

**The effect of layoffs on the mental health and safety of remaining workers:
A quasi-experimental study of the U.S. aluminum industry**

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The consequences of socioeconomic shocks such as plant closures, downsizing, and layoffs on worker well-being are well-documented. Job displacement has been linked with prolonged periods of subsequent unemployment, diminished earning, and declines in job quality.¹⁻⁷ Job loss is also a major social stressor that may simultaneously disrupt family dynamics and social conditions.⁸ The stress associated with socioeconomic upheaval and job loss has also been consistently associated with poor health,⁹⁻¹³ and has specifically been with psychiatric distress¹⁴⁻¹⁹ including mood disorders such as depression and anxiety^{16,20-26} as well as drug and alcohol abuse.²⁷⁻²⁹

Relatively fewer studies have focused on the effects of layoffs on remaining workers, although the effects of layoffs and downsizing events may extend beyond those employees who lose their jobs.³⁰ Remaining workers may experience greater job insecurity in the wake of layoffs,³¹ especially in the context of recessions when labor markets are relatively weak and other employment opportunities may be limited.^{32,33} Layoffs and the resultant real or perceived job insecurity may additionally serve to weaken remaining workers' organizational commitment and decreased job satisfaction.³⁴⁻³⁶

Evidence to date also suggests that remaining workers may experience psychiatric distress in the wake of layoffs – perhaps due to “survivors” guilt or remorse for their laid off coworkers.³⁰ For example, a study of the mental health effects of the Great Recession on continuously employed U.S. workers found that rates of mental health-related outpatient visits and prescriptions increased most among workers at plants where mass layoffs had occurred.³³ Layoffs and downsizing events may also increase rates of injury among the remaining workers, especially given that one common expectation of management following downsizing is that output levels will not decline even though there are fewer workers to complete the tasks.^{31,37,38} In addition to work intensification, multi-skilling, job-reassignment, and associated management problems may increase injury risk.³⁹ Existing research also suggests that employees who perceive their jobs to be insecure report lower levels of safety knowledge and reduced motivation to comply with safety policies.⁴⁰

The present study adds to the growing literature on the short-term effects of layoffs on the health and safety of remaining workers. Using a difference-in-differences approach, we examined the effects of layoffs on two separate outcomes - injury risk and mental health care utilization - among workers employed by a single U.S. aluminum manufacturer between 2003 and 2013. The first difference compares the probability of the outcome of interest (injury or an outpatient visit or prescription related to mental health) during the three-month period in which a major layoff event occurred to the probability of the outcome of interest in the same three-month period one year prior. For the second difference, we compare the differences in outcome probability between workers at plants with at least one major layoff events to workers employed by the same firm at plants where no such layoff event occurred.

Methods

The present analysis uses data from the American Manufacturing Cohort Study (AMC), which is comprised of detailed, longitudinal health and employment records for workers employed by a single U.S. aluminum manufacturer from January 1, 2003 through December 31, 2012. The study database includes a variety of administrative data sets – including personnel files, payroll data, occupational injury data, and medical insurance claims – that are deterministically linked using a unique, encrypted identifier for each individual worker.

To study the effects of layoffs on two measures of worker health and safety, we used a quasi-experimental, difference-in-differences approach. For each outcome, the first difference compared injury risk (and rate mental healthcare utilization) during a three-month period (i.e. quarter) in which a layoff event occurred with the same quarter one year previously. For the second difference, we compared the differences in injury risk (and mental healthcare utilization) among workers at plants where layoff events occurred (i.e. treated plants) to workers at plants where no layoff event occurred within the study period (i.e. control plants). This comparison of the same three-month period one year apart, accounts for potential seasonality of outcomes. Moreover, each

plant location serves as its own control, holding baseline plant level characteristics that may be associated with the outcomes fixed.

Outcome Assessments

We created two separate measures of mental healthcare utilization using medical claims. First, we created a quarterly indicator variable for whether each worker had at least one outpatient visit related to mental health. We identified relevant outpatient codes using primary outpatient diagnostic codes from the International Classification of Diseases, Ninth Revisions (ICD-9) including 296 (bipolar disorder), 300 (anxiety disorder), 304 (opiate dependence), 305 (alcohol abuse), 309 (mood disorder), and 311 (major depression). Second, we created a quarterly indicator variable for whether each worker filled at least one prescription related to mental health. These included opiates, antidepressants, sleep aids, and anxiolytics. We identified work-related injuries using the company injury management system. We created an indicator variable for each worker for each quarter in which an injury occurred throughout the study period.

Layoff Events

We identified layoff events using the company payroll database. We defined layoff events at the plant level as a reduction in the size of the hourly workforce of 20% or more within a given three-month period. To identify layoffs, we first calculated the number of unique workers on the company payroll for each three-month period (i.e. quarter) for 30 U.S. plants between January 1, 2003 and December 31, 2012. Next, we calculated the percent change in workforce size from quarter-to-quarter at each plant location.

Dataset Construction

For plant locations where layoffs occurred (i.e. treated plants), we retained only the quarter in which the layoff event occurred and the same three-month period from the previous year for comparison. We selected the same quarter from the previous year as the control period for two reasons. First, this approach controls for potential seasonality in mental healthcare utilization and injury risk. Second, upon inspecting the data we noted that many of the layoff events identified were preceded by a smaller but still substantial reduction in the size of the workforce. However, for plant locations that experienced layoff events, the previous year provided a comparison quarter in which the workforce was relatively stable. Control plants were those in which no layoff events occurred within the study period. Our analysis is restricted to the hourly workforce. For workers at treated plants, we retained only those workers who were actively employed and insured for all three months of the layoff quarter and the non-layoff quarter the previous years. For workers at control plants, we retained all worker-quarters pairs that corresponded to the layoff and non-layoff periods in the treated plants.

Statistical Analysis

The basic statistical approach of the difference-in-differences estimator involves taking two differences in order to isolate the effects of an exogenous shock. Here, we first take the difference between the outcome measure in each plant during the layoff quarters and the same quarter one year previously. Next, we take the difference of the differences between treated plants and control plants (where control plants are those that experienced no layoff events throughout the study period). Because layoff events occurred at different time points throughout the 10 year study period, we used a generalized difference-in-differences approach, fit using ordinary least squares. The full model specification was as follows:

$$Y_{ipk} = T_{pk}\beta + \theta_p + \lambda_k + \varepsilon_{ipk}$$

Where T_{pk} is an indicator variable for whether a layoff event occurred in location p during quarter k ; θ_p is a fixed effect for plant location p , and λ_k is a fixed effect for quarter k . Y_{ipk} is an indicator for the outcome of interest (either injury, outpatient visits or prescriptions for mental health) for worker i in plant p in quarter k . The parameter of interest β is the difference in the probability of the outcome in layoff and comparison quarters at treated versus control plants. We account for possible non-independence of worker outcomes within plant locations with robust standard errors clustered at the plant level. Because injuries and mental healthcare utilization may differ systematically between men and women, we also conducted a gender stratified analysis.

Results

We identified seven quarters in which layoff events occurred at eight unique plant locations between January 1, 2003 and December 31, 2013. The first of these events occurred in October of 2004, and the last layoff event occurred in July of 2009. In Figure 1 we depict the size of the workforce throughout the study period for one treated plant and one control plant, both of which were located in the Middle Atlantic region of the U.S. In total, we identified 15,494 workers who were employed at one of the 30 U.S. plant locations included in this study who were also employed and insured for the duration of at least one layoff quarter and the associated comparison quarter from the previous year. Of these, 4,154 were employed at plant locations where layoff events occurred. At both treated and control plants, workers were predominantly white and male (Table 1).

Table 1. Demographic characteristics of workers at 8 treated and control plants

	Treated Plants (N = 4,154)	Control Plants (N = 11,340)
Men – N (%)	3,071 (73.9)	9,488 (83.7)
Race/Ethnicity – N (%)		
White	3,011 (72.5)	8,438 (74.4)
Black	737 (17.7)	1,027 (9.1)
Hispanic	275 (6.6)	1,378 (12.2)
Other	127 (3.1)	497 (4.4)
Dependent Spouse – N (%)	2,509 (60.4)	7,492 (66.1)
Birth Year – Median (IQR)	1959 (1953 – 1969)	1960 (1953 – 1969)

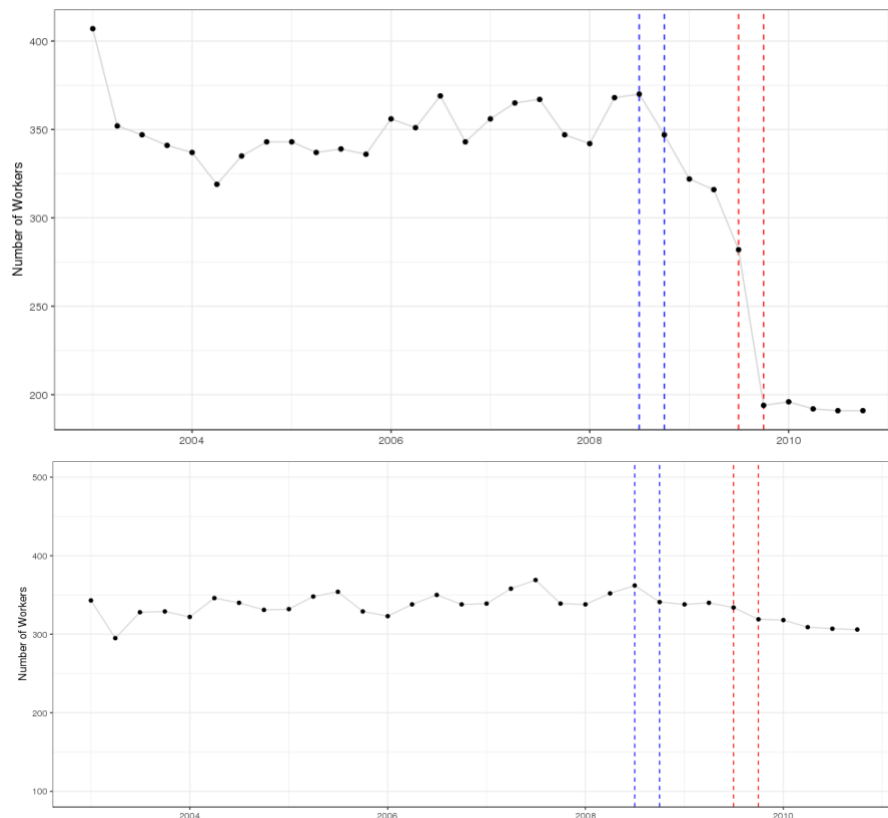


Figure 1. Depicts the size of the workforce at a plant located in the Northeast where a layoff event occurred in July of 2009 (top panel). The red dotted lines demarcate the quarter in which the layoff occurred, and the blue dotted lines demarcate the comparison quarter. The bottom panel depicts the size of the workforce at a control plant where no layoff event occurred within the study period, and the dotted red and blue lines demarcate the same layoff and comparison quarter as the top panel.

Difference-in-Differences Estimates

Our difference-in-differences estimates for the effect of layoffs suggest a decrease in reported injuries attributable to the layoffs of approximately one percent ($\beta = -0.009$, $SE = 0.0035$), although we did not observe a change in injury risk among female workers. Among all workers, our findings suggest modest but statistically significant increases in utilization of outpatient services ($\beta = 0.007$, $SE = 0.004$) and prescriptions ($\beta = 0.016$, $SE = 0.008$) related to mental health. Although the analysis lacked sufficient statistical power, our gender-stratified results suggest a larger increase in prescriptions among male workers, whereas the increase in outpatient visits was more notable for female workers. (Table 2)

Table 2. Difference-in-differences comparing remaining workers' mental health and safety during layoff and comparison quarters at treated versus control plants

	All Workers	Male Workers	Female Workers
	β (SE)	β (SE)	β (SE)
Injury	-0.009 (0.0035) **	-0.011 (0.004) ***	-0.002 (0.007)
Outpatient Visit for Mental Health	0.007 (0.004) *	0.005 (0.004)	0.012 (0.010)
Prescriptions for Mental Health	0.016 (0.008) **	0.016 (0.009) *	0.007 (0.018)

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Discussion

In the present study, we examined the short-term effects of layoff events on mental healthcare utilization and injury risk among remaining workers at a single U.S. aluminum manufacturer between 2003 and 2012. We used a difference-in-differences approach to compare workers before and during layoff events at plants where large layoff events occurred to workers at control plants where no layoff event occurred. We defined a layoff event as a reduction in the size of the workforce by 20% or more in a given three-month period.

Our analysis suggests a significant decrease in injury at treated plants during layoffs. This finding is inconsistent with the extant literature, which largely posits that injuries should be increased in the context of downsizing or layoffs because remaining workers are more likely to disregard occupational health and safety guidelines in order to maintain production levels, or be reassigned to tasks to which they are less familiar and ill-suited. One explanation for our findings is that workers who survive layoffs become hypervigilant in the context of layoffs due to perceived job insecurity. Alternatively, it may be that levels of injuries remain the same or even increase, but plants experience a lapse in the reporting of injuries.

Consistent with the existing literature on layoffs and the stress and guilt experienced by remaining workers, our analysis also suggests an increase in mental healthcare utilization – as measured with outpatient visits and prescriptions - at treated plants during layoffs. Of course, given that our outcome measurements are based on claims, it is difficult to say whether the observed increase in mental healthcare utilization reflects true underlying psychiatric distress, *ex ante* moral hazard among workers who perceive their jobs to be at risk, or some combination thereof. Our results further suggest some gender differences in utilization patterns, with male workers more likely to increase their use of prescriptions and female workers more likely to increase their use of outpatient services for mental health.

Our findings should, of course, be interpreted cautiously given the limitations of our analysis. The study data are comprised of health and employment records from workers at only one firm and therefore may have limited generalizability even to other U.S. manufacturers. Moreover, because all workers were employed by the same firm, it is possible that larger layoff events were known to workers at other plants. For later layoff events that occurred in the context of the great recession, it is possible that many of the mechanisms through which workers are thought to change their behaviors in the context of layoffs (real or perceived job insecurity, distraction) are also in place at control plants. Both of these potential sources of bias would serve to make treated and control plants more similar, and therefore would have attenuated any effect estimates.

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