Labor Unions and Social Insurance*

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Abstract

This paper examines the equilibrium impacts of labor unions on labor market outcomes, as well as the forces underlying the dramatic decline in the unionization rate in the United States in the past half-century. We first document that unionized firms are more likely to provide various employer-based insurance benefits, and we provide quasi-experimental evidence that the expansion of public insurance programs lowers unionization rates and union formation in the U.S. We then develop and estimate a frictional labor market model with endogenous union formation that accounts for their effects on wages, job security, and provisions of employment-based insurance benefits. Using the estimated model, we find that social insurance expansion and the tax/transfer programs on non-wage benefits can have a significant impact not only on unionization but also on wage inequality through their effects on unionization. Moreover, we find that skill-biased technological changes and the implementation of right-to-work laws account for about 32% and 7% of the union decline, respectively. Interestingly, social insurance expansions also account for about 15% of the union decline.
Keywords: Labor unions; Social insurance; Employment-based benefits
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1 Introduction

Labor unions in the United States have seen a steady decline over the past few decades. In 1955, approximately 36% of workers were part of unions, but today that number has decreased to less than 10%. Economists and policymakers have been interested in the causes of this long-term trend as well as its consequences on labor market outcomes and welfare. Freeman and Medoff (1984) showed that unions can influence various aspects of workers' labor market outcomes, such as increasing average wages, reducing wage inequality, and expanding employer-provided benefits such as health insurance and pensions. Building on these ideas, the Biden administration issued an Executive Order on April 26, 2021 (E.O. 14025) to promote unions and collective bargaining, emphasizing their impact on wages, benefits, and job security. However, there are also substantial concerns that unions might negatively affect labor productivity, as emphasized by Holmes (1998) and Alder et al. (2023).

When assessing the benefits and costs of unions and possible policy interventions in the U.S. context, it is essential to understand why union membership has declined significantly in the last half century. Several hypotheses can potentially explain this phenomenon. First, technological changes and globalization have shifted labor demand away from low-skilled workers, who tend to favor unionization, as discussed by Acemoglu et al. (2001), Açıkgöz and Kaymak (2014) and Dinlersoz and Greenwood (2016). Second, state governments have increasingly adopted right-to-work (RTW) laws, preventing workers from being obligated to pay union membership fees and making it challenging for unions to sustain themselves (Farber, 2005). A third, and hitherto under-explored hypothesis is that the substantial expansion of U.S. social insurance programs may also contribute to the decline in unions.[1] If union-provided insurance benefits are a primary reason workers join unions, the availability of affordable insurance options outside unions, either through the government or other sources, can reduce the attractiveness of union membership. Such dependence is especially relevant in the United States because, unlike many other European countries, employers play an important role in providing access to various essential insurance benefits, and the union formation is mainly determined at the employer level.[2]

Most existing studies evaluating the economic impact of unions focus on wages but do not consider insurance provisions.[3] Furthermore, there are few papers that quantify the

[1]The connection between social insurance and labor movement is well known. Otto von Bismarck, the German Chancellor who designed the world's first old-age social insurance program in 1889, was motivated to introduce social insurance in Germany both in order to promote the well-being of workers, and to stave-off calls for more radical socialist alternatives. See US Social Security Administration.

[2]For example, most European countries have universal health insurance systems, which likely eliminates union's role of insurance provisions from the beginning. Moreover, employers have much limited effects on union formation and collective bargaining (Jäger et al., 2022).

[3]See Cahuc et al. (2014) for an overview of recent labor market models of unions.

relative importance of the aforementioned factors that may contribute to the decline in unions. Consequently, there is almost no systematic analysis of the implications of unions on the design of social insurance, and tax/transfer systems.

The goal of this paper is to develop and estimate a model of labor unions that accounts for their effects on wages and the provision of employer-based insurance benefits, which we will use to *jointly* understand union's equilibrium impacts and their declines. To motivate our focus on the unions' role in insurance provisions, we first document that unionized firms are more likely to offer employer-based insurance benefits and provide new empirical evidence that social insurance expansions lower the unionization rate. Then, we develop an equilibrium labor search model that features endogenous union formation and employer-based insurance provisions. We estimate our model and use simulations of the estimated model to quantitatively assess how government interventions in social insurance and employer-sponsored insurance benefits affect unionization and labor market equilibrium. Moreover, we explore which factors account for the decline in unions and discuss their implications.

To establish various empirical relationships among union status, employer-provided insurance benefits, and social insurance programs, we utilize several micro-level datasets (the Current Population Study, the Health and Retirement Study, and the Survey of Income and Program Participation) and datasets on long-run trends in union density and elections. We first document the descriptive evidence that unionized firms tend to provide employer-sponsored health insurance (ESHI) and provide more job security. Then, we exploit cross-state and over-time variations in social insurance policies to examine their effects on unionization. We first examine the effect of the introduction of Medicare and Medicaid in the 1960s. By utilizing the identification approaches in Finkelstein (2007) which exploits the cross-state variations in the pre-1965 retiree health insurance coverage rates (for Medicare) or the timing of the implementation (for Medicaid), we find that the introduction of Medicare and Medicaid lower the unionization rate and the number of union elections. Moreover, by focusing on changes in social insurance programs in recent years, such as the expansion of Medicaid under the Affordable Care Act (ACA) and unemployment insurance (UI), we find that the expansion of social insurance programs tends to lower the unionization rate, especially for low-skilled workers, underscoring the importance of considering the distributional impact of social insurance policies on the labor market.

Our equilibrium model builds on the standard search and matching model (Diamond-Mortensen-Pissarides framework, Pissarides, 2000), which naturally generates a firm's monopsony power in the labor market and thus a potential role for unions as a countervailing force. The 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 firms decide on whether to unionize their workforce based on their employees' (endogenous) preferences for unionization. Second, non-wage benefits and job security are endogenously determined in the model. Following Aizawa and Fang (2020), we postulate that a firm needs to incur a fixed cost (e.g., administrative costs) and per-employee marginal cost (e.g., medical expenses for the case of health insurance) in order to provide the non-wage benefits to its workers. Unions may enhance job security by reducing worker turnover. However, this additional job retention may cause losses of firms' profits because firms may be forced to hoard less profitable matches.

A novel feature of our model is that employers' provisions of insurance benefits, firms' unionization status, firm sizes and the skill composition of their workforce, and wage inequality are all endogenously determined in equilibrium. In the model, unionized firms are more likely to provide non-wage benefits than nonunionized firms because the latter are more likely to suffer from hold-up problems. In a unionized firm, compensations are determined in *collective bargaining* where the preferences of all of its workers are aggregated. A firm and its workers split the fixed costs of providing non-wage benefits according to their respective bargaining power. In contrast, in a nonunionized firm, compensations are determined by *individual bargaining* between the firm and each worker. Each worker only bears the marginal cost of non-wage benefits; as a result, nonunionized firms need to bear all the fixed costs associated with providing the non-wage benefits, and therefore they are less willing to provide such non-wage benefits than unionized firms.

To quantitatively assess social insurance programs, we extend our model and estimate our model with micro-level data on individual union status, labor market outcomes, demographics, and non-wage benefits. We consider health insurance as the main non-wage benefits in our empirical specification and model various health insurance programs. The estimated model successfully accounts for the relationship among the union status, insurance provisions, skill premiums, and firm sizes.

Using our equilibrium model, we first examine how social insurance policies, as well as tax and transfer schemes related to insurance provisions, affect unionization and labor market outcomes. Through a series of counterfactual experiments, our findings reveal that social insurance policies can substantially influence equilibrium labor market outcomes by altering firms' unionization rates. Specifically, we demonstrate that the introduction of a tax-funded universal health coverage, which replaces the existing ESHI system, will reduce the union membership density by 3.4 percentage points (p.p.). This decline in unions is associated with a 1.5 percent lower average wage and will increase the wage inequality, measured by the wage gap between the high-skilled and low-skilled workers, by 3.4 log points.

We further show that the impact of social insurance policies on the labor market depends on their targeting strategy. For example, we find that expanding social insurance to low-skilled unemployed workers only (e.g., significant expansion of Medicaid) will lower the unionization rate by 1.8 p.p., but it will increase the average wage by 0.6%, and decrease wage inequality by 2.2 log points; however, the decline in unions also reduces access to insurance coverage for the high-skilled, suggesting a possible welfare loss to the high-skilled.

Furthermore, the structure of tax and transfer schemes on non-wage benefits also has significant implications for the unionization rate. We find that subsidies provided for non-wage benefits, such as tax exemption status for ESHI premiums, lead to a decrease in the unionization rate. Quantitatively, subsidizing firms for one-third of the insurance fixed costs results in a 1.8 p.p. decline in the union density.[4] This occurs as non-unionized firms increase their insurance provisions while unionized firms lose their competitive edge in attracting workers through insurance coverage. Notably, this change also contributes to a 0.6 log-point increase in wage inequality due to the union decline. Consequently, the current structure of employer-sponsored health insurance becomes an additional source of wage inequality due to its influence on the unionization rate.

We also examine the effect of subsidizing unions, a policy frequently discussed in policy debates. Although such a policy raises the unionization rate, it has a limited effect on wage inequality, primarily because it also affects the provision of non-wage benefits. Subsidizing firms for one-third of the fixed cost of unionization increases the union density by 15 p.p. but reduces the skill wage gap by 0.6 log points. As long as the provision of non-wage benefits is uniform across workers within a firm, a feature that emerges due to the regulatory restriction, the expansion of unions does not significantly mitigate wage inequality.

Finally, we use our model to quantitatively assess the factors that lead to the decline in the unionization rate in the United States over time. For this purpose, we re-estimate our model to fit the key statistics of the 1950s U.S. economy – prior to the introduction of Medicare and Medicaid– and then simulate the effects of skill-biased technological changes, social insurance expansions, and right-to-work laws on the union declines. We find that technological change and the implementation of RTW laws account for about 32% and 7% of the decline, respectively; interestingly, we also find that social insurance expansions through the provisions and expansions of multiple health insurance programs also contributed to about 15% of the overall decline.

Related Literature. This paper contributes to two strands of the literature. First, it is related to the literature on unions and labor markets. Our study is most related to a

[4]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 35%, among American workers.

growing number of macro labor studies that assess the impact of unions on labor market equilibrium. Acemoglu et al. (2001) argue that skill-biased technological change leads to a decline in the unionization rate and the decline in unions amplifies the effect of technological change on wage inequality. Subsequently, there are a few studies evaluating unions in quantitative general equilibrium models, including Açıkgöz and Kaymak (2014), Dinlersoz and Greenwood (2016), Krusell and Rudanko (2016), Taschereau-Dumouchel (2020), Alder et al. (2023), and Pickens (2023). For example, Taschereau-Dumouchel (2020) highlights the unions' general equilibrium effects where the threat of unionization affects firms' hiring decisions regarding the skill compositions of their workforce. There are also many empirical studies that investigate the effect of unions on wages and wage inequality. Among others, DiNardo et al. (1996), Card (2001) and Farber et al. (2021) show that unions significantly reduce wage inequality. In this vein, several empirical studies show the positive effect of unions on the level of non-wage benefits (e.g., Freeman and Medoff, 1984, Buchmueller et al., 2002, Knepper, 2020, and Lagos, 2021). We contribute to this literature in several ways. First, we document new quasi-experimental evidence about the effect of social insurance programs on labor unions. Second, we develop a new framework of labor unions that accounts for employers' insurance provisions and show how unions interact with social insurance programs and their implications for wage inequality. Third, we quantitatively show the relative importance of various factors contributing to the decline in unions in the United States.

Second, our paper also contributes to the literature that studies the welfare impact of social insurance provisions. First, a growing number of 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). In a similar vein, several studies evaluate various social insurance programs using equilibrium labor market models. Dey and Flinn (2005), Aizawa (2019), and Aizawa and Fang (2020) develop equilibrium labor search models with health insurance. Mitman and Rabinovich (2015) and Chodorow-Reich et al. (2019) evaluate the general equilibrium effects of unemployment insurance programs. Cole et al. (2019) and Aizawa et al. (2024) study the design of disability policies. We contribute to this literature by studying endogenous insurance provisions through the labor market institution and its interaction with social insurance.

The rest of the paper is organized as follows. In Section 2 we describe the institutional setting and background; in Section 3, we provide evidence about the relationship among unions, insurance provisions, and social insurance programs; in Section 4 we present our model; in Section 5 we explain our estimation strategy and present our estimates; in Section 6 we describe several counterfactual policy experiments; in Section 7 we present our accounting exercises regarding the factors that contributed to the decline in labor unions; and finally in

Section 8 we conclude.

2 Background

In this section, we document several data patterns about union membership, individual insurance coverage, and social insurance. We start by showing that the union density in the U.S. declined over the last four decades while the government spending on social insurance programs kept increasing during the same time period. We then investigate how union status is related to various fringe benefits, focusing especially on employer-sponsored insurance.

2.1 Union Formation

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 to show support for forming a union. 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 a bargaining unit. The NLRA stipulates that an appropriate unit of bargaining 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 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 Right-to-Work (RTW) laws, allowing non-members to avoid paying union dues while still being covered by collective bargaining agreements.

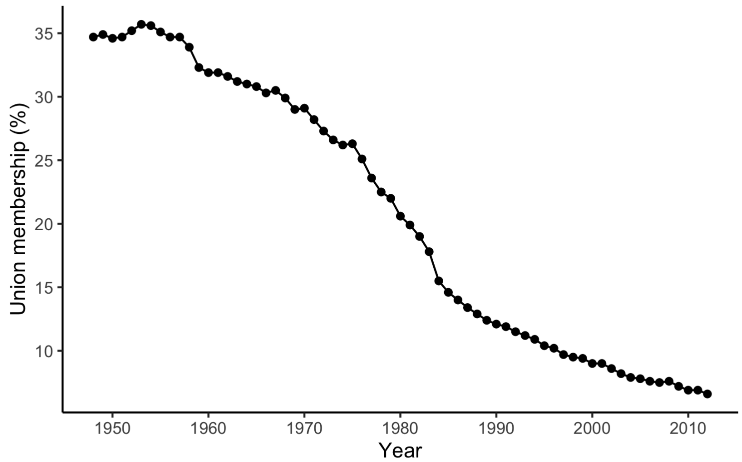
In theory, it is up to individual employees whether a union is formed in a workplace. However, in practice, firms play a crucial role in the unionization process. Firms often employ various anti-union tactics to dissuade workers from unionizing (Dickens 1983, Freeman and Kleiner 1990, Bronfenbrenner 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

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

[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). For more examples, see Bronfenbrenner (2009).

Figure 1: National Trend in the Union Membership Density



Note: 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.

through various tactics.

2.2 Decline in Unions and Potential Causes

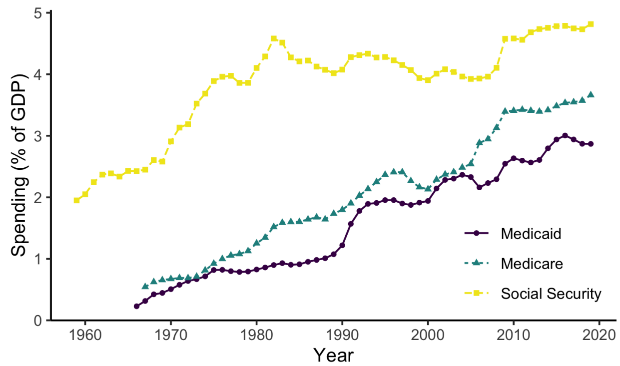
Figure 1 displays the national union membership density from 1948 onward, as taken from Farber et al. (2021). The union density was around 35% during the 1950s, and it began to decrease around 1960. It has continuously decreased, reaching to less than 10% after 2010.[8]

There are several potential explanations for the decline in unions. First, skill-biased technological change and the rise of the Chinese economy may affect unionization through their influences on a firm's production structure and labor demand. Skill-biased technological change increases the labor demand of high-skilled workers who may benefit less from joining unions (Acemoglu et al., 2001). Moreover, Charles et al. (2021) argue that trade competition with China has reduced union wage premiums by eroding profitability, resulting in union declines.

Second, the passage of state-based RTW laws could have also contributed to the decline in unions. Most of the RTW laws were passed either in the 1940s and 1950s, or after 2000. These laws allow workers who are not union members to be also covered by collective bargaining. An immediate implication of the RTW laws is that it induces the free-riding problem, and thus fewer workers will pay union due, making it difficult to sustain unions. Fortin et al. (2022) exploit the recent new approval of RTW laws in several states to find that

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

Figure 2: Trend in Spending on Medicaid, Medicare, and Social Security



Note: Data on the government spending on each social insurance program is from Federal Reserve Economic Data (FRED).

RTW laws reduce union membership by about two percentage points. In Online Appendix E, we follow Fortin et al. (2022) and also document its impact on union elections.

Third, since one of the union's main roles was to provide insurance benefits to workers, the introduction and expansion of social insurance programs could have also contributed to the decline in unions by replacing their roles. Figure 2 shows the government spending on the three major social insurance programs: Medicaid, Medicare, and Social Security, with the spending presented as a percentage of GDP. In contrast to the trend in union density, the 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. Of course, these aggregate patterns alone cannot provide causal evidence.[9,10] In the next section, we exploit plausibly exogenous variations in social insurance programs to identify the causal impacts of those social insurance programs on unionization.

3 Empirical Evidence

This section provides new evidence of the effects of social insurance on unions. We first document the fact that unionized firms are more likely to provide a variety of employer-provided insurance benefits. Then, by exploiting changes in various social insurance programs, we

[9]There are a few early studies documenting the time series association between the aggregate government welfare and social program expenditures and the union density (e.g., Neumann and Rissman, 1984 and Moore et al., 1989). These studies conclude that additional government welfare and social program expenditure is associated with lower union density in the late 20th century.

[10]Moreover, labor unions can have positive influence on workers to take up the UI (see Lachowska et al., 2022 for the recent evidence), suggesting that social insurance spendings can be endogenous to union density.

examine whether the expansions of social insurance programs lower union formation and unionization rates, possibly by diluting the unions' role in insurance provisions.

3.1 Unionization and Insurance Provisions by Employers

3.1.1 Data and Sample Selection

We mainly use household survey data from the Current Population Survey (CPS), the Health and Retirement Study (HRS), and the Survey of Income and Program Participation (SIPP). We also uses additional data on the state-level union density produced by Hirsch et al. (2001), and we obtain the NLRB union election data from Sojourner and Yang (2022).[11] We also use information on state-level political environments from KlarnerPolitics and the National Conference of State Legislatures.[12] The CPS provides cross-sectional information on union membership and basic demographic information for a large number of households over long periods of time. The HRS provides more detailed information on insurance coverage than the CPS in addition to union status, which allows us to study the relationship between union membership and insurance coverage at the individual level. In addition, we also use aggregate time-series data on the government spending on various social insurance programs such as Medicare, Medicaid, and Social Security from Federal Reserve Economic Data (FRED) to show the aggregate time trends of the spending on social insurance programs.

We use the CPS sample spanning the years 1983-2019. We restrict our sample to respondents aged 22-65 who reported their union status. The CPS sample we use does not cover information about union status for years before 1983 while we need information on the union density before 1983 in some analyses. To deal with this issue, we use estimates of the state-level union density produced by Hirsch et al. (2001) in some analyses. They used data from the CPS and the discontinued BLS publication Directory of National Unions and Employee Associations to produce the estimates of state-level union density from the year 1964.

The HRS sample span the years 1992-2019. The HRS is a panel survey of individuals aged 50 or over and their spouses regardless of their age. The HRS has information on union status and, importantly, has detailed information on insurance coverage. As in the CPS, we restrict our sample to individuals aged 65 or under who report their union status.

For the SIPP sample, we use the SIPP panels 1996, 2001, 2004, and 2008. The SIPP is a panel survey of households in the U.S. As in the other samples, we restrict the SIPP sample

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

[12] We obtained 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) while we obtain 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-sq	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. $^{*}p < 0.1;^{**} p < 0.05;^{***} p < 0.01$.

to individuals aged 22-65 who reported their union status.

3.1.2 Empirical Patterns

Employer-provided Insurance Benefits. We first 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 coverage on the worker's union status and various demographic variables. Specifically, we take a look at (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:

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

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 covariates, α_i is individual fixed effects, λ_t is time fixed effects, and ε_{it} is an error term. The coefficient β represents how much insurance coverage is related to union status. Since we control for the individual fixed effects, we exploit changes in union membership of the same individuals over time.

Table 1 shows that union membership is associated with a better access to health insurance, pension, and life insurance. Specifically, a union member is 5.6 p.p. (7.8%) more likely to be covered by employer-sponsored health insurance, 18.6 p.p. (27.4%) more likely to have a pension plan, and 3.9 p.p. (4.7%) more likely to have life insurance. Access to LTC insurance is weakly correlated with a union membership although the coefficient is not statistically significant.

Job Security. In addition to access to various types of insurance such as health insurance and pension, unions can also provide insurance to workers as a form of better protection against layoff. We investigate how union membership of a worker is related to subsequent job loss by using the sample of employed workers from the SIPP. Here, we summarize the main findings and relegate the detail of analysis in 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-losing probability associated with union membership is much larger for low-skilled workers than high-skilled workers.

3.2 Effects of Social Insurance Expansions on Unionization

In this subsection, we investigate the impact of social insurance programs on unions. We first 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 state-level changes in unemployment insurance generosity.

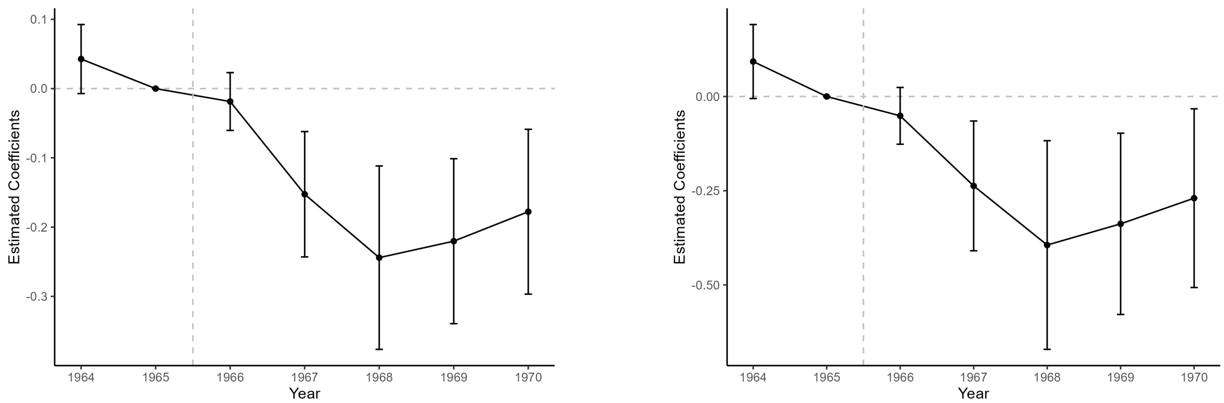
3.2.1 Introduction of Medicare

Medicare, which was enacted into law on July 1, 1965 and implemented from July 1, 1966, is a large public social insurance program that provided almost universal health insurance coverage mainly for elderly Americans who were 65 or older and whom in many cases did not have meaningful private health insurance prior to Medicare (Finkelstein, 2007). We study the impact of the introduction of Medicare on union membership.

We follow the empirical strategy of Finkelstein (2007). Prior to the introduction of Medicare, the private health insurance coverage rates of the elderly differed across regions, and the introduction of Medicare increased the coverage to, almost uniformly, 100 percent. In our context, given the role of unions in providing retiree insurance coverage, regions that had larger retiree private insurance coverage prior to Medicare would be associated with a larger decline in the union density after the introduction of Medicare because the role of unions in providing retiree insurance would be partly replaced by 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.

We now investigate how the changes in the union density in each state after the introduction of Medicare is related to the fraction of the elderly in the state with private retiree

Figure 3: 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). The error bars represent the 95% confidence intervals based on standard errors clustered at the state level.

insurance *prior to* Medicare introduction. We estimate the following difference-in-difference specification:

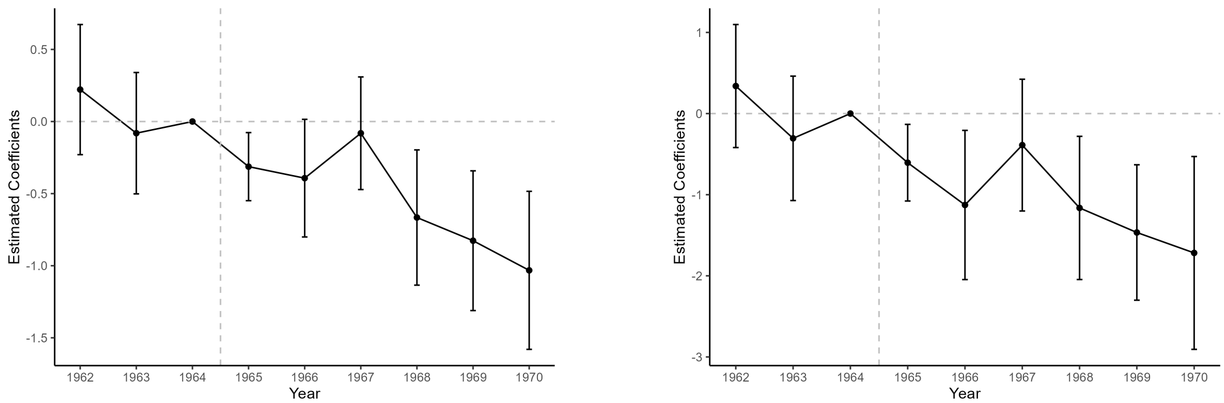
$$y_{st} = \sum_{\tau=-1,\tau\neq 0}^{5} \beta_\tau \times (Coverage_{s,1963}) \times \mathbb{1}\{t = \tau + 1965\} + x'_{st}\gamma + \alpha_s + \lambda_t + \epsilon_{st} \tag{2}$$

where the outcome variable y_{st} is the log of union membership density in our baseline analysis, and the treatment variable $Coverage_{s,1963}$ is the fraction of the elderly in state s covered by private retiree insurance in 1963; x_{st} is a vector of time-varying state-level covariates; and α_s and λ_t are the state and year fixed effects. We impose a normalization by excluding $\mathbb{1}\{t = 1965\}$.

We control for differential changes in state political environments. Specifically, we control for an indicator for a Democratic governor, the third-order polynomials of the proportion of state legislative seats held by the Democratic Party, separately for the state Senate and House. Medicaid was also enacted in 1965 but its implementation differed across states, ranging from 1966 to 1972 (except for Arizona which started its Medicaid program in 1982). We also include four indicators for the number of years before/after the implementation of Medicaid in each state.[13] We use 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.

[13]See Table A.3 for the timing of the implementation of Medicaid, which is based on Table 1.1 of Gruber (2003).

Figure 4: 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. The error bars represent the 95% confidence intervals based on standard errors clustered at the state level.

Figure 3 graphically displays the estimates of 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. Although we can check the pre-trend only for one year due to the lack of data, we confirm that there is no significant pre-trend.

We provide additional evidence on the Medicare impact using the data on NLRB elections. We use the same specification as equation (2) but use the log of the number of elections as an outcome variable y_{st}. The election data is available from 1962. Since there are multiple periods available before 1965, we normalize the impact in 1964 to zero so that we can capture the impact in the same year of the Medicare introduction.

Figure 4 displays the estimated coefficients of equation (2) where the outcome variable is the log of the number of elections. Panel (a) shows the results where the treatment is Blue Cross coverage for retirees in 1963, while panel (b) is the case where the treatment is any insurance coverage for retirees in 1963. The figure confirms the previous result that regions with larger insurance coverage prior to Medicare introduction experienced decline in union elections compared to regions with smaller insurance coverage. We do not detect significant pre-trends in both cases.

3.2.2 Introduction of Medicaid

In the previous analysis of Medicare introduction, we controlled for the varying timing of Medicaid implementation. We can also leverage this variation to estimate the impact of Medicaid implementation on unionization. Specifically, although Medicaid was signed into law in July, 1965, the timing of the implementation was up to each individual state. As a result, some states implemented the program earlier than other states. Table A.3 lists the timing of the implementation by each state.

One complication from the 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 for a long period of time. As a compromise, we take a short time window.

We begin with the following standard event study specification

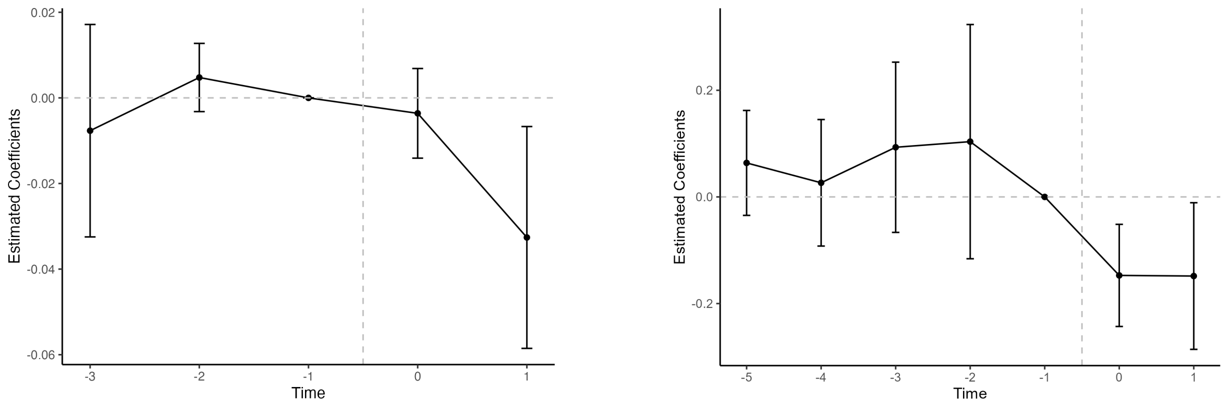
$$y_{st} = \sum_{\tau=-4,\tau\neq-1}^{1} \beta_t \mathbb{1}\{t - E_s = \tau\} + \beta_{-5}\mathbb{1}\{t - E_s \leq 5\} + x'_{st}\gamma + \alpha_s + \lambda_t + \epsilon_{st} \tag{3}$$

using the sample until $t = 1967$. The outcome of interest is either the log of union density or the log of the number of elections. E_s is the year when state s implements the Medicaid. x_{st} is a vector of time-variant covariates. α_s and λ_t are the state and year fixed effects. We control for the same set of variables representing the state political environments as in the previous regression equation (2) for Medicare. We use state population in 1960 as weights. We cluster standard errors at the state level.

Figure 5 displays the estimated coefficients of equation (3). Panel (a) shows the impact of the Medicaid implementation on union density. The estimate suggests that the union density is reduced by 3% one year after the implementation. Panel (b) shows the impact on the number of elections. It shows that the number of union elections is reduced by more than 10% after the implementation of Medicaid. In both of those cases, we do not detect significant pre-trends.

One caveat is that with treatment effect heterogeneity across states with different treatment timing, the estimated coefficients of equation (3) are harder to interpret, and testing β_τ for $\tau < -1$ does not provide a valid test for pre-trends. As a robustness check, Figure A.3 report the interaction-weighted estimates proposed by Sun and Abraham (2021) and we find similar patterns as in Figure 5.

Figure 5: Estimated Impact of Medicaid Implementation on Union



(a) Log Union Membership Density (b) Log Elections

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.

3.2.3 Expansions of Social Insurance Programs in Recent Years

So far, we have documented that the introduction of large-scale social insurance programs such as Medicare and Medicaid reduced both the union density and the union formation in the U.S. in the 1960s and 1970s. Next, we examine whether the more recent expansion of social insurance programs still lowers the unionization rate.

Here, we summarize the main analysis and findings and relegate all the details in 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). To utilize the variation in the ACA Medicaid expansion across states, we employ a difference-in-differences approach and estimate the impact of the expansion on union membership. Our empirical specifications explicitly control for other factors that may also affect the unionization rate, such as changes in the RTW laws in some states. We find that the ACA Medicaid expansion slightly lowers the union membership on average; but it lowers the unionization rate much more significantly for low-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 substitute 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 raplacement rates across states and over time to estimate the impact of UI generosity on union membership. We find that more generous UI raplacement lowers the individual unionization rate.

Summary of Findings. Overall, these patterns suggest that more generous social insurance reduces the unionization rate and union formation. Since unionized firms tend to offer employment-based insurance benefits, the evidence in this section as a whole suggests that the prevalence of unions in the economy depends on the social insurance system.

4 The Model

In this section, we formulate an equilibrium labor market model to understand the underlying mechanisms that relate labor unionization and social insurance. Our previous section documents the relationship among union status, the provision of employment-based insurance benefits, and social insurance programs. Thus, we first consider that both union formation and insurance provisions are endogenously determined in the labor market and then analyze the effects of social insurance programs.

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 $x \in \mathcal{X} \equiv \{1, \ldots, X\}$. The fraction of each type x is denoted by N_x. Workers consume wages $w > 0$ and non-wage amenity or benefits $a \in \mathcal{A}$, where $\mathcal{A}$ is a finite set. Each element of $\mathcal{A}$ represents a particular bundle of non-wage amenities or benefits; in particular, $a = 0$ denotes no benefits. Firms are risk-neutral and heterogeneous in their production technologies indexed by $y \in \mathcal{Y} \equiv \{1, \ldots, Y\}$. 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. The production function $F_y(\boldsymbol{g})$ depends on a firm's type y [see Eq. (9) for details]. The measure of type-y firms is given by M_y and the total measure of firms is $M = \sum_{y \in \mathcal{Y}} M_y$. Both workers and firms discount future value at a rate $\gamma \in (0, 1)$. For simplicity, we assume that workers cannot save or borrow.

4.2 Labor Markets

There is a frictional labor market for each skill type x. Firms can post multiple vacancies. In each 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 $\theta_x = \frac{v_x}{s_x}$. Since $m(\cdot,\cdot)$ is homogeneous of degree one, the 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 job-finding probability 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.

4.3 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 amenity provisions; (iii) Vacancies and unemployed individuals are randomly matched in each labor market; (iv) Production takes place, and wages and amenities are provided; (v) A fraction $\delta_{x,k}$ of jobs are destroyed for each x depending on the union status k.

4.4 Workers

Preferences. If a type-x worker gets wage w and amenity a, then the worker gets utility $u_x(w,a)$ where we allow preferences to depend on type x. We assume that an unemployed individual gets $u_x(b_x,0)$ where b_x is unemployment benefits (and/or home production).

Value Functions. The value for a type-x worker when employed by a firm of type y with union status $k \in \{u,n\}$ that offers 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 first term on the right hand side is the current period utility while the second term is the expected future value discounted by γ: with probability $\delta_{x,k}$, the job is destroyed and the worker gets the unemployment value V^U_x described below; with the remaining probability $1-\delta_{x,k}$, the worker continues with the same firm with the same union status k that provides the equilibrium wage and amenity $(w_{x,y,k},a_{x,y,k})$ in the next period. Firms and workers take $(w_{x,y,k},a_{x,y,k})$ as given when bargaining for the current wages.

V^U_x is the unemployment value for a type-x worker at the beginning of a period and is given by

$$V^U_x = p(\theta_x)V^M_x + (1-p(\theta_x))[u_x(b_x,0) + \gamma V^U_x], \tag{5}$$

where with probability $p(\theta_x)$, the worker meets a firm and gets the value V^M_x, and with probability $1-p(\theta_x)$, the worker remains unmatched. V^M_x denotes the expected value for a type-x worker from meeting a vacancy, and it is given by

$$V_x^M = \mathbb{E}\left[\max\{V_{x,y,k}^E(w_{x,y,k}, a), V_x^U\}\right] \tag{6}$$

where the expectation is taken over the equilibrium distribution of vacancies posted by different types of firms with different union status and insurance provision.[14]

4.5 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 more nuanced. As discussed in Section 2.1, firms often resort to various strategies to prevent unionization. To more comprehensively capture both the costs associated with unionization and those of preventing union formation, we assume that firms determine unionization but the costs they incur in this process are influenced by the collective preferences—endogenously derived below—of their workers. Consequently, while the option to remain non-unionized always exists for a firm, it may not be profitable to prevent unionization if its workers exhibit a strong collective preference for unionization.

To flexibly capture the cost of preventing unionization, we first denote by $\mathcal{W}_{x,y,n}(\boldsymbol{g}, a) \in \mathbb{R}$ denote the *willingness to pay for unionization* of a type-x worker in a type-y nonunionized firm employing $\boldsymbol{g}$ with amenity a. It represents how strongly a worker is in favor of unions in terms of consumption goods and tends to be positive for low-skill workers and be negative for high-skill workers. We relegate its formal definition to Appendix F.2. To define the cost of unionization, we aggregate them at each firm y, denoted by $\mathcal{W}_{y,n}(\boldsymbol{g}, a)$. Then, a firm's cost of preventing unionization, which we term the *union threat cost*, is given as follows.[15]

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

where $c_0 > 0$ reflects the cost of the various ways that a firm may deploy to counteract unionization. Equation (7) captures the idea that, 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 firms to prevent unionization. The union threat cost implies that if different types of workers have different willingness to pay for unionization, firms may have an incentive to distort composition of

[14]The precise expression for V_x^M is given by equation (A9) in Appendix F.1.

[15]One advantage of using this flexible cost function instead of a simple majority voting rule (e.g., Taschereau-Dumouchel 2020) is numerical tractability. With a simple majority voting rule, there is a cutoff $\hat{\alpha}$ 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. Additionally, this generates a counterfactual pattern where smaller firms (with smaller α) all become unionized.

workers to reduce the union threat cost. Equation (A10) in Appendix F.2 also makes it clear that a non-unionized firm can also modify its wage offerings $w_{x,y,n}(\boldsymbol{g}, a)$ to affect the union threat cost.

We define the similar cost function when a firm prefers unionization but its workers oppose it.[16] Given the employees' aggregate *willingness to accept de-unionization*, $\mathcal{W}_{y,u}(\boldsymbol{g}, a)$, defined in Equation (A12) 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:

$$C_{y,u}(\boldsymbol{g}, a) = F_{union} + c_0 \max\{0, \mathcal{W}_{y,u}(\boldsymbol{g}, a)\} \tag{8}$$

where $F_{union} > 0$ is the fixed cost of union that a firm needs to pay regardless of whether workers agree on unionization (See Section 4.9 for an interpretation of F_{union}). $c_0 > 0$ reflects the marginal cost of the various ways that a firm may deploy to counteract de-unionization.

4.6 Firms

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

$$F_y(\boldsymbol{g}) = A_y \left(\sum_{x \in \mathcal{X}} z_x g_x^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}\alpha_y}, \tag{9}$$

where A_y is the firm-specific total factor productivity (TFP), α_y is the returns to scale, σ 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. Notice that in the production function specified in (9), firms of different types y differ in two aspects: their TFP A_y and their returns to scale α_y.

Firms pay wages and provide amenities to their workers. The current-period profit function of a type-y firm with union status $k \in \{u, n\}$ is given by

$$\pi_{y,k}(\boldsymbol{g}, a) = F_y(\boldsymbol{g}) - \sum_{x \in \mathcal{X}} \left[w_{x,y,k}(\boldsymbol{g}, a) + c_x(a) \right] g_x - F_a(a), \tag{10}$$

where 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 which depends on union status k, and $c_x(a)$ is the per-worker expected cost of providing amenity a to a worker of type x. $F_a(a)$

[16] 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.

represents the per-period fixed cost of providing amenity level a, and $F_a(a) > 0$ if $a > 0$ and $F_a(0) = 0$.

The fixed cost $F_a(a)$ encapsulates various costs tied to amenity provisions that remain invariant with respect to the firm size. For instance, a firm might establish and run a benefits office to offer amenities to its employees. This can also encompass the transaction costs arising from making contracts with insurance providers. Also, in the case of health insurance, insurance companies often impose an administrative service over the anticipated claims costs. As noted by Karaca-Mandic et al. (2011), smaller establishments tend to bear considerably higher loading fees compared to their larger counterparts. A portion of this discrepancy can be attributed to the fixed cost in our model.[17] The fixed cost of providing amenities gives unionized firms the cost advantage in providing amenities to their workers, which we discuss in Section 4.9.

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

$$J_{y,k}(\boldsymbol{g}, a) = \max_{\{\nu_1,\dots,\nu_X\}} \pi_{y,k}(\boldsymbol{g}', a) - C_{y,k}(\boldsymbol{g}, a) - \kappa \sum_{x\in\mathcal{X}} \nu_x + \gamma J_{y,k}(\boldsymbol{g}', a), \tag{11}$$

subject to the law of motion

$$g'_x = (1 - \delta_{x,k})g_x + \nu_x q(\theta_x)e_{x,y,k,a}, \quad x = 1, \dots, X, \tag{12}$$

where $q(\theta_x)$ is defined in Subsection 4.2 and $e_{x,y,k,a}$ is worker's decision of accepting a job from this firm.[18] Notice that the objective function (11) incorporates the union threat cost $C_{y,n}(\boldsymbol{g}, a)$, or the union maintenance cost $C_{y,u}(\boldsymbol{g}, a)$, as defined by (7) and (8) respectively. The first term in the law of motion (12) 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.[19] Notice that the separation rate $\delta_{x,k}$ is allowed to differ by x and k, which can capture two relevant forces: first, workers of different skills can subject to different rates of job separation, and second, unions can affect job security and the impact can potentially differ by workers' skill type.

[17] This type of cost is quantitatively important too. Karaca-Mandic et al. (2011) report firms of up to 100 employees face loading fees of about 34%. The number is 4% for firms with more than 10,000 employees.

[18] 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 θ_x.

[19] 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 firms of type y can be rewritten as follows.[20]

$$\hat{\pi}_{y,k}(\boldsymbol{g}, a) = \pi_{y,k}(\boldsymbol{g}, a) - C_{y,k}(\boldsymbol{g}, a) - \psi_{y,k}(\boldsymbol{g}, a), \tag{13}$$

where

$$\psi_{y,k}(\boldsymbol{g}, a) = \kappa \sum_{x \in \mathcal{X}} \frac{g_x}{q(\theta_x)} - \kappa\gamma \sum_{x \in \mathcal{X}} (1 - \delta_{x,k}) \frac{g_x}{q(\theta_x)}. \tag{14}$$

The first term in (13) is the current-period profit; the second term is the union threat cost or the union maintenance cost as defined by (7) and (8) respectively; and the third term $\psi_{y,k}(\boldsymbol{g}, a)$ is the cost of posting a vacancy net of the gain from lowering the future hiring costs.[21]

Hiring and Amenity Provision. We now describe the firm's optimal choice of $\boldsymbol{g}$ and a. We introduce firms' taste shocks for amenity provision $\{\epsilon_a\}_{a \in \boldsymbol{\mathcal{A}}}$ and for union formation $\{\epsilon_k\}_{k \in \{u,n\}}$ to smooth their choices and assume that they follow Type-I extreme value distributions with scale parameters σ_a and σ_{union} respectively, and these shocks are assumed to be independently across firms but are fixed over time for each firm. Since shocks are fixed over time for each firm, each firm has the same union status and amenity-provision status over time in a steady state. We assume that these shocks are unobservable to workers and cannot be bargained over in wage bargaining that we describe in the next subsection. As a result, these shocks do not affect wage functions.

To compute the probability of choosing to provide insurance and to unionize, we first consider a firm's hiring problem. Given firm type $y \in \mathcal{Y}$, amenity provision $a \in \mathcal{A}$ and union status $k \in \{u, n\}$, a firm maximizes the steady state objective function (13):

$$\boldsymbol{g}_{y,k}(a) = \arg\max_{\boldsymbol{g}} \hat{\pi}_{y,k}(\boldsymbol{g}, a) \tag{15}$$

Given the optimal hiring choices above, a firm's value of choosing a is given by the discounted sum of 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

$$J_{y,k}(\{\epsilon_a\}_{a \in \boldsymbol{\mathcal{A}}}) = \max_{a \in \boldsymbol{\mathcal{A}}} \left\{ \hat{J}_{y,k}(a) + \epsilon_a \right\}. \tag{16}$$

Given that ϵ_a is assumed to have extreme value Type-I distribution with scale parameter σ_a (and location parameter 0), the probability that a type-y firm provides amenity a conditional

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

[21] Although the total cost of vacancy posting is linear in the number of workers, the firm's problem has a solution due to the concavity of production function.

on union status $k \in \{u, n\}$ is then given by

$$P_{y,k}(a) = \frac{\exp\left(\hat{J}_{y,k}(a)/\sigma_a\right)}{\sum_{a' \in \boldsymbol{\mathcal{A}}} \exp\left(\hat{J}_{y,k}(a')/\sigma_a\right)}. \tag{17}$$

Unionization. A firm solves the hiring problem (15) for both $k = u$ and $k = n$, and it chooses a union status that gives a higher value. Specifically, a firm of type y unionizes if and only if $J_{y,u}(\{\epsilon_a\}_{a\in\boldsymbol{\mathcal{A}}}) + \varepsilon_u \geq J_{y,n}(\{\epsilon_a\}_{a\in\boldsymbol{\mathcal{A}}}) + \varepsilon_n$, where ε_u and ε_u are respectively shocks independently drawn from Type-I extreme value distribution with scale parameter σ_{union} as described previously. Thus the fraction of unionized firms among type y firms is given by

$$\mathcal{Q}_y = \mathbb{E}\left[\frac{\exp\left(J_{y,u}(\{\epsilon_a\}_{a\in\boldsymbol{\mathcal{A}}})/\sigma_{\text{union}}\right)}{\exp\left(J_{y,u}(\{\epsilon_a\}_{a\in\boldsymbol{\mathcal{A}}})/\sigma_{\text{union}}\right) + \exp\left(J_{y,n}(\{\epsilon_a\}_{a\in\boldsymbol{\mathcal{A}}})/\sigma_{\text{union}}\right)}\right], \tag{18}$$

where the expectation is taken over the joint distribution of a firm's taste shocks for amenity provision $\{\epsilon_a\}_{a\in\boldsymbol{\mathcal{A}}}$. Notice $\mathcal{Q}_y$ as derived in (18) appears in the workers' value function (6).

Remark 1. *In our model we conceptualize that it is up to the firms to decide whether or not their workers will be unionized, but the firms cannot ignore workers' preferences. The reduced-form union threat cost $C_{y,n}(\boldsymbol{g}, a)$ as defined by (7) implies that if workers have strong preferences for unionization, firms cannot profitably prevent unionization and therefore likely end up with unionized workers; likewise, the union maintenance cost $C_{y,u}(\boldsymbol{g}, a)$, as defined by (8), implies that if workers have strong preferences for non-unionization, firms cannot profitably unionize the workers and therefore likely end up with non-unionized workers.*

4.7 Wage Bargaining

Wages are determined by Nash bargaining between an employer and its workers. In a unionized firm, *collective bargaining* takes place between the workers' union and the employer where they split the total surplus of the match. We specify the collective bargaining problem as an n-player Nash bargaining problem. In a nonunionized firm, *individual bargaining* takes place between each individual worker and the employer where they split only the surplus generated by the focal worker joining the production. These bargaining problems are solved given the hiring profile $\boldsymbol{g} = (g_1, \ldots, g_x)$ and amenity provision a.

Note that a surplus generated from employment for a worker of type x is given by

$$V^E_{x,y,k}(w, a) - u_x(b_x, 0) - \gamma V^U_x = u_x(w, a) - \upsilon_{x,y,k}, \tag{19}$$

where $\upsilon_{x,y,k}$ is the net value of unemployment which is given by

$$\upsilon_{x,y,k} = u_x(b_x, 0) + \gamma(1-\delta_{x,k})\frac{(1-\gamma)V_x^U - u_x(w_{x,y,k}, a_{x,y,k})}{1-\gamma(1-\delta_{x,k})}. \tag{20}$$

Since wage bargaining takes places in each period without commitment, $\upsilon_{x,y,k}$ is taken as given in the current-period bargaining because it is determined in future bargaining.

Individual bargaining. In individual bargaining, the firm bargains with each worker separately. Due to the decreasing returns to scale, the surplus depends on whether a worker is treated as a marginal worker or an infra-marginal worker. We take the approach by Stole and Zwiebel (1996) where every worker is treated as a marginal worker.[22] With decreasing returns to scale, the sum of each marginal worker's contribution does not equal total production.

Note that the bargaining takes place after the hiring decision and therefore the bargaining does not take into account the impact of an extra worker on the vacancy posting cost that was needed to hire the worker. Accordingly, the marginal gain for the firm from an extra worker of type x considered in the bargaining is obtained by differentiating equation (13) ignoring the first term of (14), and it is given by:

$$\Delta_{x,y,n}(\boldsymbol{w}, a) = \frac{\partial F_y(\boldsymbol{g})}{\partial g_x} - w_{x,y,n}(\boldsymbol{g}, a) - c_x(a) - \sum_{x' \in \mathcal{X}} \frac{\partial w_{y,x',n}(\boldsymbol{g})}{\partial g_x} g_{x'} + \frac{\gamma\kappa(1-\delta_{x,n})}{q(\theta_x)}. \tag{21}$$

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

$$\max_{w_x} \quad \left[u_x(w_{x,y,n}(\boldsymbol{g}, a), a) - \upsilon_{x,y,n}\right]^{\beta_n} \left[\Delta_{x,y,n}(\boldsymbol{w}, a)\right]^{(1-\beta_n)}, \tag{22}$$

where $\beta_n \in (0,1)$ is the bargaining power of a nonunion worker. Note that the bargaining problems in (22) need to be solved simultaneously for all $x \in \mathcal{X}$.

Collective bargaining. We consider a collective bargaining problem as a n-player Nash bargaining problem between a firm and all its workers represented by their union, following Taschereau-Dumouchel (2020). The collective bargaining problem is given by

$$\begin{aligned} \max_{\boldsymbol{w}} & \left[\prod_x \left(u_x(w_{x,y,u}(\boldsymbol{g}, a), a) - \upsilon_{x,y,u}\right)^{\frac{g_x}{n_y}}\right]^{\beta_u} \\ & \times \left[F_y(\boldsymbol{g}) - \sum_{x \in \mathcal{X}} (w_{x,y,u}(\boldsymbol{g}, a) + c_x(a)) g_x - F_a(a) + \kappa\gamma \sum_{x \in \mathcal{X}} \frac{(1-\delta_{x,u}) g_x}{q(\theta_x)}\right]^{(1-\beta_u)}, \end{aligned} \tag{23}$$

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

where $n_y = \sum_{x \in \mathcal{X}} g_x$ is the total size of type-y firm, and β_u is the unions' bargaining power. An important contrast between the collective bargaining problem (23) and the individual bargaining problem (22) is that the fixed cost of providing amenity F_a shows up in the collective bargaining problem since it is part of the firm's *overall* profit while it does not show up in the individual bargaining since it is not a part of each worker's *marginal* contribution.

4.8 Equilibrium

We focus on a steady-state equilibrium. To close the labor market, consider that market tightness vector for all X sub-markets, denoted by $\theta = (\theta_1, \cdots, \theta_X)$, is determined by two steady-state relationships between the mass of the unemployed and market tightness. First, on the firm side, given market tightness θ, the mass of the unemployed for each skill type x, denoted by $\mathcal{U}_x^{JC}(\theta)$, is determined by the hiring decision of firms. Second, on the worker side, given market tightness θ, the mass of the unemployed for each skill type x, denoted by $\mathcal{U}_x^{BC}(\theta)$, is determined by the flow into and out of unemployment that are dictated by the exogenous matching function and job destruction. We pin down θ so that

$$\mathcal{U}_x^{BC}(\theta) = \mathcal{U}_x^{JC}(\theta) \quad \text{for all } x \in \mathcal{X}. \tag{24}$$

See Appendix F.3 for how one can derive $\mathcal{U}_x^{JC}(\theta)$ and $\mathcal{U}_x^{BC}(\theta)$.

A steady-state equilibrium of our model consists of a set of value functions $\{V_{x,y,k}^E, V_x^U\}$, employment 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 of firms (15), (iii) the wage schedules solve the bargaining problems (22) and (23), (iv) the amenity provision functions are determined by (17), and (v) the unionization is determined by (18), and (iv) the market tightness satisfies (24).

Note that our characterization of equilibrium is much richer than existing ones: In equilibrium, amenity (or insurance) provisions, job security, wage distribution, union formation, firm size, and employment are all jointly determined. Moreover, to study the effect of social insurance and insurance provisions, we introduce risk averse workers. The cost of our approach is that we lose analytically tractability. For example, by incorporating risk averse workers, we cannot obtain a closed-form solution for wage functions $w_{x,y,k}(\boldsymbol{g}, a)$ unlike Taschereau-Dumouchel (2020). However, our model is still numerically very tractable. We develop a robust numerical algorithm to solve an equilibrium. We relegate the detail to Appendix G. Through extensive searches across parameters, our numerical algorithm allows us to find an equilibrium quickly and leads to a unique equilibrium.

4.9 Mechanisms: Incentive to Unionize and Provide Amenity

There are at least three mechanisms leading to firm's unioninization. The first one is the union threat cost (7). Note that workers in individual bargaining receive their *marginal* contribution to production while workers in collective bargaining receive the *average* contribution to production. Since every worker in a nonunionized firm is treated as a marginal worker, the decreasing returns to scale production technology imply that adding up each worker's marginal contribution to the output is smaller than the total output. As a result, a firm can extract more surplus in individual bargaining than in collective bargaining. Indeed, in a simple case with risk-neutral workers, $\beta_u = \beta_n$, no insurance provision, and no union threat cost, firms always choose nonunionization (Taschereau-Dumouchel, 2020). However, with the union threat cost, firms need to take into account worker preferences on unions. Low-skill workers prefer unionization to benefit from high-skill workers' contributions. To reduce the union threat cost, nonunionized firms change their skill composition, moving away from the optimal mix of different skills which leads to production losses. If α_y is small enough, the gain from individual bargaining compensates for the production loss due to hiring adjustments. Conversely, if α_y is large enough, the gain from individual bargaining is insufficient, and the firm chooses unionization. Since firms with higher α_y are also larger (because they are less subject to decreasing returns to scale), the model generates a positive correlation between firm size and unionization as in the data.

Second, amenity provision also incentivizes unionization by creating a surplus that firms can extract only through collective bargaining. With a positive fixed cost of amenity provision, unionized firms can offer amenity (insurance) at a smaller cost by passing part of the fixed cost onto workers in collective bargaining. This gives firms an extra incentive to unionize.

Third, with a smaller job destruction rate 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. The better job security increases the duration of a match, generating a larger surplus for each match and providing another incentive for firms to unionize. One potential cost associated with better job security is that it could result in costly labor hoarding when a firm is hit by a negative shock to productivity and wants to scale down. Although we abstract away productivity shocks in the model for tractability, the fixed cost FC_{union} would capture production losses associated with such labor hoarding in a reduced-form way.[23]

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

5 Estimation

We now extend our model to quantitatively evaluate impacts of social insurance and union policies and then explore the causes of union declines. For this purpose, we first estimate the model to fit with various data in the recent time period to obtain policy insights for the current policy debates. Then, we fit our model to the 1950s economy to understand the historical changes in labor unions.

5.1 Quantitative Extension and Estimation for the Current Economy

5.1.1 Empirical Specification

In order to estimate our model, we will make additional assumptions. First, although our model describes general non-wage benefits, we focus on health insurance in our quantitative applications. a is now a binary variable: a worker with $a = 1$ is insured while a worker with $a = 0$ is not. Second, we specify the direct utility function as follows.

$$u_x(w, a) = \int \frac{C(w, a)^{1-\zeta_x}}{1 - \zeta_x} dH_x(m_x) \tag{25}$$

where $C(w, a)$ is the level of consumption given wage w and insurance a provided by the firm, ζ_x is the relative risk-aversion parameter, and H_x is the distribution of medical expenditure for type-x workers. For the current specification, we assume that the utility from consumption is $u_x(C(w, a)) = \log C(w, a)$ for all x; i.e., $\zeta_x = 1$ for all x. Consumption level $C(w, a)$ 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 an out-of-pocket medical expenditure that depends on a worker's health insurance status.

Second, given our interests in social insurance programs, we model the public health insurance system more realistically. Specifically, we model Medicaid in the following way.[24] We assume that the fraction p_x^{Med} of type-x workers become eligible for Medicaid upon unemployment, and stay eligible until they get employed. Specifically, the (ex-ante) value of unemployment is given by

$$V_x^U = p_x^{Med} V_x^U(1) + (1 - p_x^{Med}) V_x^U(0) \tag{26}$$

[24] 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.

where $V_x^U(1)$ is the value of unemployment with Medicaid coverage and $V_x^U(0)$ is the value of unemployment without Medicaid coverage. They are respectively given by

$$V_x^U(i) = p(\theta_x)V_x^M + (1 - p(\theta_x))[u_x(b_x, a_i) + \gamma V_x^U(i)], \quad i = 0, 1. \tag{27}$$

with $a_0 = 0$ and $a_1 = 1$.

In estimating the model, we impose additional assumptions on firm's production function. We assume that firms can be different in terms of the returns to scale α_y but the same in terms of TFP A_y, i.e., $A_y = A$. We assume that α_y follows a Beta distribution, $Beta(a, b)$, on the support $[0.5, 0.9]$. We emphasize this aspect of firm heterogeneity because the heterogeneity in α_y endogenously generates a pattern that larger firms tend to be unionized even without TFP heterogeneity, as discussed in Section 4.9.

5.1.2 Externally Set or Estimated Parameters

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

The list of externally set or estimated parameters is summarized in Table A.7 in Appendix. First, we set the number of skill types to be $X = 2$. We identify low-skill workers ($x = 1$) as those who are high school graduates or have less education, and high-skill workers ($x = 2$) as those with at least some college education, which is a standard approximation in the literature (Acemoglu and Autor, 2011). Each period of the model is one 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 22.56, as derived from the Census BDS.[25] The elasticity of substitution between skill types is set to $\sigma = 1.5$ (Johnson, 1997). We set the per-quarter consumption floor $\underline{c}$ to \$1,000, taken from French and Jones (2011). We specify the matching function as $m(s, v) = \mu\frac{sv}{s+v}$ following Den Haan et al. (2000) where μ is the matching efficiency parameter. The matching efficiency parameter μ and the vacancy creation cost κ are not separately identified from the unemployment rate, thus we normalize $\mu = 1$ and internally estimate κ. We calibrate b_x so that it 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 workers and nonunionized workers to $\beta_u = \beta_n = 0.5$.[26]

[25] 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.

[26] We can also identify and estimate the bargaining power parameters within the model, for example,

The job destruction rates are allowed to depend both on the skill type and union status. Unfortunately, union status in the CPS is available only in the Outgoing Rotation Samples, which makes it impossible to infer the relationship between union membership and subsequent job loss. To deal with that, we estimate the impact of union status on subsequent job-losing probability in the SIPP data and use the estimation result to adjust the job-losing probability in the CPS. 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 log-normal distribution with a mass point at zero. We estimate the parameters of the log-normal distribution and the fraction of individuals with zero expenditure for each skill type in the 2007 Medical Expenditure Panel Survey (MEPS).[27] 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 the annual deductible is \$714 and the coinsurance rate is 18%. Since \$714 is in the 2006 dollar values, we deflate it using the CPI for medical expenditure. We also 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 the probability of Medicaid eligibility p_x^{Med} using the fraction of workers of each type being covered by Medicaid in the CPS. In our sample, we obtain $p_1^{Med} = 0.16$ and $p_2^{Med} = 0.09$.

5.1.3 Internally Estimated Parameters

Identification. We identify and estimate the rest of the parameters within the model: the firm's production technology A and the distribution of α_y, the cost associated with unions F_{union}, c_0, the fixed cost of insurance F_a, and the scale parameters for the choice-specific Type-I extreme value shocks for amenities, σ_a, and for union status σ_k. We now discuss how we can separately identify these parameters exploiting variations in union density, firm size, compensation packages, and employment.

The first set of key parameters is the parameters associated with unionization. Regarding the union cost, c_0 determines the degree of union threats. As we discussed in Section 4.9, if there is no union threat and no benefit to share the fixed cost of insurance provision with

by targeting a union wage premium. However, the literature has not arrived at 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 discussions.

[27] See https://meps.ahrq.gov/mepsweb/data_stats/.

the worker union, then no firms have the 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 rationalize the unionization rate of large firms. unionized firms are "better" at providing insurance; however, the incentives for small firms to unionize depends on the fixed cost of unionization F_{union}, which is the key to determine the unionization rate among small firms. The parameter σ_k smooths the relationship among firm size and unionization rate. Thus, we identify it via the joint distribution of these variables.

The second set of key parameters is the parameters related to insurance provision. The fixed cost of insurance F_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 because they can pass part of the fixed cost of insurance to the worker side in collective bargaining. Second, unionized firms tend to be larger, and the fixed cost of insurance is less burdensome for the large firms. A larger taste shock for insurance (in term of scale parameter σ_a) attenuates these effects. More specifically, a larger scale parameter for the shock shrinks the difference between the insured rate of unionized workers and that of nonunionized workers. Hence, the relative insured rates conditional on union status identifies σ_a separately from F_a.

The rest of the parameters is identified as follows. The distribution of firm sizes is informative about the parameters associated with the distribution of α_y (a and b). If the distribution has a larger density at the upper end of the distribution, large firms have a larger share of employment. The TFP, A, is identified by the average wage. Skill-specific productivity z_1 and z_2 are normalized so that they add up to one and are identified by the ratio of high-skill wages and low-skill wages. Finally, we identify the vacancy posting cost κ by matching the unemployment rate in the data.

Estimation Strategy. Motivated by the above identification arguments, we estimate these parameters via the GMM. The targeted moments include (i) union density; (ii) union workers' employment share by firms with more than 10 employees, and the same share by firms with more than 100 employees; (iii) nonunion workers' employment share by firms with more than 10 employees and the share by firms with more than 100 employees; (iv) ESHI coverage rate by union status and by worker's skill type; (v) average wage by worker's skill type; and (vi) unemployment rate. We minimize the objective function

$$Q(\vartheta) = [\hat{\boldsymbol{m}} - \boldsymbol{m}(\vartheta)]'\boldsymbol{W}[\hat{\boldsymbol{m}} - \boldsymbol{m}(\vartheta)] \tag{28}$$

where $\vartheta = (M, a, b, A, z_1, F_a, \sigma_a, c_0, F_{union}, \sigma_k, \kappa)$ is a vector of parameters to be estimated, $\boldsymbol{m}(\vartheta)$ is a vector of model moments based on ϑ, and $\hat{\boldsymbol{m}}$ is a vector of empirical moments. $\boldsymbol{W}$

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	Fixed cost of insurance provision	15.79	0.084
σ_a	Std. dev. of insurance cost shock	0.88	0.269
FC_{union}	Fixed cost of unionization	21.56	0.239
σ_{union}	Std. dev. of union cost shock	5.58	0.513
c_0	Cost of union threat	0.15	0.006
κ	Vacancy posting cost	1.89	0.021

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

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.

5.1.4 Estimation Results

Parameter Estimates. Table 2 reports 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 (9). The parameters of the Beta distribution of α_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 F_a is $15,790 per quarter while the standard deviation of the cost shock σ_a is estimated to be $880. The fixed cost of unionization F_{union} is about $21,560 per quarter and the S.D. of the cost shock is $5,580. The marginal cost of the union threat is estimated to be $c_0 = 0.15$. For every $1 of the workers' aggregate willingness to pay for unionization, firms need to incur $0.15 to suppress unionization.

Model Fit. Table 3 shows the fit of the estimated model. The model succeeds in fitting most moments very well. In particular, unionized workers are more likely to be covered by ESHI than nonunionized workers both in the model and in the data. The model slightly misses the moments related to insurance coverage for each skill although the model still

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.

predicts that high-skill workers are more likely to be covered.

Although we do not directly target a union wage premium in the estimation, it is worthwhile discussing whether the model generates a reasonable one. Just comparing the average wage of unionized firms with that of non-unionized firms masks the direct impact of unionization on average wages and the differences in the union wages and nonunion wages by skill type. To isolate the direct impact of unionization, we compare the average wage of unionized firms with the average wage of nonunionized firms, evaluated based on the hiring decisions of unionized firms. In our model, the union wage premium ranges between 0.3% and 3.3%, depending on the firm type. These magnitudes fall into the 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).

Sensitivity of Estimates. In the spirit of Andrews et al. (2017), we provide further evidence of our identification argument by quantifying the relative importance of each targeted moment for each parameter of interest. Following Einav et al. (2018), we conduct a perturbation exercise in which we examine the impact of a small change in model parameters from the estimated values on each moment. In Online Appendix H, we confirm our identification argument. For example, we find that changes in parameters associated with labor unions (e.g., the coefficient of the union threat effect, c_0) lead to large changes in the moments associated with labor unions relative to other moments.

Table 4: Counterfactual Policy Simulation: Insurance Policies

	(1)	(2)	(3)	(4)
	Baseline	SI for all	SI for low-skill unemp	Mandatory
Union density (%)	8.62	5.22	6.78	4.17
ESHI coverage (%)				
Overall	60.35	0.00	58.95	100.00
Union	81.32	0.00	73.42	100.00
Nonunion	58.37	0.00	57.90	100.00
Low skill	57.17	0.00	55.53	100.00
High skill	62.40	0.00	61.08	100.00
Unemployment rate (%)				
Overall	4.82	7.65	6.14	5.07
Low skill	8.70	14.79	11.80	9.90
High skill	2.14	2.72	2.24	1.74
Output per capita (% change)	0.00	-1.88	-0.81	-0.05
Labor productivity (% change)	0.00	1.13	0.59	0.22
Average wage (% change)	0.00	-1.52	0.56	-2.49
Skill wage gap (log points)	55.65	59.05	53.47	60.30
Average firm size				
Overall	22.50	21.83	22.20	22.44
Union	56.47	41.24	45.17	31.35
Nonunion	21.29	21.28	21.41	22.16

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 for low-skill unemployed workers. Column (4) is the economy in which firms are forced to provide health insurance to their employees. Every policy change is budget neutral.

6 Counterfactual Policy Experiments

In this section, we conduct various counterfactual experiments to understand the equilibrium impacts of union's influence on insurance provisions and labor market outcomes. We first examine the equilibrium impacts of social insurance policies. Second, we examine the effect of subsidizing unionized firms. Finally, we examine what happens if the labor union loses comparative advantage in providing insurance.

6.1 Social Insurance

We begin by examining the implications of social insurance for all workers. Specifically, we consider a policy where the government provides universal health insurance coverage, with the associated insurance costs being borne by the uniform payroll tax on firms. Although insurance is financed by taxes on firms, firms no longer pay fixed costs since the government provides insurance.

Column (2) in Table 4 shows the equilibrium impact of the policy.[28] First of all, the policy change reduces the union density by 3.4 p.p. from 8.62% to 5.22%. Every worker gets health insurance from the government, which removes the cost advantage of unionized firms in insurance provision and results in the decline in unions. The unemployment rate increases by 2.83 p.p. due to the higher marginal cost of hiring, which comes from the better outside option of workers and larger taxes. The higher unemployment rate in turn results in the output loss of 1.88%. Since the decline in unions increases relative hiring of high-skill workers, the labor productivity, defined as the output per employed worker, increases by 1.13%.

The union decline of 3.40 p.p. associated with the social insurance has different implications for low-skill and high-skill workers both in terms of employment and wages. Since unionized firms tend to rely more on low-skill workers than nonunionized firms, the policy change results in a sharp increase in the unemployment rate among low-skill workers through the union decline. Quantitatively, the unemployment rate among low-skill workers increases by 6.09 p.p. whereas the unemployment rate among high-skill workers increases by only 0.68 p.p. Furthermore, the union decline increases the wage inequality between high-skill workers and low-skill workers by 3.40 log points due to the different bargaining protocols between unionized firms and nonunionized firms.

Insurance Mandate. The social insurance system described above provides universal health insurance coverage by taxing firms. Another way to provide insurance to workers is to directly mandate that firms provide insurance to their employees, although in this case, unemployed workers are not covered. Column (4) of 4 shows the equilibrium impact of the insurance mandate. The impact is similar to that of universal social insurance; the mandate reduces union density, increases the unemployment rate, particularly among low-skill workers, and increases wage inequality between high-skill and low-skill workers.

6.2 Public Insurance for the Low-Income Unemployed

We next examine the impact of public insurance provided to low-skill unemployed workers only. Again, we consider a balanced budget policy where the expenditure of public insurance is financed by the uniform payroll tax on firms. Unlike social insurance considered in the previous subsection, firms privately provide health insurance to their workers. Therefore, firms still need to pay the fixed costs of insurance if they provide insurance.

Column (3) in Table 4 shows the equilibrium impact of the policy change. Since public

[28]In Appendix I, we show the partial equilibrium impact of each policy change to isolate the direct impact of policy changes on unionization from the impact through the equilibrium adjustment in market tightness.

insurance is provided only to low-skill unemployed workers in this counterfactual, the policy change is particularly damaging to unionized firms that rely more on low-skill workers than nonunionized firms. As a result, the policy change reduces the union density by 1.86 p.p. from 8.62% to 6.78%. As in the previous simulation of social insurance for all workers, the higher marginal cost of hiring workers raises the unemployment rate by 1.32 p.p., which in turn reduces the output by 0.81%. Again, the decline in unions is associated with a slight improvement in labor productivity of 0.59% due to the change in the hiring composition toward high-skill workers.

The union decline associated with the policy change is damaging to high-skill workers in terms of ESHI coverage. In the baseline, 62.40% of high-skill workers are covered by ESHI while 61.08% of high-skill workers are covered in the counterfactual, which is a 1.32% decline from the baseline. Although the ESHI coverage rate similarly declines for low-skill workers, 11.80% of low-skill workers are unemployed and all of them get free public insurance.

Finally, despite the union decline, the policy change reduces the skill wage gap by 2.18 log points. On the one hand, the union decline reduces the number of workers covered by collective bargaining, which widens wage inequality. But the policy change directly increases wages of low-skill workers by improving their outside options, which reduces wage inequality. In total, the positive impact of the union decline on wage inequality is more than offset by the direct impact of the policy change.

The results here and the ones in the previous subsection highlight the difference between the social insurance policy for all workers and the one targeting the low-skill unemployed workers only. Although union density decreases in both cases, they have different impacts on the average wage and wage inequality. Social insurance for all reduces the average wage and increases wage inequality through the union decline. In contrast, by focusing on low-skill workers, public insurance for low-skill workers helps reduce wage inequality. Also, the impact of the union decline is not strong enough to eliminate all the wage increases. However, by not providing complete insurance coverage, the union decline leads to a lower insurance coverage rate for high-skilled workers.

6.3 Subsidies and Insurance Quality

Insurance Subsidy. In this subsection, we consider subsidies for insurance provisions or unionization. In the U.S., many employer-sponsored insurance benefits are tax deductible, which incentivizes firms to provide those benefits. To examine their effects on unionization and labor market outcomes, we first study the effect of subsidies for insurance provisions. We implement this policy by reducing insurance fixed costs by one third, which amounts to about \$5,300 per quarter. Column (2) in Table 5 shows the outcomes under the insurance subsidy.

Table 5: Counterfactual Policy Simulation: Subsidies and Insurance Quality

	(1)	(2)	(3)	(4)
		Subsidy for		
	Baseline	Insurance	Union	Quality
Union density (%)	8.62	6.86	24.04	3.34
ESHI coverage (%)				
Overall	60.35	68.23	61.06	68.49
Union	81.32	83.24	79.17	60.19
Nonunion	58.37	67.12	55.33	68.77
Low skill	57.17	65.36	58.45	65.48
High skill	62.40	70.06	62.75	70.41
Unemployment rate (%)				
Overall	4.82	4.86	4.75	4.90
Low skill	8.70	8.93	8.52	9.06
High skill	2.14	2.05	2.16	2.03
Output per capita (% change)	0.00	0.03	0.06	0.00
Labor productivity (% change)	0.00	0.07	-0.01	0.09
Average wage (% change)	0.00	-0.59	-0.04	-0.60
Skill wage gap (log points)	55.65	56.25	55.07	56.56
Average firm size				
Overall	22.50	22.49	22.53	22.48
Union	56.47	47.92	49.76	27.10
Nonunion	21.29	21.64	19.20	22.34

Note: This table presents the general equilibrium impacts of subsidies and nonunion advantages. Column (2) reports the equilibrium of the economy where firms receive subsidies equal to one third of the fixed cost FC_a for providing insurance. Column (3) reports the equilibrium of the economy where firms receive subsidies equal to one third of the fixed cost FC_{union} for unionization. Column (4) reports the equilibrium of the economy where the fixed cost of insurance FC_a decreases by one third only for nonunionized firms.

Recall that one key incentive for firms to unionize (or not try hard to prevent unionization) is the cost advantage in providing insurance as collective bargaining allows firms to pass through a part of insurance fixed costs to the worker side. By making insurance fixed costs less important, the insurance subsidy reduces the union density by 1.76 p.p. As a result, the insurance subsidy, intended to help workers, has unintended consequences through the union decline. First, fewer workers are covered by collective bargaining and consequently, the subsidy widens wage inequality as the skill wage gap increases by 0.60 log points. Also, the decline in the number of unionized firms reduces the demand for low-skill workers and increases the demand for high-skill workers, pushing up the unemployment rate among low-skill workers by 0.23 p.p. while reducing the unemployment rate of high-skill workers by 0.09

p.p. This results in a slight increase in output and labor productivity by 0.03% and 0.07%, respectively.

Since insurance fixed costs matter more for nonunionized firms, the subsidy increases the ESHI coverage rate of nonunion workers by 8.75 p.p. while it increases that of union workers just by 1.92 p.p. Since union workers are more likely to be covered by ESHI in baseline, the subsidy shrinks the difference in coverage between union and nonunion workers.

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

Union subsidy. We now examine the impact of subsidies for unions. This counterfactual simulation is motivated to evaluate current policy debates to support the unionization in the U.S. We implement this by reducing the fixed cost of union F_{union} by one third, which amounts to $7,200 per quarter. Column (3) in Table 5 shows the result.

By reducing the cost of unionization, the subsidy directly encourage more firms to unionize, pushing up the union density by 15.42 p.p. The rise in unions increases the overall ESHI coverage rate by 0.71 p.p. due to unions' advantage in insurance provision. The rise in unions helps low-skill workers in particular. The ESHI coverage rate increases by 1.28 p.p. for low-skill workers, which is much larger than the increase of 0.35 p.p. for high-skill workers.

Despite the large increase in the union density, the impact on wage inequality is limited (-0.58 log points). The limited impact partly comes from the increased ESHI access. Low-skill workers tend to value ESHI coverage more than high-skill workers and hence low-skill workers accept a larger wage decline in exchange for insurance coverage compared to high-skill workers. Interestingly, the average wage decreases due to the compensation differential mechanisms; the marginal firms that switch from non-union to union start providing insurance benefits and these benefits pass through to the reduction of average wages. Finally, firms switching from nonunion to union no longer face the union threat cost and hire more low-skill workers, which slightly pushes up the output by 0.06%. The impact on labor productivity depends on the two counteracting forces. As more firms are unionized and unionized firms rely more on low-skill workers, the average skill among employed workers decreases, lowering labor productivity. At the same time, firms switching from nonunion to union no longer need to distort their hiring decision to avoid unionization, pushing up the labor productivity. On net, the labor productivity slightly decreases by 0.01%.

This result suggests that the comprehensive evaluation of unions' labor market impacts should look at not only wage inequality but also changes in insurance provisions, which also affect equilibrium wages.

Insurance Quality. Finally, we consider counterfactual where nonunionized firms gain advantage in providing insurance. For instance, nonunionized firms might be able to negotiate better terms with insurance companies. Indeed, nonunionized firms are increasingly offering benefits like defined contribution pensions. These forces generate additional but related mechanisms leading to the decline in unions. We implement this by reducing the fixed cost of insurance provision of only nonunionized firms by one third.

Table 5 shows that firms find unionization less attractive, resulting in the union density, which in turn leads to higher wage inequality. Nonunionized firms can offer cheaper insurance, increasing the insured rate among nonunion workers. Since unionized firms offering insurance now have an incentive to deunionize to save insurance costs, remaining unionized firms are less likely to offer insurance, reducing the insured rate among unionized workers.

7 Accounting for the Decline in Labor Unions

So far, we have conducted various policy experiments to see the importance of unions in assessing the labor market impacts of social insurance policies and firm subsidies, using the economy calibrated to the year 2007. Now we investigate what factors explain the large union decline over the past half-century. In particular, we study the contribution of the following three factors. The first one is skill-biased technological changes favoring high-skill workers, which is a well-documented empirical pattern over the past half-century (Acemoglu and Autor, 2011). The second one is the introduction and expansion of social insurance programs described in Section 2. The third one is the implementation of RTW laws.

To that end, we fit the model economy with the data in the year 1955. In addition, we extend the baseline model by incorporating exogenous retirement and death so that we can take into account the role of unionized firms in providing health insurance to retired workers and the introduction of Medicare. We also introduce a parameter capturing RTW laws into the model. We discuss the details these model extensions, empirical moments, and the estimated parameters to Appendix J.

Table 6: Deunionization by Technological Change, Social Insurance Expansion, 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 introduction/expansion, and RTW laws.

7.1 Quantitative Extension and Estimation for the 1955 Economy

To understand the causes of the union decline over the past half-century, we also parameterize our model to fit with the 1955 economy. We relegate the detail to Appendix J. There are two main departures from the basic environment that are considered in the specifications for the 2007 economy. First, we assume that in 1955 there was no Medicare or Medicaid. To explore the role of Medicare, we now modify our benchmark model such that workers retire stochastically, and the post-retirement insurance options depend on the availability of Medicare. Second, we allow that workers' preference for joining unions depends on the right-to-work law status. If the right-to-work law was implemented, workers may have additional "preference" to choose to be non-unionized, which captures the possible effect of workers attempting to "free ride" on others to unionize under the RTW laws. We then fit out the model with the data in the 1955 economy, essentially following the approach used to fit with 2007 economy: i.e., we first externally set the parameters, and then estimate the rest of parameters to fit with the basic data features in 1955.

7.2 Decomposition of the Decline of Unions between 1955 and 2019

We use the model calibrated to the 1955 economy and simulate technological changes, social insurance expansion, and RTW laws. We simulate each of those changes that occurred between 1955 and 2019.[29] We discuss the implementation of each of them below.

Skill-Biased Technological Changes. We start by investigating the impact of skill-biased technological changes favoring high-skill workers on unionization. While technological change is often cited as a primary factor behind deunionization, within our framework, it sets two counteracting forces into motion: one originating from firms and the other from workers. From the perspective of firms, technological change encourages them to be more aggressive in preventing unionization. As the relative productivity of low-skilled workers

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

decreases, unionized firms that predominantly rely on low-skill workers find it too costly to be unionized, leading to a union decline. Conversely, the worker-side perspective sheds light on a shift in their demand for unionization. The technological change exacerbates the wage disparity between high-skilled and low-skilled workers, making low-skilled workers more desperate for unionization. This surge in the low-skilled workers' valuation of unionization could, in turn, increase the costs for firms to deter unionization.

We implement this by changing the relative productivity of the two skill types, (z_l, z_h), together with the fraction of workers of each type (N_l, N_h). The fraction of each skill type (N_l, N_h) is directly observable in both the 1955 and the 2019 economy. To calibrate (z_l, z_h), we target the observed skill wage gap in 2019.

Social insurance expansion. As we discussed in Section 2, social insurance programs have been introduced and expanded over the last half-century, which is another potential explanation for deunionization. Indeed, counterfactual policy changes in the previous section demonstrate that social insurance expansions lead to deunionization by replacing or diluting the unions' role in insurance provisions. We implement the introduction and expansion of Medicare and Medicaid. Specifically, we assume that in the 1955 economy, unemployed workers have no access to public insurance, and retired workers can have access to insurance only through previous employers possibly negotiated by unions. The introduction of Medicare allows retired workers to be covered by public insurance. The introduction and extension of Medicaid (partially) allows unemployed workers to be covered by public insurance.[30]

Right-to-Work Laws. Another potential explanation we discussed in Section 2 is the implementation of RTW laws. By allowing workers to be covered by collective bargaining without paying the union dues, RTW laws undermine the sustainability of unions. We capture the impact of RTW laws in a reduced-form way by introducing a cost parameter c_{RTW} that reduces the probability of unionization as described in detail in Appendix J. We calibrate this parameter so that the impact of RTW laws on union density in the baseline estimated model in the previous section is consistent with data.

Results. We use the model calibrated to the 1955 economy and ask how much each of the three factors separately accounts for the observed decline in union membership from about 36% in 1955 to 6.6% in 2019. Table 6 reports the simulation results. The first column shows that 32.1% of the observed decline in union density since 1955 can be attributed to the skill-biased technological change. The second column shows that the introduction and expansion of social insurance accounts for 14.8% of the decline, about a half of the decline

[30]See Appendix J for more details.

in unions by the skill-biased technological change. Lastly, the third column shows that 6.8% of the decline can be explained by the implementation of RTW laws.

Discussions. Overall, our findings suggest that both technological changes and social insurance expansions are quantitatively relevant in accounting for the decline in unions. Importantly, we find that the decline in unions caused by these two channels lowers the insurance access of the low-skilled employed workers. Specifically, technological changes and social insurance expansions are associated with declines of 12.2 p.p. and 15.6 p.p., respectively, in the ESHI rate of low-skill employed workers. Even social insurance expansions do not provide insurance protections because social insurance benefits are mainly available to the non-employed. Therefore, a policy implication is to explore an efficient way to provide insurance coverage for those employed to compensate for the decline in unions. One possibility is to activate the subsidized individual insurance markets established under the ACA, where employee's take-up of these programs is currently still small.

8 Conclusion

In this paper, we have studied the determinants of unionization rates and their labor market implications by focusing on the union's influence on the provision of employment-based insurance benefits. We document that unionized firms are more likely to provide various employment-based insurance benefits. We also show evidences that the expansion of social insurance programs reduces unionization rates. Then, we develop and estimate a frictional labor market model that features endogenous union formation and insurance provisions by firms. By using the estimated model, we show that social insurance policies and tax/transfer policies for employment-based insurance products significantly impact labor market outcomes such as wage inequality through changes in unionization. For example, the expansion of social insurance can reduce the unionization rate by replacing or diluting the role of unionized firms in providing insurance, which in turn can increase wage inequality. Moreover, tax subsidies to employer-sponsored health insurance can also increase wage inequality through deunionization. Furthermore, we find that not only technological changes but also the expansion of social insurance programs can account for a large part of the decline in unions in the U.S that occurred over the last 60 years.

We believe that the framework developed in this paper can be useful for studying a variety of other important issues associated with interactions between labor market institutions and social insurance policies. The model could be extended to incorporate richer heterogeneity to study the distributional consequences of these policies. It would be interesting to incorporate the effect of unions on firms' entry decisions and technology choices. Moreover, there are many interesting questions about labor unions and social insurance in other countries. For example, social insurance programs in several European countries take the form of the Ghent system, where workers need to work at unionized jobs to receive welfare benefits. In Sweden, there is a discussion about whether a decline in social insurance benefits lowers the unionization rate (Kjellberg, 2011). Our framework can be adapted to study these issues. We leave these topics for future work.

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Online Appendix (Not For Publication)

Labor Unions and Social Insurance

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A Sectoral Shifts and Union Declines

Another potential factor for deunionization that are not discussed in the main text is sectoral shifts of workers. In particular, in the last half of the 20th century, employment in the service sector steadily increased over time while that in the goods-producing sector declined Lee and Wolpin (2006). Given the difference in union density across sectors, this could have also contributed to the decline in union density.

To quantify the impact of sectoral employment shifts, we calculate the following counterfactual union density:

$$union_t^{CF} = \sum_{i \in \mathcal{I}} w_{i,1983} \times union_{i,t} \tag{A1}$$

where, on the right-hand side, $w_{i,1983}$ is the share of sector i 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. The set of sectors $\mathcal{I}$ includes the following 12 sectors: (i) Agriculture, forestry, and fisheries, (ii) Mining, (iii) Construction, (iv) Manufacturing, (v) Transportation, communications, and other public utilities, (vi) Wholesale trade, (vii) Retail trade, (viii) Finance, insurance, and real estate, (ix) Business and repair services, (x) Personal services, (xi) Entertainment and recreation services, and (xii) Professional and related services.

Figure A.1 displays the actual union density and the counterfactual union density over time. It shows that the counterfactual union density is higher than the actual one, suggesting that indeed the sectoral employment shifts have contributed to the decline in unions. But it also shows that the contribution is quantitatively small. For example, in 2019, the difference between the actual union density and the counterfactual one is just 0.4 p.p. Therefore, this would not be a major factor behind the large decline in unions.

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B Labor Unions and Job Security

In addition to access to various types of insurance such as health insurance and pension, unions can also provide insurance to workers as a form of better protection against layoff. We investigate how union membership of a worker is related to subsequent job loss by using the sample of employed workers from the SIPP. We estimate the following regression equation:

$$Job\ loss_{it} = \beta \cdot Union_{it} + x_{it}'\gamma + \eta_{s(i)} + \mu_t + \epsilon_{it}, \tag{A2}$$

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 β of $Union_{it}$ that is an indicator for worker i's union membership status 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 μ_t. ϵ_{it} is an error term.

Table A.1 reports the estimated coefficients. In the first two columns, we report the results based on the pooled sample in which we do not make a distinction between high-skill workers and low-skill workers. The estimated coefficient is -0.002 with and without controls, suggesting 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) demonstrate that the impact is larger for low-skill workers. Specifically, the probability of job loss is smaller by 0.28 p.p. for low-skill union workers, and 0.12 p.p. for high-skill union workers.

C Health Insurance After Retirement

As we mentioned in Section 3.2.1, many elderly people did not have meaningful health insurance after age 65 before the Introduction of Medicare, and it appears that there is correlation between union membership and private health insurance coverage for the elderly at the state level, as displayed in Figure A.2. Unfortunately, we do not have individual-level data to see the relationship between union membership and employer-sponsored health insurance coverage before Medicare.

Nevertheless, the HRS provides the information both on union membership and retirement coverage of an ESHI plan for recent workers. More specifically, from the fifth wave, the HRS contains information on whether an ESHI plan for a worker younger than 65 provides retirement coverage after age 65. We construct an indicator variable that takes 1 if a worker is covered by such a plan and 0 otherwise. Using the sample of employed workers aged 65 or younger from the fifth wave onward, 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. Column (1) shows that, without covariates, union workers are 12.5 p.p. more likely to be covered by such a plan. Column (2) shows that, even after controlling for detailed individual characteristics and firm sizes, union workers are 10 p.p. more likely to have retirement coverage after age 65. Column (3) shows that once we control for individual characteristics, the coefficient gets smaller to 0.042 and is statistically insignificant.

The imprecise estimate in column (3) might be partly 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 the coverage.

D Additional Evidences of Effects of Social Insurance on Unionization

D.1 ACA Medicaid expansion.

Medicaid is a public social insurance program that provides health insurance to low-income households. The Affordable Care Act (ACA), which was enacted in 2010, included a provision that would significantly expand the Medicaid eligibility. Prior to the ACA expansion, Medicaid eligibility depended on income and other characteristics; specifically, children and pregnant women were likely to be eligible even if their income was larger than 138% of FPL, but disabled adults and low-income parents were eligible only if their income was much lower, and the remaining adults were not eligible in most states (Frean et al., 2017). ACA would have expanded Medicaid coverage to all people with incomes below 138% of the Federal Poverty Level (FPL). In 2012, the Supreme Court made a decision to allow each state to decide whether to adopt the Medicaid expansion, which created an exogenous variation in the Medicaid expansion across states. Specifically, twenty-six states adopted Medicaid expansion in 2014, three states in 2015, and two states year 2016, and nineteen states did not yet expand Medicaid.

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

$$Union_{ist} = \beta \cdot (ACA\ Medicaid)_{st} + x'_{ist}\gamma + \alpha_s + \lambda_t + \epsilon_{ist}, \quad \text{(A3)}$$

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. x_{ist} also includes the same set of political variables used in the analysis of Medicare and Medicaid introduction. α_s and λ_t are the state and time fixed effects. ϵ_{ist} is an error term. Medicaid is mostly targeted at low-income households while there would be many individuals in the sample who are unlikely to be eligible for Medicaid. To focus on those who are likely to be affected by the expansion, we split the sample into individuals with low education, who are more likely to be eligible due to low income, and high education, who are less likely to be eligible. Specifically, the first sample consists of individuals who have high school or less education while the second sample consists of the remaining individuals. One concern is that there are multiple states newly passed the RTW laws during this period, which would also affect union membership (Fortin et al., 2022). We alleviate this concern by controlling for indicators for time before/after the passage of the RTW laws.

Table A.5 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 the 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.4 in Appendix shows an event study plot consistent with these results, which also shows there is no pre-trend.

D.2 Unemployment Insurance

Unemployment insurance (UI) provides temporary benefits to individuals who lost their jobs. Importantly, each state can adjust the UI generosity including the amount of benefits. 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.

$$Union_{ist} = \beta \cdot (Replacement\ rate)_{ist} + \mathbf{x}'_{ist}\gamma + \eta_s + \mu_t + \varepsilon_{ist}, \tag{A4}$$

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, $Replacement\ rate_{ist}$ 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, $\mathbf{x}_{ist}$ is a vector of time-variant covariates, η_s is state fixed effects, μ_t is year fixed effects, and ε_{ist} is an error term.

Table A.6 reports the estimation result of equation (A4). 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

As discussed in Section 2, RTW laws could discourage union formation by inducing free riding among workers in an unionized workplace. Fortin et al. (2022) use the data from the CPS to find that recent passages of RTW laws reduced union membership by about 2 p.p. Here, we replicate their findings using the CPS data and we also look into the impact of RTW laws on union elections by using the NLRB election data.

E.1 Individual Union Membership

We first look into the impact of RTW laws on union membership using workers in the CPS. Specifically, we estimate the following event-study specification:

$$\begin{aligned} Union_{ist} = &\sum_{\tau=-5,\neq-1}^{4} \beta_\tau \mathbb{1}\{t - E_s = \tau\} + \beta_{-6}\mathbb{1}\{t - E_s \leq 6\} + \beta_{+5}\mathbb{1}\{t - E_s \geq 5\} \\ &+ x'_{ist}\gamma + \alpha_s + \lambda_t + \epsilon_{ist} \end{aligned} \tag{A5}$$

where the outcome variable 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 and year-by-occupation dummies. Month fixed effects are also controlled. We also 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. α_s and λ_t are state fixed effects and year fixed effects. ϵ_{ist} is an error term. We cluster standard errors at the state level.

Panel (a) of Figure A.5 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 as theirs as we control for, for example, the ACA medicaid expansion and variables capturing state political environment. We detected a slight indication of pre-trend in four years before the event.

As a further robustness check, we also implement Sun and Abraham (2021)'s interaction-weighted estimates to allow for treatment effects to be heterogeneous across cohorts. Specifically, we estimate

$$\begin{aligned} Union_{ist} = \sum_{e \in \mathcal{E}} \mathbb{1}\{E_s = e\} \times \Bigg(& \sum_{\tau=-5, \neq -1}^{4} \beta_{\tau,e} \mathbb{1}\{t - E_s = \tau\} \\ & + \beta_{-6,e} \mathbb{1}\{t - E_s \leq 6\} + \beta_{+5,e} \mathbb{1}\{t - E_s \geq 5\} \Bigg) \\ + x'_{ist}\gamma + \alpha_s + \lambda_t + \epsilon_{ist} & \end{aligned} \tag{A6}$$

where $\mathcal{E}$ is the set of all event times E_s. All the other variables are the same as in equation (A7). The interaction-weighted estimates β_τ are calculated by $\beta_\tau = \sum_{e \in \mathcal{E}} \omega_e \beta_{\tau,e}$ where ω_e is the sample weight of cohort e and given by the sample-weighted relative number of observations of cohort e.

Panel (b) of Figure A.5 displays the estimated coefficients and their 95% confidence intervals. The magnitude of the estimates are almost the same as Figure A.5 although there are indications of pre-trends.

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:

$$\begin{aligned} y_{st} = &\sum_{\tau=-5,\neq -1}^{4} \beta_\tau \mathbb{1}\{t - E_s = \tau\} + \beta_{-6}\mathbb{1}\{t - E_s \leq 6\} + \beta_{+5}\mathbb{1}\{t - E_s \geq 5\} \\ &+ x'_{st}\gamma + \alpha_s + \lambda_t + \epsilon_{st} \end{aligned} \tag{A7}$$

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. α_s and λ_t are state fixed effects and year fixed effects. ϵ_{st} is an error term. We cluster standard errors at the state level.

We first use the inverse hyperbolic sine (IHS) transformation of the number of elections in state s in time t as an outcome y_{st}.[1] We also estimate the interaction-weighted version:

$$\begin{aligned} y_{st} = \sum_{e\in\mathcal{E}} \mathbb{1}\{E_s = e\} \times \Bigg(&\sum_{\tau=-5,\neq -1}^{4} \beta_{\tau,e} \mathbb{1}\{t - E_s = \tau\} \\ &+ \beta_{-6,e}\mathbb{1}\{t - E_s \leq 6\} + \beta_{+5,e}\mathbb{1}\{t - E_s \geq 5\}\Bigg) \\ + x'_{st}\gamma + \alpha_s + \lambda_t + \epsilon_{st}. \end{aligned} \tag{A8}$$

Figure A.6 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 deunionzation 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 V_x^M in equation (6)

[1] 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.

is given by

$$V_x^M = \sum_{y\in\mathcal{Y}} \Omega_{x,y} \sum_{a\in\mathcal{A}} \bigg[\mathcal{Q}_y P_{y,u}(a) \max\{V_{x,y,u}^E(w_{x,y,u}, a), V_x^U\} + (1-\mathcal{Q}_y) P_{y,n}(a) \max\{V_{x,y,n}^E(w_{x,y,n}, a), V_x^U\} \bigg], \tag{A9}$$

where $\Omega_{x,y} = \nu_{x,y} M_y / \sum_{y'\in\mathcal{Y}} v_{x,y'} M_{y'}$ denotes the fraction of vacancies in sub-market x posted by type-y firms. In equation (6), a worker of type x meets a vacancy posted by a firm of type y with probability $\Omega_{x,y}$; and among type-y firms, a fraction $\mathcal{Q}_y$ given by equation (18) 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 (17).

F.2 Aggregate Willingness to Pay for Unionization / Nonunionization

This section provides formal definitions of the aggregate willingness to pay for unionization and nonunionization that matters for the cost functions (7) and (8) in the main text. Roughly speaking, 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 wage schedule that a type-y firm pays to type-x workers when it is unionized ($k = u$) and nonunionized ($k = n$), respectively. These wage schedules, which are determined in the bargaining problems (22) and (23), are influenced by both labor input $\boldsymbol{g}$ and the firm's chosen amenity a since these variables determine the surplus created in the firm over which the parties—the workers and the firm—will bargain.

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, and it is implicitly determined by

$$V_{x,y,u}^E(w_{x,y,u}(\boldsymbol{g}, a), a) = V_{x,y,n}^E(w_{x,y,n}(\boldsymbol{g}, a) + \mathcal{W}_{x,y,n}(\boldsymbol{g}, a), a), \tag{A10}$$

where $V_{x,y,u}^E(\cdot)$ is defined in (4). That is, $\mathcal{W}_{x,y,n}, (\boldsymbol{g}, a)$, which can be either positive or negative, gives a dollar amount a type-x worker needs to be compensated for staying nonunionized in type-y firm that provides amenity a. The willingness to pay for unionization tends to be positive for low-skill workers and be negative for high-skill workers. As detailed in Section 4.7 in the main text, this discrepancy arises because collective bargaining in unionized firms redistributes surplus from high-skill to low-skill workers.

The firm-level aggregate willingness to pay for union in a nonunionized firm of type y is given by

$$\mathcal{W}_{y,n}(\boldsymbol{g}, a) = \sum_x \mathcal{W}_{x,y,n}(\boldsymbol{g}, a) \times g_x. \tag{A11}$$

Similarly, let $\mathcal{W}_{x,y,u}(\boldsymbol{g}, a)$ denote the dollar amount a type-x worker in a type-y unionized firm that provides amenity a 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 explicitly by:

$$V^E_{x,y,u}(w_{x,y,u}(\boldsymbol{g}, a) + \mathcal{W}_{x,y,u}(\boldsymbol{g}, a), a) = V^E_{x,y,n}(w_{x,y,n}(\boldsymbol{g}, a), a). \tag{A12}$$

$\mathcal{W}_{x,y,u}(\boldsymbol{g}, a)$ can be positive or negative. As before, define the firm-level aggregate willingness to accept de-unionization for all the workers in a unionized firm of type y that provides amenity a as:

$$\mathcal{W}_{y,u}(\boldsymbol{g}, a) = \sum_x \mathcal{W}_{x,y,u}(\boldsymbol{g}, a) \times g_x. \tag{A13}$$

F.3 Equilibrium Condition for Labor Market Tightness

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

$$\bar{g}_x(\theta) = \sum_{y=1}^{Y} M_y \sum_{a \in \boldsymbol{\mathcal{A}}} \left[\mathcal{Q}_y P_{y,u}(a) g_{x,y,u}(a;\theta) + (1 - \mathcal{Q}_y) P_{y,n}(a) g_{x,y,n}(a;\theta) \right], \tag{A14}$$

where we let $g^k_{x,y,k}$ for $k \in \{u, n\}$ explicitly depend on θ. Recall that a mass of workers of each skill in the economy is $\{N_x\}_{x=1}^X$. The optimal hiring decisions of firms give us a relationship between a mass of unemployed workers and market tightness:

$$\mathcal{U}^{JC}_x(\theta) = N_x - \bar{g}_x(\theta) \tag{A15}$$

for each $x = 1, \ldots, X$. We use the superscript JC (shorthand for "job creation") to emphasize that this is the mass of unemployed workers of each skill type implied by the optimal job creation decisions on the labor demand side.

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 $x \in \mathcal{X}$, we have

$$\sum_{k \in \{u,n\}} \delta_{x,k} \bar{g}_{x,k}(\theta) = s_x(\theta) p(\theta_x), \tag{A16}$$

where the left-hand side is the flow into unemployment and the right-hand side is the flow-out of unemployment.[2] $\bar{g}_{x,k}$ is a mass of workers hired by firms with union status $k \in \{u, n\}$ and they are given by

$$\bar{g}_{x,u}(\theta) = \sum_{y=1}^{Y} M_y \mathcal{Q}_y \sum_{a \in \boldsymbol{\mathcal{A}}} P_{y,u}(a) g_{x,y,u}(a;\theta), \tag{A17}$$

$$\bar{g}_{x,n}(\theta) = \sum_{y=1}^{Y} M_y (1 - \mathcal{Q}_y) \sum_{a \in \boldsymbol{\mathcal{A}}} P_{y,n}(a) g_{x,y,n}(a;\theta). \tag{A18}$$

Given $s_x(\theta)$, we obtain the mass of unemployed workers (after firms make their hiring)

$$\begin{aligned} \mathcal{U}_x^{BC}(\theta) &= (1 - p(\theta_x)) s_x(\theta) \\ &= \frac{1 - p(\theta_x)}{p(\theta_x)} \sum_{k \in \{u,n\}} \delta_{x,k} \bar{g}_{x,k}(\theta), \end{aligned} \tag{A19}$$

where the second line following from plugging in (A16). 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 θ, 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

$$\mathcal{U}_x^{BC}(\theta) = \mathcal{U}_x^{JC}(\theta) \quad \text{for all } x \in \mathcal{X}. \tag{A20}$$

G Numerical Algorithm

In this section, we lay out our numerical algorithm to solve for the equilibrium. To begin with, we discretize the support of concavity in production function α_y into Y finite points. We set $Y = 70$. Given this, we solve for an equilibrium as follows:

1. Provide an initial guess of tightness θ, wages $w_{y,x}^k(a)$ 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.

3. Solve firm problems for each firm type and get $(w_{y,x}^{k,*}(a), Q_y^*, P_y^{k*}, g_{x,y}^{k*}(a))$:

    a. Numerically solve the individual bargaining problem. Discretize the space of labor input $\boldsymbol{g}$ and approximate the partial derivatives by finite differences. Iterate the

[2] 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.

first-order conditions until wages converge. Obtain $w^{n,*}_{y,x}(a)$.

b. Numerically solve the collective bargaining problem. Iterate the first-order conditions until wages converge. Obtain $w^{n,*}_{y,x}(a)$.

c. Given the numerically solved wage functions, solve the firm hiring problem for each union status and insurance status. Obtain $g^{k*}_{x,y}(a)$.

d. Compute insurance provision probability and union probability. Obtain (Q^*_y, P^{k*}_y).

4. Update wages, union probability, and insurance provision based on the solution in 3.

$$w^{k,new}_{y,x}(a) = \omega_w w^{k,*}_{y,x}(a) + (1-\omega_w) w^k_{y,x}(a), \tag{A21}$$
$$g^{k,new}_{y,x}(a) = \omega_g g^{k,*}_{y,x}(a) + (1-\omega_g) g^k_{y,x}(a), \tag{A22}$$
$$Q^{new}_y = \omega_Q Q^*_y + (1-\omega_Q) Q_y, \tag{A23}$$
$$P^{k,new}_y = \omega_P P^{k,*}_y(a) + (1-\omega_P) P^k_y(a), \tag{A24}$$

where $\omega_w, \omega_g, \omega_Q, \omega_P \in (0,1]$ are weights for facilitating convergence.

5. Compute $\mathcal{U}^{BC}_x(\theta)$ and $\mathcal{U}^{JC}_x(\theta)$ based on $(w^{k,new}_{y,x}(a), Q^{new}_y, P^{k,new}_y, g^{k,new}_{x,y}(a))$.

6. Update market tightness. Increase market tightness θ_x if $\mathcal{U}^{BC}_x(\theta) > \mathcal{U}^{JC}_x(\theta)$ while decrease market tightness θ_x if $\mathcal{U}^{BC}_x(\theta) < \mathcal{U}^{JC}_x(\theta)$. Specifically,

$$\log \theta^{new}_x = \log \theta_x + \omega_\theta(\mathcal{U}^{BC}_x(\theta) - \mathcal{U}^{JC}_x(\theta)) \tag{A25}$$

where $\omega_\theta > 0$ is a pre-specified constant chosen for facilitating convergence.

Importantly, the model incorporates sufficient amount of shocks and heterogeneity, which helps our algorithm very stable across different configurations of parameters. At the same time, it helps us account for observed heterogeneity in data. These features permit us to estimate our model.

H 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 10×12 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.8 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, σ_{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. The overall productivity, A, and relative productivity, z_1, impact wages, although other parameters also influence wages.

I Partial Equilibrium Impact of Counterfactual Policies

To isolate the direct impact of the policy change on firm behaviors from its equilibrium implications, we here look at labor market outcomes in partial equilibrium with fixed market tightness θ_x.

Insurance policies. Column (2) in Table A.9 shows the impact of social insurance under partial equilibrium maintaining market tightness at the baseline level. First of all, the policy change reduces the union density by 4.49 p.p., from 8.62% to 4.13%. This union decline arises primarily from two factors. First, every worker gets health insurance from the government, which removes the cost advantage of unionized firms in insurance provision. Second, the policy change increases wages by improving the workers' outside option. The higher labor cost makes firms smaller and some firms become unable to profitably cover the fixed costs of union. This impact is larger than the general equilibrium impact in Table 4 in the main text since, in general equilibrium, the second channel above is alleviated.

Column (3) in Table A.9 shows the impact of public insurance for the low-income unemployed under partial equilibrium. The policy change reduces the union density by 1.03 p.p. from 8.62% to 7.59% by increase the marginal cost of hiring low-skill workers which unionized firms rely on.

Column (4) in Table A.9 shows the partial equilibrium impact of mandating insurance provision. There are two counteracting forces affecting unionization. On the one hand, being forced to provide insurance, some firms unionize to reduce the burden of the fixed costs of insurance. On the other hand, firms become less profitable, being unable to cover the union cost. On net, the first effect is dominant and union increases by 2.08 p.p. in partial equilibrium. The effect is the opposite direction from the general equilibrium impact in Table 4 since the change in the marginal cost of hiring due to the general equilibrium adjustment in the market tightness makes firms even less profitable.

Subsidies and insurance quality. Column (2) of Table A.10 shows the partial equilibrium impact of subsidies for insurance. The union density decreases by 0.37 p.p. by making the insurance fixed cost less important for firms. Average firm sizes increases as a result of the increase in firms providing insurance. The impact on union density is larger in the general equilibrium in the main text as the tightness adjustment increases the hiring cost to reduce the labor demand.

Column (3) of Table A.10 shows the partial equilibrium impact of subsidies for unionization. The union density increases by 6.85 p.p. as a result of the smaller fixed cost of unionization.

Column (4) of Table A.10 shows the partial equilibrium impact of giving nonunionized firms the advantage in insurance provision. Unionization becomes less attractive for firms and they now try harder to prevent unionization, reducing the union density by 4.47 p.p. in partial equilibrium. The firm size increases slightly because of two reasons. First, given the firm type, nonunionized firms have the incentive to scale up to push down wages in individual bargaining. Second, insurance provision reduces the marginal cost of hiring, which also makes firms larger. The impact here is smaller than the general equilibrium effect in the main text since the tightness adjustment brings back firm sizes, and further pushes down the union density to 3.34%.

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 the introduction of Medicare. To keep the model tractable, we assume that retirement and subsequent death are stochastic. Specifically, a worker is hit by a retirement shock with probability p_R at the end of each period. If an employed worker is hit by the shock, the worker retires and the job is destroyed. If a job destruction shock and a retirement shock hit a worker simultaneously, we assume that the worker's move to non-employment is retirement and allow the worker to receive health insurance from the previous employer if the previous employer provides it. Once a worker is retired, the worker becomes dead with probability p_D. The value of being retired is given by

$$V_x^R(a) = u_x(c_x^R, a) + \gamma(1 - p_D)V_x^R(a) \tag{A26}$$

where 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. This equation can be simplified to

$$V_x^R(a) = \frac{u_x(c_r, a)}{1 - \gamma(1 - p_D)} \tag{A27}$$

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

$$\begin{aligned} V_{x,y,k}^E(w, a) &= u_x(w, a) \\ &\quad + \gamma \left[p_R V_x^R(a_{x,y,k}) + (1 - p_R)\delta_{x,k} V_x^U + (1 - p_R)(1 - \delta_{x,k}) V_{x,y,k}^E(w_{x,y,k}, a_{x,y,k})\right]. \end{aligned} \tag{A28}$$

and the value of unemployment is now

$$V_x^U = p_x^{Med} V_x^{U,I} + (1 - p_x^{Med}) V_x^{U,N} \tag{A29}$$

where

$$V_x^{U,I} = p(\theta_x)V_x^M + (1 - p(\theta_x))\left[u_x(b_x, a) + \gamma\left\{p_R V_x^R(0) + (1 - p_R)V_x^{U,I}\right\}\right], \tag{A30}$$

$$V_x^{U,N} = p(\theta_x)V_x^M + (1 - p(\theta_x))\left[u_x(b_x, 0) + \gamma\left\{p_R V_x^R(0) + (1 - p_R)V_x^{U,N}\right\}\right] \tag{A31}$$

for unemployed workers eligible for Medicaid and those not eligible for Medicaid, respectively.

The net value of unemployment is now given by

$$\nu_{x,y,k} = p_x^{Med} u_x(b_x, a) + (1 - p_x^{Med}) u_x(b_x, 0) + \gamma(1-p_R)(1-\delta_{x,k}) \frac{[1-\gamma(1-p_R)]V_x^U - u_x(w_{x,y,k}, a_{x,y,k}) - \gamma p_R V_x^R(a_{x,y,k})}{1-\gamma(1-p_R)(1-\delta_{x,k})} \tag{A32}$$

The firms' optimization problems and the wage bargaining problems needs a slight modification as well. The job destruction rate $\delta_{x,k}$ in these problems are now replaced by $\delta_{x,k} + p_R - \delta_{x,k} p_R$ since retirement results in job destruction.

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. Since retired workers are replaced by new unemployed workers each period, we have

$$\mathcal{U}_x^{BC}(\theta) = \frac{1-p(\theta_x)}{p(\theta_x)} \sum_{k=u,n} (p_R + \delta_{x,k} - \delta_{x,k} p_R) \bar{g}_{x,k}(\theta). \tag{A33}$$

The second extension is about RTW laws. How RTW laws work in practice is that the operation of unions takes cost and RTW laws reduce the sustainability 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} and assume that a firm of type y unionizes if

$$J_{y,u}(\{\epsilon_a\}_{a\in\boldsymbol{\mathcal{A}}}) - c_{RTW} + \epsilon_u \geq J_{y,n}(\{\varepsilon_a\}_{a\in\boldsymbol{\mathcal{A}}}) + \varepsilon_n. \tag{A34}$$

The fraction of unionized firms among type y firms is then given by

$$\mathcal{Q}_y = \mathbb{E}\left[\frac{\exp\left(\frac{J_{y,u}(\{\epsilon_a\}_{a\in\boldsymbol{\mathcal{A}}}) - c_{RTW}}{\sigma}\right)}{\exp\left(\frac{J_{y,u}(\{\epsilon_a\}_{a\in\boldsymbol{\mathcal{A}}}) - c_{RTW}}{\sigma}\right) + \exp\left(\frac{J_{y,n}(\{\epsilon_a\}_{a\in\boldsymbol{\mathcal{A}}})}{\sigma}\right)}\right], \tag{A35}$$

We adjust the parameter c_{RTW} so that implementing RTW laws in the baseline estimated model targeting 2007 economy induces a 2 p.p. decline in union density, which is the estimate of the impact of recent approval of RTW laws in Fortin et al. (2022). We get $c_{RTW} = 1.2$. Since c_{RTW} 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 the data limitation in the following ways.

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 exactly in 1955, but they are available in the 1950 and 1960 censuses. Using this information in the 1950 census and the 1960 census, 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 then interpolate them. We do this separately for states with RTW laws and those without. 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, and 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.[3]

As for ESHI rates, there are a few sources on the overall ESHI rates in 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 source is Cohen et al. (2009), which report that 69.1% of people under age 65 were covered by hospital insurance during 1958-1960. From those numbers, we assume that 65% of employed workers were covered by ESHI in 1955. But this number is not enough for obtaining targeted moments for 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. Then, 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

[3]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.

union status or skill types.

Table A.11 and A.12 report the externally set parameters in states with RTW laws and without, respectively, while Table A.13 and A.14 report 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.16 and A.15.

J.3 Simulation of Technological Change, Social Insurance, and RTW Laws

As described in the previous subsection, 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) so that the simulated skill wage gap is the same as the one observed in 2019. When adjusting the relative productivity, we adjust the fraction of workers 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 in the following way. 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

$$p_{1955}^{RTW} \times union_{1955}^{RTW} + (p_{2019}^{RTW} - p_{1955}^{RTW}) \times union_{CF}^{NoRTW} + (1 - p_{2019}^{RTW}) \times union_{1955}^{NoRTW} \quad \text{(A36)}$$

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 did not have RTW laws and did not implement after.

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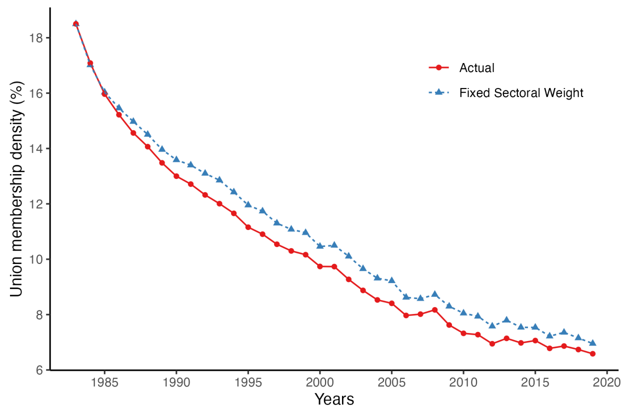
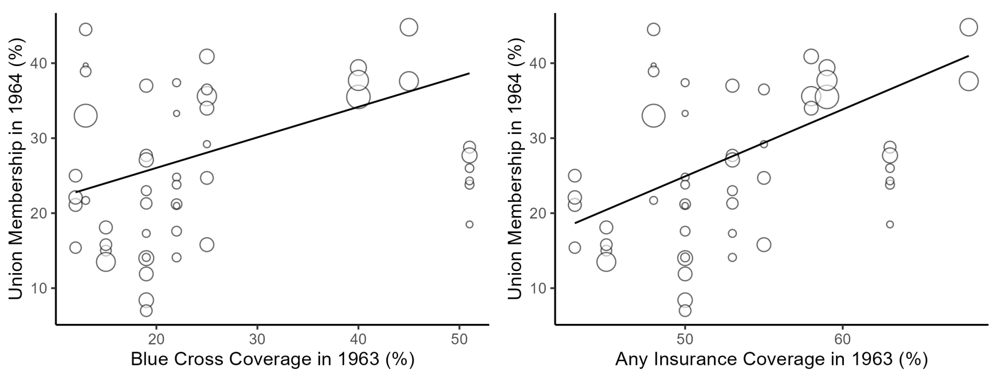
K Additional Figures and Tables

Figure A.1: 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 (A1). The data is from the CPS 1983-2019.

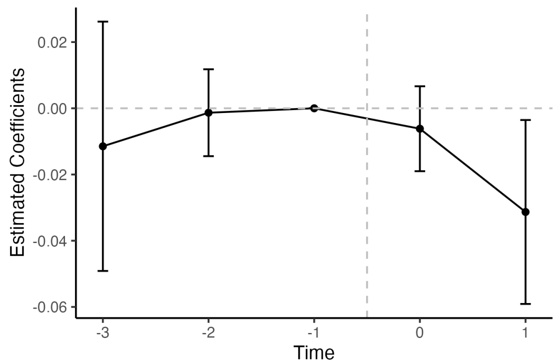
Figure A.2: Private Insurance Coverage and Union Density Prior to Medicare



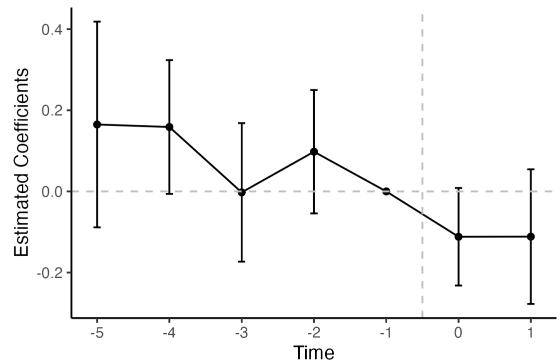
(a) BlueCross Coverage (b) Any Coverage

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.3: Impact of Medicaid Introduction on Union: Interaction-Weighted Estimate



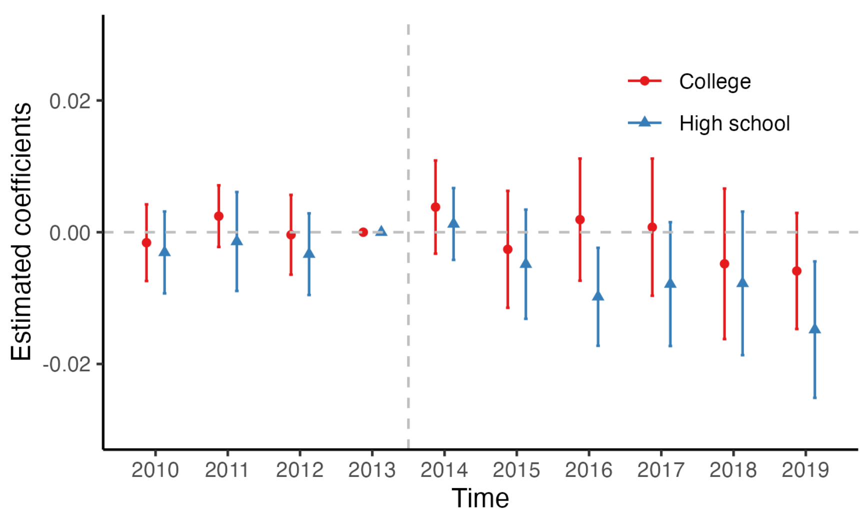
(a) Union Density



(b) Elections

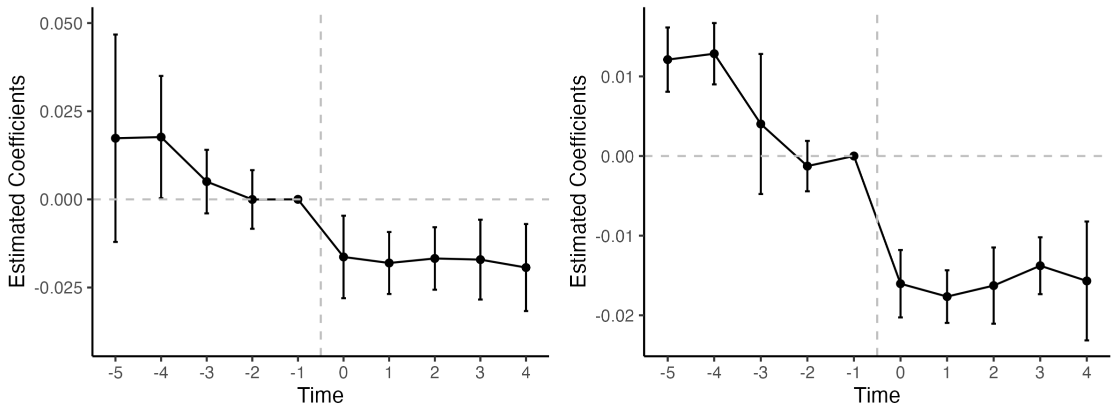
Note: This figure displays the interaction-weighted estimates by Sun and Abraham (2021). The outcome variable is the log union density in Panel (a) while it is the log number of elections in panel (b). The error bars represent the 95% confidence intervals based on standard errors clustered at the state level.

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



Note: This figure shows the estimated coefficients of equation $Union_{ist} = \sum_{\tau=2010,\tau\neq 2013}^{2019} \beta_\tau \times \text{ACA Medicaid}_s \times \mathbb{1}[t=\tau] + x'_{ist}\gamma + \eta_s + \mu_t + \varepsilon_{ist}$, 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 (A3). The covariates include dummies for sex age, education, race, year-by-occupation, year-by-industry, and political controls including an indicator for a Democratic governor and third-order polynomials of the fraction of state legislative seats held by the Democratic party each for state senate and house. Year fixed effects, month fixed effects and state fixed effects are also controlled. Person-level weights are used. Standard errors are clustered at the state level. The error bars represent 95% confidence intervals.

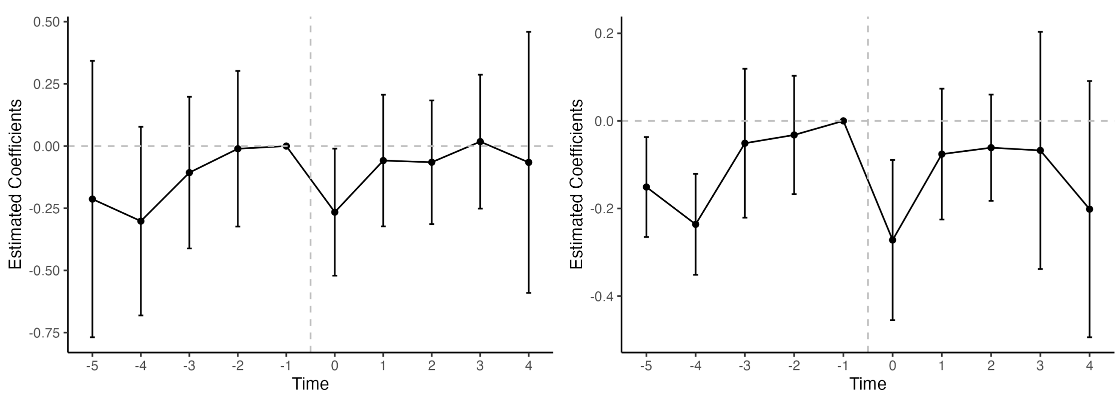
Figure A.5: RTW Law Impact on Union Membership



(a) Baseline (b) Interaction-Weighted

Note: Panel (a) displays the estimated coefficients of equation (A5) and their 95% confidence intervals. Panel(b) displays the interaction-weighted estimates of equation (A6) and the 95% confidence intervals. The sample consists of employed workers aged 22-65 in the CPS 2009-2019. Standard errors are clustered at the state level.

Figure A.6: RTW Law Impact on Union Elections



(a) Baseline (b) Interaction-Weighted

Note: The outcome variable is the IHS transformation of the number of elections. Panel (a) displays the estimated coefficients of equation (A7) and their 95% confidence intervals. Panel(b) displays the interaction-weighted estimates of equation (A8) and the 95% confidence intervals. The sample comes from the NLRB election data. Standard errors are clustered at the state level.

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. $^{*}p < 0.1$;$^{**}p < 0.05$;$^{***}p < 0.01$.

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: Medicaid Introduction by State

Year	States
1966	CA, CT, DE, HI, IA, ID, IL, KY, LA, MA, MD, ME, MI, MN, ND, NE, NM, NY, OH, OK, PA, RI, UT, VT, WA, WI, WV
1967	GA, IA, KS, MO, MT, NV, NH, OR, SD, TX, WY
1968	DC, SC
1969	CO, TN, VA
1970	AL, AR, FL, IN, MS, NJ, NC
1972	AK
1982	AZ

Note: This table lists the years when each state implemented Medicaid. See Gruber (2003) for more detailed information.

Table A.4: ACA Medicaid Expansion by State

Year	Month	States
2014	1	AZ, AR, CA, CO, CT, DE, DC, HI, IL, IA, KY, MD, MA, MN, NE, NV, NJ, NM, NY, ND, OH, OR, RI, VT, WA, WV
2014	4	MI
2014	8	NH
2015	1	PA
2015	2	IN
2015	9	AK
2016	1	MT
2016	7	LA
2019	1	ME, VA
2020	1	ID, UT
2021	7	OK
2021	10	MO
2023	7	SD
2023	12	NC

Table A.5: 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 (A3). 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.6: Unemployment Insurance Impact on Union Membership based on the CPS Sample

	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 (A4). 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.7: List of Externally Set Parameters

Parameter	Description	Value	Target
γ	Discount rate	0.984	5% annual interest rate
σ	Elasticity of substitution between skills	1.5	Johnson (1997)
μ	Match efficiency	1.0	Normalization
ζ	CRRA parameter	1.0	
$\underline{c}$	Consumption floor ($1K)	0.1	
β_u	Bargaining power of union workers	0.5	
β_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
$H_x(m)$	Distribution of medical expenditure	See text	Medical expenditure 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 $x = 2$.

Table A.8: 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
σ_{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
σ_a	Std. dev. of insurance cost shock	0.38	0.34	0.03	0.63	0.41
Labor market						
κ	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.9: Counterfactual Policy Simulation: Insurance, Partial Equilibrium (Fixed θ)

	(1)	(2)	(3)	(4)
	Baseline	SI for all	SI for low-skill unemp	Mandatory
Union density (%)	8.62	4.13	7.59	10.70
ESHI coverage (%)				
Overall	60.35	0.00	55.74	100.00
Union	81.32	0.00	75.76	100.00
Nonunion	58.37	0.00	54.10	100.00
Low skill	57.17	0.00	52.27	100.00
High skill	62.40	0.00	57.83	100.00
Output per capita (% change)	0.00	-29.94	-11.66	18.00
Average wage (% change)	0.00	0.50	2.79	-2.96
Skill wage gap (log points)	55.65	56.19	50.15	55.84
Average firm size				
Overall	22.50	14.57	19.27	27.05
Union	56.47	22.38	43.07	75.87
Nonunion	21.29	14.35	18.43	25.11

Note: This table reports the partial equilibrium impacts of each policy change where the market tightness is fixed at the baseline level. 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 for low-skill unemployed workers. Column (4) is the economy in which firms are forced to provide health insurance to their employees. Every policy change is budget neutral.

Table A.10: Counterfactual Policy Simulation: Subsidies and Insurance Quality, Partial Equilibrium (Fixed θ)

	(1)	(2)	(3)	(4)
		Subsidy for		
	Baseline	Insurance	Union	Quality
Union density (%)	8.62	8.22	22.25	4.15
ESHI coverage (%)				
Overall	60.35	70.50	59.25	71.25
Union	81.32	86.57	76.82	69.21
Nonunion	58.37	69.06	54.22	71.34
Low skill	57.17	67.67	56.60	68.27
High skill	62.40	72.27	60.98	73.10
Output per capita (% change)	0.00	3.83	-2.72	4.90
Average wage (% change)	0.00	-0.68	0.13	-0.67
Skill wage gap (log points)	55.65	55.80	55.22	55.88
Average firm size				
Overall	22.50	23.44	21.82	23.70
Union	56.47	56.78	45.77	33.72
Nonunion	21.29	22.27	18.97	23.40

Note: This table presents the partial equilibrium impacts of subsidies and nonunion advantages where the market tightness is fixed at the baseline level. Column (2) reports the equilibrium of the economy where firms receive subsidies equal to one third of the fixed cost FC_a for providing insurance. Column (3) reports the equilibrium of the economy where firms receive subsidies equal to one third of the fixed cost FC_{union} for unionization. Column (4) reports the equilibrium of the economy where the fixed cost of insurance FC_a decreases by one third only for nonunionized firms.

Table A.11: Externally Set / Externally Calibrated Parameters (year 1955, No RTW)

Parameter	Description	Value	Target
γ	Discount rate	0.984	5% annual interest rate
σ	Elasticity of substitution between skills	1.5	Johnson (1997)
μ	Match efficiency	1.0	Normalization
ζ	CRRA parameter	1.0	
$\underline{c}$	Consumption floor ($1K)	0.1	
β_u	Bargaining power of union workers	0.5	
β_n	Bargaining power of nonunion workers	0.5	
N_x	Measure of workers of each type	0.835, 0.165	Fraction of each skill group
M	Measure of total firms	0.057	Average firm size
$\delta_{u,x}$	Job destruction rate (union)	0.071, 0.038	See text
$\delta_{n,x}$	Job destruction rate (nonunion)	0.079, 0.042	See text
b_x	Consumption during unemp. ($1K)		85% of average wages for each skill
c_x	Variable insurance cost ($1K)	0.037, 0.026	Expected insurer's cost
$H_x(m)$	Distribution of medical expenditure	See text	Medical expenditure 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 $x = 2$.

Table A.12: Externally Set / Externally Calibrated Parameters (year 1955, RTW)

Parameter	Description	Value	Target
γ	Discount rate	0.984	5% annual interest rate
σ	Elasticity of substitution between skills	1.5	Johnson (1997)
μ	Match efficiency	1.0	Normalization
ζ	CRRA parameter	1.0	
$\underline{c}$	Consumption floor ($1K)	0.1	
β_u	Bargaining power of union workers	0.5	
β_n	Bargaining power of nonunion workers	0.5	
N_x	Measure of workers of each type	0.868, 0.132	Fraction of each skill group
M	Measure of total firms	0.057	Average firm size
$\delta_{u,x}$	Job destruction rate (union)	0.063, 0.031	See text
$\delta_{n,x}$	Job destruction rate (nonunion)	0.071, 0.034	See text
b_x	Consumption during unemp. ($1K)		85% of average wages for each skill
c_x	Variable insurance cost ($1K)	0.037, 0.026	Expected insurer's cost
$H_x(m)$	Distribution of medical expenditure	See text	Medical expenditure 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 $x = 2$.

Table A.13: Internally Estimated Parameters (year 1955, No RTW)

Parameter	Description	Estimate
A	TFP	3.5
$\alpha \sim Beta(a, b)$	Production curvature distribution	0.15, 0.64
z_1	Low-skill worker relative productivity	0.70
FC_a	Fixed cost of insurance provision	0.19
σ_a	Std. dev. of insurance cost shock	0.23
FC_{union}	Fixed cost of unionization	0.66
σ_{union}	Std. dev. of union cost shock	0.36
c_0	Cost of union threat	0.13
κ	Vacancy posting cost	0.11

Note: This table reports the estimated model parameters for the 1955 economy without RTW laws. Monetary values are 1955 USD.

Table A.14: Internally Estimated Parameters (year 1955, RTW)

Parameter	Description	Estimate
A	TFP	2.7
$\alpha \sim Beta(a, b)$	Production curvature distribution	0.15, 0.65
z_1	Low-skill worker relative productivity	0.72
FC_a	Fixed cost of insurance provision	0.24
σ_a	Std. dev. of insurance cost shock	0.35
FC_{union}	Fixed cost of unionization	1.31
σ_{union}	Std. dev. of union cost shock	0.35
c_0	Cost of union threat	0.20
κ	Vacancy posting cost	0.10

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

Table A.15: Model Fit (year 1955, No RTW)

Moments	Data	Model
Union density	0.39	0.37
ESHI coverage: union	0.75	0.78
ESHI coverage: nonunion	0.56	0.56
ESHI coverage: low skill	0.62	0.65
ESHI coverage: high skill	0.68	0.60
Unemployment rate	0.05	0.05
Average wage: low skill ($1K)	0.94	0.97
Average wage: high skill ($1K)	1.31	1.27
Employment share of firms with $\geq$ 10 workers: union	0.98	0.95
Employment share of firms with $\geq$ 10 workers: nonunion	0.83	0.74
Employment share of firms with $\geq$ 100 workers: union	0.84	0.89
Employment share of firms with $\geq$ 100 workers: nonunion	0.55	0.52

Note: This table reports the targeted data moments and their simulated counterparts for the 1955 economy without RTW laws. "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.16: Model Fit (year 1955, RTW)

Moments	Data	Model
Union density	0.19	0.19
ESHI coverage: union	0.84	0.84
ESHI coverage: nonunion	0.60	0.63
ESHI coverage: low skill	0.64	0.68
ESHI coverage: high skill	0.71	0.59
Unemployment rate	0.05	0.05
Average wage: low skill ($1K)	0.73	0.75
Average wage: high skill ($1K)	1.14	1.13
Employment share of firms with $\geq$ 10 workers: union	0.99	0.97
Employment share of firms with $\geq$ 10 workers: nonunion	0.86	0.77
Employment share of firms with $\geq$ 100 workers: union	0.95	0.94
Employment share of firms with $\geq$ 100 workers: nonunion	0.59	0.59

Note: This table reports the targeted data moments and their simulated counterparts for the 1955 economy with RTW laws. "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.