Collective Safety: The Impact of Right-to-Work Legislation on Workplace Injury Rates

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Abstract

I analyze the extent of the effect of Kentucky's 2017 right-to-work (RTW) legislation on injury rates, using workplace-level injury data from the Occupational Health and Safety Administration's Injury Tracking Application. The main specification uses a difference-in-differences model to estimate the causal impact of the RTW law on injuries and total days away from work at Kentucky workplaces, where Ohio is used as a control group. I also perform the same analysis on the sample of workplaces within the Cincinnati metropolitan area. The results suggest that the RTW law potentially reduced injury rates in Kentucky workplaces, thereby improving workplace safety. As a second avenue of analysis, I use a Blinder-Oaxaca decomposition to determine how much of the difference in injury rates is due to pretreatment level differences in workplace characteristics, namely workplace size and sector. These differences explain little variation in the differences in injury rates between Kentucky and Ohio.

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Introduction

In this paper, I estimate the extent of the effects of right-to-work (RTW) legislation on workplace safety outcomes. In 2017, Kentucky passed a RTW law, which forbids unions from requiring non-members to pay dues in order to take a job in the covered industry. The law's stated purpose is to prevent compulsory payment to unions, but, in effect, the law restricts the ability of unions to generate the funds necessary for operations. Using workplace-level panel data from OSHA's Injury Tracking Application (ITA), I examine changes in workplace injury rates before and after the implementation of the law in 2017.

Labor organization has played an integral part in labor force dynamics in Europe and the United States since the 19th century. Unions generally serve as a means for workers to exert control over labor supply decisions in a labor market, generating increased bargaining power when employers make hiring decisions. Unions often claim to help workers to attain better working conditions and compensation from employers, and much economic literature (e.g. Taylor, 1987; Reilly, Paci, & Holl, 1995; Morantz, 2013) has explored these claims in a number of different settings.

While modern labor movements developed first in Europe in the 19th century, organized labor efforts grew in popularity in the U.S. in the early 20th century during the depths of the Great Depression. This trend continued through World War II, and the national unionization rate peaked at 35.6 percent of private sector workers in 1953. However, due to fierce pushback from business interests in the political and legislative spheres, union membership has been on a slow but steady decline for the past 70 years. In 2019, only 6.2% of private sector workers were members of a labor union (Mishel, Rhinehart, and Windham, 2020).

While the effects of recent unionization efforts remain to be seen, unions have often been associated with higher wages and better employee benefits for their members (Fortin, Lemieux, & Lloyd, 2022; Dasgupta & Merchant, 2023). However, worker safety is another element which unions influence that gets relatively little attention in public discourse. Many unions, especially those representing workers in particularly dangerous industries, implement measures explicitly designed to improve worker safety. These include, but are not limited to, oversight committees, workplace safety advisors/consultants, training programs, and evaluations of gender and racial inequities within workplaces (United Food and Commercial Workers, 2024; UNITE HERE, 2024). Union representation could also theoretically improve safety standards indirectly. For example, workers in a collective bargaining agreement may feel that there is less risk of retribution from their employer if they report workplace safety violations or injuries (Boal, 2008; Morantz, 2013).

But does the presence of unions and their services in the economy really help improve workplace safety? I investigate this question using the implementation of a right-to-work (RTW) law in Kentucky as a treatment which restricts union activity in the state. I use difference-in-differences and Blinder-Oaxaca decomposition methods to explore the impact that this law has on workplace safety outcomes. Using Ohio (which has no RTW legislation) as a control group, I find no evidence that the RTW law increases injury rates; in fact, there is limited evidence that the law may *reduce* injury rates.

The paper proceeds as follows: Section 1 discusses the history of collective labor action in Ohio and Kentucky as well as the RTW legislation in question. Section 2 reviews the relevant literature on union effects, workplace safety, and RTW. Section 3 describes the data and provides

some preliminary analysis. Section 4 outlines the research methodology. Section 5 presents the results of the study. Section 6 concludes.

1. Ohio and Kentucky union history and RTW legislation

1.1 Kentucky and Ohio – Labor history

Union trends in both Ohio and Kentucky throughout the post-Civil War era have been largely representative of broader trends in U.S. labor organization. Workers and their union representatives have been in a constant back-and-forth struggle with business interests for legislative rights and legal protections. From the middle of the 19th century up until now, these battles have become more and more politically polarized: by the second half of the 20th century, Republicans were the primary and steadfast opponents of unionization efforts, while Democrats largely supported labor movements.

Ohio and Kentucky developed distinct economic identities throughout the 19th and 20th centuries, primarily due to their geography and natural resources. These identities helped to rapidly develop large communities of workers in particular trades which then coalesced into labor organizations. Kentucky is in the heart of the coal-rich Appalachian mountain region, and the boom in mining work brought on by industrialization led to large influxes of immigrants and poorer Americans to Kentucky's major cities, such as Louisville (Hennen, 2015). The coal industry, partly because of its economic prominence around the turn of the 20th century, was one of the first with serious labor organization efforts. In Ohio, because of its easy access to the Ohio river to ship merchandise and equipment to other regions, manufacturing developed as its

primary economic capacity. Primitive labor unions emerged in cities like Cleveland as early as the 1830's, suggesting that disputes between workers and employers proliferated even then. In 1877, large swaths of the working class in Ohio and Kentucky organized under the newly forming inter-state unions of tradespeople, such as the Knights of Labor. In some cases, workers in Ohio and Kentucky were represented by the same entity (Harrison, 2024).

Labor agitation quickly followed these developments. In Ohio, strikes and collective bargaining date back to at least the 1850's among urban workers, but these activities became more frequent as the regional economy expanded. The first major workers' strike in Kentucky took place in 1877. Earlier the same year, the so-called Great Railroad Strike began in West Virginia, in response to wage cuts for railroad workers. What began as a strike amongst workers in a single railyard quickly spread throughout the northeast and midwestern United States, including shipping hubs in Kentucky and Ohio. This was the most disruptive strike in American history up to that point: as much as 50 percent of U.S. rail networks were paralyzed during the strike (Adamczyk, 2024). Many of the workers who participated later organized into the United Mine Workers of America, which became the largest union representing mine workers in the country. Labor strikes have continued throughout Ohio and Kentucky ever since, underscoring a complicated history of the competing interests of labor and business. Perhaps most infamous are the strikes in Harlan County, Kentucky in the 1930's. Harlan County, in the heart of mining country, had many large coalfields owned by wealthy landowners. When miners' pay was cut to raise profitability, workers began strikes that endured for the next decade. Many of the altercations during this time became violent, and this event became known as the Harlan County War (Hennen, 2015).

The middle of the 20th century, however, was a period of great legislative victories for labor advocates. Up until World War I, U.S. legislation was firmly supportive of business interests. Legal precedents set in lawsuits such as *Hitchman Coal Company vs. Mitchell* (1917) gave companies great flexibility in the methods they used to disrupt labor organization. Employers were permitted to deny workers employment if they chose to unionize, disrupt bargaining efforts, and engage in other aggressive union-busting tactics. The tides turned less than two decades later, however. During the Great Depression, when workers were particularly vulnerable to employment shocks, the National Industrial Recovery Act was passed in 1933 under Franklin D. Roosevelt's administration. The Act established the formal right of workers to collectively bargain and unionize without fear of employer retaliation. The law also enabled the executive branch to set working hours, pay, and production quotas, which protected workers from overwork in many instances (National Archives, 2022). The law inspired a renewed push for labor organization in American industry. This extra pressure forced coalfield owners in Kentucky, for example, to come to the table to discuss increased benefits and protections for their employees.

The jewel in the crown of the 20th century labor movement, however, is the National Labor Relations Act of 1935. This established the National Labor Relations Board, which set new standards for officiating union petitions and elections in the workplace; the NLRB continues to facilitate unionization efforts at the workplace level today. These legislative gains further encouraged unionization efforts. Major labor organizations, such as the Congress of Industrial Organizations, appeared shortly after the act was passed. In Kentucky, labor unions and state democratic legislators created and passed a state-level equivalent of the NLRA shortly before World War II, further ensuring the rights of workers to organize. While unionization rates would

remain strong through the 1970's, union influence in Kentucky was perhaps strongest in the period surrounding World War II (Hennen 2015). Ohio enjoyed much the same ascendance of union power due to these large macroeconomic and legislative changes.

It was not long before the legislative tides shifted, however. The Taft-Hartley Act, passed in 1947 over the veto of President Harry Truman, gave businesses the legal right to use several methods to discourage or outright block labor organization. The bill arose from conservative fears that workers in the post-war era would be emboldened by the hotly growing economy to push for further concessions from their employers. Taft-Hartley gave businesses the right to interfere in elections and force employees to sit through anti-union meetings. Unions were no longer allowed to have "closed shop" provisions, which prevented non-union workers from being employed at a workplace. Unions were also no longer allowed to garnish employees' wages directly in order to pay for dues and operations. The longest-lasting and most pervasive impact of the legislation was setting the legal precedent for RTW laws. Taft-Hartley gives states the power to outlaw mandatory union fees for workers in the state. This has severely diminished the fundraising capabilities of unions in states where laws have been put into place, and is a major reason why unionization rates have weakened since the 1950's (Mishel, Rhinehart, & Windham 2020).

While Taft-Hartley was a major blow to union power, several other aspects of the modern economy have weakened the union environment. Globalization has created international competition in energy and manufacturing with workers who demand much less in terms of wage premiums and benefits (Harrison, 2024). Additionally, increased consolidation of business entities has created firms with large cash reserves. When labor disputes emerge, these large firms have far more resources for legal and workplace battles than most unions. Both of these factors

have negatively impacted the working class in Kentucky and Ohio, from fewer jobs to lower wages and decreased benefits (Shkurti and Stewart, 2018; Hennen, 2015).

National support for unions has also waned. After WWI, the far-left political leanings of many labor movements aroused suspicions of communist infiltration. These factions diverged from more moderate and mainstream union movements in their philosophies and goals for labor. The moderate wing won out in the public eye, but their numbers had been diminished by considerable infighting (Devinatz 2008). Finally, many people grew content with current wages, and thus it became more difficult to mobilize workers to stand on the picket lines. Modern business practices have appeased workers by changing dynamics between employees and supervisors. For example, professional development and teamwork are increasingly emphasized, giving workers the sense that bosses are more invested in the workers' personal well-being than in previous generations. Nevertheless, the increasing need for efficiency to remain competitive in industries like manufacturing has led many factories to push the boundaries of workplace safety standards (Hennen 2015).

1.2 Modern day political and economic environment

Since the COVID-19 pandemic, interest in unionization has surged in the U.S. Public approval of unions has reached its highest level (68%) in the past four years since 1965 (Elias and Lucas, 2022). Actual union activity seems to match these attitudes: in the first half of 2022, petitions for union elections in individual workplaces increased 57% compared to the same time in 2021 (National Labor Relations Board, 2022). This uptick reflects general workplace-level trends nationwide, but several high-profile cases, such as Amazon warehouses and Starbucks

franchises, have captured significant media attention recently as examples of workers resisting union-busting pressures from corporations and forming collective bargaining units.

Renewed American interest in unions largely stems from a mix of widespread economic troubles which have plagued the United States for decades. The COVID-19 pandemic has only exacerbated many of these issues. For one, uncertainty about the future of many of America's once-dominant industries has grown since the Cold War. The manufacturing sector, once the backbone of the American economy and one of the most heavily unionized sectors, has been gutted in the past 40 years. Almost seven million U.S. manufacturing jobs have been lost between 1979 and 2019 (Harris, 2020). While there are many factors at play, this decline seems to be caused in part by increased globalization and a failure to adapt and invest in new technologies such as renewable energy and semiconductor production. In photovoltaics, for example, US innovations have been quickly adopted by manufacturers in China, which is now the world's leading producer of solar energy and solar energy products (Joint Economic Committee, 2021).

Growing inequality has also created vast discontent among large swaths of the population. According to the Gini index, a standard measure of inequality, the wealth disparity between the richest and poorest Americans has grown over 19 percent from 1980 to 2019. By the numbers, the U.S. is in its most unequal period since measurements began (World Bank, 2024). As workers faced greater health risks from the pandemic and unemployment soared, corporations earned record profits. Government benefits and low interest rates helped push corporate profit margins above 19 percent 2021; profits would remain elevated several quarters after. This effect was greatest for the largest publicly traded companies (Palazzo, 2023).

As for the process of unionizing, the political environment has become more hostile. Following the momentous union victory that was the National Labor Relations Act of 1935, all federal legislation related to labor organization has served to make it more difficult for workers to organize and hold union elections. All efforts to bolster worker protections have been stifled in congressional proceedings. Beginning in the 1970's, companies adopted more aggressive anti-union stances, sometimes coming in conflict with labor relations law. The 1970's and 1980's saw large increases in the number of reports of corporate legal infractions against unionizing activities. This statistic is merely indicative of a broader pattern of behavior that included threatened plant closures, anti-union hiring practices, and lobbying for the further erosion of bargaining rights (Mishel, Rhinehart, & Windham, 2020).

Figure 1 shows trends in the unionization rate, or the fraction of workers who were represented by a union, in Ohio and Kentucky from 1983 to 2022. Prior to 2017, Kentucky's unionization rate closely followed the national average unionization rate, which at that point had declined to roughly 10 percent (Bureau of Labor Statistics, 2024). From 1983 to 2021, Kentucky's unionization has been more than halved, from 17 percent of workers to just 7.2. The unionization rate in Kentucky has remained depressed, with a nearly three percentage point difference relative to the national average (10 percent vs 7.5). The rate in Kentucky has remained between seven and eight percent since 2020.

Ohio has traditionally had a higher unionization rate than Kentucky. In 1983, 25 percent of workers were members of a union. This number has declined, sitting at 12.5 percent in 2023, which is still higher than the national average of 10 percent (Bureau of Labor Statistics, 2024).

There is notable heterogeneity in union membership trends between sectors. Figures 2 and 3 show the unionization rate by sector for Kentucky and Ohio, respectively. It is immediately

clear from both graphs that the construction and manufacturing sectors have a higher percentage of unionized workers than other private sectors. Although manufacturing once had the highest percentage of unionized workers, the unionization rate in this sector has declined sharply and is now at or below construction sector rate in both states. The disparities in these trends are likely determined by industry-specific anti-union efforts. Unions tend to represent only within a certain industry, so the strategies they employ are a source of heterogeneity in labor trends. Future research could explore the efficacy of different collective bargaining strategies on unionization and economic outcomes.

The political environment surrounding labor movements in both states has been remarkably similar. Unions in Kentucky and Ohio, often linked to national labor organizations and influenced by the same major federal policies, were divided along familiar party lines: unions frequently allied with Democrats in the 20th century to make legislative gains, while Republicans and business interests sought to maintain the status quo. One major difference is in the composition of the state legislatures. Whereas Kentucky's House of Representatives has historically leaned Democratic, Republicans have long held a majority in both the House and Senate in Ohio (Ohio Secretary of State, 2010; Hennen, 2015).

The Ohio state legislature has made attempts in recent years to enact anti-union legislation. In 2011, Ohio republican lawmakers introduced SB5, a measure which would give workers the right to opt out of paying union dues. The bill, which is effectively similar to RTW legislation around the country, was repealed in a special referendum (Ohio House, 2010). Nevertheless, this bill, along with separate attempts by lawmakers to pass RTW laws in the state, indicate that present-day opposition to unions is significant and influential. Ohio and Kentucky

are experiencing parallel political conflicts surrounding the union debate. Where Ohio has yet to introduce a durable piece of RTW legislation, Kentucky has succeeded.

Significant state-level political shifts in recent years created the opportunity for a new RTW law in Kentucky. The bill was passed in 2017, which is the first time in state history that Republicans have held both the state senate and house of representatives. Matt Bevin, the acting governor, was also Republican, and campaigned on a platform advocating for RTW legislation (Barton, 2017). The RTW law is the culmination of decades of opposition to unions from Republican politicians: similar legislation had been proposed many times since Taft-Hartley in 1947, and several lobbying groups have funded efforts to establish a RTW law in Kentucky. To the extent that these politicians represent the will of the electorate, the new Republican majority and the success of the RTW bill may signal changing attitudes towards unions in Kentucky. These attitudes could have an exogenous effect on unionization, in excess of the law's implications for union funding. Future research may explore public perceptions of unions surrounding major legislative changes.

2. Literature review

This paper is closely tied to existing economic literature on both the effects of unionization on workplace injury rates and the impacts of right-to-work (RTW) legislation on unionization. Following conventional labor theory and explanations proposed by several other studies, researchers expect that unionization reduces the number and likelihood of occupational injuries. However, the empirical evidence is conflicting.

The literature offers several theories explaining the presence – or expectation – of negative associations between union status and injury rates. Gillen et al. (2002) demonstrates the value of unions as workplace educators: in a survey of construction workers, those who were members of unions were far more likely to understand potential hazards in the workplace and appropriate ways to mitigate risk. Other proposed channels include advocacy for legislation protecting workers (Taylor, 1987; Donado, 2015), protection for whistleblowers (Donado, 2015), and improving the ability to pressure firms to improve safety infrastructure through collective action (Li et al., 2020). Another crucial element of union presence is general oversight. Time and time again, frequent inspection of workplace conditions by oversight committees, whether governmental or union-appointed, has been associated with lower rates of injuries (Reilly, Paci, and Holl, 1995; Eaton and Nocerino, 2002; Gray and Mendeloff, 2005).

2.1 Unionization and workplace safety outcomes

The existing literature on workplace safety is small, but the findings from these studies are rather diverse. A number of studies focus on specific, often highly injurious, industries when examining the link between unionization and workplace safety. Two papers (Boal, 2008; Morantz, 2013) use the United States coal industry as a case study for the effects of unionization on workplace injury rates. Looking at coal miners has several advantages. First, focusing on a single industry reduces heterogeneity in the types of work being surveyed, so any difference in injury rates is more likely to be due to the organizational characteristics of individual mines. Secondly, coal mining is a notoriously dangerous industry. In 2010, fatal injury rates in coal mines were six times higher than that of general private sector jobs, and nonfatal injury rates were 13 percent higher (Bureau

of Labor Statistics, 2010). We might therefore anticipate that the effects of unionization on workplace injury, if present, will be larger in absolute magnitude for the coal industry than for other, relatively safer sectors.

Boal (2008) focuses on US coal mines in the late 19th and early 20th centuries to examine whether or not unionized mines had significantly different injury rates from nonunion mines. The author combines injury data from the US Bureau of Mines, mine activity data from US Geological Survey, and mine-level unionization data assembled by the author himself in an earlier paper. The end result is a panel data set of United States mines and their annual injury rates. Using count data regression models, Boal predicts mine-level injury rates using union status and other mine characteristics. He finds that there is up to a 40 percent lower injury rate for unionized mines, and this result is unaffected by the addition of state-level controls. This is one of the strongest findings in favor of workplace unionization in the literature.

Similarly, Morantz (2013) examines the effects of union presence on workplace safety in the coal industry, instead considering the period 1993-2010. She uses more comprehensive data from the Miners' Safety and Health Administration (MSHA), which has quarterly mine-level data on all injuries that occur within mines from 1993 to 2010. This is combined with data on whether or not mines are unionized from the Energy Information Administration (EIA), which is a subsidiary of the Department of Energy. The author uses several negative binomial regression models to predict the different types of injuries. Her results show decreased fatal injuries among unionized mines, but more nonfatal injuries, potentially due to improved reporting standards. This effect is absent for fatal injuries presumably because they are much more difficult for nonunion mines to conceal. In the future, more detailed data may be available which enables

researchers to separate these effects, but doing so with workplace-level data, for example, is likely unfeasible.

Results from papers looking at industries other than coal mining are far more scattered and, often, less statistically significant. U.S. unions consistently emphasize workplace safety in their public communications and activities. These organizations procure protective equipment, negotiate for shorter shifts and breaks for workers, and establish workplace oversight committees. Unions may also channel their resources into political activities at local, state, and federal levels to advocate for legislative changes favorable to workers (United Food and Commercial Workers, 2024; Feigenbaum, Hertel-Hernandez and Williamson, 2018). One may therefore expect the association between unionization and injury rates to be significantly negative. However, this is not always the case. Few papers, for example Taylor (1987) and Litwin (2000), report these negative associations, while others find positive associations between unionization and workplace injury (Fenn and Ashby, 2004; Donado, 2015).

Taylor (1987) obtains annual industry-level data on workplace injuries and illnesses, as well as the number of workers in these industries and the number of total workers in a year that are covered by a collective bargaining agreement, from the U.S. Department of Labor (DOL). The data are annual survey observations between 1975 and 1983, and the covered industries primarily represent manufacturing, natural resources, and communications. The paper relies solely on correlation analysis, demonstrating negative associations between estimated union numbers in a given industry and that industry's injury rate. This study, while pioneering on the topic, is unable to propose a model to predict injury rates based on industry characteristics, or to establish any claim of causality.

A more comprehensive model appears in Litwin (2000), which finds a similar association between unionization and injury rates at the workplace level in the United Kingdom. The paper is a cross-sectional analysis of British workplaces using the 1998 Workplace Employee Relations Survey. The data show a positive association between union status and injury rates for workplaces without any reported injuries (that is, a higher injury likelihood), while union presence decreases injury rates for firms already experiencing occupational injuries. Litwin hypothesizes that unions flock to injury-prone workplaces in an effort to mitigate workplace hazards, and thus their effect is more pronounced on more dangerous workplaces. While the model explains a large amount (>30 percent) of the variation in injury rates among workplaces in the data set, this analysis is merely cross-sectional and does not observe trends in injury rates. It is impossible, therefore, to assess how the impact of union presence affects workplace safety over time.

Li et al. (2020) similarly finds limited evidence of a negative association between unionization and injury rates. The authors employ a unique method to analyze the effects of unionization on injury rates: firm union elections. The authors use union election results from National Labor Relations Board (NLRB) and workplace-level injury data from OSHA's Data Initiative (ODI) – a precursor to the Injury Tracking Application (ITA) data used in this paper – to examine injury rates for firms which had barely successful or unsuccessful votes to unionize. The identifying assumption is that firms around the successful vote cutoff will be very similar, and thus the firms with unsuccessful votes will serve as an adequate control. Using a regression discontinuity model, the authors find no detectable difference in injury rates for unionized and non-unionized firms.

Studies such as Fenn and Ashby (2004) and Donado (2015) contradict the above results and find positive associations. Donado (2015) acknowledges a wealth of related research demonstrating positive associations and attempts to use individual-level data to find lower magnitude, or perhaps negative, results in his regressions. The author uses the 1979 National Longitudinal Survey of Youth (NLSY79) to study workers who were between the ages of 23 and 44 at the time of analysis (the NLSY79 followed the same respondents for many years). The survey asks respondents questions about their employment, health, and history of injuries, among many other topics. The respondents were surveyed every year up until 1994, at which point surveys were conducted every two years. This paper is the only one which uses person-year data, which avoids entirely the challenge of using industry averages to extrapolate out causal relationships. While the relationship between union status and individual workplace injuries is positive in this paper, the introduction of individual fixed effects diminishes the relationship to an insignificant, near-zero estimate. This suggests that there are personal risk factors, potentially correlated with union membership, which previous studies failed to address in their analysis.

2.2 Right-to-work and unionization

The literature on RTW laws is more robust than studies of unionization and injury rates. Since RTW laws generally weaken unions by constraining their fundraising capabilities, researchers are able to approach analysis of the laws' effects from many angles. Dasgupta and Merchant (2023) study the relationship between the passage of RTW laws and the financial wellbeing and economic performance of residents in those states. Using annual individual earnings and employment data from the Current Population Survey (CPS), the authors conduct an event study

centering on six different states which passed RTW laws after 2000 (the counterfactual is, of course, states which have never implemented such a law). This initial test shows significantly higher employment yet lower earnings for workers in RTW states, on average, as well as lower unionization rates. The paper also includes a difference-in-differences model using individual data from the Survey of Household Economics and Decisionmaking (SHED) tracking financial security and job milestones such as getting hired, getting a promotion, etc. SHED data shows again that RTW states have lower union membership, and unionized workers are more likely to receive a promotion, stay at their current job, and have firm-sponsored health insurance. The breadth of the questions in the SHED survey demonstrate the multifaceted impacts of unionization and, by contrast, right-to-work legislation on workers.

Previously, Fortin, Lemieux, and Lloyd (2022) employed a similar set of methodologies to explore the potentially causal relationship between right-to-work laws and wages. The authors study the universe of RTW law passage from 2003 to 2019 in all 50 states using CPS microdata tables. In particular, they examine the effects of RTW laws on average hourly wages in the CPS outgoing rotation groups. Much like Dasgupta and Merchant (2023), the authors use both event study and difference-in-differences designs to find that RTW laws have significant, negative effects on both wages and unionization rates. These effects are heterogeneous across industries: the difference-in-differences design considers differential treatment based on the preexisting unionization rates by industry and finds that more thoroughly unionized industries experience larger declines in unionization after RTW laws are passed than industries with lower initial rates. Using RTW as an instrument for predicting the effect of union membership on wages, they find a larger significant effect of RTW on wages. However, economic theory suggests that potential

spillover effects of RTW passing on wages may complicate this method by violating critical IV exogeneity assumptions.

A few papers consider the political effects of these laws. Feigenbaum, Hertel-Hernandez and Williamson (2018), for example, examine the impact of RTW on voting outcomes. They employ a difference-in-differences strategy on counties straddling state boundaries between RTW and non-RTW states, for all states which passed RTW laws from 1980 to 2016. The data at the county-year level are drawn from Congressional Quarterly Elections data and the US Elections Atlas, providing voting shares for presidential, gubernatorial, and federal congressional races. RTW laws are associated with poorer performance for democratic candidates and fewer working-class members of state legislatures. Unions also experience decreases in funding after the introduction of RTW. The authors hypothesize that these disparities influence labor outcomes and policy making within states, and thus contribute to differences in wages across states.

Zullo (2011) is the study most similar in structure and scope to the research in this paper. This paper is the one of very few, if not the only, studies sitting at the intersection of RTW laws, unionization, and workplace safety. Zullo leverages state-level construction industry fatality data from the Bureau of Labor Statistics (BLS), the DOL, and the Census of Fatal Occupational Injuries (CFOI), from 2001 to 2009. Since this study only considers fatalities in the construction industry, the unit of observation is the state-year. In the multivariate OLS model, union density and the RTW status of a given state are independent variables used to predict the fatality rates, along with a number of controls. Union density is shown to be significantly negatively associated with fatalities, but this effect is not present in RTW states. The author theorizes that RTW laws severely diminish union influence, thus muting their effect on construction fatality.

While a strong finding in the literature, the small sample size and few controls raise the question of whether or not these results would hold at a different level of observation.

In the spirit of evaluating the same questions as Zullo (2011), this thesis advances the literature in a few important ways. First, the ITA data provide greater detail which allows for more avenues of analysis. The data are more granular, giving workplace-level measurements of annual injury rates instead of state-level. This data also include a measure of the total annual days away from work which is of economic significance – we might expect that injuries cause workers to stay home, and this could have impacts on the economic performance of the workplace. Third, by isolating a single RTW law and two bordering states in a difference-in-differences model, we are able to more effectively control for other unobserved predictors of injury rates. Within Ohio and Kentucky, we observe (and can control for) a number of different sectors and firm sizes, all of which have been demonstrated in earlier studies to have a significant impact on injury rates in their own right.

3. Data

3.1 Dataset creation and analysis

For data on workplace safety outcomes. I use injury data from Occupational Health and Safety Administration's Injury Tracking Application (OSHA ITA). The ITA is a web interface that qualifying establishments must use to log their work-related injuries for a given year. Not all U.S. establishments are required to report; for example, workplaces with fewer than 19 workers that year, as well as workplaces in industries such as retail, financial services, and tech, are

generally not required to report their injury data. Conversely, workplaces in certain industries are required to report injuries, regardless of size. These industries include ones considered to be highly dangerous, such as construction, manufacturing, and food processing. Thus, the dataset is more representative of certain industries than others, but the required industries are of greater interest due to generally higher rates of both injury and unionization. The end result is establishment-level data on the workplace size, number of injuries (broken into several types e.g. respiratory, poisonings, etc.), industry (expressed in NAICS codes), and detailed information on location.

For data on unionization rates, I use data collected and presented in Macpherson and Hirsch (2023). The data are part of a project at unionstats.com, where the authors aggregate data from annual Current Population Survey reports to create state- and industry-level measurements of unionization rates. Specifically, I use their state-level unionization data which is broken down into four "sectors": Public, Private Construction, Private Manufacturing, and Private (excluding construction and manufacturing). Put simply, the data include annual observations for each sector in each state, from the year 1983 to 2022. The authors of the dataset construct unionization rates as the ratio of workers who are members of a labor union over the total number of workers in a given state and sector. They also calculate the percentage of workers who are "covered" by a collective bargaining agreement, which is a slightly more inclusive yet analogous measure of the prevalence of labor organization (see figure A1 for a comparison of membership and coverage in the dataset).

The final analysis data combines OSHA ITA data and unionization data by merging on the sector, state, and year of the workplace observation, where the sector is found by assigning each NAICS code in the data set to one of the four sectors in the union data (see table A1 for the

exact mapping of NAICS codes to sectors). The result is data at the workplace-year level on both the characteristics and injuries of the workplace as well as the unionization rate of their sector in the same state and year. Although the RTW law in Kentucky applies to both private and public workplaces, there are no public workplaces in Ohio in the ITA dataset. Public sector workplaces are omitted from the analysis dataset entirely for ease of comparison. This change only removes 15 Kentucky workplaces from the dataset, leaving 620 workplaces in the treatment group for the final analysis.

Table 1 presents summary statistics of the variables used in the main analysis. Several of the measures, such as total injuries and days away from work, are severely right-skewed. This indicates the need to consider log-form regressions to reduce the influence of high leverage data points (i.e. extremely large workplaces with high total injuries and days away from work). Roughly 60 percent of workplaces are private non-manufacturing/non-construction. Another 30 percent are in manufacturing, and the remaining 10 percent are in construction.

Figures 4 and 5 show the composition of workplaces by sector and size in Kentucky and Ohio, respectively. Sizes 1, 2, and 3 correspond to workplaces with annual employee counts totalling one to 19, 20 to 249, and 250 or more, respectively. It is important to note that there are far more Ohio workplaces in the dataset than Kentucky workplaces, 1,848 versus 620. A majority of workplaces in both Ohio and Kentucky are in the private category, with private manufacturing being the next largest sector. In both states, the vast majority of workplaces have between 20 and 249 employees (medium-size), and there are more large (250 employees or more) workplaces than small (fewer than 20).

Figure 6 graphs the average injuries-per-worker in Kentucky and Ohio for the years 2016 to 2022. The vertical dashed line indicates 2017, which is the time of RTW implementation. The

average per-worker injury rate in Kentucky is higher across the entire period of the study. However, following the enactment of the law, injury rates in the two states diverge even further: the greatest annual difference in injuries-per-worker is in 2018, with 0.049 injuries-per-worker in Kentucky compared with 0.035 in Ohio. From 2018 onwards, the average injury rate in Kentucky falls sharply to below 0.035 injuries-per-worker, and Kentucky and Ohio seem to follow a similar trend between 2020 and 2023. The spike immediately following the RTW law is a potential sign of the law's exogenous effect on injury rates in Kentucky, and further analysis is needed.

There is significant heterogeneity in injury rates for workplaces in different sectors. Table 2 breaks down injuries-per-worker by the state, sector, and size of the workplace. It is clear that Kentucky workplaces have consistently higher injury rates per-worker than their Ohio counterparts. Interestingly, the highest per-worker injury rates appear to be in establishments with between 20 and 250 annual employees, and, in the manufacturing sector, injury rates are highest for firms with fewer than 20 employees. The data support similar findings in other studies in the literature, which find that larger workplaces are associated with lower injury rates (Fenn and Ashby, 2004).

3.2 Cincinnati MSA description

To further alleviate concerns of differences between the treatment and control groups, a second sample is constructed of only the workplaces in the Cincinnati region. Cincinnati, Ohio lies on the border of Ohio and Kentucky, and the city has very strong economic and demographic ties to the neighboring cities in Kentucky (Stone, 2014). Thus, the greater Cincinnati area comprises the

nearby counties in Kentucky. This distinction is recognized by the U.S. Census Bureau, which reports economic characteristics for the greater Cincinnati Metropolitan Statistical Area (MSA). The MSA includes counties in Ohio, Kentucky, and Indiana. By focusing on the five Ohio counties (Butler, Warren, Hamilton, Clermon, Brown) and the seven Kentucky counties (Boone, Kenton, Campbell, Gallatin, Grant, Pendleton, Bracken) in the MSA, it is much easier to argue that workplaces in the control group are highly similar to workplaces in the treated group. This improves the causal claim that any difference in injury rates in Kentucky and Ohio after the RTW law is passed is due to the legislation. The "contiguous counties" strategy is employed in a number of studies to create effective control groups (Feigenbaum, Hertel-Hernandez, and Williamson, 2019; Dube, Lester, and Reich, 2010).

Table 3 presents summary statistics for this subsample of the variables used in the main analysis. As with the main sample, average employees, total hours worked, and the measures of injury are heavily right-skewed due to large outlier values. A slightly larger share of the workplaces in the MSA are in construction compared to the full sample, 13 percent versus 10 percent.

Figures 7 and 8 show the composition of workplaces by sector and size in Kentucky and Ohio, respectively. Much like the full sample, there are far more workplaces in Ohio than in Kentucky within the Cincinnati MSA, 216 versus 65. The majority of firms have between 20 and 249 annual employees, and there are more large firms than small firms in all but Kentucky's private sector. In both states, the manufacturing sector represents a greater share of all workplaces than construction.

Figure 9 graphs the average injuries-per-worker in Kentucky and Ohio within the MSA for the years 2016 to 2022. The most notable difference is that injuries-per-worker increases in

Ohio following the passage of the RTW law, whereas it did not rise for the full sample. Additionally, injury rates between the two states are much closer from 2019 to 2022 than they are in the full sample. Both of these results lower the likelihood of finding a positive and significant difference-in-differences estimate.

Table 4 presents injuries-per-worker by the state, sector, and size of the establishment for the Cincinnati MSA. In Kentucky, the manufacturing industry is the most dangerous, with approximately 0.05 injuries-per-worker compared to 0.04 in private and 0.018 in construction. By contrast, injury rates are much more even across sectors in Ohio. Relative to other sizes, injury rates are higher for large construction and private sector firms in both states, but injury rates tend to be lower for large manufacturing workplaces. These contradict the statistics from the full sample, which suggested that mid-sized firms are the most dangerous across the board.

4. Methodology

The primary methodology will employ a difference-in-differences (DD) strategy to assess the impact of Kentucky's 2017 RTW law. This strategy is common among studies analyzing the impact of RTW laws in the U.S. (Dasgupta and Merchant, 2023; Fortin, Lemieux, and Lloyd, 2022; Farber, 1983; Feigenbaum, Hertel-Hernandez, and Williamson, 2019). The interest lies in estimating the difference in average injury rates between firms in Kentucky and Ohio, before and after the 2017 law took effect. The model takes the form:

$$I_{it} = \beta_0 + \beta_1 S_i + \beta_2 T_t + \beta_3 (S_i * T_t) + \beta_4 X_{it} + \beta_5 PC_i + \beta_6 PM_i + \epsilon_{it}$$

where I_{it} represents the injury rate or days away from work for establishment *i* in time *t*, S_i is a dummy representing whether or not establishment *i* is in Kentucky, T_t is a dummy representing whether or not the observation comes after the RTW law, X_{it} is the number of average annual employees at workplace *i* in year *t*, PC_i is a dummy for whether or not the workplace is in the private construction sector, and PM_i is a dummy for whether or not the workplace is in the private manufacturing sector (the private sector dummy is omitted). The main variable of interest is the interaction term between the state and time dummies, as this will estimate the impact of the RTW legislation on injuries in excess of any underlying difference between Ohio and Kentucky.

The identifying assumption is that, absent the RTW law, injury rates in Ohio and Kentucky would have followed the same pattern. While the ITA database does not have data before 2016 to analyze pre-RTW trends in injuries, there are reasons to believe that Ohio and Kentucky are similar enough for comparison. First, the unionization rate, which is a proxy measure of union strength since it bolsters a union's collective bargaining power, evolved similarly in Kentucky and Ohio from 1983 (Figure 1). Ohio's unionization rate is consistently higher, but this difference does not change noticeably until shortly before the RTW law was implemented. Secondly, the proximity of the states means that they share economic and geographic characteristics, such as trading partners and natural resource endowments.

To supplement the difference-in-differences analysis, this paper will also use a Blinder-Oaxaca decomposition (BO) to assess the effects of pretreatment differences in workplace characteristics between Ohio and Kentucky on the overall difference in injury rates between the two states. The overall explained variation in injury rates is the variation attributed to differences in, for example, the size of workplaces between the treatment and control groups.

Assuming that there are no omitted controls which also influence injury rates, the remaining unexplained variation is due to differences in the effects of these controls on the injury rates across states. Thus, we are able to see if the RTW law changes how factors such as the size and sector of a workplace influence workplace injury. This method is often used with individual-level data to find evidence of wage discrimination by controlling for other preexisting factors such as race, gender, and education (e.g Oaxaca, 1973). Using workplace level data in this method is unique to the literature on workplace safety and unionization.

For this particular model, the differences used will be calculated by subtracting the means and coefficients of a given predictor for the control group (Ohio) from those of the treatment group (Kentucky). The independent variable of interest will be the log of total annual injuries for a workplace.

5. Results

5.1 Difference-in-differences estimation

Table 5 shows results of the regression with the log of total injuries as the dependent variable. The coefficients of the preferred specification, with controls for workplace sector (private non-manufacturing and non-construction dummy omitted) and the log of average employee count, is shown in column three. The results are somewhat contrary to expectations: while the coefficients on the Kentucky and post-2017 dummies are positive and highly significant, the coefficient on their interaction term is significantly negative. All else being equal, being in Kentucky after the RTW law is associated with an approximately 28.7 percent *lower* average

workplace injury rate than being in Ohio after the RTW law. The magnitude of the coefficient decreases slightly when controlling for the number of employees, but the result is still highly significant. The model also reports, interestingly, that workplaces in the construction sector have significantly lower average injury rates than other private sector workplaces, all else being equal. F-tests of the joint significance of the variables shows that the state dummy and DD term are jointly significant (p-value: 0.015), while the treatment dummy and DD term are highly statistically insignificant (p-value: 0.682). All three regressors are highly jointly significant (p-value: 0.0051).

Table 6 gives the results of the same model, now using the log of days away from work as the dependent variable. These results confirm the findings of the injuries model. Being in Kentucky across the time period and operating after the RTW law is passed are both associated with higher injury rates, but DD estimator is significantly negative. In fact, the relative decrease in days away from work for Kentucky compared to Ohio is greater than the impact on injuries (28.7 vs. 38.7 percent). This estimate may capture the effects of other workplace policy changes which could restrict days away from work, such as less generous sick leave or workers compensation. Nevertheless, these results certainly do not suggest that the RTW has led to an increase in injuries. The same F-tests used for the total injuries model reveal that no combination of the main regressors of interest are jointly significant.

Tables 7 and 8 present results for the Cincinnati MSA. For total injuries, the coefficients are categorically identical to those for the statewide model. The DD estimator suggests that, all else being equal, injury rates for Kentucky workplaces after the RTW law is implemented is, on average, 42.4 percent lower than for Ohio workplaces in the same time period. This estimate is markedly larger than those for the statewide model. It is also worth noting that the model does

not find a significant difference in injury rates between sectors. The regression for total days away from work, however, does not find significant estimates for the state dummy or the DD estimator. The post-treatment period still experiences significantly higher days away from work. In both regressions, the state, time, and DD dummies are highly jointly statistically significant (p-value: 0.008 for total injuries, 0.047 for total days away from work).

5.2 Blinder-Oaxaca decomposition estimation

Figure 10 presents the level of explained and unexplained difference in each year for the BO decomposition model. The negative coefficients on the unexplained variation imply that size and sector of a workplace have a larger impact on injury rates in Kentucky than in Ohio (i.e. there is a difference in magnitude between the coefficients of a regression of log total injuries on size and sector when done for Ohio and Kentucky separately). If the RTW law actually changes the safety of work environments in Kentucky, we should expect to see an increase in the coefficients of unexplained variation. Although the unexplained variation increases modestly after the RTW law is implemented, the result becomes attenuated from 2019 onwards. The explained variation, or that which is due to initial differences in the sizes and sectors of workplaces in the treatment and control groups, is relatively small. Estimates of the impact of explained variation on overall differences in injury rates are insignificant for every analysis year except for 2022. However, this is largely due to the drastically decreased difference in injury rates over time; the overall difference declined in magnitude from -0.12 in 2016 to -0.03 in 2022.

Overall, these findings certainly suggest that the Kentucky RTW law has not worsened workplace safety. Workplaces in Kentucky may actually be safer after the passage of the law.

The relevant literature offers several potential theories for this positive association. For one, the weakened union presence following RTW law passage may lead to fewer *reported* injuries in Kentucky, even if the actual number of injuries has remained constant or increased (Li et al., 2022). Additionally, the lower union presence may reduce wage premiums for Kentucky workers. This could allow for employers to devote more funding to creating a safer workplace (Donado, 2015).

6. Conclusion

While this research adds to the literature by considering injuries at a workplace level for different industries and time periods, there are several potential avenues for further exploration. More detailed workplace-level data may become available in the future which would allow for more controls in the DD methodology. If other states implement or repeal RTW laws in the future, the ITA database would be better able to analyze pre-trends in injury rates than for Ohio and Kentucky. Finally, future research could employ the "contiguous counties" method with this data for more than one legislative change. Several papers have done this with an event study model to explore the effects of RTW legislation (e.g. Dasgupta and Merchant, 2023), but this has yet to be explored at the workplace level and with consideration of changes in actual unionization rates.

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Tables

Table 1: Summary Statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Average employees	17,276	149.5	528.2	1	23,706
Total hours worked	17,276	272,240	855,861	7	2.840e+07
Total days away	17,276	47.88	366.5	0	43,093
Total injuries	17,276	4.328	12.58	0	422
Total respiratory conditions	17,276	0.308	2.954	0	90
Construction	17,276	0.108	0.310	0	1
Manufacturing	17,276	0.299	0.458	0	1
Private	17,276	0.593	0.491	0	1

Table 2 – Injuries-per-worker by state, sector, and size

	Size of Workplace			
	1	2	3	Total
State				
KY				
Sector				
Priv.				
Construction		.0409839	.0256193	.0391193
Priv.				
Manufacturing	.0445875	.0388668	.0312514	.0374148
Private	.0236694	.0426893	.0380969	.0406382
Total	.0248508	.041719	.0329867	.0397649
OH				
Sector				
Priv.				
Construction	.0115238	.0264239	.0153689	.0252418
Priv.				
Manufacturing	.0485071	.0361858	.025995	.0346073
Private	.0303195	.0323477	.0271873	.0317682
Total	.029443	.0328601	.0258319	.0319543
Total				
Sector				
Priv.				
Construction	.0115238	.0295725	.0190561	.0283125
Priv.				
Manufacturing	.0467536	.0366681	.0271992	.0351413
Private	.0280413	.0353551	.0292347	.0343182
Total	.027934	.0350745	.0274191	.0339169

Table 3: Summary Statistics
Cincinnati MSA Only

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Average employees	1,841	193.6	1,029	1	17,645
Total hours worked	1,841	345,092	1.617e+06	1,427	2.840e+07
Total days away	1,841	44.92	107.9	0	1,314
Total injuries	1,841	4.796	14.37	0	250
Total respiratory conditions	1,841	0.397	3.844	0	90
Construction	1,841	0.133	0.340	0	1
Manufacturing	1,841	0.298	0.457	0	1
Private	1,841	0.569	0.495	0	1

Table 4 – Injuries-per-worker by state, sector, and size
Cincinnati MSA Only

	Size of Workplace			
	1	2	3	Total
State				
KY				
Sector				
Priv.				
Construction		.0178108		.0178108
Priv.				
Manufacturing		.0523424	.0415966	.0499078
Private	.0155477	.0410587	.0668789	.0397242
Total	.0155477	.0396388	.0516042	.0392301
OH				
Sector				
Priv.				
Construction	0	.0321651	.0134367	.0293961
Priv.				
Manufacturing	.0588235	.0320575	.0203762	.0300712
Private	.0277898	.03256	.0364454	.0326657
Total	.0255821	.0323632	.0276261	.0314922
Total				
Sector				
Priv.				
Construction	0	.0277435	.0134367	.0261333
Priv.				
Manufacturing	.0588235	.0366112	.0262371	.0347046
Private	.0231617	.0342854	.0420054	.0341811
Total	.0221638	.0339975	.0327873	.0332659

Table 5: Total Injuries DD Regression

VARIABLES	(1) Log(Injuries)	(2) Log(Injuries)	(3) Log(Injuries)
KY	0.119**	0.546***	0.532***
	(0.0469)	(0.133)	(0.134)
Post-treatment	-0.118***	0.261***	0.264***
	(0.0240)	(0.0795)	(0.0801)
KY, Post-treatment	-0.0244	-0.349***	-0.338***
	(0.0503)	(0.0755)	(0.0783)
Manufacturing			0.0174
			(0.0365)
Construction			-0.127**
			(0.0514)
Log(Average employees)		0.677***	0.672***
		(0.0172)	(0.0173)
Constant	1.172***	-1.739***	-1.710***
	(0.0223)	(0.0732)	(0.0739)
Observations	17,276	17,276	17,276
R-squared	0.004	0.458	0.462

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Log of Days Away DD Regression

VARIABLES	(1) Log(Days Away)	(2) Log(Days Away)	(3) Log(Days Away)
KY	0.308***	0.596**	0.533*
	(0.0996)	(0.286)	(0.292)
Post-treatment	0.00748	0.301*	0.343**
	(0.0503)	(0.172)	(0.173)
KY, Post-treatment	-0.0443	-0.416**	-0.489***
	(0.107)	(0.170)	(0.180)
Manufacturing			-0.124
			(0.0903)
Construction			-0.316**
			(0.139)
Log(Average employees)		0.961***	0.959***
		(0.0381)	(0.0383)
Constant	1.590***	-2.543***	-2.459***
	(0.0465)	(0.161)	(0.160)
Observations	17,276	17,276	17,276
R-squared	0.003	0.223	0.232

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Total Injuries DD Regression
Cincinnati MSA Only

VARIABLES	(1) Log(Injuries)	(2) Log(Injuries)	(3) Log(Injuries)
KY	0.0582	0.862*	0.848*
	(0.162)	(0.452)	(0.444)
Post-treatment	-0.0202	0.627***	0.607***
	(0.0748)	(0.202)	(0.199)
KY, Post-treatment	-0.0100	-0.614**	-0.549**
	(0.173)	(0.260)	(0.265)
Manufacturing			-0.132
			(0.107)
Construction			0.0294
			(0.135)
Log(Average employees)		0.769***	0.768***
		(0.0441)	(0.0438)
Constant	1.094***	-2.210***	-2.170***
	(0.0696)	(0.184)	(0.182)
Observations	1,841	1,841	1,841
R-squared	0.001	0.491	0.504

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Log of Days Away DD Regression
Cincinnati MSA Only

VARIABLES	(1) Log(Days Away)	(2) Log(Days Away)	(3) Log(Days Away)
KY	0.130	1.650*	1.198
	(0.302)	(0.879)	(0.888)
Post-treatment	0.205	0.908*	1.071**
	(0.154)	(0.498)	(0.504)
KY, Post-treatment	-0.171	-0.752	-0.813
	(0.328)	(0.607)	(0.650)
Manufacturing			0.184
			(0.278)
Construction			0.0590
			(0.336)
Log(Average employees)		1.092***	1.084***
		(0.115)	(0.116)
Constant	1.500***	-3.191***	-3.220***
	(0.141)	(0.468)	(0.471)
Observations	1,841	1,841	1,841
R-squared	0.001	0.223	0.241

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figures

Figure 1 - Ohio and Kentucky unionization rate

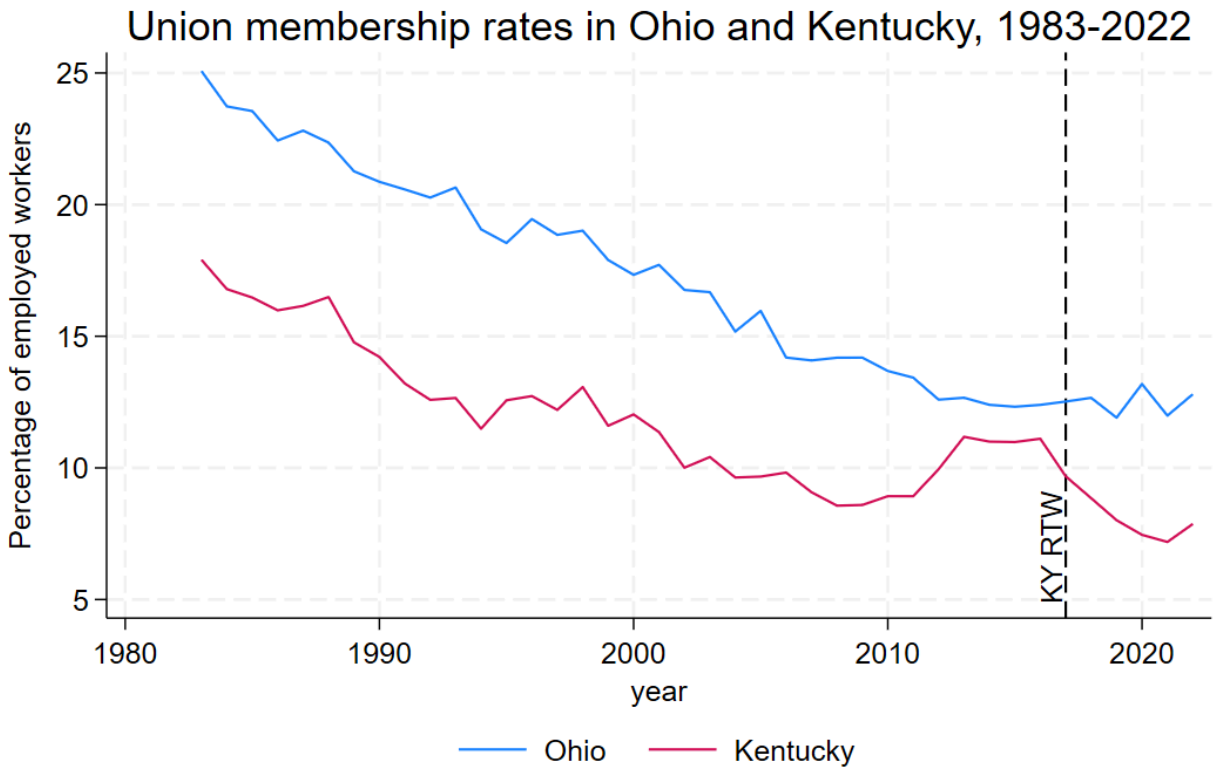


Figure 2 - Kentucky unionization rate by sector

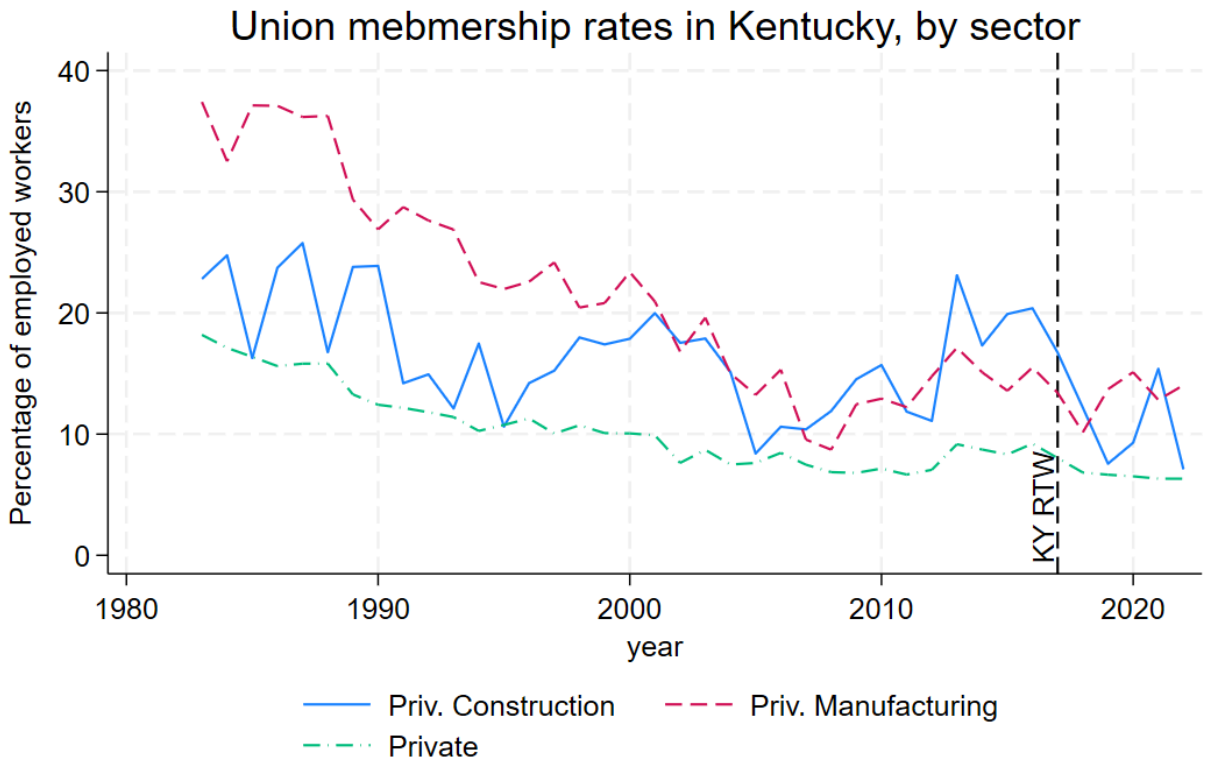


Figure 3 - Ohio unionization rate by sector

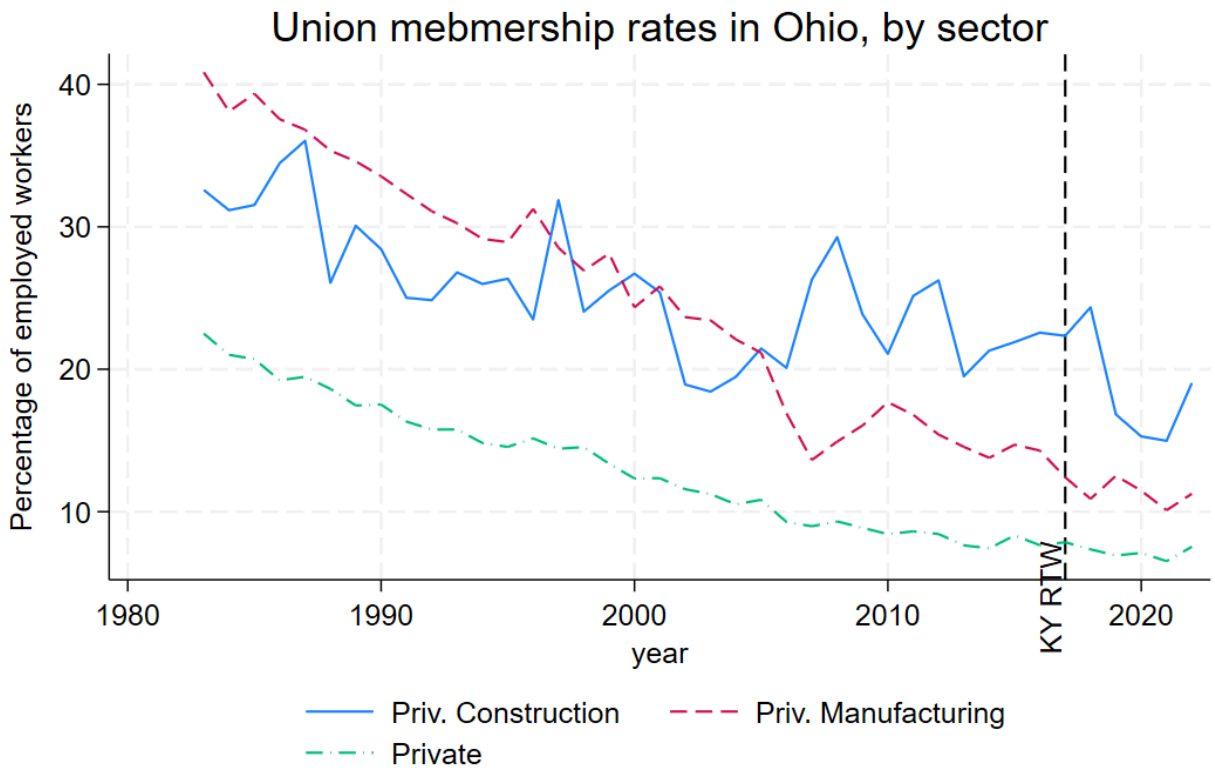


Figure 4 – Kentucky workplaces by sector and size

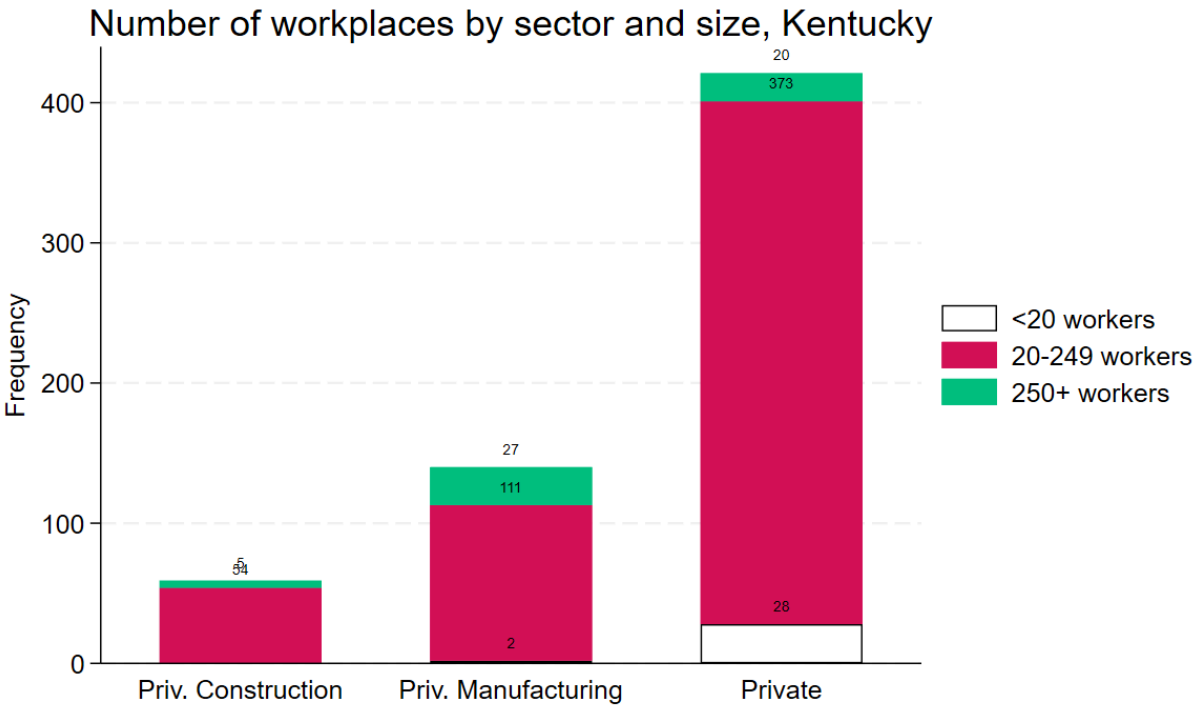


Figure 5 – Ohio workplaces by sector and size

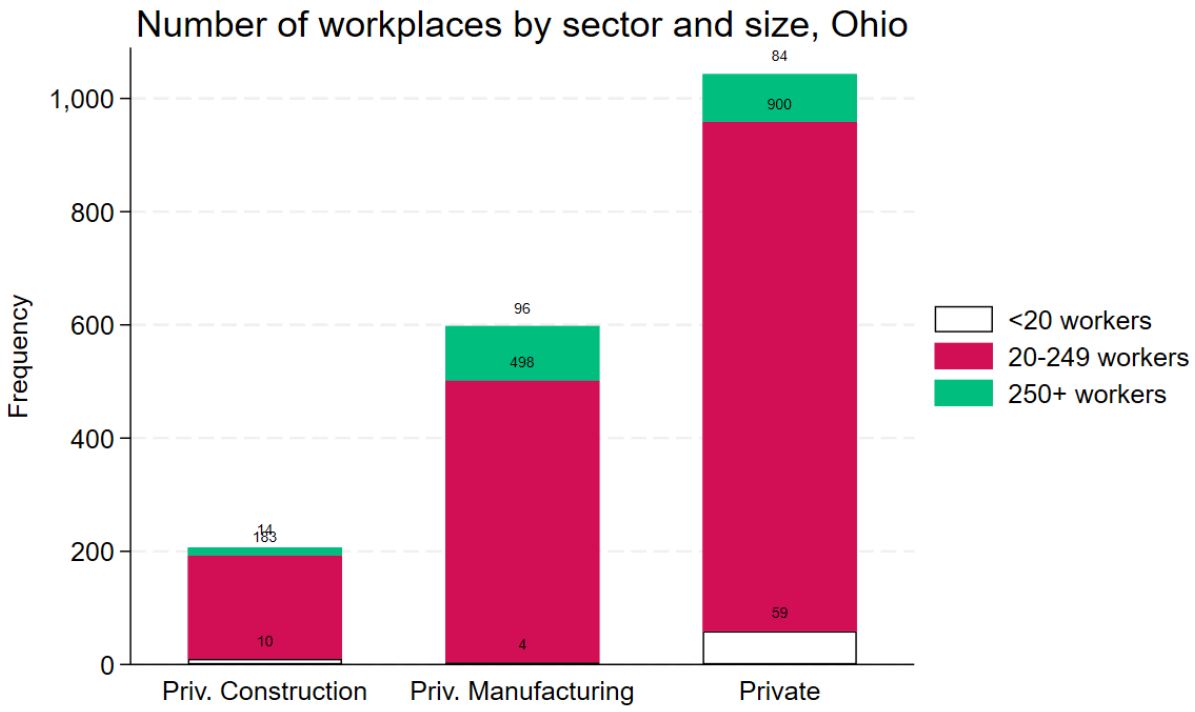


Figure 6 – Injuries-per-worker in Kentucky and Ohio

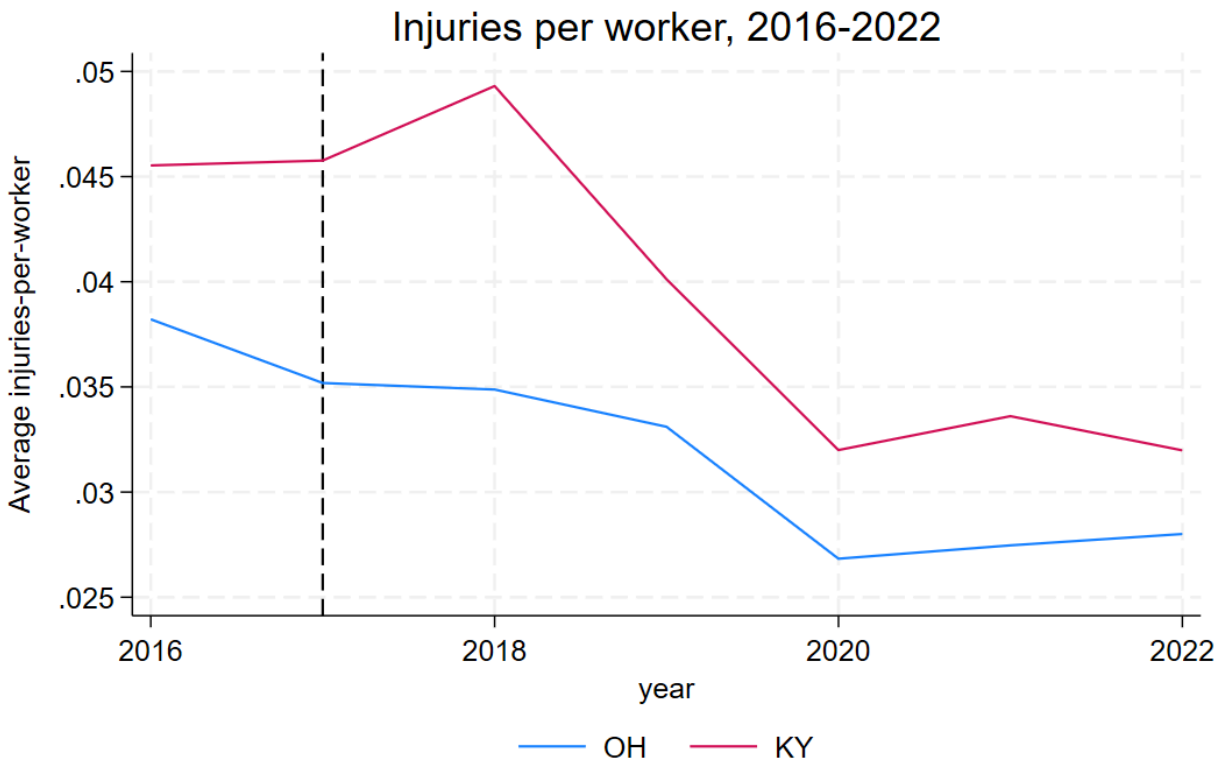


Figure 7 – Kentucky workplaces by sector and size
Cincinnati MSA only

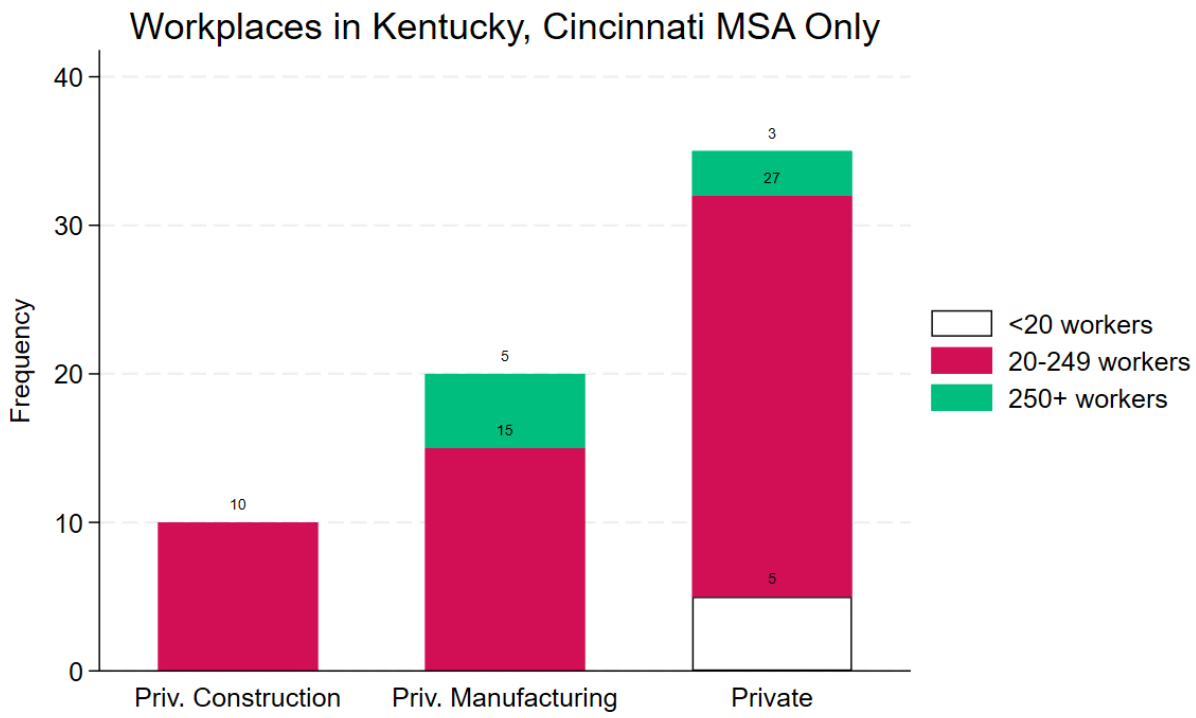


Figure 8 – Ohio workplaces by sector and size
Cincinnati MSA only

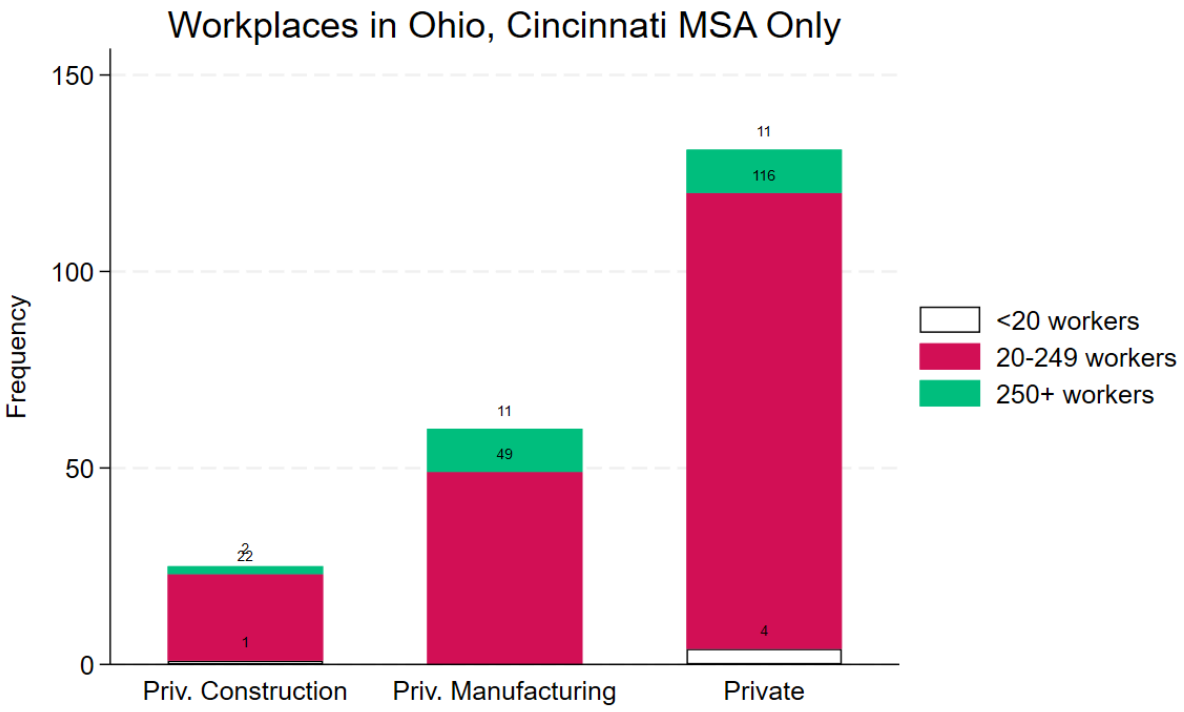


Figure 9 – Injuries-per-worker in Kentucky and Ohio
Cincinnati MSA only

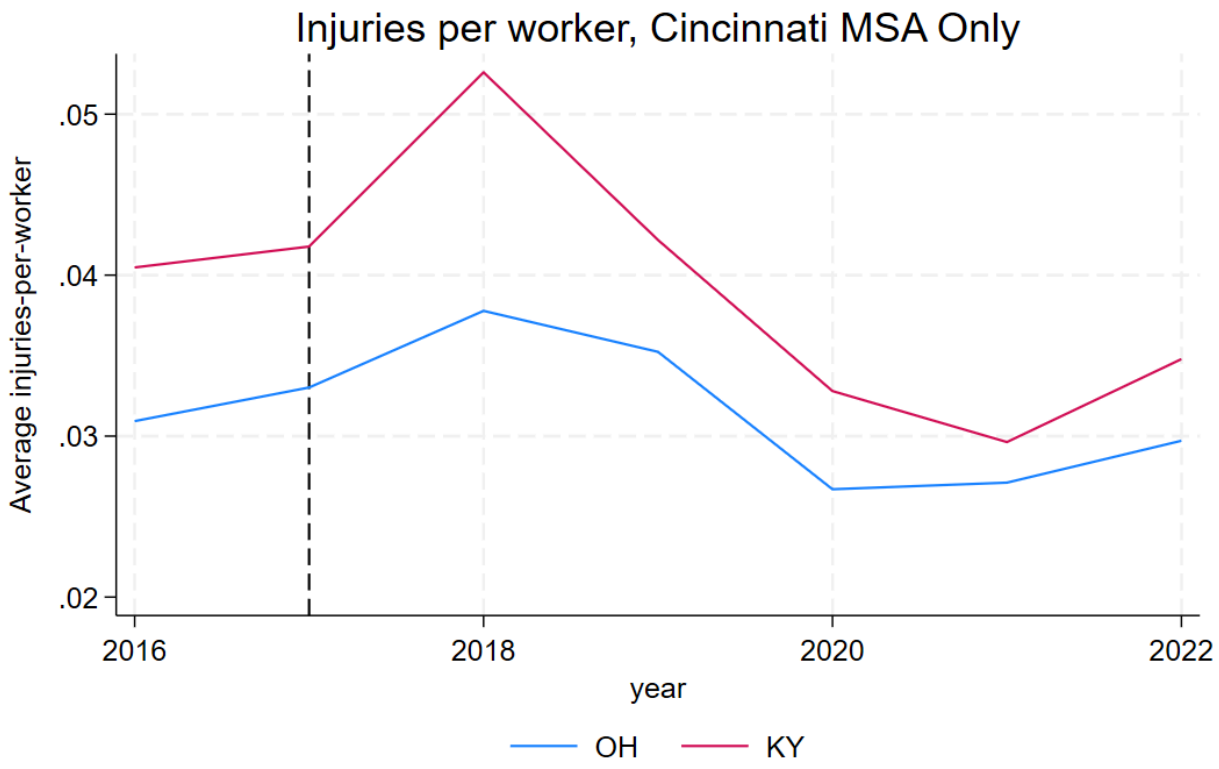
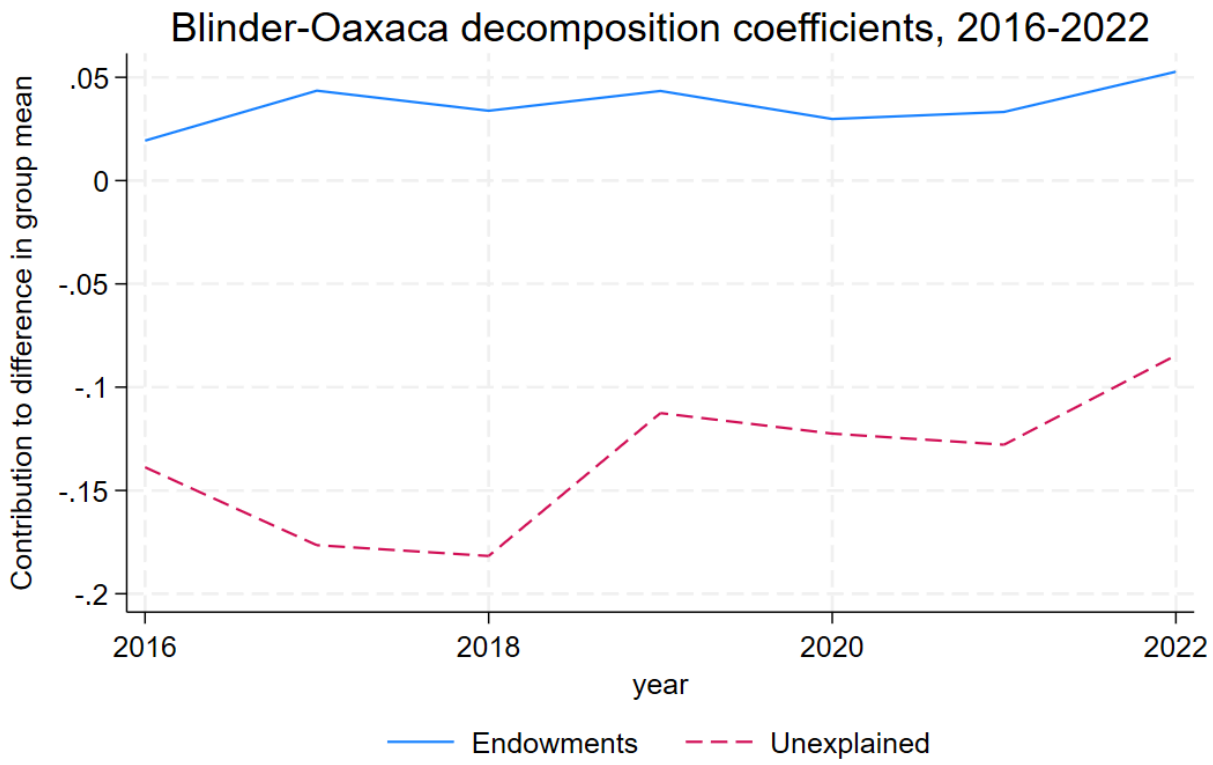


Figure 10 – Explained and unexplained coefficients of BO decomposition



Appendix

Table A1 – Mapping of NAICS codes to sectors

Sector	**NAICS Code(s)**
Private Construction	23
Private Manufacturing	31,32,33
Private	All others

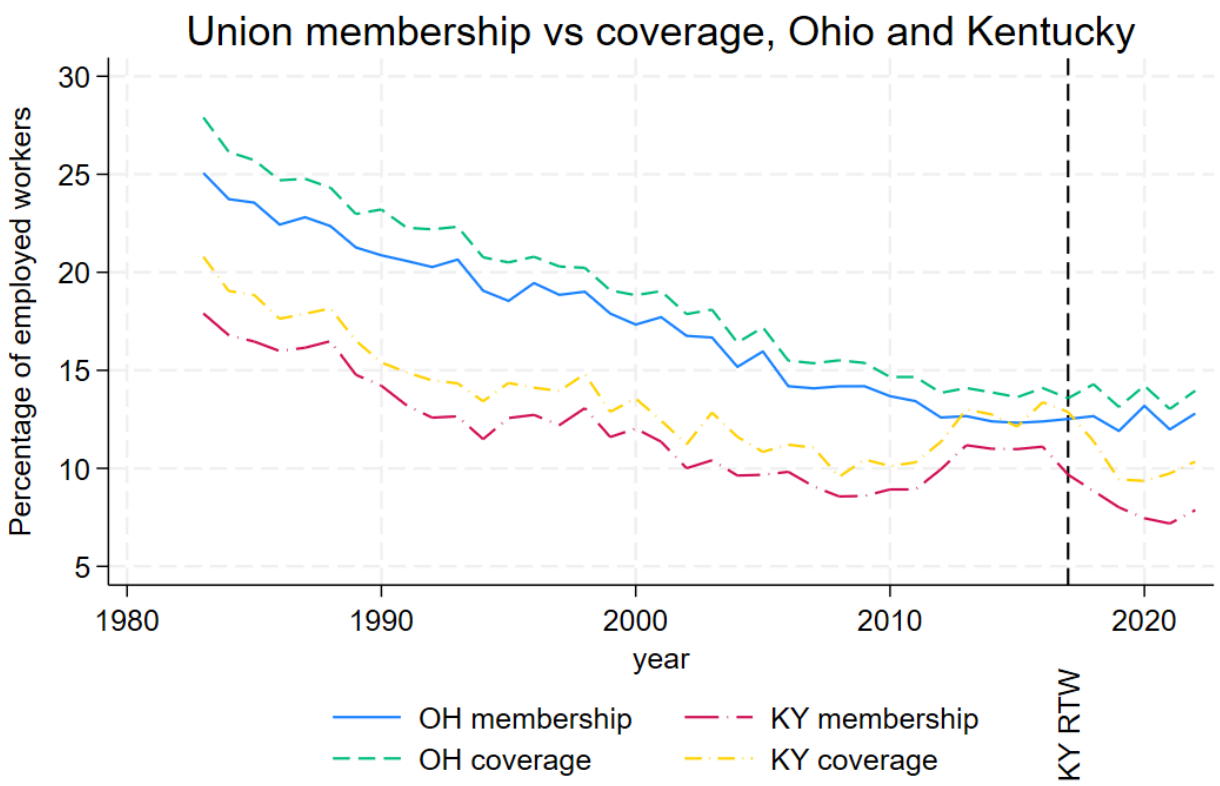



Figure A1 – Membership vs coverage for Kentucky and Ohio