data is the SIPP panels 1996, 2001, 2004, and 2008. Demographic controls include dummies for age, sex, race, and education. Person-level weights are used. State and year fixed effects are controlled in all specifications. Robust standard errors are reported. $^*p < 0.1$;$^{**}$ $p < 0.05$;$^{***}$ $p < 0.01$.

Figure A.2: Union Density with Fixed Sectoral Share

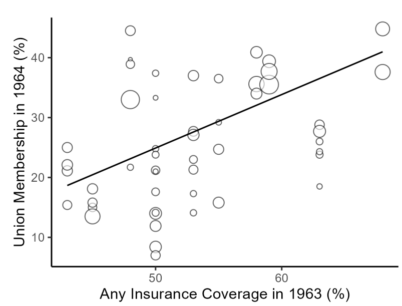



*Note*: This figure reports the actual union density (red solid line) and the counterfactual union density with fixed sectoral employment share (blue dashed line) based on equation $union_t^{CF} = \sum_{i \in \mathcal{I}} \omega_{i,1983} \times union_{i,t}$. The data is from the CPS 1983-2019.

Figure A.3: Private Insurance Coverage and Union Density Prior to Medicare



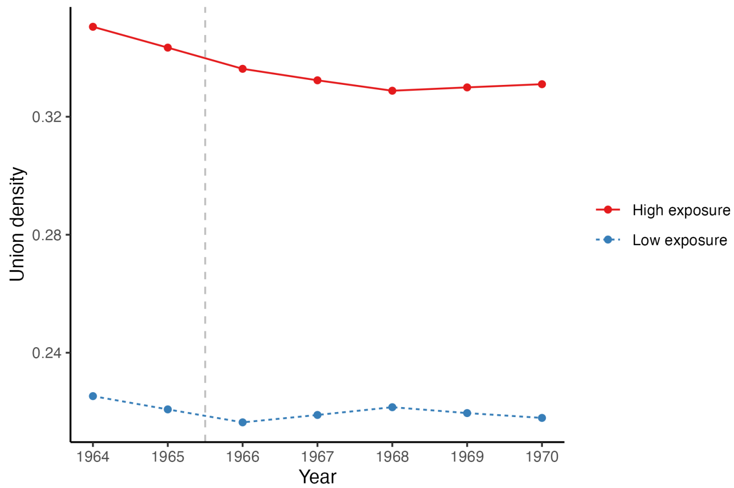

(a) BlueCross Coverage




(b) Any Coverage

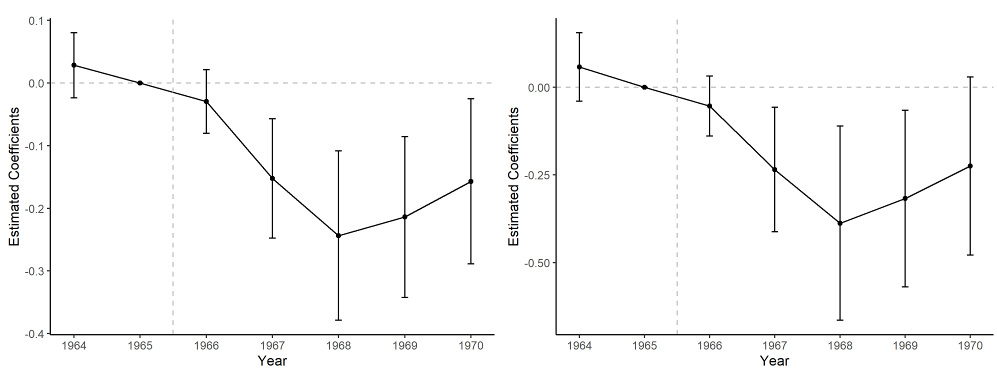
*Note*: Data on the fraction of the insured elderly is from Finkelstein (2007). Data on the union density is from Hirsch et al. (2001). Each circle corresponds to each state in the U.S. and the size of the circles represents the size of the state population in 1960.

Figure A.4: Union Density by Policy Exposure




*Note*: This figure displays the trend in union density in states with high policy exposure (red solid line) and the trend in union density in states with low policy exposure (blue dashed line). The high-exposure states are those with BlueCross coverage above the median, and the remaining states are low-exposure states.

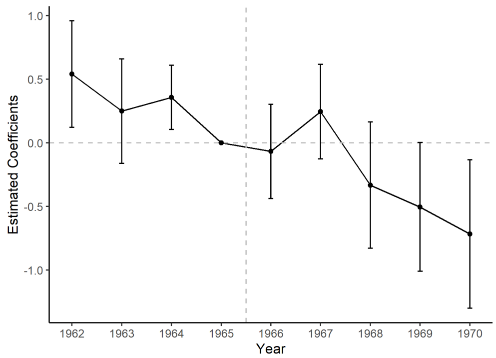
Figure A.5: Impact of Medicare Introduction on Union: Controlling Medicaid



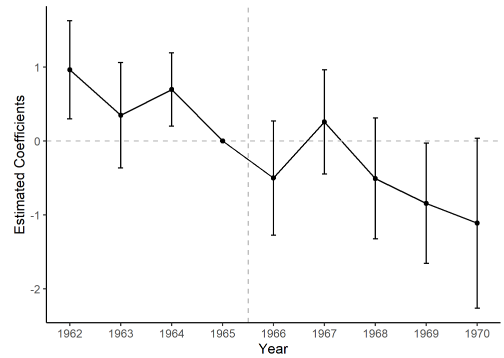

(a) BlueCross Coverage (b) Any Insurance Coverage

*Note*: This figure displays the estimated coefficients of equation (2) where we control four dummies for years before/after Medicaid implementation in each state. The error bars represent the 95% confidence intervals based on standard errors clustered at the state level.

Figure A.6: Impact of Medicare Introduction on Union Elections



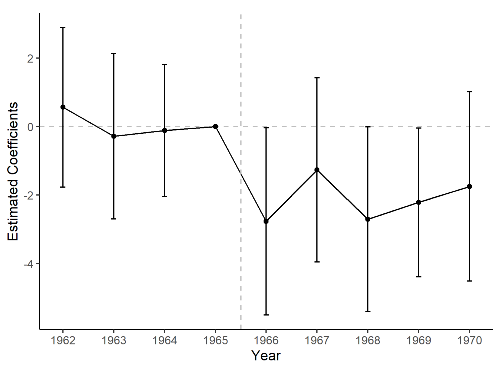

(a) Blue Cross Coverage



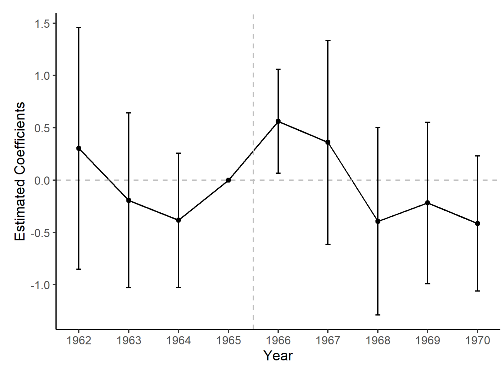

(b) Any Insurance Coverage

*Note*: This figure displays the estimated coefficients of equation (2) where the outcome is the log number of elections. Panel (a): *Coverage* is BlueCross insurance coverage in 1963. Panel (b): *Coverage* is any insurance coverage in 1963. The error bars represent the 95% confidence intervals based on standard errors clustered at the state level.

Figure A.7: Impact of Medicare Introduction on Union Elections



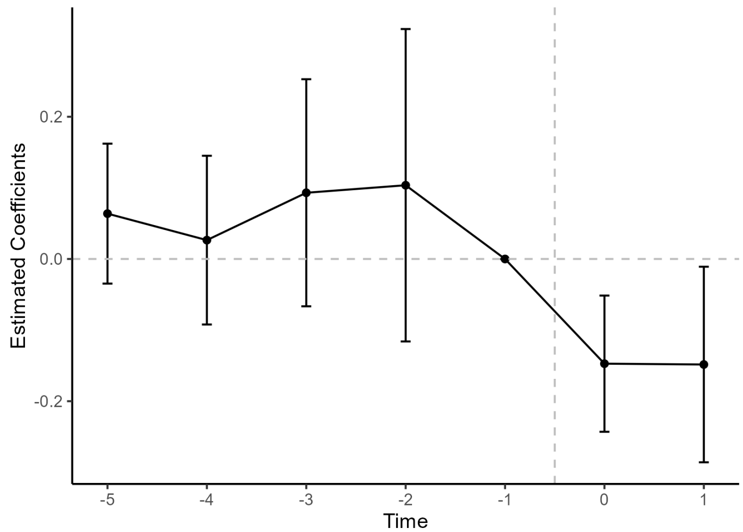

(a) Low Exposure




(b) High Exposure

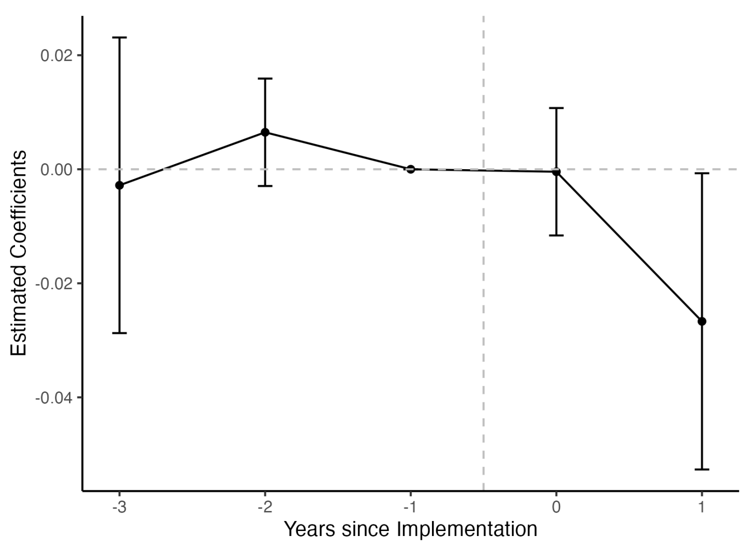
*Note*: This figure displays the estimated coefficients of equation (2) where the outcome is the log number of elections. Low Exposure: *Coverage* is below median. High Exposure: *Coverage* is above median. *Coverage* is Blue Cross coverage in 1963. The error bars represent the 95% confidence intervals based on standard errors clustered at the state level.

Figure A.8: Estimated Impact of Medicaid Implementation on Union Elections



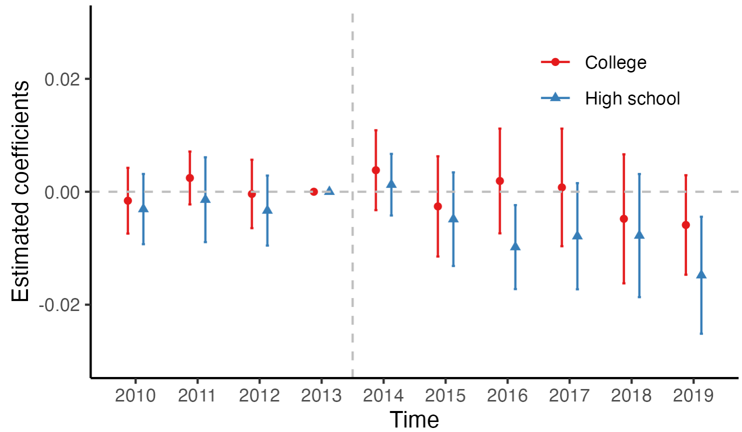

*Note*: This figure displays the estimated coefficients of equation (3) with the outcome being the log number of elections. The error bars represent the 95% confidence intervals based on standard errors clustered at the state level.

Figure A.9: Estimated Impact of Medicaid Implementation on Union Density: Controlling Medicare



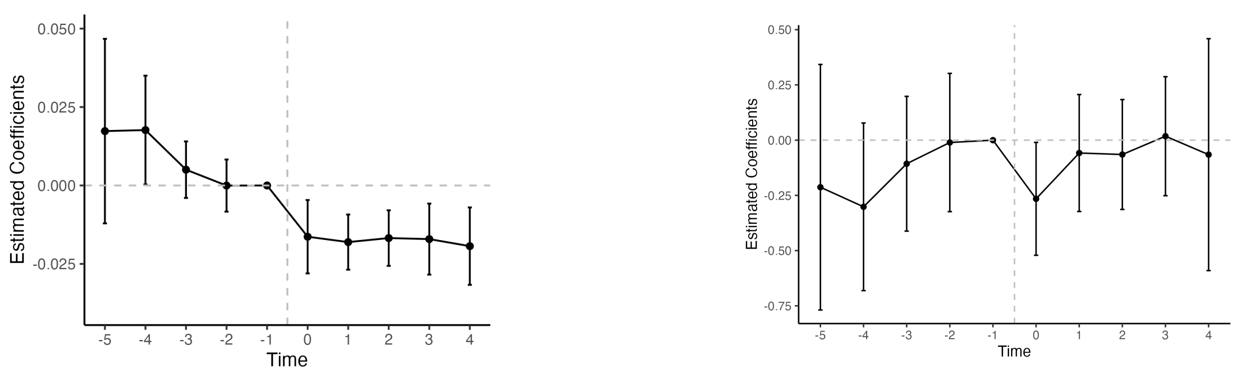

*Note*: This figure displays the estimated coefficients of equation (3), additionally controlling for Medicare exposure by including $\mathbb{1}\{t > 1965\} \times \textit{High exposure}_s$ where $\textit{High exposure}_s$ is an indicator for BlueCross coverage higher than the median. The error bars represent the 95% confidence intervals based on standard errors clustered at the state level.

Figure A.10: ACA Medicaid Expansion Impact on Union Membership




*Note*: This figure shows the estimated coefficients of equation $Union_{ist} = \sum_{\tau=2010,\tau\neq 2013}^{2019} \beta_\tau \times$ ACA Medicaid$_s \times \mathbb{1}[t = \tau] + x'_{ist}\gamma + \eta_s + \mu_t + \varepsilon_{ist}$, where ACA Medicaid$_s$ is an indicator taking 1 if a state expanded Medicaid in January 2014. Data is from the CPS 2010-2019. States that expended Medicaid in other periods during 2010-2019 are excluded. Other variables are the same as in equation (A2). Person-level weights are used. Standard errors are clustered at the state level. The error bars represent 95% confidence intervals.

Figure A.11: RTW Law Impact on Unionization




(a) Union membership

(b) Union elections

*Note*: Panel (a): The estimated coefficients of equation (A4) and their 95% confidence intervals are displayed. The sample consists of employed workers aged 22-65 in the CPS 2009-2019. Standard errors are clustered at the state level. Panel(b): The estimated coefficients of equation (A5) and the 95% confidence intervals are displayed. The sample comes from the NLRB election. Standard errors are clustered at the state level.

Table A.2: Union Membership and ESHI Coverage After Retirement

| | ESHI after 65 | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Union | 0.125*** | 0.100*** | 0.042 | |
| | (0.014) | (0.014) | (0.030) | |
| Union to Nonunion | | | | -0.013 |
| | | | | (0.034) |
| Nonunion to Union | | | | 0.079* |
| | | | | (0.047) |
| Observations | 11,675 | 11,675 | 11,675 | 11,675 |
| Covariates | | X | X | X |
| Individual FE | | | X | X |
| Mean outcome | 0.152 | 0.152 | 0.152 | 0.152 |
| R-sq | 0.028 | 0.0728 | 0.6204 | 0.6208 |

*Note*: This table reports the estimation result of equation (1). The sample consists of workers aged 65 or younger in the HRS 2000-2019. Year and region fixed effects are controlled in all the specifications. In columns (2)-(4), we control for the quadratic polynomials for age, log earnings, log firm size, sex, education, and dummies for occupation and industry. Columns (3) and (4) additionally control for individual fixed effects. Person-level analysis weights are used. Standard errors are clustered at the individual level. $^{*}p < 0.1;^{**} p < 0.05;^{***} p < 0.01$.

Table A.3: Summary Statistics of Establishment-Level Variables

| | | | Estab. Size | | Wage ($1,000) | | ESHI Offer (%) | |
|---|---|---|---|---|---|---|---|---|
| Industry | Unionized (%) | Empl. Share (%) | Union | Nonunion | Union | Nonunion | Union | Nonunion |
| All | 4.2 | 100.0 | 97.7 | 22.0 | 28.8 | 26.9 | 85.8 | 60.9 |
| Construction | 10.5 | 3.3 | 29.7 | 10.0 | 37.0 | 25.9 | 85.7 | 47.8 |
| Mining and manufacturing | 6.7 | 27.0 | 210.2 | 54.1 | 27.8 | 31.1 | 94.0 | 73.9 |
| Wholesale/retaile trade | 2.5 | 16.8 | 54.5 | 17.5 | 22.0 | 20.6 | 78.0 | 54.2 |
| Finance/insurance/real estate | 2.9 | 14.7 | 49.0 | 16.4 | 30.8 | 32.7 | 77.3 | 66.2 |
| Other services | 4.0 | 38.1 | 113.8 | 21.4 | 27.3 | 26.4 | 88.3 | 60.7 |

*Note*: This table reports the summary statistics of establishment-level variables from the 1997 Robert-Wood Johnson Foundation Employer Health Insurance Survey. Other services include Transportation/communications/other public utilities; Professional services; Other services in the original data. The agriculture/forestry & fisheries industry is dropped, which makes up less than 0.1% of total employment in the data. The original data does not contain industry information is missing for establishments with more than 5,000 employees. Establishment weights are used.

Table A.4: ACA Medicaid Expansion Impact on Union Membership

| | Union Membership | | |
|---|---|---|---|
| | All | High School | College |
| | (1) | (2) | (3) |
| ACA Medicaid | -0.003 | -0.005$^{**}$ | -0.001 |
| | (0.003) | (0.003) | (0.003) |
| Mean outcome | 0.118 | 0.103 | 0.125 |
| Observations | 1,177,618 | 393,223 | 784,395 |
| R-sq | 0.24 | 0.19 | 0.27 |

*Note*: This table reports the estimation result of equation (A2). Data is from the CPS 2010-2019. The first column uses the whole sample. The second column restricts the sample to individuals whose highest grade is not greater than the high-school graduate. The third column restricts the sample to individuals whose highest grade is greater than the high-school graduate. Person-level weights are used. The covariates include gender, dummies for age, and industries. Dummies for education are controlled in column (1). Year fixed effects and state fixed effects are also controlled. Standard errors are clustered at the state level. $^{*}p < 0.1;^{**}p < 0.05;^{***}p < 0.01$.

Table A.5: Unemployment Insurance Impact on Union Membership

| | Union Membership | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Replacement Rate | -0.215$^{***}$ | -0.215$^{***}$ | -0.217$^{***}$ | -0.218$^{***}$ |
| | (0.020) | (0.020) | (0.020) | (0.021) |
| UI Duration FE | | X | X | X |
| RTW Law | | | X | X |
| Political Control | | | | X |
| Observations | 2,680,517 | 2,680,517 | 2,680,517 | 2,598,633 |
| R-sq | 0.2543 | 0.2543 | 0.2545 | 0.2548 |

*Note*: This table reports the estimation result of equation (A3). Data is from CPS 2000-2019. The information on UI generosity is obtained from “Significant Provisions of State Unemployment Insurance Laws" published by the BLS. Dummies for age, gender, education, occupation, industry, year fixed effects, and state fixed effects are controlled in all specifications. Standard errors are clustered at the state level. $^{*}p < 0.1;^{**}p < 0.05;^{***}p < 0.01$.

Table A.6: List of Externally Set Parameters

| Parameter | Description | Value | Target |
|---|---|---|---|
| $\gamma$ | Discount rate | 0.984 | 5% annual interest rate |
| $\sigma$ | Elasticity of substitution between skills | 1.5 | Johnson (1997) |
| $\mu$ | Match efficiency | 1.0 | Normalization |
| $\zeta$ | CRRA parameter | 1.0 | |
| $\underline{c}$ | Consumption floor ($1K) | 0.1 | |
| $\beta_u$ | Bargaining power of union workers | 0.5 | |
| $\beta_n$ | Bargaining power of nonunion workers | 0.5 | |
| $N_x$ | Measure of workers of each type | 0.41, 0.59 | Fraction of each skill group |
| $M$ | Measure of total firms | 0.042 | Average firm size |
| $\delta_{u,x}$ | Job destruction rate (union) | 0.05, 0.03 | See text |
| $\delta_{n,x}$ | Job destruction rate (nonunion) | 0.06, 0.03 | See text |
| $b_x$ | Consumption during unemp. ($1K) | 6.96, 12.01 | 85% of average wages for each skill |
| $c_x$ | Variable insurance cost ($1K) | 0.77, 0.72 | Expected insurer's cost |
| $\mu_{H,x}$ | Medical exp. distribution: location | -1.21, -1.08 | Medical exp. distribution for each skill |
| $\sigma_{H,x}$ | Medical exp. distribution: scale | 1.73, 1.56 | Medical exp. distribution for each skill |
| $p_{0,x}$ | Medical exp. distribution: mass at zero | 0.23, 0.11 | Medical exp. distribution for each skill |

*Note*: Monetary values are in $1,000 in year 2007. For the "Value" column with two numbers, the first number corresponds to the value for low-skill workers $x = 1$, and the second for high-skill workers $x = 2$. For "See text", refer to the description of the job destruction rates in Section 5.1.2.

Table A.7: Impacts of Parameter Changes on Moments

| | | Percentage Impact on Moment | | | | |
|---|---|---|---|---|---|---|
| Parameter | Description | Union | Unemployment | Wage | Insurance | Firm size |
| Union | | | | | | |
| $FC_{union}$ | Fixed cost of unionization | 3.29 | 0.32 | 0.02 | 0.73 | 0.30 |
| $\sigma_{union}$ | Std. dev. of union cost shock | 15.21 | 0.22 | 0.01 | 1.27 | 1.06 |
| $c_0$ | Cost of union threat | 9.60 | 0.49 | 0.02 | 0.60 | 0.58 |
| Insurance | | | | | | |
| $FC_a$ | Fixed cost of insurance provision | 0.16 | 0.33 | 0.02 | 0.88 | 0.34 |
| $\sigma_a$ | Std. dev. of insurance cost shock | 0.38 | 0.34 | 0.03 | 0.63 | 0.41 |
| Labor market | | | | | | |
| $\kappa$ | Vacancy posting cost | 0.89 | 1.11 | 0.02 | 0.57 | 0.28 |
| Production | | | | | | |
| $A$ | TFP | 0.66 | 0.15 | 0.03 | 0.86 | 0.36 |
| $Beta(a,b) : a$ | Production curvature distribution | 1.35 | 0.12 | 0.03 | 1.05 | 0.43 |
| $Beta(a,b) : b$ | Production curvature distribution | 0.01 | 0.38 | 0.02 | 0.69 | 0.33 |
| $z_1$ | Low-skill worker relative productivity | 0.15 | 0.23 | 0.02 | 0.66 | 0.31 |

*Note*: This table shows the impact of a change in each parameter of simulated moments, categorized into five groups. We perturb each parameter by one standard error, and report the absolute value of percentage changes in simulated moments. If a group has multiple moments, we take averages.

Table A.8: List of Internally Estimated Parameters: Model with TFP Heterogeneity

| Parameter | Description | Estimate |
|---|---|---|
| $A$ | Average TFP | 39.55 |
| $Beta(a,b):a_L$ | Production curvature distribution | 1.11 |
| $Beta(a,b):b_L$ | Production curvature distribution | 0.70 |
| $Beta(a,b):a_H$ | Production curvature distribution | 1.04 |
| $Beta(a,b):b_H$ | Production curvature distribution | 1.12 |
| $z_1$ | Low-skill worker relative productivity | 0.30 |
| $FC_a$ | Fixed cost of insurance provision | 20.85 |
| $\sigma_a$ | Std. dev. of insurance cost shock | 9.76 |
| $FC_{union}$ | Fixed cost of unionization | 26.38 |
| $\sigma_{union}$ | Std. dev. of union cost shock | 7.73 |
| $c_0$ | Cost of union threat | 0.11 |
| $\kappa$ | Vacancy posting cost | 1.97 |

*Note*: This table reports the estimated model parameters and standard errors. Monetary values are 2007 USD. The parameters with the subscript $L$ ($H$) are specific to low (high) productivity firms.

Table A.9: Model Fit in Model with TFP Heterogeneity

| Moments | Data | Model |
|---|---|---|
| Union density | 0.09 | 0.08 |
| ESHI coverage: union | 0.83 | 0.79 |
| ESHI coverage: nonunion | 0.59 | 0.60 |
| ESHI coverage: low skill | 0.53 | 0.59 |
| ESHI coverage: high skill | 0.66 | 0.64 |
| Unemployment rate | 0.05 | 0.05 |
| Average wage: low skill ($1K) | 8.19 | 8.15 |
| Average wage: high skill ($1K) | 14.12 | 14.54 |
| Employment share of firms with $\geq 10$ workers: union | 0.94 | 0.95 |
| Employment share of firms with $\geq 10$ workers: nonunion | 0.83 | 0.88 |
| Employment share of firms with $\geq 100$ workers: union | 0.80 | 0.78 |
| Employment share of firms with $\geq 100$ workers: nonunion | 0.56 | 0.54 |
| Employment share of firms with $\geq 10$ workers: union & insured | 0.97 | 0.99 |
| Employment share of firms with $\geq 100$ workers: union & insured | 0.84 | 0.95 |

*Note*: This table reports the targeted data moments and their simulated counterparts. "Employment share of firms with $\geq x$ workers: (non)union" is defined as the fraction of (non)unionized firms that employ workers of size greater than or equal to $x$.

Table A.10: Counterfactual Policy Simulation in Model with TFP Heterogeneity: Insurance Policies

| | (1) | (2) | (3) |
|---|---|---|---|
| | Baseline | SI for all | Targeted SI |
| Union density (%) | 8.31 | 6.56 | 6.12 |
| ESHI coverage (%) | | | |
| Overall | 61.93 | 0.00 | 60.88 |
| Union | 78.88 | 0.00 | 70.63 |
| Nonunion | 60.40 | 0.00 | 60.25 |
| Low skill | 59.27 | 0.00 | 57.89 |
| High skill | 63.64 | 0.00 | 62.75 |
| Unemployment rate (%) | | | |
| Overall | 4.60 | 7.39 | 5.94 |
| Low skill | 8.64 | 14.74 | 11.78 |
| High skill | 1.81 | 2.31 | 1.91 |
| Output per capita (% change) | 0.00 | -1.80 | -0.83 |
| Labor productivity (% change) | 0.00 | 1.15 | 0.58 |
| Average wage (% change) | 0.00 | -1.32 | 0.25 |
| Skill wage gap (log points) | 57.83 | 60.97 | 55.11 |
| Average firm size | | | |
| Overall | 22.55 | 21.89 | 22.24 |
| Union | 51.86 | 42.93 | 38.94 |
| Nonunion | 21.45 | 21.16 | 21.64 |

*Note*: This table reports the general equilibrium impacts of each policy change in the estimated model with TFP heterogeneity. Column (2) is the economy with free public health insurance for all workers regardless of their employment status. Column (3) is the economy with free public health insurance only for low-skill unemployed workers.

Table A.11: Externally Set / Externally Calibrated Parameters (Year 1955)

| Parameter | Description | Value: RTW | Value: No RTW | Target |
|---|---|---|---|---|
| $\gamma$ | Discount rate | 0.984 | 0.984 | 5% annual interest rate |
| $\sigma$ | Elasticity of substitution between skills | 1.5 | 1.5 | Johnson (1997) |
| $\mu$ | Match efficiency | 1.0 | 1.0 | Normalization |
| $\zeta$ | CRRA parameter | 1.0 | 1.0 | |
| $\underline{c}$ | Consumption floor ($1K) | 0.1 | 0.1 | |
| $\beta_u$ | Bargaining power of union workers | 0.5 | 0.5 | |
| $\beta_n$ | Bargaining power of nonunion workers | 0.5 | 0.5 | |
| $N_x$ | Measure of workers of each type | 0.868, 0.132 | 0.835, 0.165 | Fraction of each skill group |
| $M$ | Measure of total firms | 0.057 | 0.057 | Average firm size |
| $\delta_{u,x}$ | Job destruction rate (union) | 0.063, 0.031 | 0.071, 0.038 | See text |
| $\delta_{n,x}$ | Job destruction rate (nonunion) | 0.071, 0.034 | 0.079, 0.042 | See text |
| $b_x$ | Consumption during unemp. ($1K) | 0.62, 0.97 | 0.80, 1.12 | 85% of average wages for each skill |
| $c_x$ | Variable insurance cost ($1K) | 0.029, 0.020 | 0.029, 0.020 | Expected insurer's cost |
| $\mu_{H,x}$ | Medical exp. distribution: location | -3.52, -3.84 | -3.52, -3.84 | Medical exp. distribution for each skill |
| $\sigma_{H,x}$ | Medical exp. distribution: scale | 1.02, 1.01 | 1.02, 1.01 | Medical exp. distribution for each skill |
| $p_{0,x}$ | Medical exp. distribution: mass at zero | 0.12, 0.09 | 0.12, 0.09 | Medical exp. distribution for each skill |

*Note*: Monetary values are in $1,000 in year 1955. For the "Value" column with two numbers, the first number corresponds to the value for low-skill workers $x = 1$, and the second for high-skill workers $x = 2$. For "See text", refer to the description of the job destruction rates in Section 5.1.2 for how we calculate them. Refer to Section J.2 for the discussion on extrapolation.

Table A.12: Internally Estimated Parameters (Year 1955)

| | | Estimate | |
|---|---|---|---|
| Parameter | Description | RTW | No RTW |
| $A$ | TFP | 2.7 | 3.5 |
| $\alpha \sim Beta(a, b)$ | Production curvature distribution | 0.16, 0.64 | 0.16, 0.64 |
| $z_1$ | Low-skill worker relative productivity | 0.73 | 0.71 |
| $FC_a$ | Fixed cost of insurance provision | 0.24 | 0.21 |
| $\sigma_a$ | Std. dev. of insurance cost shock | 0.33 | 0.28 |
| $FC_{union}$ | Fixed cost of unionization | 1.26 | 0.84 |
| $\sigma_{union}$ | Std. dev. of union cost shock | 0.35 | 0.35 |
| $c_0$ | Cost of union threat | 0.19 | 0.13 |
| $\kappa$ | Vacancy posting cost | 0.10 | 0.13 |

*Note*: This table reports the estimated model parameters for the 1955 economy. Monetary values are 1955 USD.

Table A.13: Model Fit (Year 1955)

| | RTW | | No RTW | |
|---|---|---|---|---|
| Moments | Data | Model | Data | Model |
| Union density | 0.19 | 0.19 | 0.39 | 0.37 |
| ESHI coverage: union | 0.84 | 0.84 | 0.75 | 0.78 |
| ESHI coverage: nonunion | 0.60 | 0.63 | 0.56 | 0.56 |
| ESHI coverage: low skill | 0.64 | 0.68 | 0.62 | 0.65 |
| ESHI coverage: high skill | 0.71 | 0.59 | 0.68 | 0.60 |
| Unemployment rate | 0.05 | 0.05 | 0.05 | 0.05 |
| Average wage: low skill ($1K) | 0.73 | 0.75 | 0.94 | 0.97 |
| Average wage: high skill ($1K) | 1.14 | 1.13 | 1.31 | 1.27 |
| Employment share of firms with $\geq 10$ workers: union | 0.99 | 0.97 | 0.98 | 0.95 |
| Employment share of firms with $\geq 10$ workers: nonunion | 0.86 | 0.77 | 0.83 | 0.74 |
| Employment share of firms with $\geq 100$ workers: union | 0.95 | 0.94 | 0.84 | 0.89 |
| Employment share of firms with $\geq 100$ workers: nonunion | 0.59 | 0.59 | 0.55 | 0.52 |

*Note*: This table reports the targeted data moments and their simulated counterparts for the 1955 economy. "Employment share of firms with $\geq x$ workers: (non)union" is defined as the fraction of (non)unionized firms that employ workers of size greater than or equal to $x$.