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Organized labor and the employment trajectories of workers in routine jobs: Evidence from U.S. panel data

Zachary Parolin
Columbia University

Abstract

Technological change has contributed to declines in the employment shares of routine occupations, such as office clerks and industrial workers. Less clear, however, is whether organized labor mitigates the pace and consequences of technological change for workers in routine occupations. This study investigates the extent to which union membership affects the employment and earnings trajectories of workers in routine jobs. Using data from the Panel Study of Income Dynamics (PSID) spanning 1970 to 2015, this study employs individual fixed effects and propensity score matching estimates to assess the effect of union membership on the likelihood that an adult in a routine job (1) remains employed in a routine job for a longer duration of time, (2) avoids unemployment, and (3) achieves higher earnings over time relative to non-unionized routine workers. The results demonstrate that union membership contributes to a 13 percentage point increase in the likelihood that a worker in a routine occupation remains in that occupation during the two decades after obtaining the job, a 5 percentage point decrease in the likelihood of becoming unemployed, and a 4 percentage point decrease in the likelihood of earning below 50 percent of national median earnings. Results are broadly consistent across decade, age group, race/ethnicity, sex, and level of educational attainment. The findings suggest that organized labor is an important actor in shaping the pace and social consequences of technological change.

Introduction

Technological change has contributed to declines in the employment shares of routine occupations, such as office clerks and industrial workers, throughout recent decades (Acemoglu and Autor 2011, Autor, Levy and Murnane 2003, Autor and Dorn 2013, Goos, Manning and Salomons 2014). As routine occupations tend to be concentrated in the middle of the earnings distribution, their decline has prompted concern regarding the polarization of occupational employment shares. More generally, concern has mounted that the decline of these middle-pay, middle-skill jobs threatens to close a pathway to economic prosperity for many adults without a college degree.

While several studies in recent years have documented the changing structure of the labor market in the U.S. and abroad (Autor and Dorn 2013, Goos, Manning and Salomons 2009), few studies have sought to understand how technological change affects the employment and earnings trajectories of individual workers (exceptions include Kurer and Gallego (2019) and Cortes (2016)). Similarly, few studies have sought to place the processes of automation and labor market change into political-institutional context. This study investigates how organized labor, and union membership in particular, shapes the employment and earnings trajectories of workers in routine occupations. I use data from the Panel Study of Income Dynamics (PSID) spanning 1970 to 2015 to investigate two sets of research questions.

The first set focuses on the pace of labor market change, looking particularly at *employment tenures and transitions* of workers in routine occupations. I investigate, first,

whether unionized routine workers maintain their routine occupations for a longer duration relative to non-unionized routine workers. Second, I investigate whether unionized routine workers are less likely to become jobless relative to non-unionized routine workers over time.

The second set of research questions focuses on the *earnings* of workers in routine occupations. Specifically, I analyze whether unionized routine workers experience higher earnings while in routine work relative to (a) non-unionized routine workers and (b) former routine workers who have switched to other occupations.

Using descriptive findings, individual fixed effects estimates, and propensity score matching estimates, I consistently find that union membership leads to more employment stability for routine workers, lower likelihood of unemployment, and reduced risk of low earnings. These findings hold when adjusting for observable characteristics that affect positive selection into union membership. An event study specification demonstrates that the effect of unionization on the earnings and employment of routine workers persists for nearly 20 years after the adult's first entry into routine work. The findings are broadly consistent across decade, age group, race/ethnicity, sex, and level of educational attainment. The results thus suggest that organized labor is an important actor in shaping the pace and social consequences of technological change.

Background

Routine-Biased Technological Change

The employment and earnings of workers in routine occupations have been central to analyses of routine-biased technological change (RBTC). In short, the RBTC perspective suggests that technological advancements generate two primary sets of consequences for workers in routine occupations (Acemoglu and Autor 2011, Autor, Levy and Murnane 2003, Goos, Manning and Salomons 2014). One is the decline in employment shares of routine occupations, such as machine operators, sales clerks, and other occupations composed primarily of routine tasks. Routine occupations, the most susceptible to automation, tend to be in the middle of the earnings and skill distributions (Acemoglu and Autor 2011, Dwyer 2013). Their decline thus leads to a dip in employment shares near the median of the earnings distribution, potentially leading to a period of employment polarization (Goos, Manning and Salomons 2009, OECD 2017). Meanwhile, technological advancements are theorized to take a factor-augmenting form for higher-skill occupations, contributing to rising employment shares at the top the earnings and skills distributions (Autor, Levy and Murnane 2003, Autor and Dorn 2013). While scholars have not reached consensus on how to measure polarization or the extent to which it is occurring (Hunt and Nunn 2019, Mishel, Schmitt and Shierholz 2013, Salvatori 2015), there is nonetheless general agreement that technological change contributes to declines in the employment shares of routine occupations.

In addition to its employment effects, technological change can also affect the relative

earnings growth of routine occupations (Acemoglu and Autor 2011, Goos, Manning and Salomons 2009). If declining demand for routine tasks translates into declining relative earnings among high RTI occupations, then *earnings* polarization, in addition to employment polarization, might occur (Böhm 2017, Firpo, Fortin and Lemieux 2011). In the U.S. during the 1990s, for example, the earnings of occupations at the bottom and top of the wage distribution increased at a greater rate than earnings of occupations in the middle of the distribution (Acemoglu and Autor 2011, Mishel, Schmitt and Shierholz 2013). Even in periods when routine occupations experienced greater earnings growth than lower-pay, service-sector occupations, this growth has typically been modest and among a declining share of routine jobs.

While this past research has adequately documented the shifting task composition of the labor market, less research has investigated the consequences of technological change for the individual workers who are employed in the routine occupations. Where do the workers in routine jobs go when their work is made redundant? Do they compete for lower-pay, service-sector jobs, or are they able to move into higher-pay, professional occupations? Or, perhaps, is the decline in routine occupations a product of reduced hiring of routine jobs rather than accelerated firing of current workers in routine jobs? Two studies that have asked such questions are Cortes (2016) and Kurer and Gallego (2019). Using panel data on U.S. workers, Cortes (2016) finds that high-ability routine workers are more likely to switch out of routine jobs and into non-routine cognitive jobs. The study also finds that workers who switch to non-routine cognitive jobs experience greater earnings growth relative to workers who remain in routine occupations. Using panel data on employed adults in the United Kingdom, Kurer and Gallego (2019) find that about 64 percent of workers in routine jobs remain in routine work five years later, while around 24 percent of workers switch out of routine occupations. A very small share (3.4 percent) of workers in routine jobs in the British sample became unemployed.

These two studies have provided useful insights on the employment trajectories of workers in routine occupations. However, the role of labor market institutions, and organized labor in particular, in shaping the employment and earnings outcomes of such workers remains unclear. This study builds on their work to identify whether union membership affects the employment and earnings trajectories of workers in routine jobs. In doing so, this study advances our understanding of the extent to which the social consequences of technological change are conditional on the strength of organized labor.

The Role of Organized Labor

A rich history of literature suggests that labor market institutions are central in shaping the market earnings distribution. Organized labor, and trade unions in particular, have been linked to more compressed earnings distributions, lower likelihood of working poverty, more generous social policies, the spread of egalitarian pay norms, and greater job protections (Biegert 2017, Brady 2009, Korpi 1983, Parolin 2019, VanHeuvelen 2018, Western and Rosenfeld 2011). These patterns hold not only in a cross-national context,

comparing to the U.S. to countries where organized labor is stronger, but also in a cross-state context within the U.S. Recent research has found, for example, that stronger unions are associated with more favorable earnings growth for routine occupations relative to other occupations in the U.S. (Parolin 2019). Prior research from sociologists has also found that labor unions enhance the relative power of workers in the face of technology-induced declines in the demand for routine tasks (Fernandez 2001, Kristal 2013).

While these past studies have shed light on the role of worker power in affecting labor's share of national income, inequality, and earnings growth, they have largely done so from the perspective of aggregate employment shares, aggregate earnings patterns, and national-level changes in inequality. In contrast, this study concerns itself with the role of organized labor in shaping the earnings and employment trajectories of individual workers over time. Using panel data that follows individuals throughout their adulthood, this study looks at two sets of research questions.

The first focuses on the pace of labor market change and, more specifically, the employment tenures and transitions of workers in routine occupations. An underlying premise of this analysis is the idea that the *pace* of labor market change carries importance consequences for the wellbeing of the affected workers. A more rapid displacement of workers, particularly if concentrated in certain geographic areas, is likely to impede efforts to reintegrate displaced workers back into the labor market, and is likely to have negative spillover effects for the surrounding community. Recent empirical work on trade and globalization corroborates this perspective (Autor, Dorn and Hanson 2016). Likewise, political-economists have long expressed concerns over the political consequences of a rapid displacement of similarly-skilled workers (Polanyi 1944).

While labor market change is unavoidable, the pace at which workers are displaced from routine jobs may have negative welfare consequences if the alternatives are joblessness or lower-pay employment. This is particularly true in a political-institutional context, such as that of the U.S., that gives relatively little priority to income support and social services for jobless, working-age adults. Thus, this study investigates whether union membership leads to longer employment tenures for workers in routine occupations and/or a lower likelihood of unemployment.

The second research focus narrows in on the earnings trajectories of workers in routine occupations. Ample research on the union wage premium suggests that union members earn more than their non-unionized counterparts (Denice and Rosenfeld 2018, Hirsch and Schumacher 2001). This study is not only concerned with a union wage premium among routine workers, but also with the relative earnings of unionized, routine workers compared to non-routine jobs (such as professional occupations or service occupations). Moreover, are unionized workers in routine occupations more likely to experience higher earnings during, and even after, their spell of routine employment? If so, this would again point to the role of worker power in shaping the social consequences of technological change.

Analytical strategy

Data Source

This study uses individual-level panel data from the Panel of Study and Income Dynamics (PSID). The PSID features a nationally-representative sample of more than 18,000 individuals spanning from 1970 to 2015. Due to inconsistencies in occupational coding in the early years of the sample, this study focuses primarily on employment and earnings outcomes during the years of 1981 to 2015. I use the WZB-PSID version of the PSID, which transforms the data from household-level to individual-level panel responses (Brady and Kohler 2016). In the standard PSID, the household head is the only respondent for each household. The data provided thus refer to the household head and to other individuals in the household, but all stored at the household level. The WZB-PSID File uses this information about individuals within each household to create individual-level panel data. I limit the sample to adults who are between the ages of 25 and 65. This leads to a sample of 213,750 responses from 1970 to 2015.

Routine Occupations

I follow Cortes (2016) and others in using the Autor and Dorn (2013) classification of occupations to segment occupations in the PSID into three primary categories: routine, non-routine manual, and non-routine cognitive. Table 1 displays the three primary occupation categories and the sub-occupations within each. The final column of Table 1 presents the share of the occupation set with earnings under 50 percent of median earnings over 2013-2015, a benchmark for low income status that will be used throughout this study.

Table 1: Overview of occupation categories

Occupation Type	Sub-Occupations (ISCO-88 Codes)	Share with Earnings < 50% Median (2013-15)
Non-Routine Cognitive	Managers (12-13); professionals (21-24); associate professionals (31-34); legislators and senior officials (11)	6.1%
Routine Occupations	Office clerks (41); customer service clerks (42); trades workers (71-74); plant and machine operators (81-83); laborers (93)	9.9%
Non-Routine Manual	Sales and services (91); Personal and protective service workers (51); models, salespersons, and demonstrators (52)	16.2%

Non-routine cognitive occupations include professional and managerial occupations. These occupations tend to be toward the top of the earnings distribution. During 2013-2015, only 6.1 percent of workers in these occupations had earnings below 50 percent of the given

year’s median. Routine occupations are those at greatest risk of automation. This group includes office clerks, trades workers, machine operators, and laborers. Non-routine manual occupations primarily include service-sector occupations. This group has the highest share of workers with low earnings (around 16.2 percent, compared to 9.9 percent among routine occupations).

Estimation Strategy

The estimation strategy proceeds in two parts. First, I document the differing employment and earnings outcomes for unionized versus non-unionized workers in routine occupations at two, four, six, eight, and 10 years after first year of observed employment in a routine occupation. This exercise is mostly descriptive, but provides initial evidence on whether outcomes tend to differ for routine workers who were covered under a union contract. As a second step, I employ individual fixed effects and propensity score matching techniques to further test whether unionization has an effect on employment and earnings outcomes.

To document employment and low earnings status in the years following routine employment, I estimate:

$$y_{ist} = \beta_1 Union_{it} + \beta_2 X_{it} + \alpha_t + \alpha_s + \varepsilon_{ist} \quad (1)$$

The outcome, y_{ist} , is first set as a binary indicator of routine employment for a given individual (i) in a state (s) at t years after first entering routine employment. I estimate the model at $t = 2, 4, 6, 8,$ and 10 years after the individual’s first observed spell in routine employment. Union membership is operationalized as a binary variable indicating whether the worker was unionized while in routine work in at least one year prior to t years after first entry into routine work. In subsequent analyses, I also estimate Equation (1) with the following outcomes: non-routine cognitive employment, non-routine manual employment, unemployment, and a binary indicator of whether the individual’s earnings are below 50 percent of median earnings (“low earnings”). The coefficient on the binary union indicator (β_1) informs us whether union membership is associated with different likelihood of, say, still being in routine employment in the years following first entry into routine employment. I expect that union membership will have a positive effect on the likelihood of remaining in a routine job and a negative effect on the likelihood of unemployment and earning low pay.

While Equation (1) provides a useful portrait of the conditional effect of unionization on employment and earnings, it suffers from two sets of identification challenges. First, the estimations do not account for unobservable differences among adults that might affect their employment or earnings trajectories. Second, and relatedly, they do not account for selection into unionization. I present two additional sets of estimates to attempt to address these challenges.

To control for between-worker heterogeneity, I estimate fixed effects (FE) models using person- and year- fixed effects. The FE models take advantage of the fact that many routine workers join a union during their spell of routine employment while many never do. Person-level fixed effects control for stable differences between workers in the sample. The year

effects control for time-varying effects on the outcome that affect all individuals. To measure the effect of union membership on employment and earnings, I estimate:

$$y_{ist} = \beta_1 Union_{it} + \beta_2 X_{it} + \alpha_i + \alpha_t + \alpha_s + \varepsilon_{ist} \quad (2)$$

Different from Equation (1), Equation (2) now includes the individual fixed effects (α_i). The sample now includes data for each worker from the first year at which he/she entered routine employment to 20 years after that year (or at age 65, whichever comes first). The panel is unbalanced and includes workers who began routine employment between 1970 and 2005. Later, I produce sensitivity checks segmenting the sample by decade of first entry into routine work, as well as by age group, race, sex, and education status. The union indicator (β_1) is a binary indicator of whether the individual is unionized in a given year. The vector of control variables now excludes characteristics that are generally fixed at the individual level, such as race/ethnicity and biological sex, as the person-level fixed effects control for these stable features.

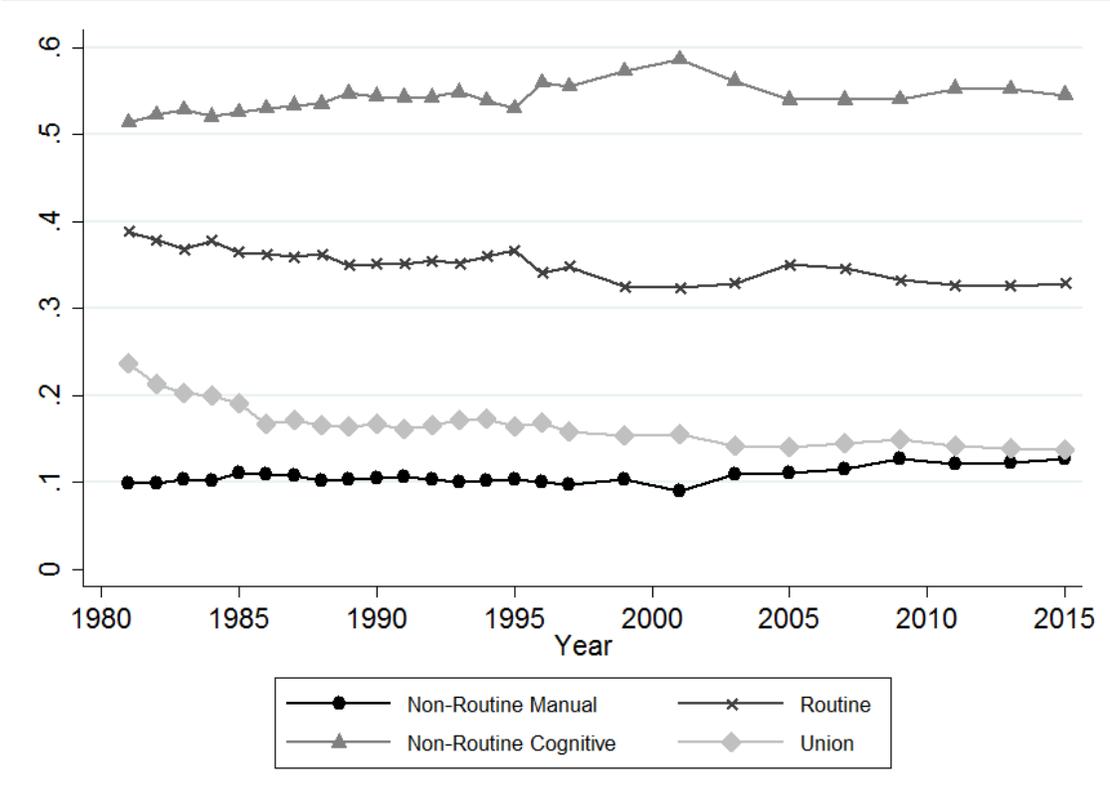
A central assumption in this FE model is that the unionized group is not notably dissimilar from the non-unionized group before unionization occurs. This can occur if, as one example, individuals with favorable earnings and employment potentials are positively selected into unionization. To account for possible selection effects, I also estimate propensity score matching (PSM) models. The PSM technique matches the union and non-union groups on observed characteristics prior to the treatment. Put differently, the PSM approach reweights the sample so that the means of the observed, baseline characteristics of those who become unionized (such as age, education, sex, and pre-union earnings) match the group that never becomes unionized. Notably, statistical matching still does not account for unobserved characteristics of workers that might affect selection into unionization; it is thus not a perfect fix. Nonetheless, it serves a useful sensitivity check to the primary FE results.

As a final step, I also display results using an event study specification to trace out changes in the outcomes in the years preceding and following unionization. This practice helps to ensure that the parallel trends assumption between the union and non-union group is met. The event study specification uses a similar setup as the FE and PSM estimations, but operationalizes the treatment as a series of binary indicators marking whether the given year is t years before or after unionization. In this study, I examine the pre-treatment outcomes at 2, 4, and 6 years before unionization, as well as two-year intervals from 2 to 20 years after unionization.

Results

Descriptive Results

Figure 1: Employment shares and union membership, 1981 - 2015

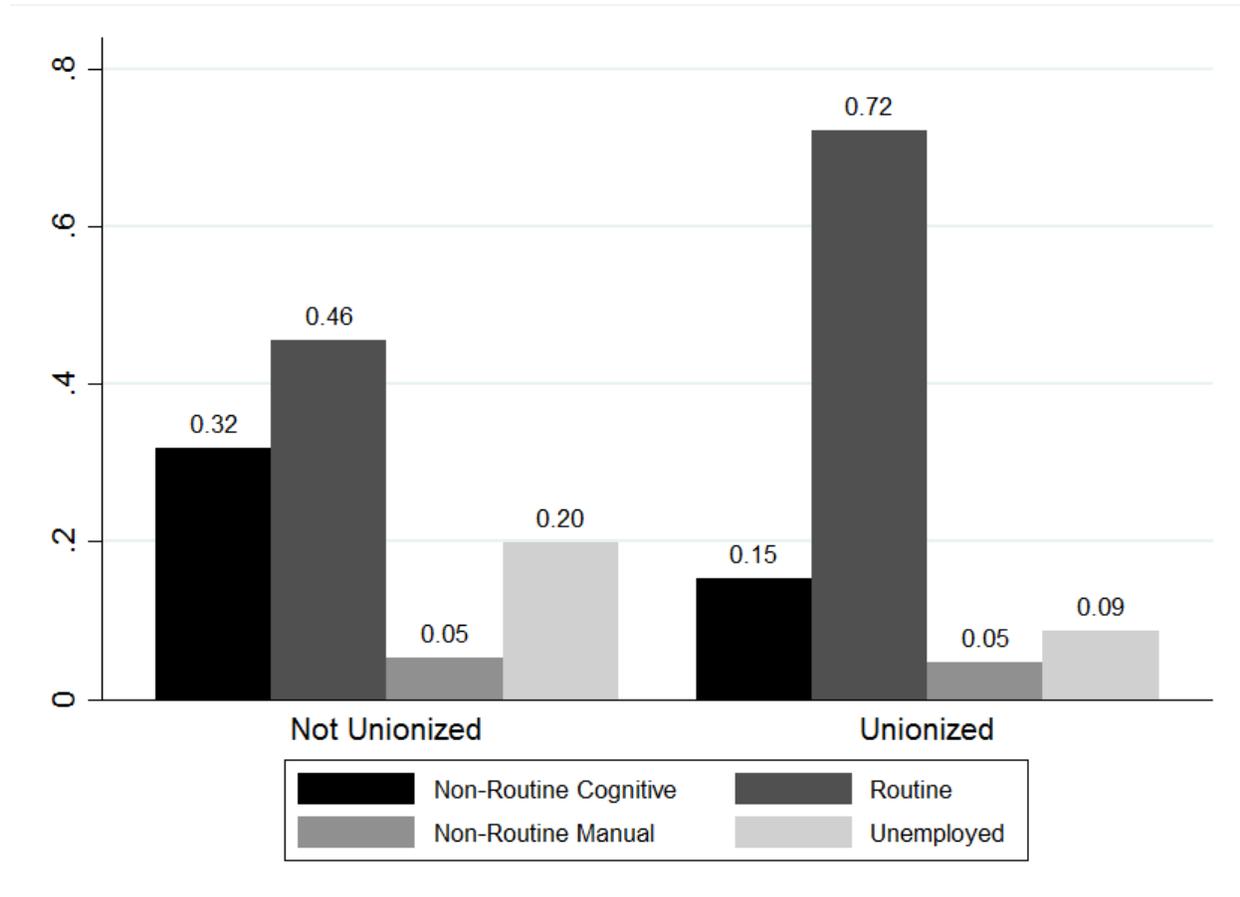


Note: Data from PSID.

Figure 1 presents descriptive trends on employment shares and union membership among the PSID sample of working-age adults from 1981 to 2015. The top line in Figure 1 shows that the employment shares of non-routine cognitive jobs have remained relatively stable at about 55 percent of the employed workforce from 1981 to 2015. The share of these jobs peaked in the early 2000s at around 60 percent before declining slightly afterward.

Consistent with prior evidence, the share of routine occupations has declined over time. In 1981, routine occupations made up around 39 percent of all jobs among employed adults in the PSID sample. By 2015, however, this had fallen to around 32 percent. Non-routine manual jobs – those primarily in the service sector – have experienced slight gains over time, growing to around 13 percent of working-age adults in 2015. Finally, Figure 1 also demonstrates that union membership has fallen in half from 1981 to 2015, dropping from around 25 percent of employed workers to 13 percent over the observed timeframe.

Figure 2: Employment status 10 years after entering routine occupation (unconditional means)



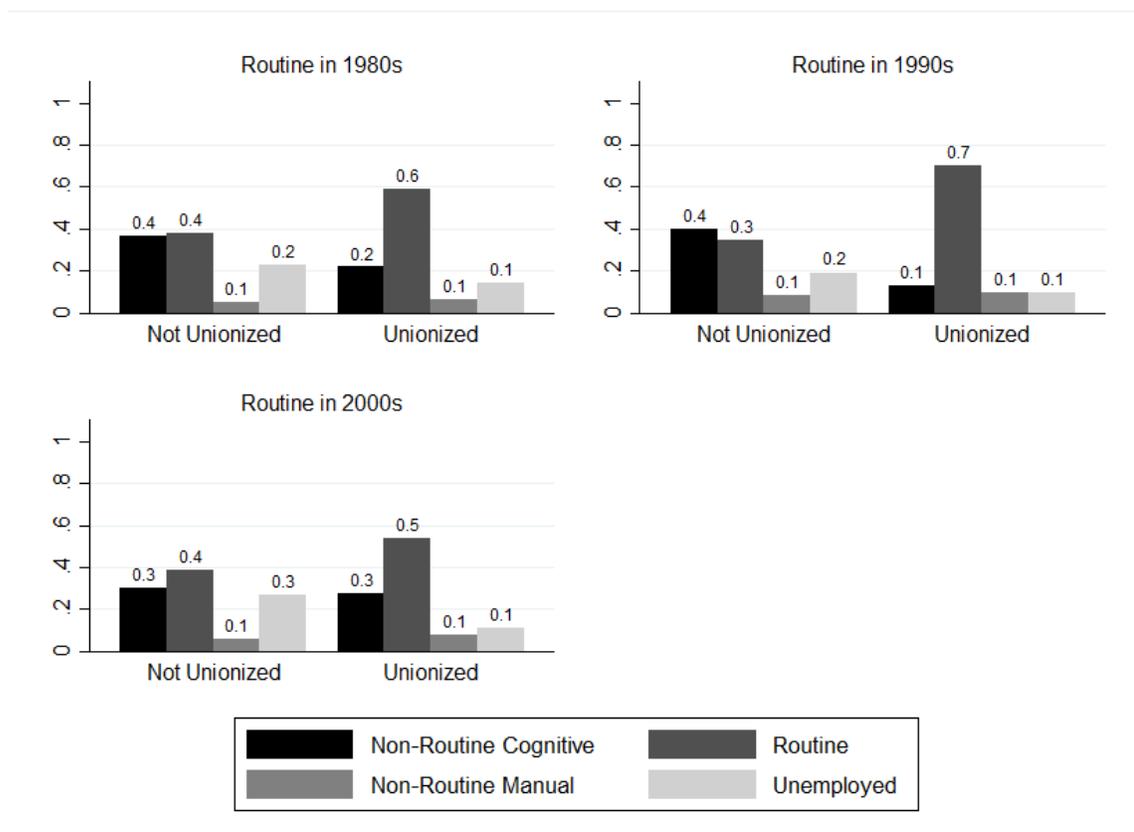
Note: Data from PSID.

Though union membership is shrinking, is it the case that unionized routine workers maintain employment longer than non-unionized routine workers? Figure 2 presents the unconditional means of an adult’s employment and occupation status 10 years after he or she was first observed working in a routine occupation. The left half of the figure presents the averages for adults who were not unionized during their routine employment, while the right half shows the averages for unionized adults. To emphasize, these findings do not yet control for age, education, sex, year, or other factors that are likely to emphasize union status or employment transitions. Nonetheless, Figure 2 shows a clear divide between unionized and non-unionized routine occupations. Only 46 percent of adults who worked in a non-unionized routine job were still in a routine job 10 years later. In contrast, nearly 72 percent of adults in a unionized routine job were still in routine work 10 years later.

Among the non-unionized group, adults were more likely to end up in non-routine cognitive jobs (32 percent relative to 15 percent for the unionized group) and to be unemployed (20 percent relative to 9 percent for the unionized group). No difference appears to exist in the likelihood that a unionized vs. non-unionized routine worker transitions to a non-routine manual occupation.

The results in Figure 2 present the unconditional means regardless of when the adult was first observed in a routine occupation. In contrast, Figure 3 segments the samples into three groups depending on when the adult entered routine work: the 1980s, 1990s, or 2000s. For each time period, the general pattern remains: unionized routine workers are more likely to still be in routine work 10 years later relative to the non-unionized. However, the differences between the groups vary by decade.

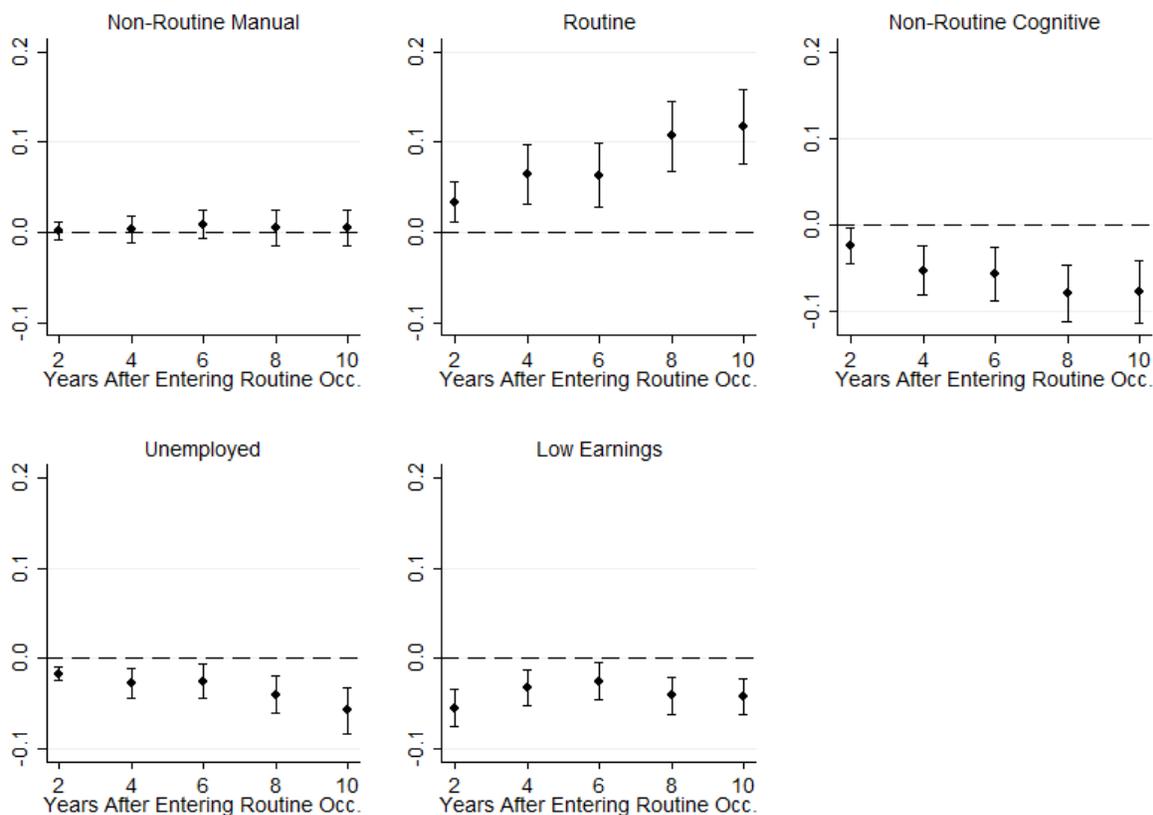
Figure 3: Employment status 10 years after entering routine occupation, by decade in which routine occupational spell began (unconditional means)



Note: Data from PSID.

For adults starting routine work in the 1980s, union members were less 20 percentage points more likely to still be in routine work after 10 years. For adults starting routine work in the 1990s, in contrast, the difference is about 40 percentage points (70 percent to 30 percent). In most decades, non-unionized routine workers are more likely to end up in unemployment or a non-routine cognitive job. The 2000s are the primary exception. Non-unionized routine workers who started their job between 2000 and 2005 were not more likely than unionized routine workers to end up in non-routine cognitive jobs 10 years later, but were about three times as likely to be unemployed (30 percent relative to 10 percent). These findings suggest that the employment protections that unions tend to offer have perhaps become more important for routine workers over time.

Figure 4: Conditional effect of union membership on likelihood of employment and low-income status after first year of work in routine occupation



Note: Coefficients on the effect of union membership presented. Models control for age, education, sex, race, state, and year of observation. Low earnings excludes unemployed.

Figure 4 displays the results of the conditional effect of union membership on employment and earnings status in the decade following. These results follow Equation (1) in controlling for age, education, sex, race, state, and year of observation. Figure 4 thus plots the estimated effect of union membership during routine employment on the outcome of interest, independent of these other factors.

Consistent with the prior figures, the top-left panel of Figure 4 suggests that union membership during routine employment had no statistically significant effect on the likelihood that an adult in a routine job transitioned to a non-routine manual job. The top-middle panel, however, shows that union membership had a large and significant effect on the likelihood that an adult in a routine occupation was still working in a routine job at two, four, six, eight, and 10 years after first starting the routine job. At the 10-year mark, an adult who was unionized during routine work was about 12 percentage points more likely to still be in routine work relative to a non-unionized adult. Put differently, it appears that union members experience longer job tenures in routine work relative to the non-unionized.

The top-right panel suggests again that the non-unionized tend to transition into non-routine cognitive occupations. Union membership reduces the likelihood that an adult in a routine job will transition to a non-routine cognitive job; instead, as observed before, they are more likely to remain in their routine job.

The lower-left panel suggests that union membership also reduces the likelihood of unemployment for workers in routine occupations. The effect of unionization grows over time, contributing to an estimated 5 percentage point reduction in the likelihood of unemployment at 10 years after first entry into routine work.

Finally, the lower-middle panel presents similar findings for the likelihood of having a low income (again, defined as less than 50 percent of median earnings). At two, six, eight, and 10 years after entering routine employment, adults who were unionized are less likely than the non-unionized to have low levels of earnings. Thus, even if union membership reduces the likelihood that an adult transitions into a non-routine cognitive job, it appears that union membership still has a net positive benefit on the earnings status of adults in the decade after they begin the routine work.

In the Appendix (Figure A1), I decompose routine occupations into their three primary sub-occupations (sales/office clerks, operators, and trades) and investigate whether union membership increases the likelihood that an adult remains in the given sub-occupation 10 years later. Consistent with the findings presented above, unionization boosts the employment tenures of each of the three types of routine occupations.

Table 2: Demographics by occupation status 10 years after first year in routine occupation (among employed)

Occupation	Occ. Share	% w/ Low Earnings	Mean Age	Edu: Low	Edu: High	Female	White
Non-Routine Cog.: Manager	11.5%	5.2%	40	34.6%	30.3%	47.3%	86.3%
Non-Routine Cog.: Professional	13.5%	8.2%	39	36.0%	25.6%	50.1%	82.8%
Non-Routine Cog.: Associate Pro.	7.2%	6.1%	40	52.8%	16.6%	40.5%	83.4%
Routine (Non-Unionized)	40.4%	9.2%	40	64.8%	10.6%	42.8%	76.1%
Routine (Unionized)	11.4%	1.2%	38	66.7%	5.9%	33.1%	73.3%
Non-Routine Manual	5.8%	23.3%	41	63.8%	14.7%	55.9%	71.5%

Who are the individuals who tend to transition out of routine work compared to those who remain? Table 2 provides a more detailed breakdown of the demographic characteristics of individuals by occupation status 10 years after first entry into routine work. Here, I segment the non-routine cognitive jobs into their primary sub-occupations (manager, professional, and associate professional) for greater specificity.

The top row of Table 1 shows that 11.5 percent of adults who were in a routine job transitioned to a non-routine cognitive Manager occupation 10 years after entering routine

work. This group has a very low share of workers with low earnings and tends to be better educated, more male, and more white relative to the other groups in the table.

An estimated 13.5 percent of routine workers transitioned to a non-routine cognitive Professional occupation after 10 years. Relative to the Managers, this group has slightly higher levels of low earnings, is less likely to have a college degree, and achieves roughly even gender parity. Among the Associated Professionals (7.2 percent of those leaving routine work), we see a greater share of individuals with only a high school degree. The group is about 60 percent male.

About 40 percent of routine workers are in non-unionized routine work, and about 11 percent are in unionized routine work, at 10 years after first entry into the routine job. Though the share of the non-unionized routine workers is about four times larger than the routine group, recall that the average unionized routine worker is more likely to maintain his or her job over time. Comparing these two groups, we see that the prevalence of low earnings is far smaller for the unionized group (1.2 percent) relative to the non-unionized group (9.2 percent). In fact, routine workers who are unionized feature the lowest share of workers with low earnings of all the occupations examined in Table 2. Those who remain in routine, unionized employment are far less likely to have a college degree (5.9 percent) and are less likely to be female (about two-thirds men) and white (around 26 percent non-white).

Finally, about 5.8 percent of adults in routine work were in non-routine manual jobs at 10 years after first entry into routine work. This group has the highest rate of low earnings (20.8 percent), has levels of education that compare to that of the routine groups (though with slightly higher levels of college degree attainment), and features more females and non-white adults relative to the other groups.

Estimation Results

As discussed, two difficulties of establishing a causal effect of union membership on the employment and earnings premiums of routine occupations are (1) accounting for unobservable differences between workers and (2) positive selection into union membership. Put differently, workers in routine occupations who join a union might already have higher earnings (or earnings potential) relative to the non-unionized group. If future union members have unobservable characteristics that make them more likely to join a union and more likely to have favorable earnings, then union membership is less effective than the descriptive results presented before suggest. The individual FE estimates presented below control for stable between-worker differences, while the propensity score matching estimates presented afterward help to more appropriately account for selection into unionization.

Table 3: Individual fixed effects estimates of effect of union membership during routine work on employment and earnings status

	Routine	NR Manual	NR Cognitive	Unemployed	Low Earnings
Union	0.18*** (8.04)	-0.00 (-0.17)	-0.13*** (-7.07)	-0.05*** (-4.33)	-0.06*** (-3.64)
Age 25-30	0.04*** (4.20)	-0.00 (-0.88)	-0.06*** (-5.58)	0.01* (2.13)	-0.02* (-2.52)
Age 41-50	0.02 (1.51)	0.01 (0.96)	0.01 (1.41)	-0.04*** (-5.78)	-0.01 (-0.85)
Age 51-60	0.04* (1.98)	-0.00 (-0.28)	-0.04* (-2.23)	-0.01 (-0.45)	-0.01 (-1.23)
Age 61+	-0.01 (-0.33)	-0.02 (-1.47)	-0.14*** (-6.10)	0.15*** (8.00)	0.01 (0.64)
Attainment of High School Degree	0.01 (0.47)	-0.00 (-0.36)	-0.03 (-1.78)	0.03* (2.33)	0.01 (1.24)
Attainment of Bachelor's Degree	0.00 (0.17)	-0.01 (-0.70)	-0.00 (-0.12)	0.01 (0.56)	-0.06** (-3.11)
Observations	60,126	60,126	60,126	60,126	60,126

Note: Model includes individual, year, and state fixed effects. NR = Non-Routine. T-Scores in parentheses. Robust standards errors. Sample includes adults (age 25-65) from year in which they are first observed in routine work until 20 years afterward. Union indicates that individual was unionized during routine occupation spell.

Table 3 presents the results from the FE estimates (see Equation 2) using person and year fixed effects. Recall that the sample includes individuals from the first year in which they enter routine work until 20 years later. Union membership is operationalized as a permanent treatment that activates when a worker in a routine job joins a union. The effect of unionization, as presented in the first row of Table 3, is thus the average difference in the given outcome when in the years following unionization relative to the years prior. The first column in Table 3 presents the effect of union membership during routine work on the likelihood that the adult remains in routine work (rather than transitioning to a separate occupation or becoming unemployed). Consistent with the descriptive results, the effect is positive and significant. Specifically, unionization contributes to a 18 percentage point increase in the likelihood that the worker remains in routine work in subsequent years.

Model 2 suggests that unionization had no effect on the likelihood that a routine worker transitioned into a non-routine manual occupation, while Model 3 shows that union membership reduced the likelihood that a worker transitioned into non-routine cognitive occupation. These findings are again consistent with the descriptive patterns presented before.

Models 4 and 5 present the results for unemployment and low-income status, respectively. Union membership decreases the likelihood that a routine worker experiences unemployment. After becoming unionized, the likelihood that the unionized routine worker experiences unemployment drops by 5 percentage points. Similarly, the likelihood that the routine worker earns below 50 percent of median earnings in the given year falls by about 6 percentage points. Note that jobless adults are excluded from the low-earnings calculations.

The estimates presented above include workers who started routine work between the 1970s and 2000s. Though the year dummies control for time-varying effects on the outcome variables, it is nonetheless useful to segment the estimates by decade to assess the consistency of the results over time. Table A1 in the Appendix re-estimates the results while segmenting workers by the decade during which they were first observed in routine work: the 1970s, 1980s, 1990s, or 2000s. The results are broadly consistent across the four decades. Tables A2 through A5 segment samples according to education, age, sex, and race/ethnicity. Again, the results are generally consistent across different demographic groups, which particularly large effects of unionization found for individuals without a college degree and non-white adults.

Table 4: Individual fixed effects estimates of average effect of union membership during routine work on employment and earnings status, matching on baseline observables

	Routine	NR Manual	NR Cognitive	Unemploye d	Low Earnings
Union	0.13*** (31.81)	0.02*** (8.21)	-0.11*** (-30.00)	-0.05*** (-18.36)	-0.04*** (-15.62)
Age 25-30	0.10*** (17.26)	-0.01* (-1.98)	-0.07*** (-13.32)	-0.03*** (-7.41)	0.00 (0.46)
Age 41-50	-0.04*** (-8.03)	0.01** (3.26)	0.03*** (6.64)	-0.00 (-0.45)	-0.01*** (-3.48)
Age 51-60	-0.07*** (-11.23)	0.00 (0.52)	-0.00 (-0.34)	0.07*** (17.39)	-0.00 (-1.06)
Age 61+	-0.16*** (-14.84)	-0.02*** (-4.15)	-0.10*** (-10.54)	0.28*** (41.49)	0.02** (3.24)
Attainment of	0.08***	0.01***	-0.12***	0.03***	0.02***

High School Degree	(18.46)	(4.40)	(-29.57)	(9.66)	(6.31)
Attainment of Bachelor's Degree	-0.14*** (-19.53)	-0.01** (-2.90)	0.16*** (25.57)	-0.01** (-2.92)	-0.00 (-0.36)
Observations	60,126	60,126	60,126	60,126	60,126

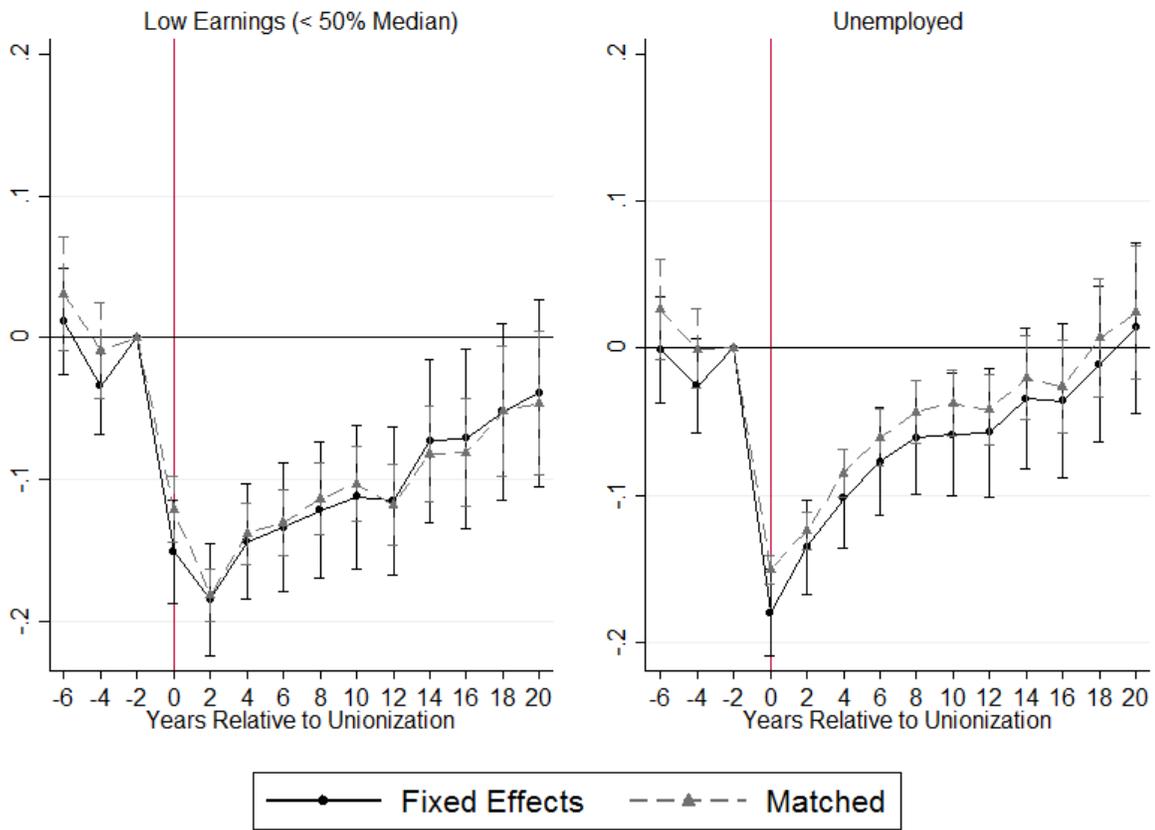
Note: Model includes individual, year, and state fixed effects. NR = Non-Routine. T-Scores in parentheses. Robust standard errors. Sample includes adults (age 25-65) who worked in routine occupation for at least one year. Union indicates that individual was unionized during routine occupation spell.

Table 4 presents the propensity score matching estimates. Recall that the matching approach reweights the comparison group (those who do not become unionized) to match the observed characteristics of the treatment group (those who become unionized) at baseline. In this case, the baseline year is the first year in which an adult is employed in a routine occupation (which is also the first year in which the adult is included in the sample for these estimations). Appendix Table A6 demonstrates that the reweighting technique successfully balances the treatment and comparison groups on baseline levels of age, sex, education, race/ethnicity, year, and state of residence. Thus, the propensity score matching approach appears to largely account for selection into unionization, at least among observable covariates.

Account for selection effects should reduce the estimated effect of unionization on the likelihood of remaining in routine employment or earning a higher wage. Indeed, this is what the results from Table 4 suggest. Rather than unionization contributing to a 18 percentage point increase in the likelihood of remaining in a routine job (as found in the individual fixed effects estimates), the results from Table 4 point a 13 percentage point effect. Thus, accounting for selection into unionization reduces the estimated effect of unionization on the likelihood of remaining in routine employment by about one-fourth. The effect of unionization on unemployment remains at 5 percentage points. The effects of unionization on the likelihood of earning a low wage declines slightly to -4 percentage points. Thus, while selection into the treatment group dampens the effect of unionization on remaining in routine work, it does not appear to effect the role of union membership in contributing to higher earnings and reduced likelihood of unemployment.

As a final step, Figure 5 presents the event study specification to dive deeper into the role of union membership in shaping the unemployment and low earnings outcomes. The event study visualizes whether the unionized group experiences a different likelihood of being unemployed or receiving low earnings relative to the non-union group prior to unionization. Results from both the FE and matching estimates are presented. Recall that the sample now includes all adults who worked in a routine job at some point during their professional careers. The point estimates in Figure 5 thus present the estimated effect of union membership on the likelihood of being unemployed or receiving low earnings in the years preceding and following the treatment.

Figure 5: Event study specification of effect of union membership during routine work on employment and earnings status



Note: See Equation (2) for specification. Fixed effects indicates results from person and year fixed effects models. Matching indicates results from propensity score matching to align baseline characteristics of treatment and control groups.

The left panel presents the results for the likelihood of low earnings. Prior to the treatment, we see that the treatment group does not experience a differential likelihood of having low earnings relative to the control group. This is true both for the FE and matched estimates. Immediately after unionization, the likelihood of low earnings decreases. Unionization contributes to around a 15 percentage point decrease (relative to all other workers) in the likelihood that the routine worker earns below 50 percent of median earnings in the given year. This effect is persistent from two to nearly 20 years after unionization. Recall that union membership is treated a permanent treatment here regardless of whether the worker remains unionized; thus, the results suggest that, on average, union membership is beneficial for future earnings of routine workers regardless of future union status. As found in the estimation results presented in the prior tables, there appears to be little difference between the estimated effect of unionization in the FE and matched samples.

The right panel presents the results for the likelihood of unemployment. Again, we see that the unionized group does not face a differential likelihood of unemployment relative to the non-unionized group prior to unionization. After unionization, however, the likelihood of unemployment falls substantially. In the treatment year, this reduction in the likelihood of unemployment is more or less a statistical given: if unionized, one is generally also employed. More interesting is the persistence of the effect in the following 20 years. Up until around the 12 year mark, having been unionized is associated with a reduction in the likelihood of being unemployed. The results from the event study specification point more toward a lasting effect of unionization on the likelihood of low earnings and unemployment for individuals who work in routine occupations.

Discussion

In recent decades, technological advancements have contributed to a decline in the employment shares of routine occupations with important consequences for the economic wellbeing of adults without a college degree. Using panel data from the PSID, this study set out to investigate the employment and earnings trajectories of workers in routine occupations from 1970 to 2015. Specifically, this study analyzes whether union membership contributes to more favorable employment and earnings trajectories for adults in routine occupations. Two primary findings emerged.

First, the findings suggest that unionized routine workers are more likely to maintain their routine job for a longer period of time relative to non-unionized routine workers. Around 72 percent of unionized workers remained in routine jobs at 10 years following the start of their routine employment. In contrast, only 46 percent of non-unionized routine workers remained in routine jobs at the 10 year benchmark. The non-unionized routine workers were twice as likely to be unemployed, but also twice as likely to be working in a non-routine cognitive occupation. Individual fixed effects estimates, propensity score matching estimates, and an event study specification point toward a positive effect of unionization on the long-term employment stability of workers in routine jobs. Though the effect of unionization on the likelihood that an adult remains in routine work (rather than other occupation types) appears to be partially related to positive selection into unionization, the positive effect of unionization on the likelihood of employment in any job (relative to unemployment) persists for nearly two decades after the first year of unionization, even when accounting for selection effects.

The second set of findings relates to the earnings of workers in routine occupations over time. Unionized routine workers are much less likely to have low earnings (defined as earnings below 50 percent of the national median in the given year) relative to non-unionized routine workers. Moreover, unionized routine workers appear to have rates of low earnings that mimic the average rate of adults in professional and managerial occupations (around 3 percent for either group). Though the share of unionized routine workers is steadily declining as a share of all employed adults, the results demonstrate that the group remaining in unionized routine work fares particularly well in terms of annual

earnings. Relative to non-routine cognitive occupations, this group of workers is more likely to be non-white and is far less likely to have a college degree, suggesting that union membership in routine work has important consequences for differences in wellbeing across class and race/ethnicity. Results from individual fixed effects estimates, propensity score matching estimates, and the event study specification again point toward a causal effect of union membership on the earnings of workers in routine jobs. The earnings gains appear to be persistent up to nearly 20 years after first year of union membership, even among adults who are no longer unionized.

These findings have several implications for our understanding of changing labor markets and the economic prosperity of adults without a college degree. First, the results reinforce the importance of placing analyses of automation and labor market change in the context of prevailing labor market institutions. As sociological research has demonstrated throughout recent decades, worker power, and union membership in particular, plays an immensely important role in shaping the distribution of resources. In this case, union membership appears to (1) dampen the pace at which workers in routine jobs are displaced and (2) enhance the earnings of workers who remain in routine jobs. While the reversal of the decades-long decline in unionization in the U.S. is unlikely, mechanisms to enhance worker power, such as a shift toward sectoral-level bargaining, could perhaps have similarly beneficial effects on the economic wellbeing of workers in routine occupations.

Second, and relatedly, the findings emphasize that the economic fate of middle-wage, middle-skill workers is not merely a product of exogenous shifts in demand away from routine tasks. While technological innovation may be inevitable, its effects on the financial wellbeing of the workers in routine occupations is in large part a product of policy, politics, and power relations. Though this study focuses exclusively on the role of worker power in shaping the *pace* and *consequences* of technological change, it seems likely that other labor market and welfare state institutions – such as minimum wage policies, access to education or job training, and social insurance/assistance programs for jobless adults – could similarly help cushion the blow of labor market change for adults working in routine jobs.

In closing, several limitations and opportunities for future research should be noted. This study does not look at the potential endogeneity between organized labor and investments into new technology. If greater union density were to attract greater investments into innovations that make routine work more obsolete, then the net effects of union membership on employment and earnings outcomes of routine work, as demonstrated in this study, could be overstated. Similarly, this study does not investigate whether greater union density inhibits access to unionized, routine work among new labor market entrants or the unemployed. Finally, future work should measure in more detail whether greater worker power has meaningful, heterogeneous effects on the employment and earnings trajectories of workers across demographic differences. More generally, researchers should continue to place analyses of labor market change in institutional context. As this study demonstrates, worker power is one factor among many that shapes the social consequences of technological change.

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Appendix

Table A1: Individual fixed effects estimates by decade

	NR Manual	Routine	NR Cognitive	Unemploye d	Low Income
<i>First year in routine occupation was 1970s (n=10,823)</i>					
Union	-0.00 (-0.63)	0.07*** (3.69)	-0.04** (-2.86)	-0.03** (-2.63)	-0.03* (-2.05)
<i>First year in routine occupation was 1980s (n=30,779)</i>					
Union	0.00 (0.02)	0.17*** (6.14)	-0.13*** (-5.82)	-0.04** (-2.99)	-0.09*** (-3.98)
<i>First year in routine occupation was 1990s (n=14,247)</i>					
Union	0.01 (0.47)	0.22*** (5.83)	-0.17*** (-5.69)	-0.07** (-3.22)	-0.07* (-2.06)
<i>First year in routine occupation was 2000s (n=8,879)</i>					
Union	-0.02 (-0.41)	0.21*** (5.16)	-0.14*** (-3.83)	-0.05** (-2.85)	-0.08* (-2.40)

Note: Model includes individual, year, and state fixed effects. NR = Non-Routine. T-Scores in parentheses. Robust standards errors.

Table A2: Individual fixed effects estimates by education status

	NR Manual	Routine	NR Cognitive	Unemploye d	Low Income
<i>Low Education: High School Degree (n=43,331)</i>					
Union	0.01 (0.71)	0.11*** (6.53)	-0.07*** (-5.62)	-0.05*** (-5.37)	-0.05*** (-3.88)
<i>Medium Education: More than High School, No Bachelor's Degree (n=16,374)</i>					
Union	-0.02 (-0.82)	0.20*** (4.77)	-0.16*** (-4.87)	-0.03 (-1.46)	-0.08** (-3.15)
<i>High Education: College degree (n=7,370)</i>					
Union	0.01 (0.27)	0.24*** (4.36)	-0.24*** (-4.08)	0.01 (0.24)	-0.06 (-1.79)

Note: Model includes individual, year, and state fixed effects. NR = Non-Routine. T-Scores in parentheses. Robust standards errors.

Table A3: Individual fixed effects estimates by age group

	NR Manual	Routine	NR Cognitive	Unemploye d	Low Income
<i>Age 25-35 (n=26,045)</i>					
Union	0.00 (0.41)	0.17*** (10.00)	-0.14*** (-9.50)	-0.04*** (-4.70)	-0.04** (-2.80)
<i>Age 36-45 (n=25,235)</i>					
Union	-0.01 (-1.02)	0.14*** (5.20)	-0.10*** (-4.34)	-0.03 (-1.83)	-0.02 (-0.63)
<i>Age 46-55 (n=23,555)</i>					
Union	-0.02 (-0.59)	0.13** (2.58)	-0.09* (-2.26)	-0.01 (-0.86)	-0.02 (-0.56)
<i>Age 56-65 (n=16,259)</i>					
Union	-0.03 (-1.37)	0.18 (1.87)	-0.13 (-1.86)	-0.02 (-0.37)	-0.10 (-1.41)

Note: Model includes individual, year, and state fixed effects. NR = Non-Routine. T-Scores in parentheses. Robust standards errors.

Table A4: Individual fixed effects estimates by sex

	NR Manual	Routine	NR Cognitive	Unemploye d	Low Income
<i>Male (n=32,579)</i>					
Union	0.00 (0.45)	0.12*** (6.12)	-0.11*** (-6.79)	-0.02 (-1.52)	-0.05*** (-4.95)
<i>Female (n=34,469)</i>					
Union	-0.00 (-0.29)	0.15*** (6.51)	-0.09*** (-5.29)	-0.06*** (-4.77)	-0.06** (-3.00)

Note: Model includes individual, year, and state fixed effects. NR = Non-Routine. T-Scores in parentheses. Robust standards errors.

Table A5: Individual fixed effects estimates by race/ethnicity

	NR Manual	Routine	NR Cognitive	Unemploye d	Low Income
<i>Race/Ethnicity: White (n=38,685)</i>					
Union	0.00 (0.11)	0.13*** (7.57)	-0.10*** (-6.77)	-0.04*** (-4.68)	-0.06*** (-4.10)
<i>Race/Ethnicity: Black (n=24,739)</i>					
Union	-0.01 (-0.87)	0.16*** (5.36)	-0.11*** (-4.61)	-0.04* (-2.41)	-0.08*** (-3.43)
<i>Race/Ethnicity: Hispanic/Latino (n=3,125)</i>					
Union	0.02 (0.30)	0.12 (1.56)	-0.09 (-1.71)	-0.06 (-1.38)	-0.05 (-0.80)

Note: Model includes individual, year, and state fixed effects. NR = Non-Routine. T-Scores in parentheses. Robust standards errors.

Table A6: Balance in baseline characteristics of unionized and non-unionized workers in routine occupations

	Comparison group (no union); n=42,962		Treatment group (union), baseline; n=3,830		Matched comparison group (no union); n=42,962	
Variable	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
Ever Treated	0	0	1	0	0	0
Age 25-30	50.5%	0.7%	65.2%	1.7%	62.5%	0.7%
Age 31-40	23.4%	0.6%	23.5%	1.6%	24.6%	0.6%
Age 41-50	14.6%	0.5%	8.4%	1.0%	8.8%	0.4%
Age 51-60	9.4%	0.4%	2.5%	0.6%	3.5%	0.3%
Age 61+	2.2%	0.2%	0.3%	0.2%	0.6%	0.1%
Female	53.5%	0.7%	46.2%	1.8%	47.4%	0.7%
Low Education	58.0%	0.7%	66.9%	1.7%	65.3%	0.7%
High Education	16.2%	0.5%	7.9%	1.0%	9.2%	0.4%
White	80.5%	0.6%	68.8%	1.7%	68.6%	0.7%
Black	11.4%	0.5%	24.5%	1.6%	21.2%	0.6%
Hispanic	5.9%	0.3%	3.6%	0.7%	5.5%	0.3%
Low Income	19.3%	0.6%	21.0%	1.5%	20.6%	0.6%
Year	1994.2	0.1	1990.7	0.3	1990.8	0.1

Baseline year represents first observed year in which adult was employed in routine occupation.

Figure A1: Shared of adults in same occupation 10 years after first year in routine occupation, depending on whether unionized during routine; subcategories of routine occupations



Figure A2: Shared of adults in given occupation 10 years after first year in routine occupation, depending on whether unionized during routine; subcategories of non-routine cognitive occupations

