TECHNICAL PAPER

What Did Labor Unions Do for Their Members During the COVID-19 Pandemic?

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July 2022

The COVID-19 pandemic presented huge challenges to the U.S. labor market. By January 2022, more than 800,000 workers had died from the virus, and many workers were suffering from long-term health problems (physical and mental) related to exposure to COVID-19 (Bach 2022). Millions of workers were laid off or furloughed during the pandemic-led recession; from 2019 to 2020, total wage and salary employment fell to 132.2 million, a decline of 9.6 million or 6.7% of the workforce (BLS 2021).

This report examines what labor unions did for the workers they represent in the face of this unprecedented macroeconomic downturn and public health crisis.

1. What labor unions did for union workers during the pandemic-induced recession

Figure A shows by union status the total number of workers ages 16 to 64 years old in each month of 2019, 2020, and 2021. After the onset of the pandemic in March 2020, the number of employed nonunion workers dropped substantially, while the decrease in union employment was smaller in both absolute and proportional terms. This different experience for union and nonunion workers is consistent with two features of the labor market. First, the pandemic had a bigger direct impact on industries and occupations with lower union density (such as restaurants, retail, and other in-person intensive industries), along with the private sector, in general. Second, union contracts may have protected union workers from layoffs or facilitated other work arrangements such as work-sharing or short-time compensation.

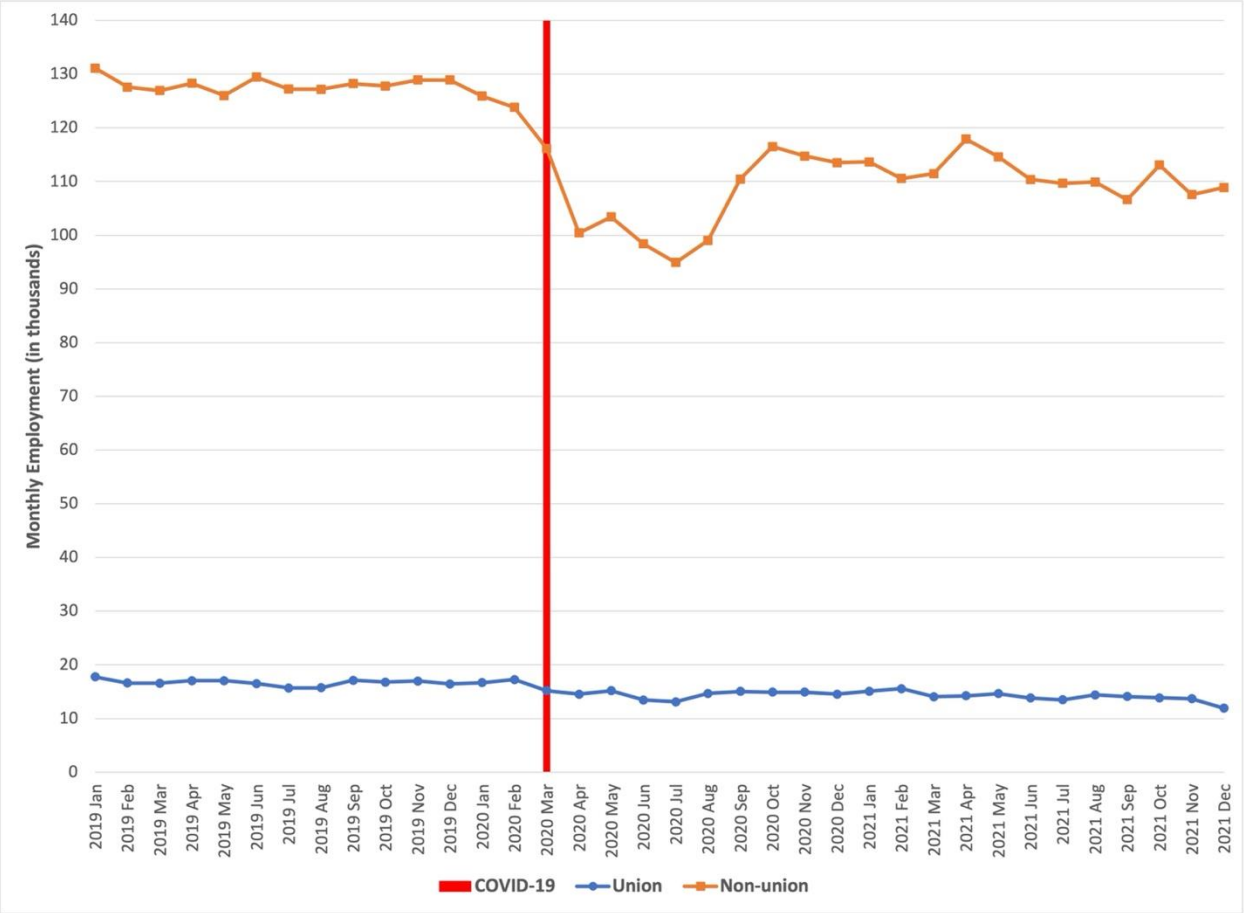
Starting in August and September of 2020, the employment of nonunion workers picked up, as the labor market began to recover from the initial shock, in part in response to large-scale economic relief measures. But, even by the end of the period studied here (December 2021), the labor market had not yet achieved full recovery.

Based on the employment pattern for nonunion workers in **Figure A**, the analysis that follows will define the "pandemic trough" as covering the first six months of the COVID-19 outbreak from March 2020 through August 2020, and the recovery period from September 2020 through December 2021 (the last month analyzed here).

The Data

The primary data source analyzed here is the Current Population Survey (CPS), administered by the Bureau of Labor Statistics (Flood et al. 2021). The CPS is a nationally representative source of data on U.S. labor force characteristics. After restricting the sample to the adult working population, ages 16 to 64, who are full-time wage and salary workers, I pool monthly data from 2015 through 2021. I also use a subset of the CPS, the Merged Outgoing Rotation Group file (MORG), to obtain additional employment information including union membership status, weekly earnings, and hourly wages. I define a binary indicator for labor unions if a worker is a member of a labor union or is covered by a union contract at their place of employment, even if they are not a member of a union.

Figure A. Full-time employment, by union status

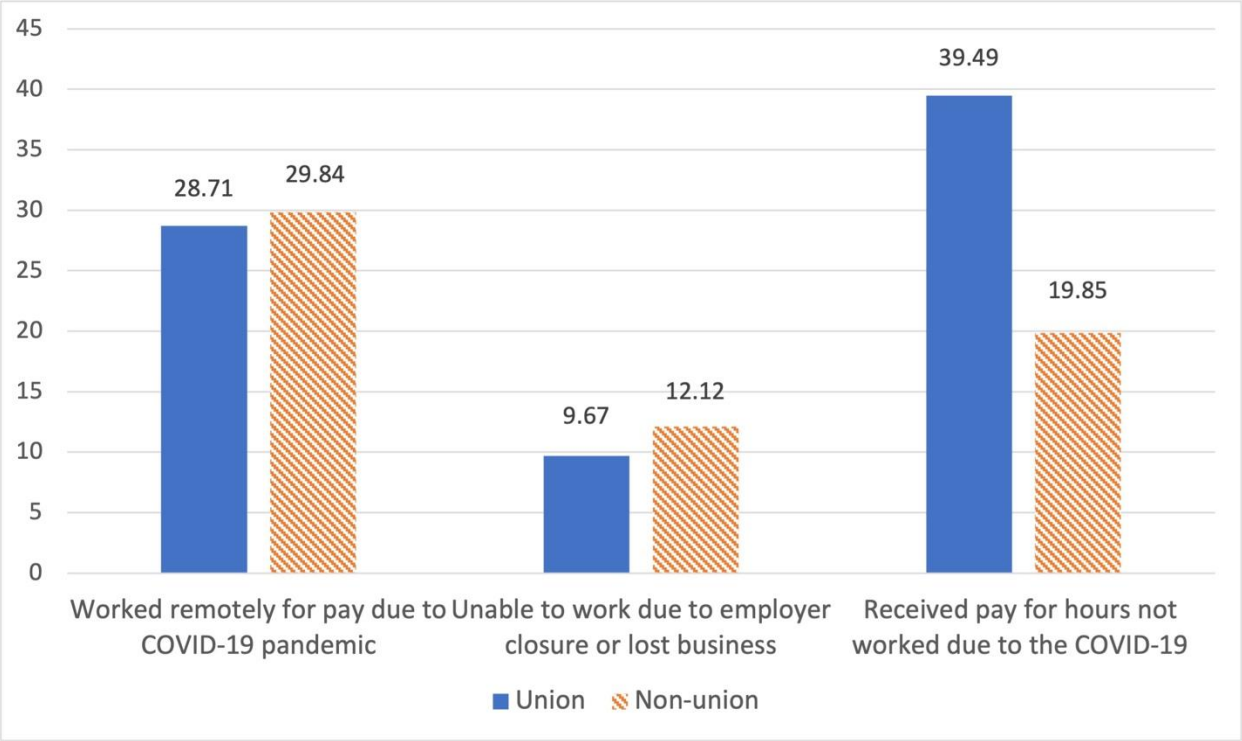


Notes: Sample includes full-time wage and salary workers, between ages 16 and 64 years old. Union refers to a member of union or a nonmember who is covered by a union contract.
Source: CPS Basic data, 2019–2021 (Flood et al. 2021).

a) Did COVID-specific labor market conditions differ for union members, compared with nonunion workers?

Starting in May 2020, the BLS included a series of questions related to the COVID-19 pandemic at the end of the CPS basic monthly questionnaire. In what follows, I use the answers to these questions to measure differences in the available labor market indicators across union and nonunion workers during the pandemic trough and subsequent recovery.

Figure B. Labor market conditions by union status during pandemic trough (expressed as a percent of workers)



Notes: The difference in outcomes between union and nonunion workers is not statistically significant for the likelihood of working remotely, but the differences in the other two items are statistically significant at the 1% significance level.
Source: CPS 2020 and 2021 (Flood et al. 2021). In May 2020 the BLS added to the CPS basic monthly questionnaire a series of questions related to COVID-19 and its impact on households.

Figure B shows that, during the pandemic trough, union workers (28.7%) were less likely than nonunion workers (29.8%) to work remotely, but the difference was not statistically significant. However, union workers (9.7%) were significantly less likely than nonunion workers (12.1%) to report that they were unable to work due to employer closure and lost business. And, among those who were unable to work during the early stages of the pandemic, union workers (39.5%) were also substantially more likely than nonunion workers (19.9%) to receive pay for hours missed due to the COVID-19 pandemic.

These simple mean comparisons in **Figure B** may be affected by other differences in employer and employee characteristics between the union and nonunion workers. In an attempt to solve this problem, I control for various worker and employer characteristics, such as a worker's age, usual work hours, and number of children age 5 and under; the proportion of workers who are male; and include categorical variables for education level, race, ethnicity, marital status, veteran status, citizenship status, metropolitan area, sector, and industry.

I also control for a worker's state of residence to minimize the impact of potential time-invariant confounders specific to each state, such as demographics, industrial structure, economic background, and local cultural or political characteristics. In addition, I include year and month

dummy variables to control for national macroeconomic conditions, federal holidays, and the common pandemic timeline that hit all states, such as economic relief by the federal government.

Table 1 presents the estimated relationship between union representation and the COVID-19-related items, controlling for these factors. During the pandemic trough, on average, union workers were 8.8 percentage-points less likely than nonunion workers to work remotely. Union workers were 1.2 percentage-points less likely to report that they were unable to work due to employer closure and lost business than non-union workers. Among those who were unable to work due to the pandemic, union workers were 9.8 percentage-points more likely to receive pay for hours not worked due to COVID-19. The similar pattern was observed during the recovery period, but the magnitudes of the differences between union and nonunion workers are somewhat smaller.

Table 1. Impact of COVID-19 pandemic on other labor market conditions of union workers

	(1)	(2)	(3)
VARIABLES	Worked remotely for pay	Unable to work due to employer closure or lost business	Paid for hours not worked
Panel A: Pandemic trough (May 2020–August 2020)			
Union	-0.0877***	-0.0118*	0.0982***
	(0.0088)	(0.0069)	(0.0307)
Panel B: Recovery period (September 2020–December 2021)			
Union	-0.0540***	-0.0044***	0.0940**
	(0.0038)	(0.0013)	(0.0384)

Notes: Standard errors are clustered within states (presented in parenthesis). ***p<0.01, **p<0.05, *p<0.1. Sample includes wage and salary workers who are full-time employed and between 16 and 64 years old. The models are weighted by final basic weights. Covariates include gender, age, education, race/ethnicity, full-time status, work hours, number of children aged five and under, veteran status, marital status, citizenship, sector, industry, metropolitan area, state, year and month dummies.
Source: CPS Basic data combined with CPS ORG data, 2020 and 2021 (Flood et al. 2021). In May 2020, the BLS added to the CPS basic monthly questionnaire a series of questions related to COVID-19 and its impact on households.

The findings in Table 1 suggest that labor unions influenced labor market outcomes beyond general employment and pay during the pandemic-led recession. Although union workers were less likely to telework, they were more likely to receive pay (including, in some cases, severance pay) for the hours they did not work due to pandemic-related closures or lost business. As severance pay is not required by law and usually up to employers' discretion, this study shows that labor unions seemed to be able to yield more generous terms of severance pay during the pandemic, implying that unions provide their members with financial buffers during economic hardship.

b) Did unions help protect job security for their members during the COVID-19 pandemic?

It is also critical to examine what unions did for their members in terms of other important and general features of labor markets, such as employment and wages.

To estimate the causal impact of the COVID-19 pandemic on employment and wages, I employ a statistical method that compares the changes in employment conditions of union workers (*treatment group*) with the changes in employment conditions of nonunion workers (*control group*). In this approach, I use the difference between the two groups before the pandemic as a baseline and then see if the difference between them changes after the pandemic. Under the assumption that the trend of employment conditions between the two groups is consistent before the pandemic, we can attribute the change in the size of the difference post-pandemic compared with the difference pre-pandemic as the causal effect of the pandemic on union workers relative to nonunion workers.

Table 2 presents the estimated results of the effect of the COVID-19 pandemic on the monthly employment of union workers, relative to nonunion workers. Panel A focuses on the pandemic trough and panel B on the recovery period as the "after" period. Both panels show that the pandemic had a negative impact on the employment of both union and nonunion workers, but the magnitude of the impact was much greater for nonunion workers. Panel A shows that, before the COVID-19 pandemic, the number of nonunion workers who were employed is greater by 9,684 per month than the number of union workers who were employed. During the pandemic trough, this gap was reduced to 7,308. This implies that the causal impact of the pandemic on the relative monthly employment of union workers is 2,376. The estimate during the recovery period was 1,552, which is smaller than the estimate during the pandemic trough, suggesting that the union effect on employment diminished as the economy began to bounce back.

Table 2. Impact of COVID-19 on relative employment of union workers

Monthly employment (in thousands)	Before	After	Difference = after– before
Panel A: Pandemic trough	**January 2015–February 2020**	**March 2020–August 2020**	**Diff-in-Diff**
Union	1.496	1.197	-0.299***
	(0.012)	(0.030)	(0.032)
Nonunion	11.180	8.505	-2.675***
	(0.047)	(0.253)	(0.257)
Difference = Union–nonunion	-9.684***	-7.308***	**2.376*** **
	(0.049)	(0.236)	**(0.241)**
Panel B: Recovery period	**January 2015–February 2020**	**September 2020 –December 2021**	**Diff-in-Diff**
Union	1.496	1.189	-0.307***
	(0.012)	(0.017)	(0.021)
Nonunion	11.180	9.321	-1.859***
	(0.047)	(0.066)	(0.081)
Difference = Union–nonunion	-9.684***	-8.132***	**1.552*** **
	(0.049)	(0.067)	**(0.083)**

Notes: Standard errors are clustered within states (presented in parenthesis). ***p<0.01, **p<0.05, *p<0.1. Sample includes wage and salary workers who are full-time employed and ages between 16 and 64 years old. Union refers to a member of union or nonmember but covered by a union contract. The models are weighted by earnings weights.
Source: CPS Basic data combined with CPS ORG data, 2015–2021 (Flood et al. 2021).

The baseline estimates presented in Table 2 do not account for other employer and employee characteristics that may be correlated with both employment and union status. To address this problem, I include various control variables, such as the monthly averages of worker's age, usual work hours, number of children age 5 and under, proportion of workers who are male, categorical variables for education level, race, ethnicity, marital status, veteran status, citizenship status, metropolitan area, sector, and industry. I also add state dummy variables, as well as year and month dummy variables.

Even after controlling for a full set of covariates, the alternative estimates are similar to the baseline estimates presented in Table 2. Overall, in the first six months of the pandemic, labor unions saved 2,192 jobs per month, or a total of 13,152 jobs, during the pandemic trough. As the labor market rebounded, labor unions saved 1,697 jobs per month, or 27,152 jobs in total, during the 16 months of the recovery period covered in this study.

c) What was the impact of COVID-19 on the union wage premium?

Table 3 presents the estimated results of the monthly average of real weekly earnings that are adjusted to 2015 dollars and truncated at the top and the bottom 1%. Panel A shows that both union and nonunion workers received a wage gain during the pandemic trough, with nonunion workers receiving a slightly higher raise than union workers (7.8% vs. 7.1%). In Panel B, nonunion and union workers earned higher weekly earnings by 7.1% and 7.0%, respectively, during the recovery period. However, in both panels, the change in earnings differences between union and nonunion workers over the pandemic period are not statistically significant, indicating that the pandemic did not have a detectable impact on the union wage premium.

Table 3. Impact of COVID-19 on relative earnings of union workers

Log (real weekly earnings)	**Before**	**After**	**Difference = after–before**
Panel A: Pandemic trough	**January 2015–February 2020**	**March 2020–August 2020**	**Diff-in-Diff**
Union	6.758	6.829	0.071***
	(0.003)	(0.009)	(0.009)
Nonunion	6.479	6.557	0.078***
	(0.002)	(0.005)	(0.005)
Difference = Union–Nonunion	0.279***	0.272***	**-0.007**
	(0.012)	(0.013)	**(0.013)**
Panel B: Recovery period	**January 2015–February 2020**	**September 2020 –December 2021**	**Diff-in-Diff**
Union	6.758	6.828	0.070***
	(0.003)	(0.005)	(0.006)
Nonunion	6.479	6.550	0.071***
	(0.002)	(0.004)	(0.004)
Difference = Union–Nonunion	0.279***	0.278***	**-0.001**
	(0.012)	(0.012)	**(0.010)**

Notes: Standard errors are clustered within states (presented in parenthesis). ***p<0.01, **p<0.05, *p<0.1. Sample includes wage and salary workers who are full-time employed and ages between 16 and 64 years old. Weekly earnings are truncated at the top and bottom 1%, and they are adjusted to 2015 dollars. The models are weighted by earnings weights.
Source: CPS Basic data combined with ORG data, 2015–2021 (Flood et al. 2021).

After controlling for various employer and employee characteristics (worker's gender, age, usual work hours, number of children age 5 and under, categorical variables for education, race, ethnicity, marital status, veteran status, citizenship status, metropolitan area, sector, industry, state, year, and month), the estimate of the effect of the pandemic on real wages of union workers is still not statistically significantly different from that of nonunion workers. I also look at real hourly wages as a sensitivity test, and the general patterns of the alternative results are similar to Table 3. Overall, the union wage premium during the pandemic was largely intact.

2. What the research tells us about unions and recessions

a) Employment

Various factors can contribute to the less severe job loss among union workers during the pandemic-led recession.

First, unions are able to arrange work-sharing, which encourages employers to temporarily reduce the work hours of their employees instead of laying them off, in order to save jobs and avert layoffs during an economic downturn (Freeman and Gottschalk 1998; Goodstein 1996; Glassner and Keune 2010; Zwickl, Disslbacher, and Stagl 2016; Houseman et al., 2017). For instance, employees' unions in Michigan and Rhode Island have shared their positive experiences in utilizing work-sharing programs during the COVID-19 pandemic (Cohen 2020; Gregg 2020).

Second, unions also serve as workers' "voice" in the workplace. Thus, compared with nonunion workers, union members are less fearful of retaliation when they speak out regarding their concerns about stronger safety measures on their behalf (Celine et al. 2020; Miller 2020; Batt, Colvin, and Keefe 2012; Freeman, Boxall, and Haynes 2007; Freeman 1980).

Third, unionized employers are more likely to offer health insurance and generous paid sick leave than nonunion employers (Murray 2007; Jones, Schmitt, and Woo 2014; Ghilarducci and Farmand 2020; Budd and Brey 2003; Mishel 2012; Marshall 2006). Thus, with better access to health care and medical treatment than their nonunion counterparts, union workers are more likely to remain in their jobs even when facing the same health risks.

Lastly, union density is significantly higher in the public sector, where jobs are more stable, compared with the private sector. Even within the private sector, service industries that experienced the sharpest declines in employment immediately after the pandemic hit (such as retail, trade, restaurants, and other face-to-face service jobs) traditionally have had lower union membership rates (Hirsch and Macpherson 2003; Freeman 1986). Thus, the negative impact of the COVID-19 pandemic on employment might be less severe among employees in highly unionized sectors and industries.

Therefore, facing a more favorable trade-off between their jobs and health risks than nonunion workers while working in a relatively more stable sector where job-sharing is a viable option, union workers are better able to secure their employment during a pandemic than their nonunion counterparts. The data analyzed here confirm that labor unions indeed saved jobs, even during the pandemic-induced recession.

b) Wages

Unlike the optimistic expectation for the employment of union workers relative to nonunion workers, however, the impact of the pandemic on relative labor earnings between union and nonunion workers is less clear. On average, union workers earn a wage premium ranging between 5% and 20%, depending on sector, industry, and occupation (Farber et al. 2021; Mishel

2012; Hirsch 2004; Gittleman and Pierce 2007; Freeman and Ichniowski 1988. Whether union workers are able to maintain this pay advantage over nonunion workers during a pandemic depends on various factors.

In the heart of the COVID-19 pandemic, many businesses struggled to stay open. According to unions' rent-sharing models, unions attempt to lower wages by trying to save jobs when a firm is in trouble (Freeman and Kleiner 1999). This model shows that unions whose members earn above-market wages should be willing to give concessions up to the point where their firm can stay in business. Indeed, unions made sizable wage and benefit concessions to save jobs in dealing with the financial crisis during the Great Recession in 2008–2009 (Freeman and Han 2012; Roche, Teague, and Coughlan 2015; Visser 2016).

The rent-sharing model is aligned with the theory of compensating wage differential (CWD), where union jobs may offer lower wages in exchange for greater job security, which is a form of "negative CWD" (Rosen 1986; Miller 2004). The theory of CWD also predicts that risk-averse union workers who are concerned with health risks may be willing to take wage cuts (or reduced work hours for social distancing) for better health protection and safety measures. (Biddle and Zarkin 1988). This scenario will lead to a reduced union wage premium during a pandemic.

On the other hand, a theory of CWD also predicts that there exists a positive wage premium for health risks on the job, and numerous studies find higher wages when the risks on the job are greater (Cousineau, Lacroix, and Girard 1992; Kniesner et al. 2012; Cole, Elliott, and Lindley 2009). Because the COVID-19 pandemic introduced a huge crisis to worker health, labor unions, which aim to promote workplace safety, could negotiate a more generous risk premium, or "positive CWD," to compensate for employment-related risk, potentially increasing the union wage premium. Union employers who find it challenging to provide a safer work environment, due to the intrinsic nature of their work environments, may have to offer even greater compensation to attract and retain their workers. According to a meta-analysis by Viscusi and Aldy (2003), out of the ten studies that evaluate the role of unions in risk premiums, nine find that union workers receive greater CWD for bearing risk than nonunion workers. If these phenomena dominate, unions' wage premium can increase during a pandemic.

Thus, which channel dominates and whether unions are able to maintain the union wage premium during a pandemic can only be answered through empirical analysis. My analysis above provides evidence that unions might have canceled the negative CWD with a positive CWD, preserving the pre-pandemic union wage premium.

c) Other employment conditions

The existing research also hints at other labor market conditions that union workers are more likely to face during a pandemic. By analyzing more than 4,300 documents in Bloomberg Law's online library of collective bargaining agreements, Wallender (2020) finds that less than 4% of union contracts over the past five years mention "telecommuting," "telework," or "work from home." Similarly, "flexible work scheduling" is not a popular item in union contracts. This may be due to the innate feature of many union jobs that requires workers' physical presence

(manufacturing, construction, transportation, health care, and education, for instance). Thus, unionized employers prefer to keep their employees working on site.

This study shows that these earlier experiences regarding teleworking in pre-pandemic periods continued during the COVID-19 pandemic. Union employers were less likely to move toward remote working, compared with nonunion employers, during the COVID-19 pandemic.

When facing furloughs or layoffs, unionized employers offer superior terms and conditions of employment, such as better severance packages (Holzmann et al. 2012; Auray, Danthine, and Poschke 2020). Although severance pay is not required in the United States by the Fair Labor Standards Act (FLSA), most employers tend to offer it as a gesture of goodwill or to remain competitive in the labor market. According to a recent study by LHH and Compensation Resources Inc., nearly all U.S. businesses (97%) indicate that they offer some form of severance pay to workers, and more than 70% of those businesses define severance pay in their formal employment agreement (LHH 2020). Typically, severance pay is based on the length of employment for which an employee is eligible upon termination, and the majority of employers who pay severance offer one to two weeks of paid salary for every year worked. Unions often negotiate severance payments for their members through collective bargaining, so severance pay arrangements differ substantially by union status of the workers (Parsons 2005a, 2005b, 2005c; Kodrzycki 1998; Millward et al. 1992).

This study proves that, during the pandemic, union employees were more likely than nonunion employees to receive pay for the periods they did not work. The difference in this payment likelihood is substantial, and it persisted during the recovery period.

3. Conclusion

The findings of this study show that the overall labor market outcomes were far better for union workers than nonunion workers during the pandemic. Union workers enjoyed better job security while maintaining their pre-pandemic level of the wage premium. Even when they were unable to work due to the pandemic, union members were more likely to receive pay. Labor unions played an important role in promoting members' well-being by providing workers with employment stability and a financial buffer during the pandemic-induced economic downturn.

The pandemic has made working remotely the new norm for many workers. Thus, when union workers were less likely to work from home, relative to nonunion workers, this lack of flexible work scheduling could have been considered a disadvantage of union jobs during the pandemic. Thus, some unions are already working to change this, as they navigate this relatively new terrain. For example, the recent bargaining agreement between the Environmental Protection Agency and the American Federation of Government Employees allows employees to work remotely up to two days a week (Ogrysko 2020). More unions are starting a dialogue on remote working, flexible work scheduling, or a "hybrid" work model (which incorporates a mixture of on-site and remote work) and addressing these items in their collective bargaining contracts to accommodate the needs of workers and remain competitive in their industries.

The research presented here examines the impact of the COVID-19 pandemic on the relative labor market outcomes of union workers. To identify the effect of the pandemic on the labor market conditions of union workers, relative to nonunion workers, I compare the employment and earnings of union workers to that of nonunion workers before and after the pandemic, based on nationally representative data.

I find that, compared with nonunion workers, union workers were less likely to work remotely and less likely to report that they were unable to work due to employer closure and lost business. Among those who were unable to work due to employer closure and lost business, union workers were more likely to receive pay for hours not worked due to COVID-19, relative to nonunion workers. I also find that union workers experienced a higher level of job security during the pandemic, relative to nonunion workers. On average, the pre-pandemic level of the union wage premium remained largely unchanged after the pandemic.

Labor unions in the U.S. have seen a sharp membership decline in the last several decades. In recent years, several states launched unprecedented legal initiatives substantially restricting the collective bargaining rights of public-sector employees. The 2018 Supreme Court decision in *Janus v. American Federation of State, County, and Municipal Employees Council 31* declared illegal the collection of mandatory "fair share" or "agency" fees from nonmembers in the public sector. In 2021, the union membership rate in the private sector fell to 6.1%, a historic low point (BLS 2022). Considering the positive roles labor unions have played during the pandemic-induced recession, the changes in labor laws in recent periods are likely to have shifted our labor market in the wrong direction.

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Appendix

The primary data source of this study is the Current Population Survey (CPS), a monthly household survey conducted by the Census Bureau for the Bureau of Labor Statistics. The CPS basic monthly survey is the primary source of data on labor force characteristics, as well as demographic information, of the U.S. population. The instrument surveys more than 65,000 households, resulting in 90,000–120,000 individual observations per month. Every household that enters the CPS is interviewed each month for four months, ignored for eight months, and then interviewed again for four more months. Thus, we observe the same individuals in the same household twice yearly if they do not move.

Household members that are interviewed for the fourth or eighth month are asked additional labor questions (also known as the "earner study" of the CPS), such as union membership, weekly earnings, hourly wage, if they are 16 years and older, and currently employed as a wage or salaried worker. These outgoing interviews are the only ones included in the extracts of the Outgoing Rotation Group (ORG). The ORG households, which typically constitute a fourth of every basic monthly sample for a calendar year, are extracted and merged together by the Census Bureau and are released as the Merged Outgoing Rotation Group file (MORG).

In May 2020, the BLS included a series of questions related to the COVID-19 pandemic at the end of the basic monthly questionnaire. I select three questions to measure the effects of the COVID-19 pandemic on other labor market conditions:

- Q1. At any time in the last 4 weeks, did you telework or work at home for pay because of the coronavirus pandemic? (Yes or No)
- Q2. At any time in the last 4 weeks, were you unable to work because your employer closed or lost business due to the coronavirus pandemic? (Yes or No)
- Q3. (Asked if "yes" is the response to Q2.) Did you receive any pay from your employer for the hours you did not work in the last 4 weeks? (Yes or No)

After restricting the sample to the adult working population, ages 16 to 64, who are wage and salary workers, I pool monthly data from 2015 through 2021. I define a binary indicator for labor unions if a worker is either a member of a labor union or not a union member but covered by a union contract.

To examine the role of labor unions on other COVID-related labor market conditions, I run the OLS regressions of the following equation:

$$Y_{imst} = \beta_0 + \beta_1 UNIONWORKER_{imst} + \beta_2 X_{imst} + \delta_s + \lambda_t + \varepsilon_{imst,} \quad (1)$$

where *i*, *m*, and *t* indicate individual, month, state, and years, respectively. Y represents the new COVID-specific labor market items. *Union* measures union status. X is the vector of control variables. δ_s represents state dummies, λ_t the year dummy, and ε the error term reflecting variation not accounted for in the model.

I examine the impact of the COVID-19 pandemic on the labor market condition of union workers by comparing the employment and earnings of union workers (treatment group) to that of nonunion workers (control group). The method uses the difference-in-difference (DID) estimation and under reasonable assumptions provides a causal estimate, computed by the difference between the average change in employment and real wages before and after the COVID-19 pandemic for the treatment group and the average change in employment and real wages before and after the COVID-19 pandemic for the control group.

To identify the impact of the COVID-19 pandemic on the employment of union workers, relative to nonunion workers, I estimate the following baseline DID equation:

$$Emp_{smt} = \alpha_0 + \alpha_1 Treat_{smt} + \alpha_2 After_{smt} + \alpha_3 (Treat_{smt} * After_{smt}) + \varepsilon_{smt}, \quad (2)$$

where s, m and t indicate state, month, and years, respectively. *Emp* represents the number of people employed. *Treat* equals to 1 for the treatment group (union workers) and 0 for the control group (nonunion workers), and *After* equals to 1 if the time period is March 2020 or later and 0 if otherwise. The coefficient α_3 gives us the DID estimator, which estimates the difference in the number employed between union workers and nonunion workers before and after the COVID-19 pandemic.

To estimate the effect of COVID-19 on the earnings of union workers, relative to the earnings of nonunion workers, I use the baseline DID estimation of the following equation:

$$log(Wage)_{ismt} = \alpha_0 + \alpha_1 Treat_{ismt} + \alpha_2 After_{ismt} + \alpha_3 (Treat_{ismt} * After_{ismt}) + \varepsilon_{ismt}, \quad (3)$$

where *i*, *s*, *m*, and *t* indicate individual, state, month, and years, respectively. *Wage* represents the real weekly earnings adjusted to 2015 dollars and truncated at the top and bottom 1%. *Treat* equals to 1 for the treatment group (union workers) and 0 for the control group (nonunion workers), and *After* equals to 1 if the time period is March 2020 or later and 0 if otherwise. The DID estimator, α_3, estimates the difference in real weekly earnings between union and nonunion workers before and after the COVID-19 pandemic.

The DID results may not be driven by the pandemic, but by systematic differences in the treatment (union workers) and control groups (nonunion workers). Thus, the key assumption for the DID estimator is that the treatment and control groups would have parallel trends in employment and real wages before the pandemic. Although I cannot observe the counterfactual—what would have happened to the outcome variables for the treatment group if the pandemic had not occurred, I can examine the trends in outcome variables for both groups before the pandemic and examine whether they are indeed comparable. I examine whether the parallel trends assumption is likely to hold, using an event-study approach of the following equation:

$$Y_{smt} = \beta_0 + \beta_1 Event_{smt} + \lambda_s + \gamma_m + \tau_t + \varepsilon_{smt}, \quad (4)$$

where *Event* is the number of periods since the COVID-19 pandemic outbreak (March 2020). *Event* is normalized to -1 for control units. Each of the event study estimated coefficients β_1 is a

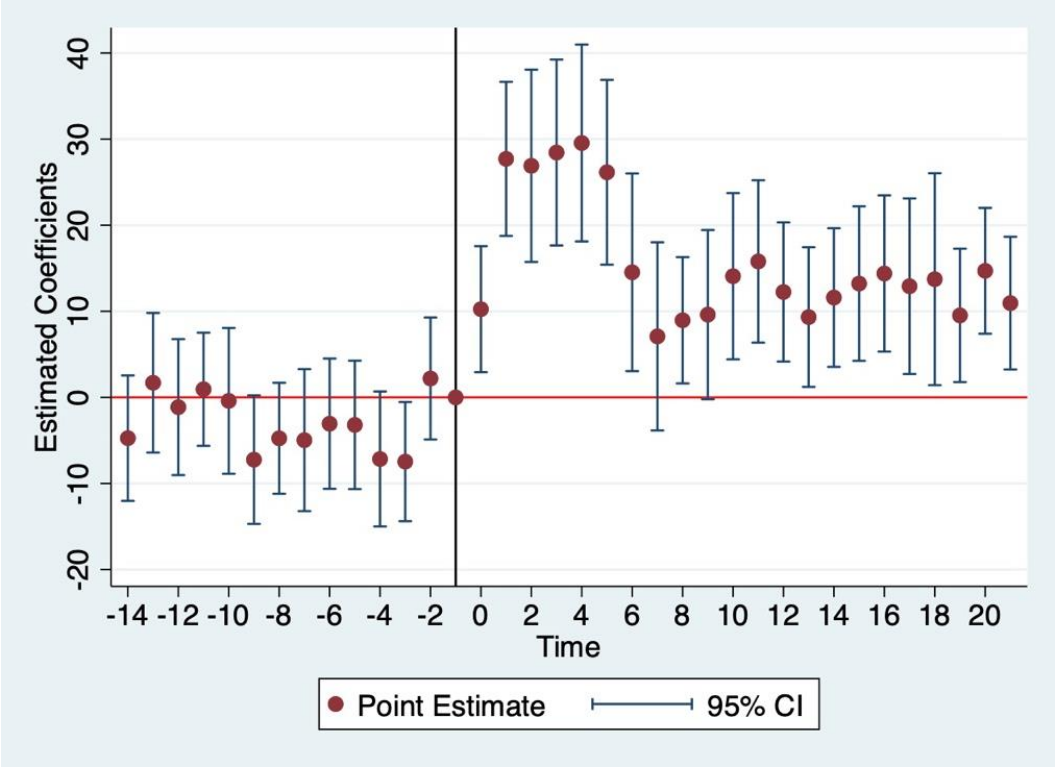
simple DID estimator, using the period just before the onset of the COVID-19 pandemic as the "before" period, and the period of the event study coefficient as the "after" period.

The figures below presents the testing of the parallel-trend assumption of the DID estimation for monthly employment in **Figure A-1** and monthly average of real wages in **Figure A-2**, using the event-study approach. The estimated coefficients and their 95% confidence intervals are plotted, and the vertical lines refer to the pandemic outbreak.

If the pre-treatment trends are parallel, the estimated coefficients would be close to zero for any period before the pandemic. The estimated coefficients in both figures are close to zero, which indicates that the pre-treatment trends for both employment and real weekly earnings are constant for union and nonunion workers, providing evidence that the parallel-trend assumption is likely to be satisfied.

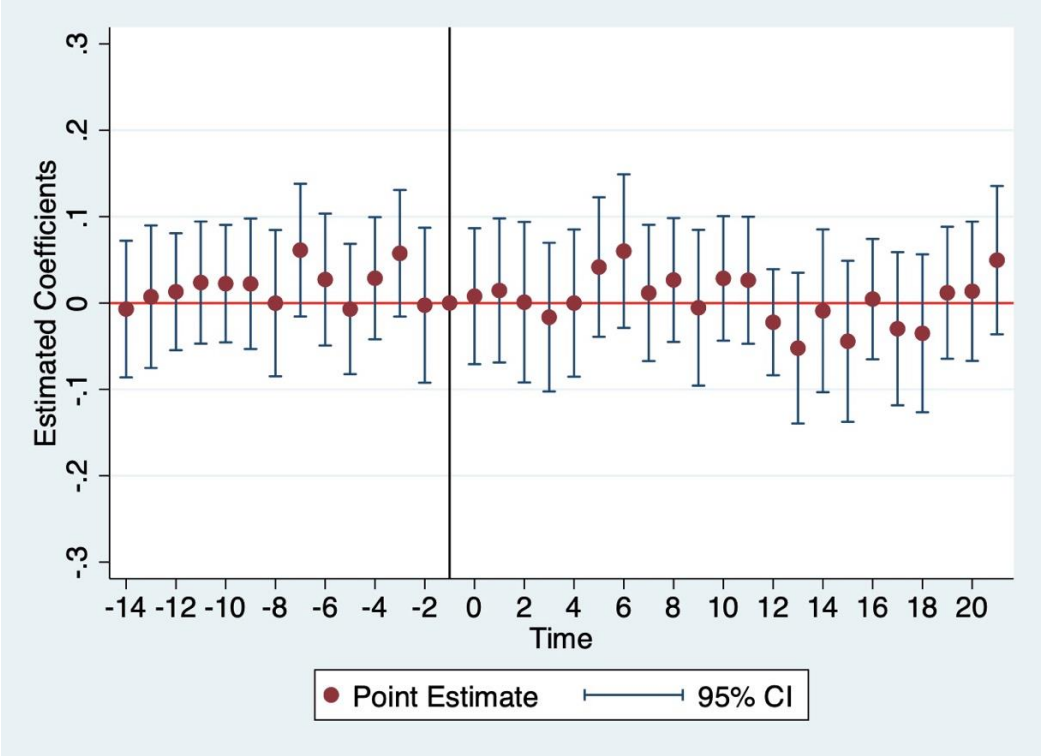
If the pandemic improved the employment status and real wages of union workers relative to nonunion workers, the estimated coefficients would be positive for any period after the pandemic. Figure A-1 shows that the estimated coefficients are around zero before the pandemic, but they turn positive after the pandemic, indicating that union workers enjoyed greater job security following the pandemic than nonunion workers. Figure A-2 depicts the estimated coefficients that fluctuate around zero both before and after the pandemic. This shows that the pandemic did not influence the difference in earnings between union workers and nonunion workers, and union workers were able to maintain their wage premium during the pandemic.

Figure A-1. Tests for parallel trends assumption based on event study design: Trends in monthly employment



Notes: Sample includes full-time wage and salary workers, ages 16–64 years old. Union refers to a member of union or a nonmember who is covered by a union contract. Employment is weighted by earnings weights.
Source: CPS Basic data combined with ORG data, 2019–2021 (Flood et al. 2021).

Figure A-2. Tests for parallel trends assumption based on event study design: Trend in monthly average of log (real weekly earnings)



Notes: Sample includes full-time wage and salary workers, ages 16–64 years old. Union refers to a member of union or a nonmember who is covered by a union contract. Weekly earnings are weighted by earnings weights and truncated at the top and bottom 1%. Weakly earnings are adjusted to 2015 dollars.
Source: CPS Basic data combined with ORG data, 2015–2019 (Flood et al. 2021).