The Long-Term Effects of Workplace Injury on Labor Market Outcomes: Evidence from California*

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Abstract

Although workplace injury is more common than job displacement, we have limited evidence about the long-term impacts of workplace injury on earnings, employment or labor force exit due to disability or retirement. We link workers' compensation claims data for California workers injured in 2005 to earnings records spanning 2003-2019, providing a long panel for analyzing the long-term effects of workplace injuries. Our difference-in-differences research design compares injured workers who were paid benefits for lost work time (temporary disability) or permanent impairment (permanent disability) to "medical-only" workers with minor injuries. We estimate large reductions in employment and earnings due to workplace injuries. Difference-in-differences estimates controlling for worker characteristics find earnings losses averaged \$920 per quarter over 14 years post-injury (or \$51,000 without discounting). Event-study estimates show that earnings losses as a percentage of counterfactual earnings do shrink over time (from 19.6% over years 1-4 post-injury to 10.9% over years 10-14 post-injury), yet the presence of a 10.9% earnings reduction more than 10 years after injury suggests that average impacts on labor market outcomes are highly persistent. We also estimate hazard models that examine whether the rate of labor force exit responds to incentives created by Social Security's disability and retirement programs, exploiting age-specific thresholds in program eligibility. We find no evidence of increased labor force exit for injured workers at the Early or Normal Retirement Age, but we do find suggestive evidence that more favorable disability evaluation rules for workers aged 55 and over are associated with increased labor force exit among injured workers.

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1 Introduction

In 2020, there were 2.7 million nonfatal workplace injuries and illnesses in the United States.[1] Workplace injuries represent large health and economic shocks to households and create substantial societal costs as well; the number of workplace injuries annually outpaces the number of displaced workers. However, we have a limited understanding of the long-term economic effects of workplace injuries. As workplace safety and compensation for injuries incurred at work are influenced by policy, extensive knowledge of the full costs of injuries is needed. Long-term effects are especially critical to quantify to understand the potential enduring effects of workplace injuries which potentially outlast workers' compensation benefits.

While a large literature quantifies the costs of job displacements to households (e.g., Kletzer and Fairlie (2003); Podgursky and Swaim (1987); Stevens (1997)), there is limited work studying short- and medium-term effects of workplace injuries and even less focused on understanding the long-term impacts. Research has documented earnings losses after injury lasting up to ten years post-injury (Seabury et al., 2014), and a small literature attempts to estimate the relationship between workplace injuries and longer-term mortality (Boden et al., 2016) and SSDI enrollment (O'Leary et al., 2012) as measures of long-term effects. However, workplace injuries potentially represent life-altering events for workers and households, permanently altering earnings potential and ability or willingness to work. We have a limited empirical understanding of these enduring economic consequences.

A related literature studies how workers' compensation benefit generosity affects injury duration (e.g., Neuhauser and Raphael (2004a)), typically with a specific focus on returns during the period of benefit receipt. Several papers explore how workplace injuries alter earnings potential in the first years after the injury. There is limited work exploring longer-term effects. Boden and Galizzi (1999, 2003) study earnings up to 4 years after injury. Crichton et al. (2011a) study outcomes for up to 3 years post-injury for New Zealand workers. Woock (2009) uses the NLSY to study earnings up to 6 years post-injury. Two studies exist with ten-year follow-up: Dong et al. (2016) study 10 year effects in the NLSY (focusing on construction workers), and Seabury et al. (2014) study earnings up to 10 years after injury for injured workers from New Mexico. These studies show that earnings losses are very persistent, but had a limited ability to examine mechanisms and dynamics of earnings losses due to limited sample sizes.

The shortage of evidence in this area is likely due to a few factors. First, it is necessary to link workplace injuries to long-term earnings records, a merge that requires linking

[1] See `https://www.bls.gov/news.release/osh.nr0.htm`.

multiple restricted data sources together. Prior studies have often relied on self-reported injury and earnings histories. Second, even when using administrative workers' compensation claims to study injury duration, it is often difficult to follow injured workers past the point of their interaction with the workers' compensation system. Third, the literature often compares injured workers to uninjured workers, typically relying on fixed effects to account for differences between injured and uninjured workers with few useful tests of the comparability of the groups. This approach can lead to comparisons between workers with quite different levels of pre-injury earnings or with different demographics, which alone might predict differential trends even in the absence of injuries.

Despite these difficulties, quantifying the long-term costs is critical for several reasons. First, this type of analysis may show that some fraction of workers are disproportionately impacted by workplace injuries in ways that can be measured even a decade later. Workers' compensation systems, while designed specifically to compensate workers for earnings losses due to workplace injuries, may not be designed to provide adequate protection against such enduring and large economic losses given the short length of temporary benefits and the typically lower benefit levels associated with permanent benefits.[2] Understanding the magnitude and prevalence of these types of losses is a first-order question for policy. Injuries resulting in long-term earnings reductions also potentially reflect additional burdens on other social insurance programs given that many programs depend on income thresholds and some, like SSDI, consider work-limiting disabilities specifically.

The possible long-term effects of workplace injuries also help inform our understanding of the importance of health and disability for labor outcomes as we are able to observe how large health shocks alter earnings potential. Labor outcomes are functions of human capital, which is often considered fixed or gradually changing over time. Workplace injuries represent large and often immediate reductions in work capacity. This paper provides evidence about the long-term effects of such human capital shocks.

In this paper, we study the earnings and labor force participation of injured workers for up to 14 years post-injury. We link administrative workers' compensation claims data to Unemployment Insurance records in California. We use "medical-only" injuries as a comparison group. These workers were injured and filed a claim, but were not injured severely enough to miss more than three days of work. Because these workers filed workers' compensation claims, the same covariates observed for workers with indemnity injuries are

[2]Future work on this paper will analyze differences in post-injury earnings dynamics between workers with and without permanent disability benefits, which in California are assigned on the basis of a medical examination after the worker reaches maximum medical improvement.

also observed for those with medical-only injuries, allowing us to adjust for age, gender, and other characteristics.[3]

Prior work has found that workplace injuries result in large earnings losses (Dworsky et al., 2016a; Hunt and Dillender, 2017a). It is not clear a priori whether the long-run impact of injury on labor force exit will be smaller or larger than suggested by currently available medium-term estimates (up to 3 years post-injury). On the one hand, reductions in employment following injury may be transitory for some workers due to medical improvement or to "lock-in" effects during vocational rehabilitation (Holm et al., 2017). On the other hand, workers who initially experience a successful return to work may be more vulnerable to job loss in the future and may experience difficulty finding employment after job separation due to discrimination or other barriers to job search (Boone et al., 2011; Ameri, 2017).

Our paper makes three primary contributions. First, we study the long-term effects of workplace injuries for a timeframe beyond what the literature using administrative data has previously studied. Second, we study these effects for different age groups. The ramification of a workplace injury may be very different at age 25 than age 55. An injury at older ages may prompt an early retirement. There is little evidence in the literature about age-specific heterogeneity. Third, we also consider age-specific impacts in terms of access to alternative forms of income support and social insurance. Social insurance programs can, and often do, include age-specific information when determining benefit propensities. We evaluate whether earnings and employment disproportionately respond to age thresholds in other social insurance programs for injured workers. While we do not directly observe program benefit receipt, this evidence would suggest that workplace injuries are impact enrollment in other social insurance programs.

2 Background

Earnings Losses Due to Injury Prior studies have estimated earnings losses due to injury in a number of state and (Canadian) provincial workers' compensation systems, including California, Michigan, New Mexico, Oregon, Washington, Wisconsin, and several Canadian provinces. Hunt and Dillender (2017a) provide a thorough review of this literature. Studies in the literature vary due to differences in workers' compensation programs across states, over time, and in the particular methodology used to estimate the potential

[3] We also match each injured worker to uninjured workers in the same firm. This match is based on earnings in the year prior to the injury and tenure at the firm. These matched workers provide a counterfactual earnings and employment trajectory for the injured workers. We do not estimate earnings losses compared to these workers in the current draft of this paper because data on age and other covariates is unavailable for workers who do not file a workers' compensation claim. We plan to use them for sensitivity analyses in future work, however.

wage loss of injured workers.

Some of the earliest studies surveyed injured workers directly to ask about their wage losses after injury (Johnson et al., 1979) (Johnson, Cullinan, and Curington, 1979; California Workers' Compensation Institute, 1984). Subsequently, a series of studies estimated wage loss by comparing a worker's pre- and post-injury earnings with administrative earnings records (for example, from the Social Security Administration (Berkowitz and Burton Jr, 1987) (Tompa et al., 2010) or by comparing lost earnings between injured workers who missed work for extended periods of time and injured workers missing only one or two weeks of work (Boden and Galizzi, 2003; Galizzi and Boden, 2003). Other studies, including Seabury et al. (2014) and Savych and Hunt (2017), compare earnings losses for workers with indemnity benefits to workers with medical-only claims. And, finally, another series of reports compares earnings between injured and similar uninjured workers in the same firm (Peterson et al., 1998; Reville et al., 2001; Reville, Bhattacharya, and Sager Weinstein, 2001). Crichton et al. (2011b) used a similar approach with matched employer-employee data in New Zealand.

Despite the early use of pre-post analyses, this small literature has generally recognized that it is important to account for natural changes in employment propensities and earnings growth. Assuming that earnings would continue to grow at some constant rate requires the fairly strong assumption that the worker would not have experienced any other voluntary or involuntary disruptions in employment, despite the fact that these events are fairly common.

Workers' Compensation and Disability Duration Much of the literature on workers' compensation studies how injury duration responds to temporary disability benefit generosity (Meyer et al., 1995; Neuhauser and Raphael, 2004b; Cabral and Dillender, 2020). This literature has found ample evidence that temporary disability duration increases when the wage replacement rate (benefits as a percentage of the worker's typical weekly wage) is higher. Given the long-term focus of our paper, however, we do not analyze the role that such behavioral responses play in modifying the causal effect of injury on labor market outcomes.

We abstract from labor supply incentives created by workers' compensation because we are studying outcomes up to 14 years post-injury. California temporary total disability (TTD) benefits, which are conditioned on work absence (and this create very high effective marginal tax rates on labor income for workers considering return to work) are capped at 104 weeks (2 years) over the life of the claim. Substitution or income effects in labor supply driven by TTD benefits should not affect labor supply after TTD benefits are terminated (either when the worker's condition stabilizes or the treating physician deems the worker to have reached *maximum medical improvement*). California's permanent disability (PD) benefits, meanwhile, are determined on the basis of a disability rating assigned by a medical examiner and are paid regardless of the worker's labor supply or employment status. PD benefits should not create substitution effects, and we assume that income effects generated by PD benefits are not large enough to contribute meaningfully to earnings losses over the long-term follow-up period examined here.[4]

We note that we are unable to observe participation in other disability programs that are also known to discourage labor supply, and we cannot rule out the possibility that some of the earnings losses estimated reflect labor supply disincentives created by other programs. Our hazard analysis of labor force exit at key ages in the SSDI and SS Retirement programs (discussed below) attempts to provide some evidence on the potential role of incentives created by SSA programs as a mechanism contributing to the long-term consequences of injury.

Job Displacement A rich literature studies the long-term effects of job displacement using administrative earnings data similar to the data we use for this study (Jacobson et al., 1993; Kletzer, 1998).[5] These papers have documented long-term adverse effects of job displacement on labor market outcomes, a phenomenon referred to as *scarring*. Scarring effects after job displacement, which have been documented in both European and US labor markets, are generally attributed to the destruction of firm-specific human capital that results from job displacement (Kletzer, 1998).

Workplace injury might be viewed as similar to job displacement in the sense that both displacement and injury are exogenous to the individual worker and are likely to result in job separation. Unlike job displacement, workplace injury by definition involves an adverse health event for the worker that affects the worker's capacity to work. The involvement of a health shock is one reason why we might expect to see scarring effects after workplace injury of a similar or greater magnitude to those observed after job displacement. However, because job displacement simultaneously affects many or all of an employer's workers (if

[4]Although the current draft of this paper does not examine implications for benefit design or optimal policy in detail, we discuss some evidence comparing the duration of PD benefits to the apparent duration of labor market impacts in the conclusion.

[5]Kletzer (1998) defines displaced workers as follows: "Displaced workers are understood to be individuals with established work histories, involuntarily separated from their jobs by mass layoff or plant closure (rather than because of individual job performance), who have little chance of being recalled to jobs with their old employer."

not the entire region or industry), it might also be reasonable to expect that scarring after workplace injury might be more limited in comparison to job displacement.

Spillover Effects of Workplace Injury and Interactions of WC with Other Programs Workers' compensation benefits do not provide workers with full insurance against earnings losses (Hunt and Dillender, 2017b), and uncompensated earnings losses are widely believed to be borne in part by other public and private insurance arrangements as well as by workers and their families (Leigh and Marcin, 2012). Several lines of research have examined interactions between WC and Social Security Disability Insurance (SSDI), the primary federal social insurance program for disabled workers.

Several papers have examined whether changes in the generosity of WC result in spillover effects on SSDI. Several mechanisms could result in such spillovers, but different plausible mechanisms could lead to opposing effects of WC generosity on SSDI entry.[6] Research on WC-SSDI spillovers has been motivated by two long-term trends that have occurred since the 1980s: SSDI participation grew rapidly for three decades starting in 2014, while workers' compensation programs in many states were reformed in ways that make them less generous to workers.[7] Two papers that leveraged variation across and within states in temporary disability benefits reached differing conclusions about the nature of WC-SSDI spillover effects driven by WC policy changes (McInerney and Simon, 2012; Rupp and Riley, 2011).

Our paper focuses on a cohort of workers injured in a single year (2005), so we are not well-suited to study the effects of WC policy changes on SSDI entry or Social Security Retirement. A more relevant finding on program spillovers comes from a study that linked WC claims from New Mexico to SSA program records, finding that lost-time injuries predicted a substantial increase (6 percentage points at 14 years post-injury, or 60% of counterfactual) in SSDI receipt O'Leary et al. (2012).

Although we did not access SSA program data in this project, we revisit the question of WC-SSDI interactions indirectly by studying how the hazard of non-employment evolves as injured workers reach ages that are accompanied by changes in SSDI application review

[6]Briefly, workers receiving lower WC benefits, whose benefits terminate earlier, or whose claims are denied may have a higher marginal utility of income and may therefore be more likely to apply for SSDI. However, because SSDI applications and appeals may create hardship for workers until benefit payment begins, additional workers' compensation income could make it easier for workers to apply for SSDI.

[7]Workers' compensation reforms in this period frequently limited indemnity benefits or made more subtle changes affecting the likelihood that a claim will be accepted and will thus result in the payment of benefits (Boden and Ruser, 2003). See U.S. Department of Labor (2016); Grabell and Berkes (2015) for more recent critical perspectives.

criteria or Social Security Retirement eligibility and benefits. Although previous research has shown that the onset of poor health affects retirement timing (Hurd and Rohwedder, 2013); however we are not aware of previous research on how workplace injury (a common and exogenous type of health shock) affects retirement timing.

3 Data

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 2005,[8] the earliest year available. We have access to later years of data, but we focused on the earliest injury cohort available so we would have the longest post-injury earnings history possible.

California law requires workers' compensation claims administrators (insurers, self-insured employers, and third-party administrators) to report new claims to the WCIS, and to submit additional reports reflecting material changes in the status of the claim, such as claim closure or the start or end of benefit payments. The WCIS contains basic demographic information about injured workers (age at injury and gender). We also rely on codes for the *Nature, Origin, and Cause of Injury* to classify injuries based on characteristics observed as of the date of injury. The workers' compensation data also allow us to identify workers who receive settlements or benefit payments for Temporary Disability (TD) or Permanent Disability (PD), and to observe the total amount of payments to date.

We use data on paid benefits to distinguish workers with lost-time injuries (those resulting in either temporary or permanent disability) from minor, *medical-only* injuries that either result in no work absence or that result in 3 or fewer days of work absence and so do not result in disability benefit payments. Medical-only injuries receive compensation for medical care received due to an injury received at work. Most injuries are medical-only injuries.

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. 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

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

appearing in the linked data. After identifying injured workers and excluding individuals with inconsistent name information in the Base Wage File, the data were de-identified and assigned an ID number that could be used to match to the WCIS data.[9]

We used the wage records to create a measure of total quarterly wage and salary earnings by summing earnings over all employers in each quarter. We used the Consumer Price Index for All Urban Consumers (CPI-U) to inflate earnings to real 2019$ and winsorized quarterly earnings at $90,358, the 99.8th percentile of quarterly earnings. We also created an indicator variable for employment, which we defined as having positive quarterly earnings from 1 or more employers in a quarter.

We collected data on labor earnings through the fourth quarter of 2019 for all injured workers. In order to explore long-run effects of injury, this version of the paper focuses on workers injured in 2005, which is the earliest injury cohort. For workers injured in 2005Q4, there are 56 quarters (14 years) of post-injury earnings and employment data available, in addition to 8 quarters of pre-injury earnings data and data from the quarter of injury. We constructed a balanced panel containing 65 quarters of earnings and employment data (from eight quarters prior to injury to 56 quarters after injury) for each injured worker. Our main sample consists of workers ages 21-60 at time of injury.

UI earnings records are frequently used to measure labor market outcomes, as they are often the best available source of data on individual earnings. However, there are limitations since we only observe UI-eligible earnings in California. We do not observe other sources of earnings or earnings from work in other states. Our results should be interpreted as the effects on UI earnings/employment in California. The use of a comparison group of workers with medical-only injuries (as we discuss below) is helpful for distinguishing the causal effects of injury from the effects of numerous other factors that might cause workers to exit the California labor force.

4 Empirical Strategy

4.1 Difference-in-Differences

Our main empirical strategy is to compare injured workers receiving indemnity benefits to medical-only workers injured in the same quarter. We estimate the following event-study specification:

$$y_{iqt} = \alpha_{qt} + \beta^I I_i + \sum_{s=-8}^{56} \gamma_s I_i + X_i' \beta^X + \sum_{s=-8}^{56} X_i' \beta_s^X + \varepsilon_{iqt}, \quad (1)$$

[9] Additional details on earnings data collection can be found in Dworsky et al. (2018), specifically Chapter 2 and the Appendix.

where y_{iqt} represents employment or earnings at time t for individual i injured in quarter q. I_i is equal to 1 if the injured worker received indemnity benefits. Medical-only workers injured at time q independently identify the α_{qt} fixed effects.

We are primarily interested in the estimates of γ_s, which trace out the labor outcome trajectory of the indemnity workers relative to the medical-only sample. We omit time effects for the calendar quarter before the quarter of injury ($\gamma_{-1} = 0$). We assess differences in the pre-period as one test of whether the medical-only sample represents an appropriate counterfactual.

To summarize the long-run effects of indemnity injuries, we also estimate a difference-in-differences model with a constant effect over the post-injury period:

$$y_{iqt} = \alpha_{qt} + \beta^I I_i + \gamma I_i \mathbf{1}(t > q) + X_i'\beta^X + \mathbf{1}(t > q) X_i'\beta^{X,\text{post}} + \varepsilon_{iqt}. \tag{2}$$

We report the estimate of γ from this specification.

While a recent literature highlights problems associated with two-way fixed effects models (e.g., Goodman-Bacon (2021)), we do not exploit any differential timing of injuries above. Instead, the controls for each injured workers were injured at the same time. We are not using later (earlier) injuries as controls for earlier (later) injuries so these critiques are not relevant here.

4.1.1 Entropy Balancing to Ensure Parallel Pre-Injury Trends in Earnings

Because of concerns that the different types of injured workers might have different pre-injury earnings trajectories, we provide estimates of equation (2) using weighted least squares, generating weights from entropy balancing (Hainmueller, 2012).[10] Entropy balancing reweights the two groups to balance based on a set of covariates. Our primary focus here is to reweight medical-only workers on pre-injury trends in earnings, which we operationalize as the first-difference of earnings up to the last quarter before the quarter of injury.[11] We define the weights to balance the first and second moments of these pre-injury trends in earnings between medical-only and indemnity injuries. We simultaneously reweight to achieve balance on the first moments of age (dummies for single years of age), gender, age-gender interactions, and the quarter of injury. We will show event study estimates with and without these weights. Weights were calculated for each quarter of injury (2005Q1 to 2005Q4); a balance table confirming that entropy balancing succeeded in balancing the indemnity and

[10] We implement this method using the `ebalance` package in Stata (Hainmueller and Xu, 2013).

[11] That is, if we let y_{-8} denote earnings 8 quarters before injury, y_{-7} denote earnings 7 period before injury, and so on, we balance on $\Delta_{-7}y := y_{-7} - y_{-8}$, $\Delta_{-6}y := y_{-6} - y_{-7}$, and so on up to $\Delta_{-1}y := y_{-1} - y_{-2}$.

medical-only injuries is shown for 2005Q1 in the Appendix (Appendix Table A1).

We note that we do not balance on the level of pre-injury earnings, only the slope of the earnings profile. This is similar in spirit to nearest-neighbor matching approaches used in many previous studies on injured workers' earnings losses (Dworsky et al., 2016b; Reville et al., 2005). Because we reweight on the slope of the earnings profile and not the level of earnings, bias due to mean-reversion (discussed in Daw and Hatfield (2018)) that can occur when matching is combined with difference-in-differences estimators should not be a problem.

4.2 Hazard Models

Event-study estimates of earnings losses are useful to describe the long-term effects of injury and the dynamics of earnings losses over time relative to injury. In order to indirectly examine the impacts of workplace injury on SSDI and Social Security Retirement timing, we are also interested in how employment of injured workers evolves over time after the injury. We construct a measure of *sustained non-employment*, which we define as a full year without any wage and salary employment. Because all workers are (by definition) employed at the time of injury, we can analyze the timing of workers' first transition from employment to sustained non-employment by specifying and estimating a discrete-time hazard model using OLS (Allison, 1984). In this modeling approach, we drop observations after the first transition to sustained non-employment from the sample, so that the outcome data contributed by each worker consists either of a sequence of zeroes ending in a 1 (for the workers who are observed transitioning to non-employment) or a sequence of zeroes ending at the exogenous right-censoring point (14 years post-injury). This model can be written as follows:

$$\begin{aligned} N_{iqt} = & F\Big(f(A_{it};\gamma_A) + \alpha_{t-q} + \alpha^I_{t-q} \times I_i + \beta^{50}\mathbf{1}(A_{it} \geq 50) \times I_i + \beta^{55}\mathbf{1}(A_{it} \geq 55) \times I_i \\ & + \beta^{ERA}\mathbf{1}(A_{it} \geq ERA) \times I_i + \beta^{NRA}\mathbf{1}(A_{it} \geq NRA) \times I_i\Big), \end{aligned} \tag{3}$$

where N_{iqt} is an indicator equal to 1 for individual i's first sustained period of non-employment.

The medical-only comparison group identifies how the hazard of labor force exit varies with age $f(A_{it};\gamma_A)$ and duration since injury α_{t-q}. We note that, while minor injuries should not have a substantial impact on labor force exit, duration dependence in the hazard of labor force exit is likely to exist among the workers with medical-only injuries because all workers are employed when sampled. As a consequence, job separation, retirement, non-occupational health events, and other factors unrelated to injury will lead to a rate of labor force exit among the medical-only comparison group that varies with time relative to injury.

We test whether injured workers receiving indemnity benefits experience differential increases in the exit rate at four age thresholds that are associated with changes in SSDI application or Social Security Retirement claiming incentives:

- At age 50, use of the *vocational grid* in SSDI disability evaluation begins. Briefly, these rules provide that some workers who could potentially do some jobs in the national economy (but not their previous job) are eligible for SSDI benefits, a looser standard than the one that applies under age 50.[12]
- At age 55, use of the *vocational grid* in SSDI disability evaluation leads to a further loosening of the standard for a disability award.
- At age 62 (SS Retirement Early Retirement Age), eligible workers can first claim SS Retirement benefits at a reduced rate.
- At Normal Retirement Age (NRA), eligible workers can first claim full SS Retirement Benefits. NRA is between 66 and 67 for workers in our analysis sample, with older NRAs phasing in gradually.[13]

Equation 3 assumes that age effects and duration dependence (in terms of the time post-injury) are additively separable. In the regression tables, we show estimates where $f(A_{it}; \gamma_A) = A_{it}\gamma + \gamma^{50}\mathbf{1}(A_{it} \geq 50) + \beta^{55}\mathbf{1}(A_{it} \geq 55) + \beta^{ERA}\mathbf{1}(A_{it} \geq ERA) + \beta^{NRA}\mathbf{1}(A_{it} \geq NRA)$. Because we also include indicators for age above the key Social Security ages that are not interacted with the indemnity injury indicator, this specification models the effect of age on the hazard of sustained non-employment as a piecewise linear function with breaks at ages 50, 55, 62, and NRA.[14] We also estimated a more flexible version of the model where $f(A_{it}; \gamma_A)$ is a full set of indicators for age (measured in calendar quarters); we use estimates from this model to plot the estimated impacts of age on the hazard of sustained non-employment for workers with medical-only injuries and workers with indemnity injuries.

The duration dependence terms α, which are estimated controlling for age in equation 3, may also be of some substantive interest. The α^I_{t-q} parameters capture differences in the hazard rate due to indemnity injury for workers at a given time relative to injury while

[12]Source: `https://secure.ssa.gov/poms.nsf/lnx/0425025035`

[13]Source: `https://www.ssa.gov/oact/progdata/nra.html`

[14]Estimates with no covariates that specify $f(A_{it}; \gamma_A)$ as a quadratic or a cubic in age yield identical estimates (up to 4 decimal places) of the β coefficients on the age $\times$ indemnity injury interactions.

controlling for the workers' current age. Comparison of these adjusted hazard functions can shed light on how long after injury workers with an indemnity injury are at elevated risk of transitioning to sustained non-employment. A finding that the risk of labor force exit elevated for a long time after injury might offer guidance for the targeting of interventions to help workers with health problems remain in the labor force. In contrast, a finding that the hazard of labor force exit quickly returns to the counterfactual level might suggest that any such interventions may have less scope for effectiveness.

5 Results

5.1 Descriptive Statistics

Table 1 shows sample averages of outcomes and selected covariates for workers with indemnity and medical-only injuries. In the full sample of workers aged 21-60 at injury, workers receiving indemnity benefits are two years older on average, 3 percentage points more likely to be male, and have higher weekly wages at the time of injury.[15]

The nature of injury and the affected body parts are distributed similarly between medical-only and indemnity injuries. Most injuries (about 5 in 6) are specific injuries (i.e., those affecting a single body part and caused by a single incident). About 10% of indemnity injuries and 9% of medical-only injuries are cumulative, about 3 percent of each group involve multiple body parts, and a smaller proportion reflect occupational disease or other work-related health conditions. Upper extremity injuries are a larger share of medical-only than indemnity injuries, while injuries to the trunk (including back injuries) are a larger share of indemnity injuries than medical-only injuries. Lower extremity injuries are also more common among indemnity injuries. The proportion of self-insured employers (which includes most public-sector employers as well as larger private-sector employers, and which may be higher-wage) is very similar in both groups.[16]

We also report summary statistics for adults aged 45-60 at injury (the sample for our hazard models) and adults aged 50-60 at injury (who we estimate our event study and difference-in-differences models for). Age differences between indemnity and medical-only injuries largely disappear when we subset to these groups of older workers, and indemnity injuries in these subgroups have slightly lower earnings than the medical-only injuries. How-

[15] The weekly wage measure is an amount reported on the workers' compensation claim. It reflects both the hourly wage and usual hours worked, but does not reflect spells of non-employment. We winsorized this variable at four times the state average weekly wage (approximately $4,800 in 2018). Differences between the weekly wage and pre-injury quarterly earnings may be driven by topcoding and multiple job holdings.

[16] Industry and occupation codes were not available at the time this draft was prepared, but will be added to the summary statistics table in future versions.

ever, other group differences are qualitatively similar to those noted for the full ages 21-60 sample.

5.2 Unadjusted Earnings and Employment Profiles After Injury

We begin by presenting earnings trends for injured workers, stratified by whether they received indemnity benefits or were classified as medical-only. Figure 1 presents these trends for the full sample. Prior to injury, both groups have similar earnings trends. Earnings peak in the quarter prior to injury. The rising levels of earnings prior to injury are because people must be working to experience a workplace injury. Thus, employment rates are mechanically rising during the pre-injury time period.

The immediate impact of the workplace injury is evident, represented by a large differential reduction in earnings in the quarter of the injury, followed by another large drop in the subsequent quarter. Using the medical-only injuries as the counterfactual, there is some evidence of convergence in the short-term. Interestingly, however, we observe persistence in the effect of the workplace injury even 14 years after the injury.

The equivalent results for employment are provided in Figure 2. The patterns are similar. Prior to injury, the groups have similar employment trends. However, we observe a large differential reduction in employment rates.[17] This employment rate decrease last at least 14 years.

In Figures 3 and 4, we provide the same trends for workers ages 50-60 at time of injury. For this age group, we observe evidence of sharp earnings losses immediately after injury. We also, as for the full sample, find that the employment and earnings costs of injuries persist for at least 14 years. However, the earnings and employment gaps close for this age group, likely due to retirement within the medical-only sample, implying less scope for employment and earnings gaps.

5.3 Regression Estimates of Earnings Losses

Table 2 reports difference-in-differences estimates of the earnings and employment impacts of injury over the 14-year follow-up period observed in our data. All estimates are weighted using the entropy balancing weights. Due to limited computing power, this table used a 10% random sample of injured workers. Our focus is on the coefficient associated with the interaction of Post-Injury with Lost-Time Injury, though we report the independent (pre-injury) differences associated with lost-time injuries as well.

Without covariates, earnings declined \$924 (standard error = \$86) more per quarter

[17] We do not observe a relative decrease in employment in period 0 since all workers were employed during this quarter. Workers injured during a quarter still worked prior to the injury.

on average for the 56 quarters after injury. Employment falls by 7.3 percentage points (standard error = 0.4 pp) over the 14 years after injury. Including covariates has no meaningful impact on these estimates.

The DD regression results above do not capture the dynamics of earnings losses post-injury. To explore whether earnings losses are increasing, are stable over time, or begin to fade out, Table uses estimates of the event-study regression model given by equation 2 to calculate predicted and counterfactual earnings for injured workers in each quarter post-injury, while holding all other observable characteristics constant. We then summed predicted and counterfactual earnings over three windows of post-injury time (1-4 years post-injury, 5-9 years post-injury, and 10-14 years post-injury) and calculated the earnings loss (injured minus counterfactual earnings) as a percentage of counterfactual earnings. Analogous calculations were performed for employment losses. The focus on earnings losses in percentage terms (rather than levels) is motivated by the fact that the level of the counterfactual is different in the short term and the long term.

Table indicates that, earnings losses and employment losses in the long term (10-14 years post-injury) are more modest than in the short (1-4 years) and medium term (5-9 years). Earnings losses are 19.6% of counterfactual over 1-4 years post-injury, 13.6% of counterfactual over 5-9 years post-injury, and 10.9% over 10-14 years post-injury. Patterns for employment losses are similar: the reduction in employment is 14.6% over 1-4 years post-injury, 11.1% of counterfactual over 5-9 years post-injury, and 9.3% over 10-14 years post-injury.

In one sense, these results point toward convergence in the long term, since the earnings loss relative to counterfactual decays over time. That said, the finding that earnings losses from 10-14 years post-injury are still 10.9% of earnings underscores that there are, on average, economically meaningful long-term effects of injury.

5.3.1 Earnings Loss Estimates for Older Workers

Table 4 shows similar estimates for the sample of workers ages 50-60 at time of injury. Entropy balancing weights were estimated separately for each age subgroup. Due to limited computing power, this table used a 20% random sample of injured workers over age 50.

Earnings are reduced, on average, by \$998 (standard error = \$137) for workers aged 50+ over the 14 years following injury. Including covariates reduces this effect by about three quarters, to a statistically insignificant \$253 (standard error = \$225). However, we still find large and statistically significant reductions in employment among the over-50 sample both without covariates and without covariates. The effect of injury on employment over the 14 years following injury is an 8.6 percentage point reduction (standard error = 0.6pp) without covariates, and a 5.2 pp reduction (standard error = 1.1pp) with covariates.

We present the corresponding employment event studies estimates in Figure 5. We normalize the difference in the quarter prior to injury between lost-time and medical-only injuries to 100% and provide changes relative to this baseline. We observe the large immediate employment reductions, which gradually grows in magnitude for about 6 years. After this time, the effect appears to plateau.

5.4 Transitions to Sustained Non-Employment

In this section, we study transitions to sustained non-employment. The unadjusted age-specific propensities are provided in Figure 6. We observe a large rate of labor force exit immediately after the workplace injury. This higher rate of exit remains substantially higher for lost-time workers relative to medical-only workers for over five years. At that point, the rates converge, though lost-time workers still have persistently higher rates.

Table 5 provides our hazard model estimates for the transition from employment to sustained (4Q or more) non-employment. When we include only duration and age effects (the first column), we see a statistically significant increase in the hazard of labor force exit (holding duration since injury constant) of 0.25pp between ages 55 and 61 when compared to the hazard at ages 50-54. This is about a 10% increase relative to the average hazard rate over all person-quarter observations in the sample. This significant difference falls by 2/3 and becomes small and statistically insignificant when covariates are added, however.

Turning to the age effects in the lower part of the table, we see that the probability of labor force exit for workers with medical-only injuries increases with age, declines between ages 50-54, and then increases sharply between age 62 and NRA (66 to 67 in our sample).

We can observe the differential shift in labor force exit in the duration-adjusted age-specific hazard trends for the lost-time and medical-only workers, shown in Figure 7. Exit propensities are relatively similar across the two groups until age 55. After age 55, the hazards diverge and these differences persist until the ERA. These results suggest differential levels of enrollment in SSDI. However, retirement benefits do not appear to be used disproportionately for income support. The Figure also illustrates that, although the Indemnity $\times$ ERA interaction term was small and insignificant, the hazard of labor force exit remains elevated for workers with indemnity injuries between ERA and NRA.

Finally, in Appendix Table A1, we plot the estimated duration-dependence terms α and $\alpha + \alpha^I$ that capture the hazard of labor force exit as a function of time since injury, adjusting for age and observable covariates. As expected, the figure shows that the incremental hazard of labor force exit is highest immediately after the injury and declines sharply within the first year after injury. Yet the increase in the hazard of exit for workers with lost-time injuries persists into the fourth year post-injury. These results support the notion that the time immediately after the onset of a work-limiting health problem is likely the most critical period for intervention to prevent labor force exit, but they also suggest that labor force exit continues for several years post-injury among workers who do not exit immediately.

6 Conclusion

Using administrative workers' compensation claims linked to longitudinal earnings records, we estimate large earnings and employment reductions associated with workplace injuries. We compare lost-time injuries, severe injuries that require the workers to miss work, to medical-only injuries. The medical-only injured workers provide a useful counterfactual because they also interacted with the workers' compensation system. However, they also incurred injuries so we suspect that our main estimates are conservative since we are differencing-out part of the effect of interest.

The estimated employment and earnings reductions are large and immediate. We find that they also persist for at least 14 years, the end of time period that we observe. While we found evidence that injured workers' earnings were gradually converging toward their counterfactual earnings, the fact that earnings 10 to 14 years post-injury remain 10.9% lower for injured workers confirms that the economic consequences of workplace injury are long-lasting for some workers.

Our findings raise some interesting questions about the design of workers' compensation systems and the availability of other sources of income replacement for workers who experience long-term earnings losses. In future work, we plan to disaggregate the injured worker sample by receipt of permanent disability benefits and more fully explore the timing and adequacy of disability benefits in comparison to the long-term losses estimated here. For now, we can remark that the duration of statutory PD benefits (i.e., the duration for which benefits are to be paid under law to workers who do not accept a lump-sum settlement) for many workers with PD is likely to be far shorter than the duration of losses estimated in this study. PD benefits for workers injured in 2005 were paid at a maximum of $220 per week.[18] for a number of weeks determined by the worker's disability rating. The disability ratings required to receive PD benefits for time frames of 1, 2, 3, or 4 years were 15%, 25%, 33%,

[18] California Labor Code, Section 4453. Available at `https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=LAB&division=4.&title=&part=2.&chapter=1.&article=` as of September 9, 2022.

or 41% respectively.[19] In our sample, 74% of workers' with PD had completed receipt of PD benefits or accepted a lump sum settlement by the end of 2008, and 92% had completed receipt of PD benefits or accepted a lump sum settlement by the end of 2011. The relatively short duration of PD benefit and settlement receipt for most permanently disabled workers is consistent with findings on disability ratings in California at this period, which indicated that the average rating in a large (but potentially unrepresentative) sample of workers who received medical evaluations from a state agency was 20%. We caution that, because we have not yet analyzed the generosity of PD settlements in comparison to long-term earnings losses, these statistics must not be interpreted as reflecting the adequacy or inadequacy of benefits. Furthermore, research on injured workers in California has shown that continued involvement with the workers' compensation system (which often takes the form of litigation) can be detrimental to workers' labor market outcomes. We interpret these statistics, rather, as motivation for further investigation into the economic status and income sources of injured workers during the later post-injury years when economic consequences of injury are apparent, but income from the workers' compensation system is likely unavailable.

One implication of our study is that many policy analyses that have examined the adequacy of workers' compensation benefits, including our own past work, has likely understated the life-cycle impact of injury on workers (and overstated the present-value wage replacement rate) by abstracting from earnings losses incurred in the long term. For instance, our recent work has used replacement rates over five years post-injury (Dworsky et al., 2016b, 2022); earlier studies have calculated wage replacement rates over ten years post-injury (Reville et al., 2001). Limitations of benefit adequacy measures that are truncated at a fixed time after injury have been acknowledged in all these works. However, evidence on the dynamics of long-term earnings losses (and thus what functional form to use for extrapolating from observed earnings losses to the long term) has generally been unavailable. As discussed in (Reville et al., 2001), long-term extrapolations are highly sensitive to functional form assumptions (e.g., about the linearity or nonlinearity of injured and counterfactual earnings trajectories over time). A valuable future application of the data and methods presented here would be to provide guidance on optimal approaches for extrapolating from short- or medium-term post-injury outcomes to long-term outcomes.

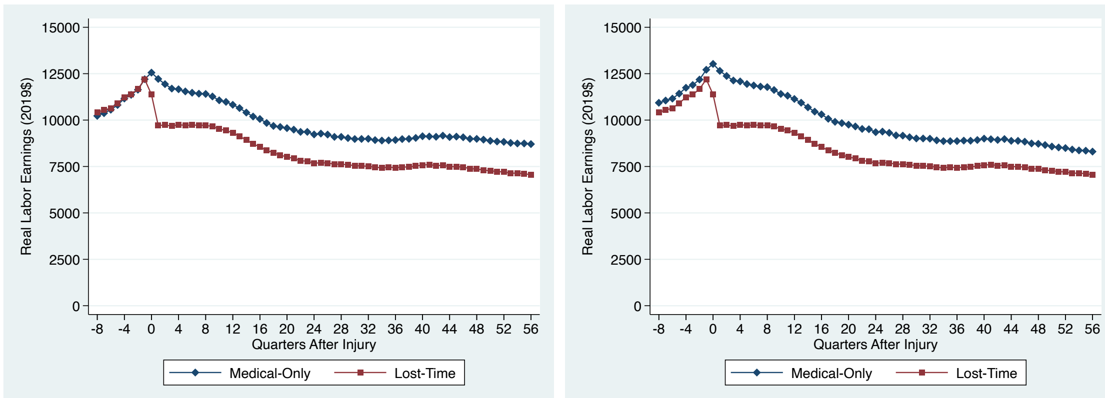
Our analysis of labor force exit also suggests some novel and potentially important policy implications. We observe some evidence that lost-time workers disproportionately exit the labor force at age 55, when SSDI guidelines become discontinuously more favorable to

[19]Source: Authors' calculations based on California Labor Code, Section 4658. Available at `https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=LAB&division=4.&title=&part=2.&chapter=2.&article=3.` as of September 9, 2022.

applicants. This evidence suggests that injured workers use other social insurance programs for income support, implying meaningful spillovers of workplace injuries to programs beyond workers' compensation. However, we do not observe clear evidence of use of Social Security retirement benefits in the same manner. Finally, our estimates of time-since-injury (duration dependence) effects in the hazard of transition to sustained non-employment suggest that, while the hazard of labor force exit is highest immediately after injury, workers with lost-time injuries continue to exit the labor force at higher rates as long as four years post-injury. These estimates, which separate the effect of duration since injury from the effect of age and other covariates, suggest that there may be potential benefits to targeting workers with lost-time injuries for active labor market interventions even several years after injury. Further analysis of the duration to labor force exit after injury may also be a valuable direction for future research with linked workers' compensation and earnings data.

Figures

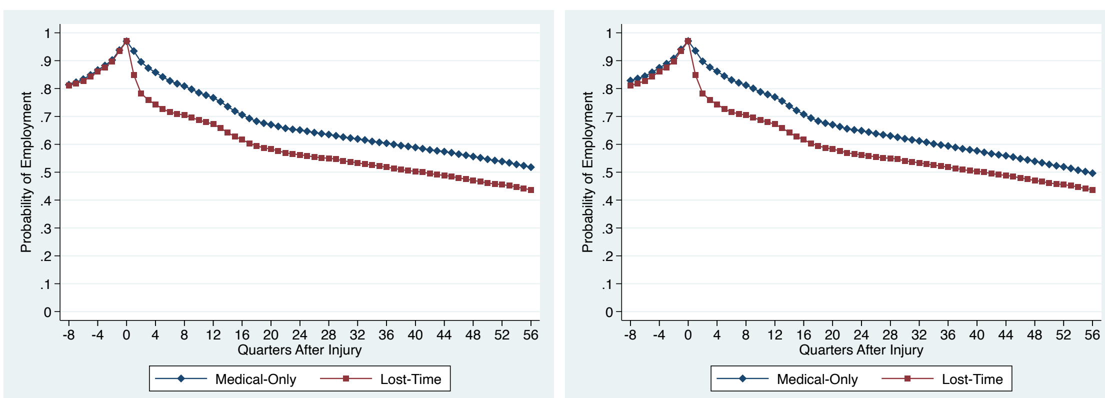
Figure 1: Earnings for Workers with Lost-Time vs. Medical-Only Injuries
Ages 21-60 at Injury



A: Unweighted B: Weighted

Panel A: unweighted. Panel B: Weighted on Pre-Injury Earnings Growth

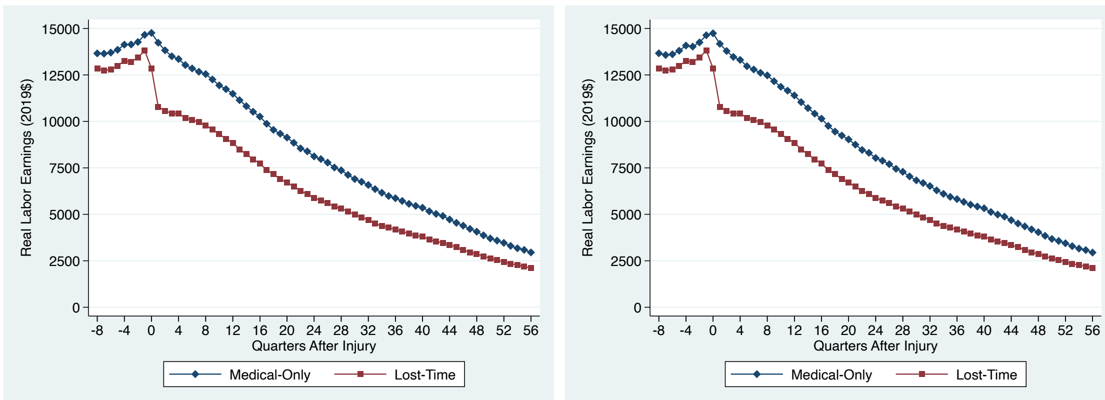
Figure 2: Employment for Workers with Lost-Time vs. Medical-Only Injuries
Ages 21-60 at Injury



A: Unweighted B: Weighted

Panel A: unweighted. Panel B: Weighted on Pre-Injury Earnings Growth

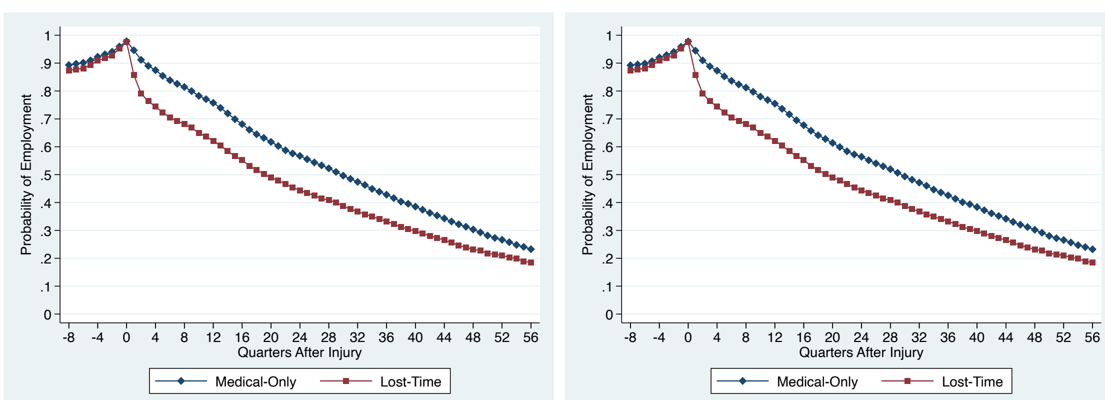
Figure 3: Earnings for Workers with Lost-Time vs. Medical-Only Injuries
Ages 50-60 at Injury



A: Unweighted B: Weighted

Panel A: unweighted. Panel B: Weighted on Pre-Injury Earnings Growth

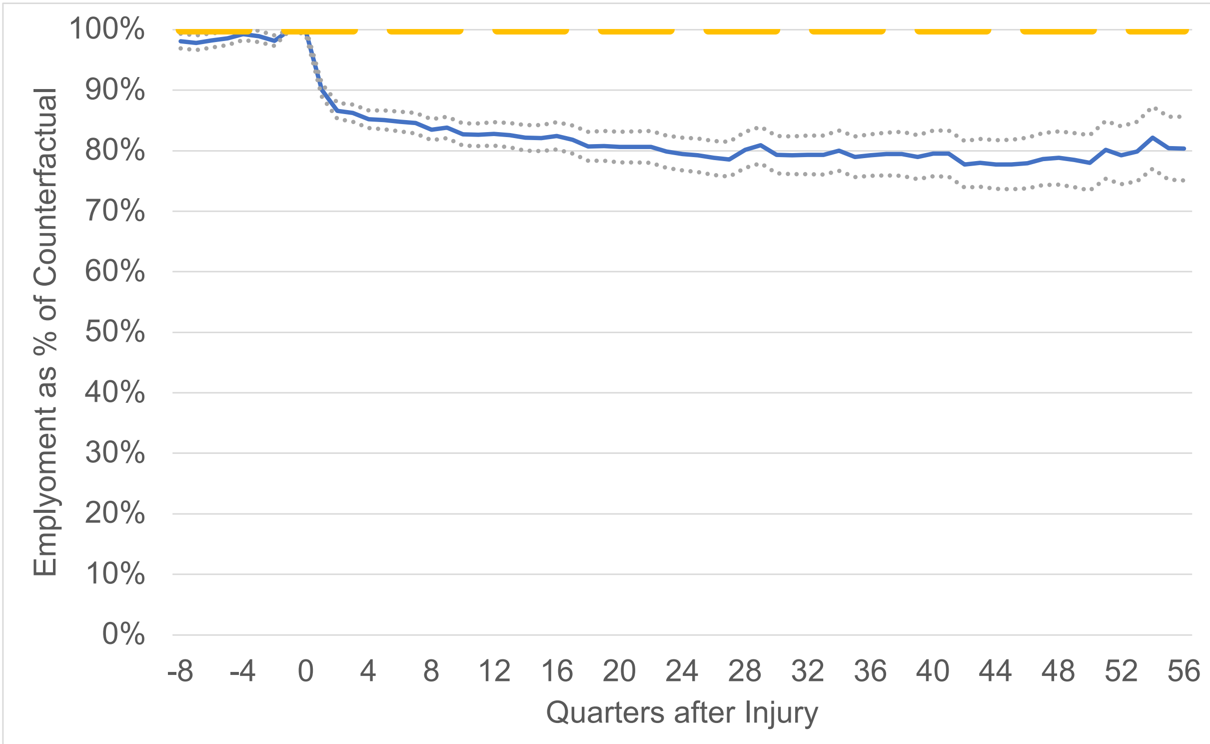
Figure 4: Employment for Workers with Lost-Time vs. Medical-Only Injuries
Ages 50-60 at Injury



A: Unweighted B: Weighted

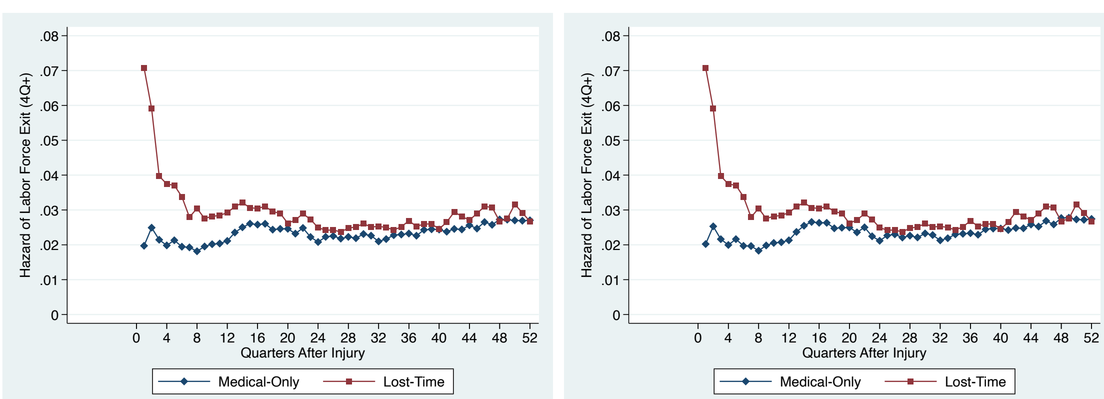
Panel A: unweighted. Panel B: Weighted on Pre-Injury Earnings Growth

Figure 5: Event-Study Estimates: Effect of Lost-Time Injury on Employment
Ages 50+ at Injury



Dashed lines indicate 95% confidence intervals. Standard errors are clustered on person. Sample comprises workers aged 50 to 60 at injury. Regression model includes time since injury effects, indicator for indemnity injury, and interactions between indemnity and time since injury effects. No covariates are included. Medical-only injuries reweighted using entropy-balancing weights that balance age at injury, gender, quarter of injury, and trend in pre-injury earnings. Time period -1 (1 quarter before injury) is omitted time category.

Figure 6: Hazard of Sustained (4Q+) Non-Employment,
Workers with Lost-Time vs. Medical-Only Injuries
Ages 45+ at Injury



A: Unweighted B: Weighted

Panel A: unweighted. Panel B: Weighted on Pre-Injury Earnings Growth

Figure 7: Duration-Adjusted Hazard of Sustained (4Q+) Non-Employment by Current Age, Workers with Lost-Time vs. Medical-Only Injuries: Ages 45+ at Injury

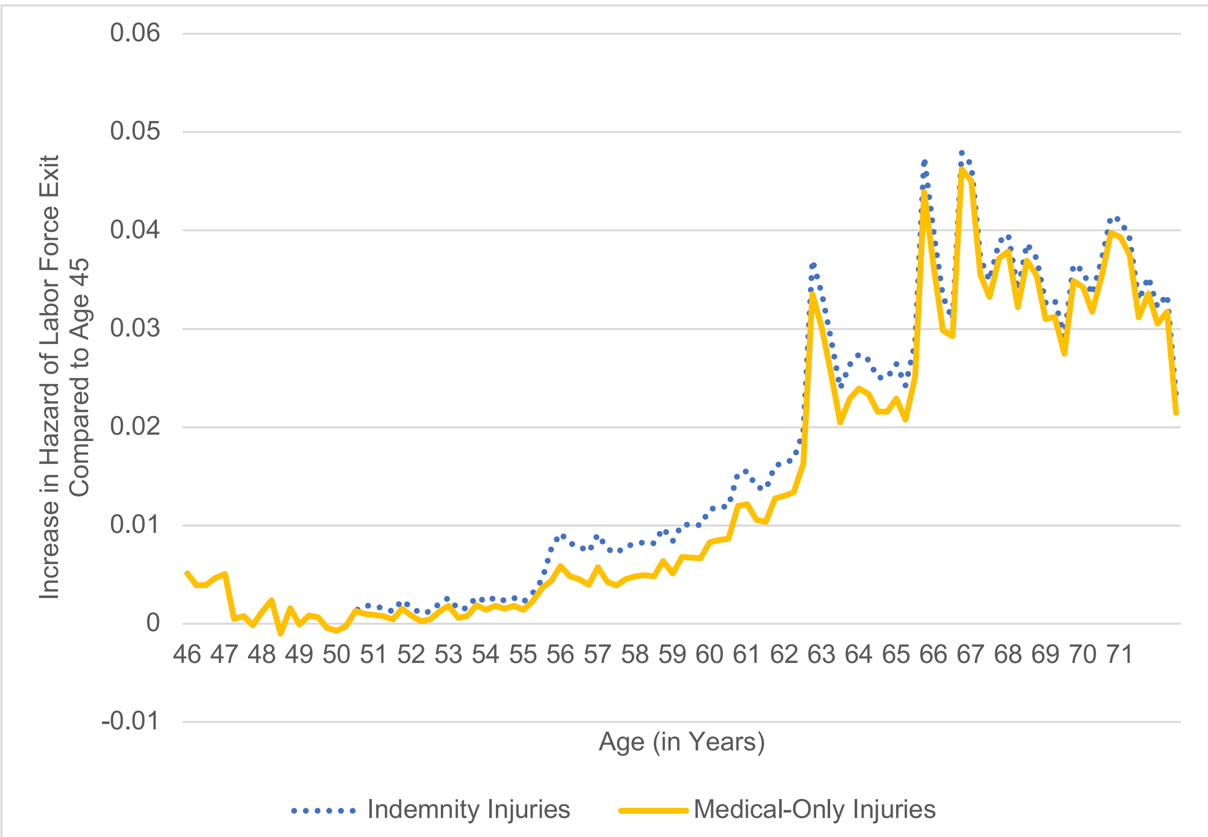


Figure plots coefficient point estimates for age fixed effects from hazard model for first sustained (1+ year) exit from employment for workers injured at ages 45-60. Regression model includes fixed effects for time since injury (duration dependence), indicator for indemnity injury, and interaction between time-since-injury fixed effects and indemnity injury. Other covariates not included in model. Estimates are unweighted (i.e., entropy balancing weights are not used).

Tables

Table 1: Summary Statistics

All Ages	Ages 21-60		Ages 45-60		Ages 50-60	
Group of Workers	Medical-Only	Indemnity	Medical-Only	Indemnity	Medical-Only	Indemnity
Age	38.1	40.4	51.2	51.3	54.2	54.2
% Female	38.8%	35.3%	45.3%	40.6%	46.5%	41.5%
Pre-Injury Weekly Wage	$534.11	$673.76	$629.02	$745.79	$642.55	$751.86
Outcomes (1-4Q Pre-Injury)						
Average Quarterly Earnings	$11,590	$11,618	$13,971	$13,251	$14,298	$13,427
(SD)	($10,186)	($10,294)	($10,745)	($10,662)	($10,820)	($10,663)
Average Employment Rate	89.7%	89.2%	93.2%	92.0%	93.9%	92.7%
Nature of Injury						
Specific Injury	86.4%	85.4%	84.4%	83.7%	83.9%	83.0%
Cumulative	8.8%	10.1%	10.1%	11.5%	10.4%	11.9%
Multiple	2.5%	3.5%	3.0%	3.8%	3.2%	4.0%
Other Exposure	1.4%	0.7%	1.4%	0.7%	1.4%	0.7%
Infectious	0.5%	0.1%	0.4%	0.1%	0.4%	0.1%
Respiratory Disease	0.4%	0.3%	0.6%	0.3%	0.6%	0.4%
Body Part of Injury						
Upper Extremities	37.1%	31.7%	35.1%	32.4%	34.4%	32.5%
Trunk	20.0%	27.3%	19.1%	24.5%	18.6%	23.6%
Lower Extremities	16.1%	20.7%	17.1%	21.4%	17.7%	21.7%
Multiple	14.3%	13.7%	16.9%	15.1%	17.6%	15.6%
Eyes	5.1%	1.2%	4.1%	0.9%	3.8%	0.8%
Face	2.9%	1.1%	2.7%	1.0%	2.7%	1.0%
Head	2.4%	1.5%	2.5%	1.4%	2.6%	1.5%
Neck	1.8%	2.6%	1.9%	3.0%	1.9%	2.9%
Ears/Hearing	0.4%	0.2%	0.6%	0.4%	0.7%	0.5%
Self-Insured Employer	29.7%	29.2%	37.3%	35.5%	39.0%	36.6%
No. injured workers	306,814	115,633	95,392	44,421	56,072	26,784

Sample limited to 2005 injury dates with complete records and data submitted by reliable claim administrators. Pre-Injury Earnings = average quarterly earnings over 4Q pre-injury. Pre-Injury Employment Rate = average employment probability over 4Q pre-injury. Estimates are unweighted.

Table 2: Earnings and Employment Effects of Lost-Time Injury: Difference-in-Differences Estimates

Outcome:	Real Quarterly Earnings		Employment	
Weighted?	Y	Y	Y	Y
Covariates Included?	N	Y	N	Y
Post-Injury × Lost-Time Injury	-923.81***	-913.85***	-0.0729***	-0.0762***
	(86.39)	(151.93)	(0.0040)	(0.0074)
Lost-Time Injury	-689.73***	-1,475.65***	-0.0100***	-0.0222***
	(103.12)	(151.12)	(0.0026)	(0.0048)
N (person-quarters)	2,750,800	791,180	2,750,800	791,180
N (persons)	42,320	12,172	42,320	12,172
Mean of Dependent Variable†	$11,069	$11,341	0.863	0.855

Notes: ***Significance 1%, ** Significance 5%, * Significance 10%. † Mean of dependent variable reported over pre-injury time period (1 to 8 quarters pre-injury). Standard errors clustered on worker. All regressions use entropy balancing weights that balance the following variables between lost-time and medical-only injuries: pre-injury earnings growth (first and second moments); quarter of injury (set of indicators, first moments only); gender and age interactions (set of indicators, first moments only). Regression sample is 10% sample of injured workers. Models with covariates drop singleton observations (those perfectly predicted by fixed effects).

Table 3: Dynamics of Earnings and Employment Impacts of Lost-Time Injury As a Percentage of Counterfactual

Time period	Earnings % Loss	Employment % Loss
1-4 Years Post-Injury	19.6%	14.6%
	(0.8%)	(0.5%)
5-9 Years Post-Injury	13.6%	11.1%
	(0.9%)	(0.6%)
10-14 Years Post-Injury	10.9%	9.3%
	(1.0%)	(0.7%)

Notes: Table reports predicted injured worker earnings and counterfactual earnings by time period relative to injury, based on event-study estimates using specifications corresponding to columns (2) and (4) of Table 2. "1-4 Years" post-injury = 1 to 16 quarters after injury. "5-9 Years post-injury" = 17-36 quarters after injury. "10-14 Years post-injury" = 37-56 quarters after injury. Standard errors in parentheses calculated by delta method and based on variance-covariance estimates clustered on worker (as discussed in notes to Table 2). Wald tests for equality of proportional losses between time periods reject equality across time periods for all pairs of time periods.

Table 4: Earnings and Employment Effects of Lost-Time Injury: Difference-in-Differences Estimates, Ages 50-60 at Injury

Outcome	Real Quarterly Earnings		Employment	
Weighted?	Y	Y	Y	Y
Covariates Included?	N	Y	N	Y
Post-Injury X Indemnity	-997.68***	-252.93	-0.0857***	-0.0524***
	(137.36)	(224.60)	(0.0058)	(0.0109)
Indemnity Injury	-703.20***	-1,204.46***	-0.0124***	-0.0231***
	(166.93)	(229.35)	(0.0033)	(0.0062)
N (person-quarters)	1,082,705	342,420	1,082,705	342,420
N (persons)	16,657	5,268	16,657	5,268
Mean of Dependent Variable†	$13,609	$13,739	0.913	0.913

Notes: ***Significance 1%, ** Significance 5%, * Significance 10%. † Mean of dependent variable reported over pre-injury time period (1 to 8 quarters pre-injury). Standard errors clustered on worker. All regressions use entropy balancing weights that balance the following variables between lost-time and medical-only injuries: pre-injury earnings growth (first and second moments); quarter of injury (set of indicators, first moments only); gender and age interactions (set of indicators, first moments only).

Covariates are interactions of time effects with: age-gender interactions; indicators for quartile of weekly wage; indicators for industry; indicators for nature of injury; indicators for body part of injury; indicators for region (within California); and indicator for self-insured employer. Regression sample is 20% sample of injured workers aged 50-60 at injury. Models with covariates drop singleton observations and those perfectly predicted by fixed effects.

Table 5: Hazard Model for Sustained Labor Force Exit, Workers Injured at Ages 45-60

Weighted?	Y	Y
Covariates Included?	N	Y
Age Controls	Linear	Linear
Lost-Time Injury*Age ≥ 50	0.0008	0.0013
	(0.0007)	(0.0012)
Lost-Time Injury*Age ≥ 55	0.0025***	0.0008
	(0.0005)	(0.0008)
Lost-Time Injury*Age ≥ 62	0.0002	-0.0008
	(0.0007)	(0.0012)
Lost-Time Injury*Age ≥ NRA	-0.0018	-0.0019
	(0.0013)	(0.0023)
Age ≥ 50	-0.0036***	-0.0023**
	(0.0004)	(0.0007)
Age ≥ 55	0.0002	0.0014*
	(0.0003)	(0.0006)
Age ≥ 62	0.0135***	0.0143***
	(0.0004)	(0.0008)
Age ≥ NRA	0.0058***	0.0045**
	(0.0007)	(0.0014)
Age	0.0002***	0.0003***
	(0.0000)	(0.0000)
N (person-quarters)	4,153,981	1,231,778
N (persons)	139,813	44,519
Mean of Dependent Variable	0.025	0.028

Notes: ***Significance 1%, ** Significance 5%, * Significance 10%. Standard errors clustered on worker. Age ≥ 50 is time-varying indicator for whether worker's age on first day of the quarter is 50 or greater; other age indicators defined similarly. Age ≥ NRA is time-varying indicator for whether worker's age on first day of the quarter is greater than the Social Security Normal Retirement Age for the worker's birth year at the start of the quarter. Model includes fixed effects for age (in calendar quarters) at start of current quarter. Models with covariates drop singleton observations and those perfectly predicted by fixed effects.

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Appendix Tables

Table A1: Entropy Balancing Balance Table for 2005Q1 Injuries

			Medical-Only Injuries			
	Indemnity Injuries		Before Weighting		After Weighting	
Variable	Mean	SD	Mean	SD	Mean	SD
$\Delta_{-7}y$	\$359	\$4,512	\$222	\$4,516	\$359	\$4,513
$\Delta_{-6}y$	\$195	\$4,596	\$291	\$4,613	\$195	\$4,597
$\Delta_{-5}y$	\$598	\$4,695	\$671	\$4,768	\$598	\$4,695
$\Delta_{-4}y$	-\$470	\$4,720	-\$455	\$4,780	-\$470	\$4,721
$\Delta_{-3}y$	\$354	\$4,664	\$525	\$4,688	\$354	\$4,665
$\Delta_{-2}y$	\$774	\$4,610	\$460	\$4,711	\$773	\$4,612
$\Delta_{-1}y$	\$829	\$4,921	\$1,143	\$4,880	\$830	\$4,922

Table shows mean and standard deviation (SD) of first-differences in earnings for workers with indemnity and medical-only injuries occurring in 2005Q1. $\Delta_t y := y_t - y_{t-1}$, where y_t denotes real (2019\$) quarterly labor earnings in quarter y relative to the quarter of injury. Maximum standardized difference before weighting is 0.068. Maximum standardized difference after weighting is 0.0001.

Weights also balance first moments of age (a set of indicators for 2-year bins from ages 20-29 and 1-year bins from ages 30-60), gender, and age interacted with gender. Maximum difference (not standrdized) in share of injured workers in any age/gender bin before weighting is 3.2 percentage points; maximum difference after weighting is less than 0.01 percentage point.

Figure A1: Estimated Duration Dependence Terms for Lost-Time and Medical-Only Injuries, Adjusted for Age and Other Covariates

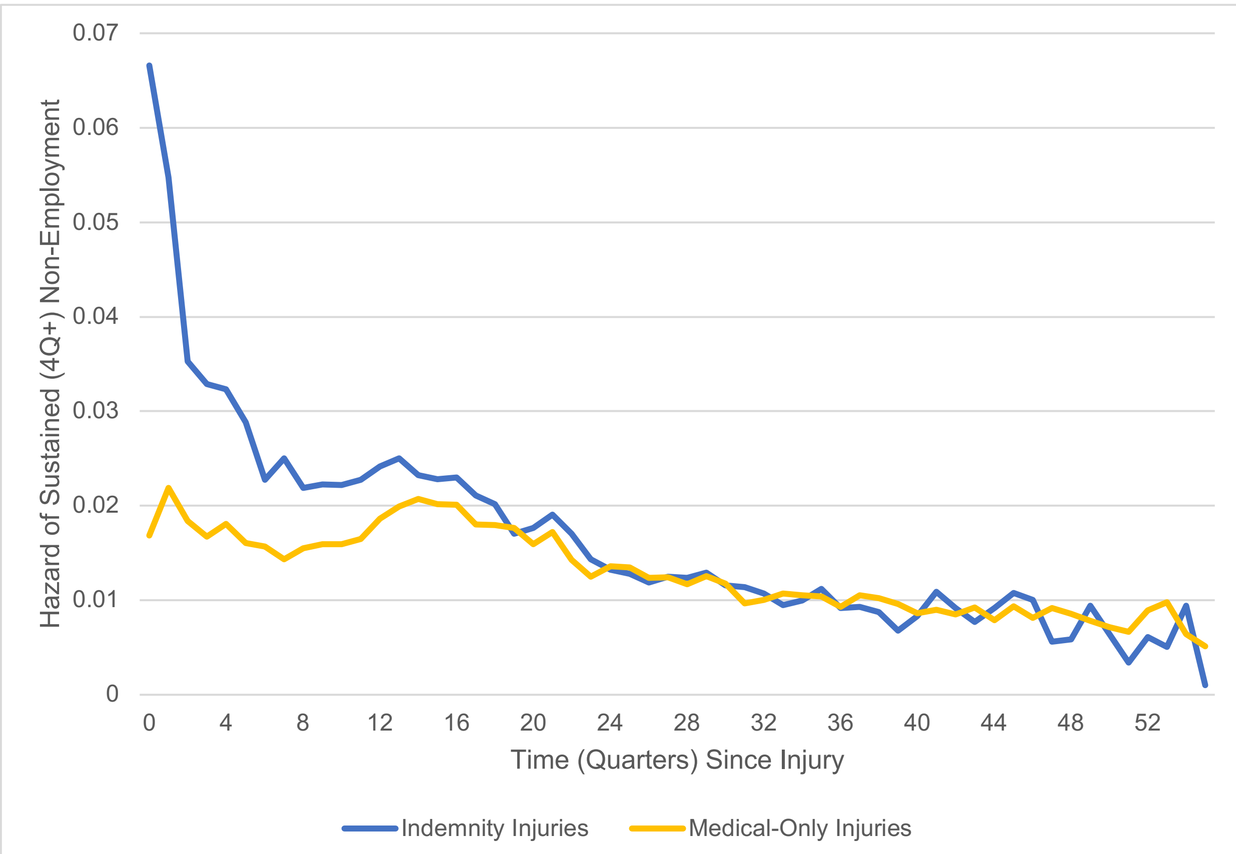

Figure plots point estimates of duration since injury fixed effects from Equation 3. "Medical-Only Injuries" series plots α_{t-q}, where $t-q$ indexes time since injury at date q. "Indemnity Injuries" series plots $\alpha_{t-q} + \alpha^I_{t-q}$. Sample consists of workers aged 45+ at injury.