Disability Risk in Alternative Work Arrangements*

Nicholas Broten
Michael Dworsky†
David Powell

September 2018

Abstract

Alternative work arrangements, such as independent contracting and employment through temporary help agencies, have become increasingly common in recent years. Although temporary agency workers have been shown to have higher injury rates than direct-hires in the same industries, the employment impacts of workplace injuries among temporary workers or those in other alternative work arrangements have not been studied. We use rich administrative claims data to compare employment among temporary and contract workers after suffering a workplace injury to employment for comparable direct-hire workers, examining the possibility that temporary workers may face additional employment and disability risk after injury in addition to facing higher probabilities of injury. We find that temporary workers experience greater reductions in employment after a workplace injury in comparison to observably similar direct hire employees. We observe a relative employment reduction over 7.5 percentage points immediately after injury followed by some convergence. However, employment remains 2.9 percentage points lower than would be expected for direct-hires two years after injury. This reduction cannot be attributed to differences in employment trajectories across the different categories of work arrangements. The loss of employment resulting from workplace injury is about 26 percent greater for temporary workers than for direct-hire workers. Workplace injury risk may thus place temporary and contract workers at elevated risk for transitioning to SSDI through two channels: higher injury rates, and larger reductions in employment conditional on injury.

Keywords: temporary workers, workers' compensation, disability, occupational health

*We thank audiences at the 2018 Conference of the American Society of Health Economists and the 2018 Disability Research Consortium Meeting for helpful discussions and comments, especially our discussants Nick Ziebarth and David Mann. This research was supported by the U.S. Social Security Administration through grant #5 DRC12000002-06 to the National Bureau of Economic Research as part of the SSA Disability Research Consortium. The findings and conclusions expressed are solely those of the author(s) and do not represent the views of SSA, any agency of the Federal Government, or the NBER. The authors are grateful to the California Department of Industrial Relations for providing the data used in this study.

†Corresponding author: mdworsky@rand.org

1 Introduction

Many employee benefits and social insurance programs are tied to employment in the sense that eligibility is based on the existence of a traditional, direct-hire relationship between workers and employers. Social insurance programs and mandatory benefits like Unemployment Insurance and workers' compensation are effectively universal for wage and salary employees, while voluntary fringe benefits such as health insurance or sick leave are typically offered to entire classes of workers within a firm (e.g., all full-time employees). Neither employment-based social insurance programs nor voluntary benefits are likely to extend to workers in *alternative work arrangements*, including independent contractors or workers supplied by labor intermediaries such as temporary help agencies.[1] As a growing number of jobs are filled using alternative work arrangements, observers have raised questions about the degree to which benefits and social insurance programs that evolved in an era of traditional, direct-hire work arrangements are able to meet the needs of nonstandard workers (Krueger, 2017). Although limited or nonexistent coverage of nonstandard workers is the most obvious

[1]The Bureau of Labor Statistics (BLS) distinguishes between two broad groups of workers in non-traditional work arrangements:

- "Contingent workers are people who do not expect their jobs to last or who report that their jobs are temporary. They do not have an implicit or explicit contract for ongoing employment."
- "Alternative employment arrangements include independent contractors, on-call workers, temporary help agency workers, and workers provided by contract firms."

BLS notes that "a person's job may be defined as both contingent and an alternative employment arrangement, but this is not automatically the case because contingency is defined separately from the four alternative work arrangements."

Source: BLS "Frequently asked questions about data on contingent and alternative employment arrangements." 2018. Online Resource. Available at `https://www.bls.gov/cps/contingent-and-alternative-arrangements-faqs.htm` as of June 20, 2018.

Temporary agency employees are nonstandard workers and are typically also contingent workers, but may also work at a single host employer for an extended period in an arrangement sometimes called *permatemping*. Contract workers, which are employed by a Professional Employer Organization (PEO) or other staffing agency, are nonstandard workers but are more likely than temporary agency employees to have long-term, non-contingent employment at a single host employer. We refer to both temporary agency employees and PEO employees as *temporary workers* for convenience.

We use *nonstandard workers* to refer to the broad group of workers in *alternative work arrangements*. The term *contingent workers* is often used to refer broadly to workers in either type of non-traditional work arrangement, but we do not have access to data on the degree to which jobs observed in our data are contingent or non-contingent and so we avoid this terminology.

shortcoming of traditional benefits and social insurance programs, programs that have been tailored to the risks associated with direct-hire employment might also have benefit designs that are suboptimal for nonstandard workers if these workers face systematically different patterns of health and employment risks from direct-hire workers. Similarly, one might anticipate that a lack of coverage or inadequate benefits from UI or workers' compensation would lead nonstandard workers who experience an adverse economic event (such as job loss or disability onset) to pursue income or in-kind assistance from social insurance and safety net programs such as the Supplemental Nutrition Assistance Program (SNAP), Supplemental Security Income (SSI), or Social Security Disability Insurance (SSDI) in which eligibility is not limited to workers in traditional work arrangements. Direct evidence on how alternative work arrangements affect the economic risks faced by nonstandard workers or their public program take-up remains scarce, however, making it difficult to judge the degree to which alternative work arrangements impose external costs on federal social programs or to evaluate the welfare effects of extending traditional workplace benefits to nonstandard workers.

In this paper, we estimate the effect of a subset of alternative work arrangements—specifically temporary or contract work—on the risk of employment loss following a disabling workplace injury, which we define as an injury that results in the payment of either temporary or permanent disability benefits through the workers' compensation system. We exploit a unique administrative dataset from California to identify differences in employment risk associated with work arrangements while holding constant a wide range of confounding factors (including age, job tenure, and type of work performed) that often make it difficult to attribute differences in outcomes between temporary and direct-hire workers to the work arrangements themselves. Our dataset includes administrative claims from the universe of California workers' compensation claims from 2005 to 2012. Workers were linked to administrative earnings records to provide pre- and post-injury earnings and employment outcomes, permitting us to compare the trajectory of labor outcome across different categories of workers.

In our data, we can distinguish between direct-hire workers, temporary workers, and contract workers. Although temporary workers do not encompass the entire contingent workforce, independent contractors are unlikely to be covered by workers' compensation or participate in state Unemployment Insurance programs and so it is not possible to study independent contractors using the high-quality administrative datasets available in this study. Temporary and contract workers, in contrast, are covered by both workers' compensation and Unemployment Insurance, enabling us to observe injuries and labor market outcomes over time among these workers. We view the post-injury outcomes of temporary workers as a window into how employment risk compares between workers who are and who are not direct-hires. Because we are able to control for job tenure at injury and the type of work being done at the establishment where the injury took place, we are able to separate differences in employment risk associated with alternative work arrangements holding constant confounding factors like job tenure, demographics, and the type of work.

We find that temporary workers suffer worse post-injury outcomes relative to comparable direct-hires, conditional on demographics and tenure. Because temporary workers have different employment trajectories than direct-hires even in the absence a workplace injury, however, a more sophisticated empirical strategy is needed to isolate the impact of alternative work arrangements on employment. We therefore adopt a triple-difference research design that uses workers' compensation claims for minor, non-disabling injuries as an additional comparison group to account for the different employment dynamics observed among temporary and direct-hire workers. These *medical-only* claims are injury claims which do not result in enough days away from work to result in the payment of temporary disability benefits. Our key identifying assumption is that, within each type of work arrangement studied, differences in employment between workers with minor injuries and workers wth disabling injuries would evolve similarly over time if alternative work arrangements had no effect on employment outcomes. We use event-study methods to provide an indirect test of this assumption by examining whether alternative work arrangements are associated with

a difference in employment between temporary and direct-hire workers prior to the date of injury. Our preferred triple-difference specification shows that, prior to the injury date, work arrangements are not associated with differences in employment between workers who will go on to have minor injuries and those who will go on to have disabling injuries, a finding that indirectly validates our identification strategy.

After a disabling workplace injury, however, temporary workers have significantly lower employment rates relative to similar direct-hires. Although temporary workers recover relative to direct hires after the first year after injury, employment remains 2.9 percentage points lower than would be expected for direct-hires two years after injury. The reduction in employment due to injury is about 26 percent greater for temporary workers than for direct-hire workers. The relative risk of employment loss after injury due to alternative work arrangments is similar to published estimates of the relative risk of injury associated with temporary work (Smith et al., 2010). Because the presence of a disabling health condition and the inability to engage in Substantial Gainful Activity (i.e., to work) are necessary conditions for entry onto SSDI, our findings suggest that temporary work may increase workers' risk of transitioning from employment to SSDI through two distinct channels: higher injury rates, and larger reductions in employment conditional on injury.

There is ample reason to expect that workers in alternative work arrangements might face greater employment risk after workplace injury than comparable direct-hire workers do. Temporary workers may have limited employment protection and less scope for wrongful dismissal concerns. They may also be less knowledgeable about labor law protections and, consequently, less likely to pursue wrongful dismissal cases. Employers may be less likely to invest in accommodations for injured temporary workers since the workers have less employer-specific human capital and can more easily be replaced. Finally, the higher job turnover inherent in temporary employment could leave temporary workers more exposed to re-employment barriers such as hiring discrimination at an earlier and perhaps more eco-

nomically vulnerable stage in the rehabilitation process. Although we cannot identify the precise mechanisms that lead to the observed differences in employment risk, future research should test these hypotheses in order to guide development of policies that can interrupt the progression from workplace injury to long-term disability when workers lack a traditional, direct-hire relationship with their (*de facto* or host) employers at the time of injury.

Our research complements a growing epidemiological literature showing that temporary workers face greater health and safety risks than direct-hire workers (Benavides et al., 2006; Fabiano et al., 2008; Smith et al., 2010; Underhill and Quinlan, 2011). More recent studies have begun to identify some mechanisms that explain the effect of work arrangements on occupational health and safety, confirming that alternative work arrangements can alter employer incentives to improve safety and report injuries (Foley et al., 2014). What has not previously been established, however, is how labor market outcomes, including job separation and employment risk after the end of the initial work absence following injury, differ between temporary workers and direct hires. These outcomes are interesting for several reasons. First, workplace injuries represent large economic and health shocks to households. Examining heterogeneity in these effects is of special policy interest for the purposes of identifying gaps in the social safety net as well as for potentially targeting groups who experience especially large losses through policy interventions such as job training. Second, projecting benefit adequacy for social insurance programs requires examining how adequacy may be affected by shifts in the distribution of outcomes (i.e., changes in risk) due to changes in working conditions or labor relations. Changes in the prevalence of different types of work arrangements may require social insurance systems to adjust to fulfill their missions. Third, workplace injuries are predictive of future SSDI enrollment (O'Leary et al., 2012) and workers' compensation generosity further impacts decisions to claim SSDI (Guo and Burton, 2012; McInerney and Simon, 2012). Estimates of differences between temporary workers and direct-hires will help project the future burden on SSDI and other components of the social safety net if the rise of alternative work arrangements continues.

This paper is structured as follows. Section 2 reviews the research literature on health, safety, and employment risk for temporary workers and provides background on workplace injury risk, workers' compensation systems, and temporary employment. Section 3 introduces our data sources and provides summary statistics characterizing differences between temporary and direct-hire workers. Section 4 describes our empirical strategy. Section 5 presents our results. Section 6 presents conclusions and suggests some directions for future research.

2 Background

In 2015, there were 2.9 million reported nonfatal occupational injuries and illnesses in the U.S. (Bureau of Labor Statistics, 2017); these occupational injuries impose a substantial economic cost on workers and the economy as a whole: Leigh (2011) estimates that the total social cost of workplace injuries in the United States was $250 billion per year as of 2007. In order to help protect workers against the financial and health risks arising from workplace injury and illness, workers' compensation (WC) laws have been enacted in every state to ensure that injured workers have access to needed medical care and rehabilitation services. Workers' compensation laws create a statutory responsibility for employers to provide specified wage replacement and medical benefits to injured workers on a no-fault basis. Employers typically meet these obligations by purchasing workers' compensation insurance or through self-insurance. Outside of Texas, where participation in the workers' compensation system is optional for employers, workers' compensation is essentially universal for wage and salary employees in all states, with 97.2 percent of UI-covered workers covered by workers' compensation (McLaren and Baldwin, 2017). In 2014, state workers' compensation systems paid a total of $62.3 billion in medical and cash benefits to injured workers (Baldwin and McLaren, 2016). Cash benefits in workers' compensation are designed to provide partial insurance against earnings losses due to injury, typically paying workers two-thirds of their weekly wage at the time of injury (subject to a minimum and maximum benefit) during

an initial spell of temporary total disability and providing additional permanent disability benefits to workers whose injuries result in long-term impairment. Workers' compensation provides only partial wage replacement, a design feature that is justified by strong evidence that disability duration (and thus the cost of providing benefits) is responsive to the level of benefits or the wage replacement rate (Meyer et al., 1995; Butler et al., 2013).

Developments in state workers' compensation policy over the past several decades have spurred interest in understanding the post-injury outcomes of injured workers, as many states have taken measures to control workers' compensation costs by reducing cash benefits, by imposing stricter controls on medical spending, and by adopting narrower definitions of work-related injuries and illnesses (Spieler, 2017). Although the federal government has no jurisdiction over state workers' compensation programs, several federal agencies have recently raised questions about the performance of state workers' compensation systems in promoting successful rehabilitation and protecting workers and their families from risks to their health and financial well-being (Occupational Safety & Health Administration, 2015; U.S. Department of Labor, 2016).

Thanks in part to the broader fiscal challenges facing the major federal disability and health insurance programs, the fiscal implications of occupational injuries for SSDI, Medicare, and Medicaid have also received growing attention from researchers and policymakers. When injured workers experience severe disability following injury, they are likely to use social insurance programs beyond the workers' compensation system: Leigh and Marcin (2012) estimated that occupational injuries result in about $1 of federal costs due to increased Social Security Disability Insurance (SSDI), Medicare, and Medicaid benefits for every $2 paid by state WC systems. In a study suggesting that such cost spillovers could be quite extensive, Reville and Schoeni (2004) estimated that 1 in 3 SSDI recipients over the age of 50 reports being disabled due to a work-related injury as of 1992. The most compelling evidence on the link between occupational injury and federal disability program participation comes from a

series of studies involving SSA researchers that linked workers' compensation claims from New Mexico to SSA records on earnings, SSDI receipt, and mortality. O'Leary et al. (2012) confirms that workers with lost-time workers' compensation claims face an elevated risk of SSDI receipt over the subsequent decade, while a follow-up study shows that injured workers even face elevated mortality risk (Boden et al., 2016).

Like other major social insurance programs focused on risks endemic to employment, the workers' compensation system has largely been tailored to a world of traditional, direct-hire employer-employee relationships. Injured workers report workplace injuries to their employers in order to access benefits. Employer premiums are typically experience-rated based on previous injury rates and the cost of those injuries. Employers of injured workers may also be encouraged through benefit design to offer employment to workers following injury. As workers become less closely tied to firms, the nature of workplace injuries and the consequences of those injuries for workers may change, and certain aspects of workers' compensation policy may be less effective at promoting their original goals.

While not focusing on the role of the changing labor force specifically, the Department of Labor recently issued a report which "sounds an alarm" that workplace injuries have become increasingly associated with a risk of falling into poverty and that workers' compensation system are not providing adequate benefits (U.S. Department of Labor, 2016). Meanwhile the ability of employers to avoid labor laws, including workers' compensation coverage requirements, by substituting alternative work arrangements for direct-hire labor, is thought by some observers to incentivize the use of these arrangements. In response, observers have called for expansion of workers' compensation coverage requirements to independent contractors (Howard, 2016; American Public Health Association, 2017).[2]

Coverage gaps are not the only challenge for workers' compensation policy posed by the rise of alternative work arrangements. As in other social insurance systems, the

[2] https://www.washingtonpost.com/news/wonk/wp/2015/11/12/tech-companies-labor-advocates-and-think-tan last accessed July 13, 2018.

design of cash benefits in workers' compensation involves a fundamental tradeoff between risk protection and moral hazard. A locally optimal benefit design will strike a balance between the social benefit of increased risk protection and the social cost of distorted labor supply or claims-filing decisions. If workers in alternative work arrangements face substantially different income risks from direct hires following an injury, then a workers' compensation system that is optimal for direct-hire wage and salary workers could be suboptimal for workers in alternative work arrangements.[3]

Nonemployer firms and employment at such firms have grown continuously since 1997;[4] Katz and Krueger (2016) estimate that alternative work arrangements increased from 10.1% in February 2005 to 15.5% in late 2015 while tax records suggest large increases as well (Jackson et al., 2017). As the nature of the labor force changes, it is important to understand whether social insurance programs designed for more traditional arrangements are adequate for this new labor force. In this paper, we study the employment and earnings consequences of workplace injuries for both direct-hire workers and workers with temporary jobs. Our focus on workers' compensation is motivated by the large earnings losses associated with workplace injuries, suggesting a critical role for social insurance, and the historical relationship between workers' compensation benefits and employers.

As noted above, temporary workers are employees of a labor intermediary—either a Temporary Help Agency (NAICS code 56132) or, for contract workers, a Professional Employer Organization (PEO, NAICS code 56133)—that sells their labor services to a separate host employer. Legally, both the temporary help agency (or PEO) and host employer are legally responsible for providing safe working conditions (Howard, 2016). Temporary work is commonly used for many low-skilled occupations as well as higher-skilled jobs which require less firm-specific specialization, such as nursing and computer programming (Kilcoyne,

[3]This might also be the case if the two groups of workers have sharply different behavioral responses to benefit generosity.

[4]See https://www.brookings.edu/research/tracking-the-gig-economy-new-numbers/, last accessed July 13, 2018.

Table 1: Temporary Agency Employment by Occupation in California

Title	SOC Code	Number of Workers	Share of Temporary Employment	Cumulative Share
Laborers and Freight, Stock, and Material Movers, Hand	53-7062	89,130	23.3	23.3
Packers and Packagers, Hand	53-7064	24,850	6.5	29.8
Assemblers and Fabricators, All Other, Including Team Assemblers	51-2098	14,960	3.9	33.7
Production Workers, All Other	51-9199	14,150	3.7	37.4
Customer Service Representatives	43-4051	12,250	3.2	40.6
Packaging and Filling Machine Operators and Tenders	51-9111	11,090	2.9	43.5
Office Clerks, General	43-9061	10,530	2.8	46.2
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	43-6014	9,810	2.6	48.8
Personal Care Aides	39-9021	8,180	2.1	50.9
Industrial Truck and Tractor Operators	53-7051	7,500	2.0	52.9

Source: Bureau of Labor Statistics. 2018. "May 2017 OES Estimates"

2004). Table 1 shows the occupations in California with the highest shares of temporary workers using data from the Bureau of Labor Statistics.

A number of studies have found that temporary workers have higher WC injury claim rates than direct-hires in the same industries (Park and Butler, 2001; Smith et al., 2010; Zaidman, 2017). Studies have reached differing conclusions about the extent to which higher claim rates reflect moral hazard or actual safety differences. Park and Butler (2001) argue that temporary workers may be less deterred from filing claims by the threat of retaliation than direct-hire employees (for whom there is an implicit contract of continued employment), resulting in greater claim-filing moral hazard (i.e., higher claim-filing rates conditional on injury occurrence and severity). While such a mechanism is likely to affect claiming behavior, a growing literature has also provided evidence for important safety and health differences between temporary and direct-hire workers (Benavides et al., 2006; Underhill and Quinlan, 2011). Many of these differences are attributable to observable differences in risk factors such as age and job tenure (Zaidman, 2017). However, the type of work arrangement is also likely to have an independent effect on safety due to lower access to safety training and worse communication with co-workers Foley (2017). Analysis of the injury mix for temporary workers bolsters the idea that poor working conditions and worse hazard communication contribute to higher injury risk: "struck by or against" and "caught in" injuries are more common among temps (Smith et al., 2010).

Beyond occupational health and safety, an extensive literature in labor economics has examined the broader question of whether temporary employment is beneficial to workers' career development, or whether job experience as a temporary worker somehow results in less skill development. This has been a difficult question to answer because different workers are likely to sort into temporary versus direct-hire employment on the basis of productivity or labor supply preferences, and because it is unclear whether the right counterfactual for temporary employment is direct-hire employment in a similar job or, perhaps, unemploy-

ment.

In general, there have been two different views of temporary work in the labor economics literature. Some researchers and observers have viewed temporary agency work as a stepping-stone to permanent and higher-wage employment for entry-level workers such as young adults or mothers transitioning off of the Temporary Assistance for Needy Families program after welfare reform. Other researchers, however, have argued that temporary work fails to promote career progression since workers may fail to develop skills and lack opportunities for promotion. To the extent that temporary work is associated with greater health and safety risks as well as reduced access to retirement accounts and other benefits, it might even be seen as an obstacle to human capital accumulation. Early studies on temporary work were broadly consistent with the stepping-stone theory (Heinrich et al., 2005; Lane et al., 2003; Andersson et al., 2009). However, Autor and Houseman (2010) were able to revisit this question with an instrumental variables strategy that leveraged quasi-random variation in job placement for welfare leavers.[5] They found that temporary work failed to increase employment after the end of the initial job assignment, suggesting that temporary workers were very likely to revert to non-employment rather than using the job to build a career.

While there are no previous studies that examine how alternative work arrangements affect employment risk following disability onset, a 2015 study by Cook et al. (2015) examines data from a randomized supported employment intervention to estimate the effects of job placement in contingent work for adults with severe mental illness. They found that initial job placements in contingent work arrangements as opposed to permanent jobs led to worse labor market outcomes two years later, in part because workers were unlikely to transition from temporary to permanent jobs following the initial placement. Although the identification strategy of this study is not as compelling as that used by Autor and House-

[5]Autor et al. (2016) studies the distributional consequences of job placement using quantile regression methods.

man (2010), it is notable as the only study to focus on the employment effects of temporary employment specifically for people with disabilities.

We caution that the findings of Autor and Houseman (2010) and Cook et al. (2015) are not likely to be directly applicable to our setting. Many of the temporary workers in our sample are likely to have more employment experience and higher labor force attachment than the welfare leavers that have largely been the focus of public economics and labor economics literature on temporary workers. Likewise, the disabled individuals studied by Cook et al. (2015) were assigned to temporary employment well after disability onset. Psychiatric disability is also rare (as a primary impairment) in the workers' compensation population that is the focus of our study. Where Cook et al. (2015) examine the effect of temporary job placement as a first step in the rehabilitation or return to work process, we examine the effect of temporary employment on the risk of transitioning to non-employment following a disabling injury that is likely to represent either a new-onset disability or a significant worsening of a work limitation that may have already been present in some form. Even so, previous findings strongly suggest that employment dynamics are likely to be systematically different for temporary and direct-hire workers, a pattern that we find in our data for workers incurring workplace injuries. We address this concern by focusing on a triple-difference specification that uses temp workers with less severe injuries to control for temporary workers with lost-time injuries, as we discuss below.

3 Data

In this paper, we use administrative workers' compensation claims reported to the California Department of Industrial Relations (DIR). These data were linked to administrative earnings data maintained by the state Employment Development Department, the agency that administers California's Unemployment Insurance (UI) program. We discuss these data sets below as well as the variables that we constructed for our analysis.

3.1 Workers' Compensation Claims

Our primary data source for identifying injured workers in California is the Workers' Compensation Information System (WCIS), an all-payer database of workers' compensation claims collected and maintained by the Division of Workers' Compensation (DWC) in the California DIR for years 2005 to 2012.[6] We used data from WCIS on First and Subsequent Reports of Injury (FROIs and SROIs) to capture the filing of workers' compensation claims, to construct a rich set of worker and injury characteristics at the time of injury (using data reported on the FROI), and to identify workers who receive settlements or benefit payments for Temporary Total Disability (TTD) or Permanent Partial Disability (PPD). All claims administrators (insurers, self-insured employers, and third-party administrators) in California are required to report new claims to the WCIS using a FROI within 10 days of being notified of the new claim. Material changes in the status of the claim, including the beginning or the end of benefit payments, must also be reported to WCIS using a SROI. The WCIS is known to suffer from a degree of underreporting of SROI, but reporting quality has improved over time. Despite some imperfections, there is no other data source with comparable detail that captures workers' compensation claims from both fully insured and self-insured employers, and the WCIS is believed by DWC to be broadly representative of the California workers' compensation system.[7]

We take demographic information about injured workers (age at injury and gender) from the FROI. We also rely on codes for the *Nature, Origin, and Cause of Injury* to classify injuries based on initial characteristics observed at the time of the FROI. We use workers' compensation classification codes (*class codes*) to proxy for the level of job demand and injury risk faced by workers within an industry. Class codes in California are developed by the Workers' Compensation Insurance Rating Bureau (WCIRB) to allow efficient risk

[6] Information about the WCIS is available at `https://www.dir.ca.gov/dwc/wcis.htm`.

[7] See Dworsky et al. (2016) for discussion of the strengths and weaknesses of the WCIS as a data source for research.

segmentation in the pricing of workers' compensation coverage. Class codes are meant to group workplaces on the basis of risk and expected cost for workers' compensation insurers. Class codes thus are not directly comparable to either industry or occupation codes, but are likely to incorporate information about both industry and occupation that affects injury risk and disability costs across workplaces and, in cases where low-risk workers are employed at high-risk workplaces, between employees within workplaces.[8] Because our industry codes are defined at the level of the employer (specifically the UI tax ID number) rather than the establishment, class codes are important for capturing detail about the work environment and job demands faced by injured workers. This is especially true for large, multi-establishment employers such as state and local governments. We used the class codes to compare workers injured within the same type of job.

3.2 Earnings and Employment Outcomes

We linked the WCIS data with administrative earnings records. The EDD base wage file captures all quarterly wage and salary income earned by UI-covered workers in California. Under an interagency agreement between DIR and EDD, we submitted programs for EDD staff to link individuals appearing in the WCIS to their earnings histories in the Base Wage File. Linkage was performed primarily using the injured worker's Social Security Number (SSN). 6-digit NAICS codes reported to EDD were provided to identify the industry of employers appearing in the linked data. After identifying injured workers, the data were de-identified and assigned an ID number that could be used to match to the WCIS data.

We used the wage records to construct indicator variables for employment (defined as having total quarterly earnings from all employers greater than $200) and employment at

[8] In general, the highest-risk classification present at an establishment is the *governing classification* that is used to set workers' compensation premiums. However, California and other states allow for covered payroll to be divided into higher- and lower-risk classifications under some circumstances. The most important *standard exception* is for clerical employees at high-risk workplaces (e.g., a receptionist at a shipping warehouse) whose work is physically separated from the high-risk production processes. See WCIRB (2013) for further details.

the at-injury employer.

3.3 Sample Definition and Ascertainment of Temporary Status

Our treated group consists of temporary help agency workers, represented by NAICS code 56132, and contract workers, represented by NAICS code 56133. Nationally, these categories of workers compose 30% of the contingent workforce, though this percentage is growing over time (Abraham, 2018). We observe 52,112 injured workers in these categories with the majority (80%) in the temporary agency category. We assume that all other injured workers are direct-hires, and we will use a subset of the direct-hires to form our control group.

Table 2 presents temporary worker shares by class code in our data. The categories with the highest shares, while not directly comparable to occupation codes, suggest strong similarities to the occupations observed in Table 1. Since we study post-injury labor outcomes *within* class code, our analysis uses class codes with a mix of direct-hires and temporary workers.

The prevalence of temporary and contract work varies widely across industries and occupations, and many class codes have very few injuries among temporary workers. Because we are interested in comparing temporary and direct-hire workers injured doing similar jobs, class codes without substantial temporary/contract employment do not contribute to our empirical strategy, and we exclude these class codes from our analysis sample. Specifically, we tabulated the number of temporary and direct-hire injuries by class code and restricted the sample to class codes in which there was at least one calendar quarter between 2005-2012 with 20 or more injuries among temporary or contract workers. As discussed below, we will include separate fixed effects for class code-quarter of injury interactions in our regression models, ensuring that temporary workers are always compared to direct-hires who are injured at roughly the same time.

This sample restriction leaves us with 63 class codes represented in our analysis

Table 2: Temporary Employment by Workers' Compensation Classification Code among Injured Workers

Class Code	Total Injury Count	Temporary/PEO Injury Count	Share Involving Temporary/PEO Workers
WAREHOUSES - GENERAL MERCHANDISE	30,793	8,506	27.6%
STORES - CLOTHING, DRY GOODS - WHOLESALE	4,182	1,084	25.9%
FRUIT - DRIED FRUIT PACKING	1,500	321	21.4%
PALLET MFG, REPAIR, RECONDITION - WOOD	1,270	257	20.2%
CARPENTRY - NOC - LOW WAGE	6,261	1,263	20.2%
INSPECTION FOR INSURANCE OR VALUATION	1,636	306	18.7%
PRINTED CIRCUIT BOARD ASSEMBLING	1,366	247	18.1%
GARBAGE, ASHES OR REFUSE DUMP OPERATIONS	3,800	677	17.8%
WAREHOUSES - SELF STORAGE	1,680	250	14.9%
FRUIT - CITRUS FRUIT PACKING	2,175	295	13.6%

Table lists top 10 California class codes by proportion of injuries occurring among temp workers. Source: Authors' calculations, WCIS-EDD data.

sample (see Appendix A). The included class codes correspond closely to the occupational distribution shown in Table 1: transportation and warehousing, low-wage construction, and manufacturing are well-represented, as are some higher-wage occupations with a high temporary/contract worker prevalence (such as health care professions and computer programming).

To avoid results being driven by very high earners, outliers were removed. The outlier threshold was defined by calculating the 99.8^{th} percentile of CPI-adjusted total earnings for each quarter in the analysis (before, during, and after the injury) for injured workers only, and taking the minimum value across quarters relative to injury. The resulting outlier threshold in the merged sample was \$65,584 per quarter, or \$262,336 in annualized terms.[9] If an injured or control worker's CPI-adjusted total earnings exceeded this value in any quarter, they were classified as an outlier and removed. 1.43% of injured workers in the merged data met this criterion.

Table 3 shows differences in characteristics, using the administrative WCIS data, between direct-hire workers and temporary workers with indemnity claims. Overall, the temporary workers have lower weekly wages and are less likely to work full-time. They are also less likely to be female and are younger on average. Temporary workers also have fewer cumulative injuries which is consistent with them having less tenure at the firm.

Using the linked earnings data, Table 4 compares earnings and employment across our different categories. Before the injury, direct-hires have much higher earnings and employment propensities than temporary workers. These pre-injury differences motivate our use of an empirical strategy which accounts for these differences by studying changes in labor outcomes. Relying on simple changes in means presented in Table 4, we find that temporary workers – proportional to pre-injury outcomes – have worse post-injury outcomes. The post-injury employment of temporary workers sinks to 74.5% of pre-injury levels in the first

[9]Dollar values are expressed in real 2014\$.

Table 3: Characteristics of Temp and Direct-Hire Workers with Indemnity Claims

Job Characteristics	Direct-Hire	Temp
Weekly wage	$621.99	$478.29
Full time	79%	67%
Demographics		
Female	46%	39%
Age	41.2	38.8
Cause of Injury		
Caught in	2.8%	5.0%
Rubbed by	0.6%	1.0%
Striking	3.2%	4.8%
Struck By	9.6%	12.2%
Strain	42.3%	41.4%
Fall	19.4%	18.5%
Cut	5.6%	5.0%
Burn	1.8%	1.4%
Misc.	11.8%	8.7%
Crash	3.0%	2.0%
Nature of injury		
Specific Injury	88.0%	89.5%
Cumulative Injury	8.4%	5.1%
Multiple Injury	2.9%	4.8%
Other Injury	0.7%	0.6%
Sample size (unweighted)	323,415	15,263

Source: Authors' calculations, WCIS-EDD data.

Table 4: Pre- and Post-Injury Labor Market Outcomes for Temps and Direct Hires

Pre-injury Earnings/Employment	Direct-Hire		Temporary/Contract	
	Value	(% of baseline)	Value	(% of baseline)
Earnings in Year Before Injury	$35,167		$18,112	
Employed 1 Year (4Q) Before Injury?	87.2%		65.6%	
Employed at At-Injury Employer 1 Year (4Q) Before Injury?	72.1%		30.7%	
Post-Injury Earnings/Employment				
1st year post-injury earnings	$26,616	(75.7%)	$13,026	(71.9%)
2nd year post-injury earnings	$25,443	(72.4%)	$12,938	(71.4%)
Post-injury Employment				
1 year (4Q) post-injury employment	69.5%	(79.6%)	48.8%	(74.5%)
2 years (8Q) post-injury employment	63.8%	(73.2%)	46.8%	(71.3%)
Post-injury Employment at Same Firm where Injury Occurred				
1 year (4Q) post-injury employment at same firm	57.0%	(79.0%)	19.8%	(64.6%)
2 years (8Q) post-injury employment at same firm	44.1%	(61.1%)	10.4%	(33.8%)

Source: Authors' calculations, WCIS-EDD data.

year post-injury, compared to 79.6% for direct-hires. We observe especially large post-injury differences in the probability of employment at the firm where the worker was employed at the time of injury, (or the *At-Injury Employer*): 64.6% for temporary workers versus 79.0% for direct-hires.

4 Empirical Strategy

Our data permit us to compare outcomes after an injury relative to labor outcomes before the injury. Our treated group is temporary workers receiving indemnity benefits due to missed work days because of the injury. As discussed in the previous section, the focus on outcome *changes* is motivated by the differences between direct hire and temporary employees even prior to injury. Given the nature of these different types of work arrangements, it is not surprising that temporary workers have lower employment propensities and earnings before the injury. We will show the full trajectory of these outcomes to analyze outcome changes, accounting for level differences across work arrangement types.

However, one concern with this empirical strategy is that temporary workers may

naturally have different employment and earnings trajectories compared to direct hires even in the absence of an injury. Our preferred specification, therefore, uses "medical only" workers' compensation claims as an additional comparison group to account for differential underlying trends. "Medical only" claims are injury claims which do not result in missed days at work. We use these claims to account for differences in labor market dynamics between direct-hires and temporary workers that we would expect to see even in the absence of a workplace injury. Thus, we rely on a triple difference specification in which the main variables are the interactions of (1) temporary worker indicator; (2) injured worker receiving indemnity benefits indicator; and (3) time-relative-to-injury indicators. We include indicators controlling for all two-way interactions of these categories in the specification.

Controlling for the natural differences between direct hires and temporary workers using a triple-differences approach is also beneficial if temporary workers are less likely to claim workers' compensation benefits conditional on a workplace injury. This method accounts for such differential selection concerns. The disadvantage of the triple-differences approach is that the "medical only" claims may include part of the effect that we are interested in if temporary workers with medical only claims also causally suffer relatively worse post-injury outcomes. Consequently, our estimates are likely biased against finding an effect and should represent lower bounds on the true differentials.

We also condition on interactions based on class codes, calendar time of injury, time-relative-to-injury, and contract type (direct hire or temporary). Thus, we are comparing temporary and direct hire employees working in the same type of job at the same time. In addition, we control for observable differences between workers in different types of arrangements. A primary motivation for controlling for these observable differences is that we do not want to attribute post-injury outcome differences because of age differences or job tenure differences to the work arrangement differential. We interact the following vari-

ables with quarter-relative-to-injury indicators: age group-gender interactions,[10] job tenure indicators, type of injury indicators, geographic region within California indicators,[11] full-time/part-time status, and the average weekly wage variable calculated for the workers' compensation claim.[12] Interacting these covariates with time-relative-to-injury dummies permits these variables to have their own independent effects on the full trajectory of labor outcomes.

Our specification can be represented by

$$\begin{aligned} y_{icdqt} =& \mu_{cdqt} + \sum_{s=-4}^{8} I_i \beta_s^I \mathbf{1}\{t-q=s\} \quad \textit{(indemnity difference from medical-only)} \\ &+ \sum_{s=-4}^{8} \beta_s^{TI} I_i T_i \mathbf{1}\{t-q=s\} \quad \textit{(indemnity X temp triple-difference)} \\ &+ \sum_{s=-4}^{8} \beta_s^X X_i \mathbf{1}\{t-q=s\} \quad \textit{(observable characteristics)} \\ &+ \varepsilon_{icqt}, \end{aligned} \tag{1}$$

where y_{icdqt} is a labor outcome for individual i in class c and contract type (work arrangement) d injured at time-relative-to-injury q for an injury incurred in calendar year-quarter t. T_i is equal to 1 if the worker was a temporary worker when injured while I_i is equal to 1 for indemnity claims (0 for medical only claims). We study the relative trajectory of the labor outcomes for 4 quarters prior to injury up to 8 quarters after injury, plotting the estimates of β_s^{TI} for all s. Standard errors are adjusted for clustering based on class code, quarter of injury, and temporary worker status. This variance structure allows for serial correlation of outcomes within individuals and across individuals injured in the same job at the same time with the same contract type.

[10] Age cutpoints are at 25, 35, 45, 55, and 65.

[11] California DWC defines 10 regions for statistical reporting. See `https://www.dir.ca.gov/dwc/wcis/WCIS_tables/TABLE-7/WCIS_Reports-Table7.html` for details.

[12] The weekly wage is correlated with but not perfectly collinear with annual earnings since individuals with the same weekly wage may have differing numbers of weeks worked during the year.

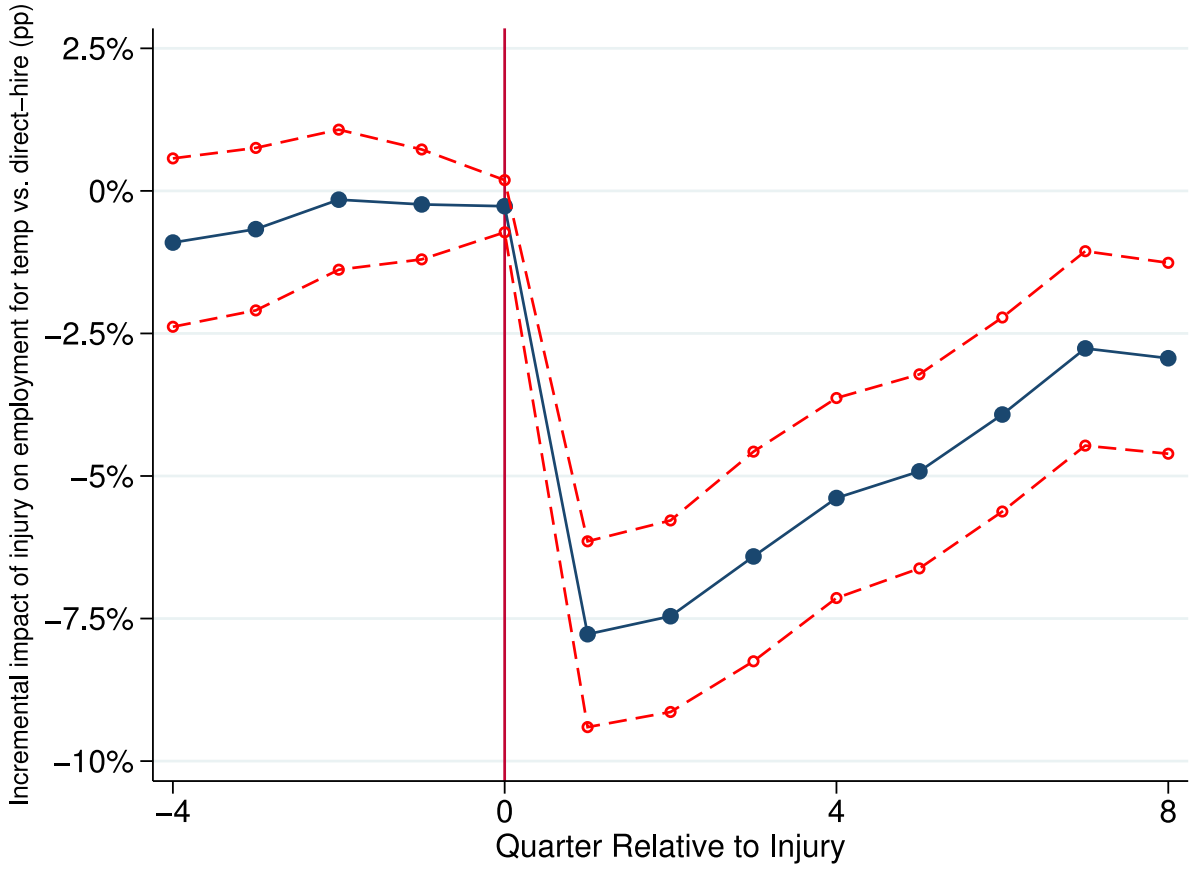
We note that, in contrast to more typical differences-in-differences event studies, where one of the interactions between treatment and time period must be omitted to avoid perfect collinearity, the coefficients of interest here are triple interactions β_s^{TI} between temporary worker status (treated group = temp workers), claim severity (treated group = indemnity), and time. We have parametrized these triple interaction terms to fully absorb the double interaction between temp worker status and claim severity, i.e., the two-way interaction between indicators for temp worker status and claim severity is not included so that it is not necessary to omit the triple interaction term for any of the time periods in the sample window. As a result, the triple-interaction event time coefficients capture the difference between temp worker X indemnity injury outcomes from the additive (uninteracted) effects of temp worker and indemnity worker status in each time period. As a result, there is no time period in our event-study window in which the effect of temporary employment is normalized to zero; instead, the β_s^{TI} coefficients capture the difference, at each point in time relative to the injury date, between the effects of indemnity injury relative to medical-only for temporary workers and the effects observed among observably similar direct-hire workers.

5 Results

5.1 Triple-difference results

We present our results graphically, showing the full trajectory of (relative) employment outcomes. Our main results are shown in Figure 1. We find little evidence of differential pre-injury employment trends or differential levels (conditional on covariates and fixed effects). In fact, we cannot reject the null hypothesis that pre-employment differences remain the same throughout the pre-period. Upon injury, however, we observe large relative decreases. We estimate that employment of temporary workers falls by 7.5 percentage points more than direct-hires (relative to their medical only differential) in the first quarter post-injury.

Figure 1: Triple Difference Estimates for Employment Outcomes



Source: Authors' calculations, WCIS-EDD data. Point estimates from triple-differences event study plotted along with 95% confidence intervals. Specification includes all two-way interactions between work arrangements, indemnity benefit vs. medical only sample, and time-relative-to-injury. Interactions based on class code, work arrangements, calendar time of injury, and time-relative-to-injury also included. Controls (interacted with time-relative-to-injury) include age-gender interactions, job tenure, type of injury, geographic region, full-time/part-time status (pre-injury), and quartiles of the administrative workers' compensation weekly wage variable. Confidence intervals adjusted for clustering by class code, quarter of injury, and quarter relative to injury.

Over time, however, we find that these differences converge. The differential shrinks to 2.5 percentage points by seven quarters after injury, a meaningful difference but one-third the size of the original differential. We can statistically reject that temporary and direct-hire workers experience the same employment effects throughout the post-injury period.

Thus, we observe rather striking evidence of a large employment reduction for temporary workers relative to direct-hires injured in the same job class at the same time. Despite the convergence of these post-injury trends over time, we are finding rather large effects

even two years after the date of the injury, implying long-term effects of workplace injuries. Given the employment risk associated with workplace injuries in general and the evidence that workplace injuries increase SSDI enrollment for a broad set of workers, this evidence suggests that temporary and contract workers are disproportionately affected by workplace injuries, resulting in significant employment and disability risk over the long-term.

5.2 Difference-in-Differences components

The Figure 1 estimates could potentially be driven by decreases in employment of temporary workers with indemnity benefits, or by increases in employment temporary workers with medical-only injuries. In this section, we present the underlying difference-in-difference estimates for both groups. We first show the difference-in-differences estimates for the indemnity benefit group. This analysis compares temporary worker outcomes to direct hire outcomes using the specification

$$\begin{aligned} y_{icqt} =& \mu_{cqt} + \sum_{s=-4}^{8} T_i \beta_s^T \mathbf{1}\{t-q=s\} \qquad \textit{(temp vs. direct hire)} \\ &+ \sum_{s=-4}^{8} \beta_s^X X_i \mathbf{1}\{t-q=s\} \qquad \textit{(observable characteristics)} \\ &+ \varepsilon_{icqt}. \end{aligned} \tag{2}$$

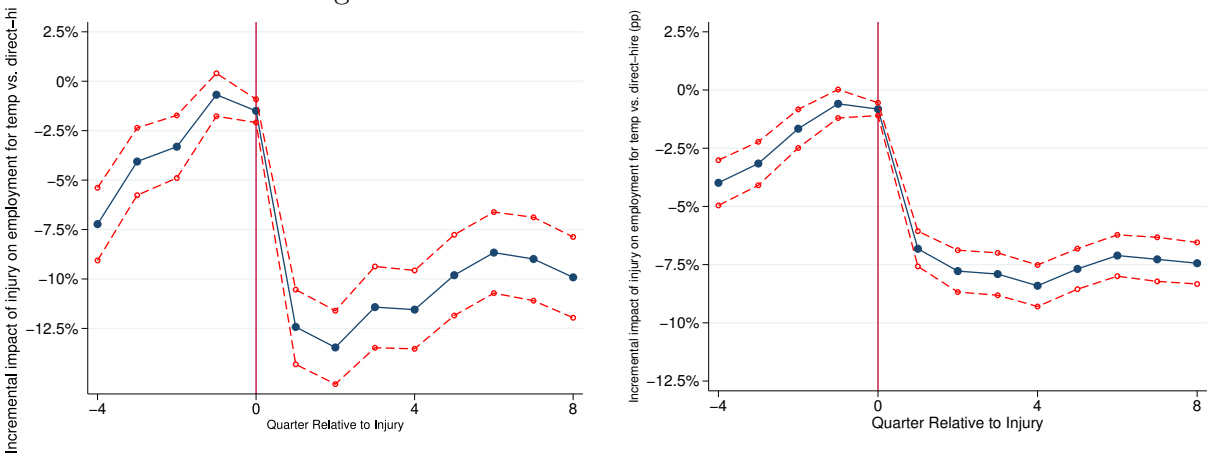
Figure 2A presents the estimates for those receiving indemnity benefits. We observe evidence of a rise in employment before the injury, followed by a sharp relative decline in employment for temporary workers after suffering a workplace injury.

Figure 2B presents the corresponding difference-in-differences figure for the medical only claims. Note that these estimates are essentially the "control" in the triple-difference specification. Here, we also observe pre-existing differential increases in employment propensities. One advantage of the triple-differences specification is that we account for these underlying differences between temporary and direct-hire workers that exist even prior to injury.

We observe similar pre-injury trends for both the medical only and indemnity benefit groups, suggesting that these trends represent the natural (differential) progression of employment rates prior to a workplace injury.

In Figure 2B, we also observe a large relative decrease post-injury, suggesting that temporary workers in the medical only group also suffer large employment decreases due to workplace injuries. Thus, our triple-difference estimates likely represent a lower bound of the true effect. However, the medical only group also provides a nice counterfactual for the differences in employment trajectories that we might expect between temporary workers and direct-hires. We conclude that our previous triple-difference estimates were not driven by differentially positive employment experiences for temporary workers with medical only claims.

Figure 2: Difference-in-Differences Estimates



A: Indemnity Benefit Sample B: Medical Only Sample

Notes: Point estimates from difference-in-differences event study plotted along with 95% confidence intervals. Interactions based on class code, calendar time of injury, and time-relative-to-injury included. Controls (interacted with time-relative-to-injury) include age-gender interactions, job tenure, type of injury, geographic region, full-time/part-time status (pre-injury), and quartiles of the administrative workers' compensation weekly wage variable. Confidence intervals adjusted for clustering by class code, quarter of injury, and quarter relative to injury.

5.3 Selection Concerns

We only observe injured workers who make a workers' compensation claim. Injured workers claiming workers' compensation benefits are likely different from non-claiming injured

workers. To some extent, we are primarily concerned with differences among the claiming populations. Moreover, claiming behavior will only affect our results if it is systematically different across contingent workers and direct-hires, and these differences are not adequately controlled for by differences observed in the medical only sample. However, it is of interest to what extent the observed differences estimated above are driven by systematic selection. We replicate our analysis while selecting only on traumatic injuries. There is less scope for reporting differences for traumatic issues so selection should be less of a concern for this sample.

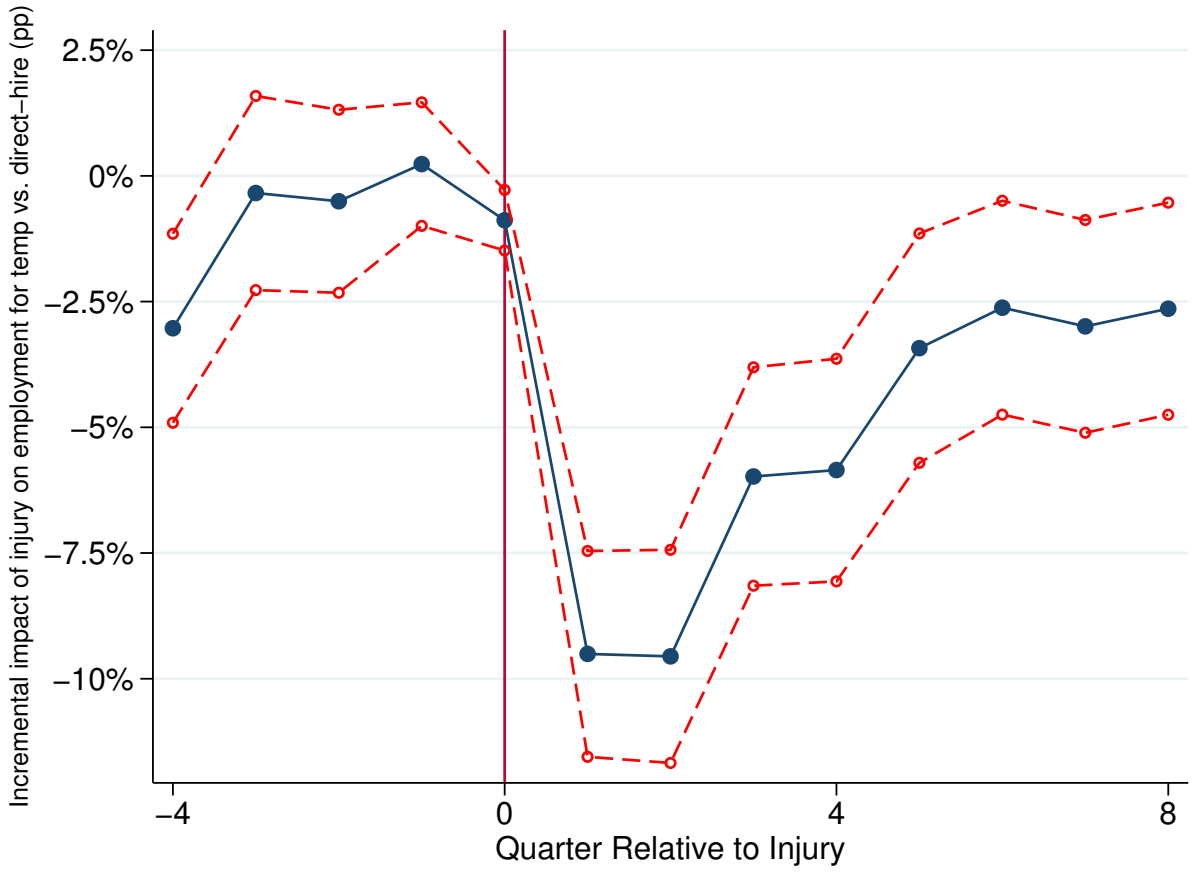
Figure 3 presents these results. While noisier due to the smaller sample, the results are similar to the main estimates presented in Figure 1. The consistency of the estimates suggests that differential selection is not driving the main results.

Table 5: Triple-Differences Estimates

	All Injuries		
	4 quarters prior	4 quarters post	8 quarters post
DDD	-0.0091	-0.0539***	-0.0294***
	(0.0075)	(0.0089)	(0.0085)
N	5,866,029	5,866,029	5,866,029
	Traumatic Injuries Only		
	4 quarters prior	4 quarters post	8 quarters post
DDD	-0.0303**	-0.0585***	-0.0264*
	(0.0096)	(0.0113)	(0.0108)
N	3,466,333	3,466,333	3,466,333

Notes: ***Significance .1%, ** Significance 1%, * Significance 5%. Specification includes all two-way interactions between work arrangements, indemnity benefit vs. medical only sample, and time-relative-to-injury. Interactions based on class code, work arrangements, calendar time of injury, and time-relative-to-injury. Controls (interacted with time-relative-to-injury) include age-gender interactions, job tenure, type of injury, geographic region, full-time/part-time status (pre-injury), and quartiles of the administrative workers' compensation weekly wage variable. Standard errors in parentheses adjusted for clustering by class code, quarter of injury, and quarter relative to injury.

Figure 3: Triple Difference Estimates for Employment Outcomes – Traumatic Injuries Only



Notes: Point estimates from triple-differences event study plotted along with 95% confidence intervals. Specification includes all two-way interactions between work arrangements, indemnity benefit vs. medical only sample, and time-relative-to-injury. Interactions based on class code, work arrangements, calendar time of injury, and time-relative-to-injury also included. Controls (interacted with time-relative-to-injury) include age-gender interactions, job tenure, type of injury, geographic region, full-time/part-time status (pre-injury), and quartiles of the administrative workers' compensation weekly wage variable. Confidence intervals adjusted for clustering by class code, quarter of injury, and quarter relative to injury.

5.4 Discussion

This study provides estimates of the incremental employment risk following workplace injury associated with temporary or contract employment in comparison to direct-hire employment. We found that temporary workers are 2.9 percentage points (95% CI [-4.6pp, -1.3pp]) less likely to be employed two years after injury in comparison to observably similar direct-hire workers.

By way of context for this estimated difference in employment outcomes, we can consider findings from a related RAND study that compared injured workers with indemnity claims to matched controls who were employed at the same employer but did not file a workers' compensation claim at any time between 2005-2013.[13] That study found that, for the average worker with an indemnity claim in California between 2005-2012, employment two years later was 11.4 percentage points lower relative to a counterfactual based on the labor market outcomes of their matched, uninjured co-workers. Since temporary workers represent only about 3% of indemnity claims in the sample used by Dworsky, Rennane, and Broten (2018), it is reasonable to interpret the 11.4 percentage point estimate as representing the effect of injury for the average direct-hire worker in California. Our estimated 2.9 percentage point reduction in the probability of employment would thus represent a 26 percent increase in the risk of non-employment after two years when compared to similar direct-hire workers.

Because our data do not contain SSDI application or enrollment outcomes, additional assumptions are needed to infer how differences in labor market outcomes after injury might affect the risk of entry onto SSDI. As a highly simplified model of SSDI eligibility and application behavior, we can assume that SSDI-eligible workers who are currently employed

[13] See Dworsky, Rennane, and Broten (2018, in press). It is critically important to use a control group to measure the earnings and employment losses due to workplace injury because earnings dynamics for a sample of currently employed workers will be driven in large part by workers who transition to non-employment as the employment rate reverts from 100 percent (by construction) at the time of injury toward the long-run average.

are able to apply to SSDI ($A = 1$) when they both have a disabling health condition ($D = 1$) and transition to non-employment ($E = 0$) for a sustained period in the future. The relationship between injury risk, employment risk, and SSDI program outcomes conditional on temporary ($T = 1$) vs. direct-hire status ($T = 0$) could then be expressed as:

$$P(DI = 1|T) = P(D = 1|T)P(E = 0|D = 1, T)P(A = 1|D = 1, E = 0, T) \tag{3}$$

The relative risk of future SSDI entry for temporary workers compared to direct-hire workers (given that both are currently employed) could then be written as

$$\overbrace{\frac{P(DI = 1|T = 1)}{P(DI = 1|T = 0)}}^{\substack{\text{RR of SSDI Entry} \\ \text{Temp Relative to Direct-Hire}}} = \overbrace{\frac{P(D = 1|T = 1)}{P(D = 1|T = 0)}}^{\text{RR of Injury}} \overbrace{\frac{P(E = 0|D = 1, T = 1)}{P(E = 0|D = 1, T = 0)}}^{\substack{\text{RR of Non-Employment} \\ \text{Conditional on Injury}}} \overbrace{\frac{P(A = 1|D = 1, E = 0, T = 1)}{P(A = 1|D = 1, E = 0, T = 0)}}^{\substack{\text{RR of SSDI Entry} \\ \text{Conditional on Injury and Non-Employment}}} \tag{4}$$

That is, the probability that a currently employed worker in good health enters SSDI by a given point in time is the product of the probability of disability onset, the probability of future non-employment conditional on disability onset, and the probability of application conditional on non-employment and disability onset. Our estimates, in conjunction with the overall impact of indemnity injury on employment, suggests that the second term on the right-hand side is roughly 1.26. Data collection for this study was limited to workers with workers' compensation claims and their matched controls, so we did not attempt to estimate incidence rates of indemnity injuries or the relative risk associated with temporary employment. Indeed, because our research strategy relies on the workers' compensation class code to group together temporary and direct-hire workers in similar jobs, it is not clear to us that it would be possible to measure temporary worker exposures at the class code level even

if we had access to the entire EDD Base Wage File. Exposure data at the NAICS industry level would not allow us to differentiate temporary agency or PEO employees by the work performed at the host employer.

Fortunately, researchers at the Washington State Department of Labor and Industries (the state's exclusive workers' compensation insurer) have estimated incidence rate ratios for temporary work because Washington uses 19 separate class codes to differentiate between temporary workers performing different types of work (Smith et al., 2010). Smith et al. (2010) report very high incidence rate ratios (IRRs) when comparing temporary worker classifications in high-risk industries to comparable NAICS industries.[14] The total IRR for temporary versus direct-hire workers is 2.67 in construction, 3.07 in manufacturing, and 1.11 in transportation and warehousing. In other industries, the IRR for temporary versus direct-hire workers is 0.59.

The incidence rate ratios we calculated based on the figures in Smith et al. (2010) indicate that both injury rates and employment outcomes after injury may lead to elevated risk of SSDI entry for temporary workers in high-risk industries, but that the relative importance of injury risk and employment risk conditional on injury vary widely across industries. In construction and manufacturing, the relative risk of injury for temporary workers dwarfs the relative risk of non-employment conditional on injury. In transportation and warehousing, however, differences in employment risk after injury may be more important than differences in injury risk. We caution that these calculations require strong assumptions and should be viewed as reflecting rough orders of magnitude rather than precise estimates. For one thing, we have combined estimates from Washington between 2003-2006 with estimates from California in 2005-2012. Furthermore, the IRR estimates in Smith et al. (2010) are not ad-

[14]Table IV of Smith et al. (2010) partitions injury claims into eight categories and reports unadjusted industry-specific injury counts, incidence rates, and IRRs for temporary relative to direct-hire workers within four industries: construction, manufacturing, transportation and warehousing, and all others. We calculated an overall lost-time injury incidence rate for each industry, which is equivalent to summing the injury-specific injury rates.

justed (beyond stratification by industry) and are thus likely to confound within-industry differences between temporary and direct-hire workers in important risk factors like age and job tenure. This could lead Smith et al. (2010) to overestimate of the relative risk associated with a difference in labor contract type holding constant job and worker characteristics, whereas our regression estimates control for these factors.

The above calculations suggest that differences in post-injury employment outcomes between temporary and direct-hire workers likely represent a meaningful increase in the overall probability that a worker will both disabled and non-employed, placing them at elevated risk for entry onto SSDI. The relative importance of employment risk and injury risk may differ across industries.

6 Conclusion

This study used administrative data from California to study whether temporary workers face greater employment risk than similar direct-hire workers following a disabling workplace injury. Using a triple-difference identification strategy that controls for the very different employment dynamics observed for temporary and direct-hire workers even in the absence of a workplace injury, we found that temporary workers are 2.9 percentage points less likely than observably similar direct-hire workers to be employed two years after injury, an increase of 26 percent in the risk of non-employment due to injury. Our findings suggest that the additional health and safety risks associated with temporary work may increase labor income risk and the size of the population likely to apply for SSDI through differences in labor market outcomes after injury as well as through an elevated risk that an injury will occur. Although some unobservable differences in jobs and human capital are likely to exist between temporary and direct-hire workers even after conditioning on the rich set of observable characteristics available in our data, we maintain that our triple-difference research design represents a credible attempt to isolate the effect of labor contract type on post-injury

employment dynamics while holding constant confounding factors known to differ between temporary and direct-hire workers such as job tenure, age, work environment, and type of injury.

Our findings underscore that improvements in injury prevention for temporary workers may warrant attention, since employment risk after injury appears to be greater for temporary and contract workers. Even if injury rates were equalized between temporary and direct-hire workers, however, our estimates suggest that temporary workers would continue to face greater employment risk.

This study also raises several economic and policy questions that should be addressed in future studies using other data sources. Additional research will be needed to verify whether the employment differences identified in this study do, in fact, result in increased SSDI applications or entry for temporary workers who experience workplace injuries. Our analysis relies on findings reported by O'Leary et al. (2012) that lost-time injury doubles the hazard of entering SSDI to infer that workers with lost-time injuries who exit the labor force are at elevated risk of SSDI entry. This seems reasonable, but it will be difficult to interpret the magnitude of our effects without direct measurement of SSDI program outcomes for injured temporary workers. This question has not been directly addressed in part because of data limitations. It is already rare for administrative datasets to combine information on injuries or health status with labor market outcomes, and integrating these data with social security outcomes requires an additional layer of federal-state coordination. Panel survey datasets such as the PSID, SIPP, or HRS contain the necessary data elements, but are unlikely to contain sufficient sample sizes of nonstandard workers to study labor market outcomes specifically among members of this population who experience a workplace injury; there is also the problem that it can be challenging to identify nonstandard workers on the basis of survey data.

The net federal budget impact of continued growth in alternative work arrange-

ments also requires additional investigation. Our findings highlight an additional mechanism through which alternative work arrangements may lead to greater disability risk holding constant job characteristics, worker demographics, and injury risk: temporary workers are not only at greater risk of experiencing workplace injury, as previously established, but they are also more likely, after an injury, to transition to non-employment and earn below the Substantial Gainful Activity threshold. However, because workers in alternative work arrangements earn lower wages and are likely to have lower earnings and less job security, workers with a substantial history of nonstandard work may be less likely to become or remain eligible for SSDI benefits. This problem is likely more important for independent contractors than for temporary and contract workers. Our data are not appropriate to address this question directly, but SSA earnings data such as the Detailed Earnings Record or W-2 data maintained by the Department of the Treasury should allow government researchers to examine the association between alternative work histories and SSDI eligibility.

Finally, as we discussed in the introduction, the finding that employment risk differs between temporary and direct-hire workers raises questions about the optimality of workers' compensation benefit design for the nonstandard workforce. Future work with our dataset will attempt to compare benefit adequacy for the temporary and direct-hire workers in our sample, and to explore whether differences in benefit adequacy are aligned with differences in the responsiveness of disability duration or labor supply to benefit generosity. Evidence on these questions for the temporary and contract workforce can help to shed light on the likely welfare implications of expanding workers' compensation in its current form to independent contractors or gig workers.

References

Abraham, K. G. (2018). What Do We Know About Nonstandard Work?

American Public Health Association (2017). The Critical Need to Reform Workers' Compensation. pp. 1–8.

Andersson, F., H. J. Holzer, and J. Lane (2009). Temporary Help Agencies and the Advancement Prospects of Low Earners. In D. H. Autor (Ed.), *Studies of Labor Market Intermediation*, Number November, Chapter 11, pp. 373–398. Cambridge, MA: University of Chicago Press.

Autor, D. H. and S. N. Houseman (2010). Do Temporary-Help Jobs Improve Labor Market Outcomes for Low-Skilled Workers? Evidence from "Work First". *American Economic Journal: Applied 2*(3), 96–128.

Autor, D. H., S. N. Houseman, and S. P. Kerr (2016). The Effect of Work First Job Placements on the Distribution of Earnings: An Instrumental Variable Quantile Regression Approach. *Journal of Labor Economics 35*(1).

Baldwin, M. and C. McLaren (2016). Workers ' Compensation: Benefits, Coverage, and Costs, (2014 data). Technical Report October, National Academy of Social Insurance, Washington, DC.

Benavides, F. G., J. Benach, C. Muntaner, G. L. Delclos, N. Catot, and M. Amable (2006). Associations between temporary employment and occupational injury: what are the mechanisms? *Occup Environ Med 63*, 416–421.

Boden, L. I., P. K. O'Leary, K. M. Applebaum, and Y. Tripodis (2016). The Impact of Non-Fatal Workplace Injuries and Illnesses on Mortality. *American journal of industrial medicine 59*, 1061–1069.

Bureau of Labor Statistics (2017). Employer-related Workplace Injuries and Illnesses 2016. (202), 2011–2014.

Butler, R. J., H. H. Gardner, and N. L. Kleinman (2013). Workers' Compensation: Occupational Injury Insurance's Influence on the Workplace. In G. Dionne (Ed.), *Handbook of Insurance*, pp. 449–469. New York, NY: Springer.

Cook, J. A., J. K. Burke-Miller, and D. D. Grey (2015). Impact of Contingent Work on Subsequent Labor Force Participation and Wages of Workers with Psychiatric Disabilities.

Dworsky, M., S. A. Seabury, F. W. Neuhauser, U. Kharel, and R. Euller (2016). *Benefits and Earnings Losses for Permanently Disabled Workers in California: Trends Through the Great Recession and Impacts of Recent Reforms*. Santa Monica, CA: RAND Corporation.

Fabiano, B., F. Currò, A. P. Reverberi, and R. Pastorino (2008). A statistical study on temporary work and occupational accidents: Specific risk factors and risk management strategies. *Safety Science 46*(3), 535–544.

Foley, M. (2017). Factors underlying observed injury rate differences between temporary workers and permanent peers. *American Journal of Industrial Medicine 60*(10), 841–851.

Foley, M., J. Ruser, G. Shor, H. Shuford, and E. Sygnatur (2014). Contingent workers: Workers' compensation data analysis strategies and limitations. *American Journal of Industrial Medicine 57*(7), 764–775.

Guo, X. and J. F. Burton (2012). The Growth in Applications for Social Security Disability Insurance: A Spillover Effect from Workers' Compensation. *Social Security Bulletin 72*(3), 69–88.

Heinrich, C., P. Mueser, and K. Troske (2005). Welfare to temporary work: implications for labor market outcomes. *Review of Economics and Statistics 87*(February), 154–173.

Howard, J. (2016). Nonstandard work arrangements and worker health and safety. *American Journal of Industrial Medicine 10*, 1–10.

Jackson, E., A. Looney, and S. Ramnath (2017). The Rise of Alternative Work Arrangements: Evidence and Implications for Tax Filing and Benefit Coverage. *Office of Tax Analysis Working Paper* (114).

Katz, L. F. and A. B. Krueger (2016). The Rise and Nature of Alternative Work Arrangements in the United States, 1995-2015.

Kilcoyne, P. (2004). Occupations in the Temporary Help Services Industry.

Krueger, A. B. (2017). Independent Workers: What Role for Public Policy.

Lane, J., K. S. Mikelson, P. Sharkey, and D. Wissoker (2003). Pathways to Work for Low-Income Workers: The Effect of Work in the Temporary Help Industry. *Journal of Policy Analysis and Management 22*(4), 581–598.

Leigh, J. P. (2011). Economic Burden of Occupational Injury and Illness in the United States. *Milbank Quarterly 89*(4), 728–772.

Leigh, J. P. and J. P. Marcin (2012). Workers Compensation Benefits and Shifting Costs for Occupational Injury and Illness. *Journal of Occupational and Environmental Medicine 54*(4), 445–450.

McInerney, M. and K. Simon (2012). The effect of state workers' compensation program changes on the use of federal social security disability insurance. *Industrial Relations 51*(1), 57–88.

McLaren, C. F. and M. L. Baldwin (2017). *Workers ' Compensation : Benefits, Coverage, and Costs*. Number October.

Meyer, B., W. K. Viscusi, and D. Durbin (1995). Workers' Compensation and Injury Duration. *American Economic Review 151*(3712), 867–8.

Occupational Safety & Health Administration (2015). Adding Inequality To Injury: the Costs of Failing To Protect Workers on the Job. Technical report.

O'Leary, P., L. I. Boden, S. A. Seabury, A. Ozonoff, and E. Scherer (2012). Workplace Injuries and the Take-Up of Social Security Disability Benefits. *Social Security Bulletin 72*(3), 1–17.

Park, Y. and R. J. Butler (2001). The safety costs of contingent work: Evidence from Minnesota. *Journal of Labor Research XXII*(4), 831–849.

Reville, R. T. and R. F. Schoeni (2004). The fraction of disability caused at work. *Social security bulletin 65*(4), 31–37.

Smith, C. K., B. a. Silverstein, D. K. Bonauto, D. Adams, and Z. J. Fan (2010). Temporary Workers in Washington State. *American journal of industrial medicine 53*, 135–145.

Smith, C. K., B. A. Silverstein, D. K. Bonauto, D. Adams, and Z. Joyce Fan (2010). Temporary workers in Washington State. *American Journal of Industrial Medicine 53*(2), 135–145.

Spieler, E. A. (2017). (Re)assessing the Grand Bargain: Compensation for Work Injuries in the U.S., 1900-2016.

Underhill, E. and M. Quinlan (2011). How Precarious Employment Affects Health and Safety at Work: The Case of Temporary Agency Workers. *Relations industrielles 66*, 397–421.

U.S. Department of Labor (2016). Does the Workers' Compensation System Fulfill Its Obligations to Injured Workers? Technical report.

WCIRB (2013). California Workers' Compensation Uniform Statistical Reporting Plan - 1995.

Zaidman, B. (2017). Examining the injuries of temporary help agency workers.

A Appendix: List of Class Codes in Analysis Sample

0016:ORCHARDS - CITRUS AND DECIDUOUS FRUITS

0042:LANDSCAPE GARDENING

0050:FARM MACHINERY OPERATION

2003:BAKERIES AND CRACKER MFG

2107:FRUIT - FRESH FRUIT PACKING

2108:FRUIT - CITRUS FRUIT PACKING

2109:FRUIT - DRIED FRUIT PACKING

2111:FRUIT OR VEGETABLE PRESERVING

2142:WINERIES

2501:CLOTHING MFG

2812:CABINET MFG - WOOD

3060:DOOR OR WINDOW MFG - METAL OR PLASTIC

3179:ELECTRICAL APPARATUS MFG

3507:MACHINERY OR EQUIPMENT MFG

3572:MEDICAL INSTRUMENT MFG - ELECTRONIC

3577:PRINTED CIRCUIT BOARD ASSEMBLING

3632:MACHINE SHOPS - NOC

3681:INSTRUMENT MFG - ELECTRONIC

4299:PRINTING - ALL OTHER EMPLOYEES

4354:PRINTED CIRCUIT BOARD MFG

4478:PLASTIC GOODS MFG

5146:CABINET OR FIXTURES - INSTALLATION

5183:PLUMBING - LOW WAGE

5190:ELECTRICAL WIRING - LOW WAGE

5201:CONCRETE WORK - SIDEWALKS - LOW WAGE

5213:CONCRETE CONSTRUCTION

5348:TILE, STONE, MOSAIC OR TERRAZZO WORK

5403:CARPENTRY - NOC - LOW WAGE

5474:PAINTING OR DECORATING - LOW WAGE

5552:ROOFING - LOW WAGE

6504:FOOD PRODUCTS MFG OR PROCESSING

7198:PARCEL DELIVERY COMPANIES

7219:TRUCKING FIRMS

7382:BUS OR LIMOUSINE OPERATIONS

7610:RADIO TELEVISION BROADCASTING STATION

8008:STORES - CLOTHING AND DRY GOODS - RETAIL

8017:STORES - RETAIL

8018:STORES - WHOLESALE

8031:STORES - MEAT, FISH OR POULTRY - RETAIL

8032:STORES - CLOTHING, DRY GOODS - WHOLESALE

8046:STORES - AUTOMOBILE ACCESSORIES

8062:STORES - COMPUTERS

8232:LUMBERYARDS - COMMERCIAL

8290:WAREHOUSES - SELF STORAGE

8291:WAREHOUSES - COLD STORAGE

8292:WAREHOUSES - GENERAL MERCHANDISE

8742:SALESPERSONS - OUTSIDE

8808:BANKS

8810:CLERICAL OFFICE EMPLOYEES

8827:HOMEMAKER SERVICES

8829:NURSING HOMES

8834:PHYSICIANS

8859:COMPUTER PROGRAMMING OR SOFTWARE DEVELOPMENT

9008:JANITORIAL SERVICES - BY CONTRACTOR

9009:BUILDING OPERATION - COMMERCIAL

9011:APARTMENT OR CONDOMINIUM COMPLEX OPERATION - ALL OTHER EMPLOYEES

9015:BUILDING OPERATION

9043:HOSPITALS

9050:HOTELS

9070:RESIDENTIAL CARE FACILITY - ELDERLY

9079:RESTAURANTS OR TAVERNS

9403:GARBAGE, ASHES OR REFUSE COLLECTING

9424:GARBAGE, ASHES OR REFUSE DUMP OPERATIONS