The Effect of Firm Finances on Workplace Safety*

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Abstract

This paper studies the impact of a firm's financial structure and condition on workplace safety using establishment-level injury data. We find that injury rates increase with leverage, controlling for a number of other factors (including establishment fixed effects). They also increase (decrease) in response to plausibly exogenous negative (positive) cash flow shocks, especially in more leveraged firms. We interpret these results as evidence that firms cut investment in activities that enhance workplace safety when they lack financing. This represents a previously unexplored channel through which a firm's finances can impact the well-being of its employees, an important set of non-financial stakeholders in the firm.

The annual cost of work-related injuries and illnesses in the U.S. is estimated at $250 billion (Leigh, 2011). Faced with such costs, firms expend considerable resources on efforts to improve workplace safety. However, such expenditures depend on a firm's ability to finance them. A firm facing a financing shortfall may find it optimal or even necessary to pare spending on safety-related activities. While the finance literature has extensively examined how capacity to finance affects more traditional forms of investment, its effect on workplace safety has not been explored. This is important, as workplace safety has a major impact on employee well-being.

Activities affecting workplace safety include maintenance and replacement of machinery, employee training and supervision, and implementation and monitoring of workplace policies and procedures. Spending on these types of activities is especially vulnerable to cutbacks when a firm faces a financing shortfall. Unlike debt service, wages, payments to suppliers, and warranty fulfillment, which are governed by explicit contracts, spending on workplace safety is generally governed by implicit contracts between employer and employee. In addition, the benefits of spending on safety are difficult to quantify, which can make such spending difficult to justify internally in a tight-cash situation. Moreover, cutting spending on safety – for example by delaying the replacement of aging machinery or reducing the frequency of safety meetings – is less likely to disrupt a firm's long-term strategy than scaling back production capacity, employment, marketing, or product development.

In this paper, we investigate the sensitivity of a firm's workplace safety to its financial circumstances using 2002-2009 establishment-level data from the Bureau of Labor Statistics's (BLS's) annual Survey of Occupational Injuries and Illnesses (SOII). Our analysis focuses on the sensitivity of injury rates to financial leverage and cash flow shocks. This is motivated by the large corporate finance literature broadly studying investment with financial frictions, which analyzes the effects of both on investment decisions. Internal cash flow is a direct source of financing, and is likely the marginal source of financing if frictions in capital markets make raising external capital costly. Leverage exacerbates these frictions, which include adverse selection, debt overhang, and collateral requirements, making it more difficult to raise external capital to fill an internal cash shortfall.[1]

To investigate the effect of leverage on injury rates, we begin by regressing injuries on leverage, controlling for a number of firm characteristics as well as establishment fixed effects.[2] We find that an establishment's injury rate in a year is likely to be significantly higher if the establishment's parent firm enters the year with a higher debt-to-assets ratio. The result is driven by firms in industries with more tangible assets, where investments in safety are likely to be more relevant. Estimating a panel vector auto-regression (VAR) model to analyze lead-lag relations in the data, we find that higher parent firm leverage predicts a higher injury rate in the following years, but that the converse is not true. That is, leverage causes higher injury rates in the sense of Granger (1969), but not vice versa.

These results could indicate that more debt causes higher injury rates. Of course, there are alternative explanations for this relation as well. For example, both leverage and injury rates may proxy for a firm's growth rate, with firms relying on debt to finance new investment and injury rates rising as employees learn to use new equipment or or become temporarily overburdened. We address this concern by controlling directly for capital investment in our regressions. Alternatively, poorly-run firms are likely to have high injury rates and to accumulate debt due to losses.

Our use of establishment fixed effects allows us to rule out any time-invariant omitted firm or establishment characteristics driving the results. Any alternative explanation must also account for the lead-lag relation between leverage and injury rates. Nevertheless, it is difficult to completely rule out alternative explanations. However, even though we can

[1] Fazzari, Hubbard, and Petersen (1988), Lamont (1997), and Rauh (2006) are examples of empirical papers studying the sensitivity of investment to cash flow. Denis and Denis (1993) and Lang, Ofek, and Stulz (1996) are examples of papers studying the sensitivity of investment to leverage.

[2] We control for cash flow in this analysis, but do not interpret the relation between injuries and cash flow because of the potential mechanical relation between the two.

only draw tentative conclusions about causality, these results are important because they suggest a new channel through which capital structure decisions can affect the well-being of employees.

In principle, we could estimate the sensitivity of injuries on cash flow the same way we estimate its sensitivity to leverage – by regressing it on cash flow. However, spending on safety-related activities consumes cash and hence reduces operating cash flow in the short run.[3] Indeed, this is the very reason a firm facing a financing shortfall might cut investment in these activities, even if they create value in the long run. If spending on safety reduces injury risk, then a firm's targeted level of injury risk affects its cash flow, making it impossible to interpret any estimates of the relation between injuries and cash flow in such a regression.

We therefore instead study three quasi-natural experiments involving plausibly exogenous variation in cash flow. The first is the American Jobs Creation Act ("AJCA") of 2004. The AJCA lowered the cost of accessing cash tied up overseas by temporarily lowering the tax rate on income repatriated from foreign subsidiaries.[4] Second, following Lamont (1997), we examine the impact of oil price innovations on injury rates at non-oil producing establishments of firms that also have oil-producing establishments. Our third experiment follows Almeida, Campello, Laranjeira, and Weisbenner (2012) and focuses on the financial crisis. Because of the difficulty in rolling over debt during the crisis, firms that happened to have a lot of debt maturing shortly after the beginning of the crisis effectively faced negative cash flow shocks.

We employ a difference-in-differences approach in all three experiments, comparing changes in injury rates at firms experiencing a shock (firms with previously-unrepatriated foreign profits at the time of the AJCA, with oil-producing establishments, or with a large mass of

[3]This is further complicated by the fact that many expenditures impacting safety are expensed for accounting purposes, causing them to have a negative effect on standard operating cash flow measures.

[4]The IRS estimates that $312 billion of cash was repatriated as a consequence of the AJCA. There is debate in the literature about whether this led to an increase in investment in the U.S. in general (see, e.g., Dharmapala, Foley, and Forbes (2011) and Faulkender and Petersen (2011)).

debt maturing at the onset of the crisis) to those at firms not experiencing the shock, to account for aggregate time trends. We control for establishment fixed effects in these tests to ensure that only time series variation within establishment is used to identify the effects. The results across all three experiments are consistent. Firms receiving a positive (negative) cash flow shock experience subsequent decreases (increases) in injury rates. Moreover, for the first two experiments, the effects are concentrated in firms with more leverage and therefore less access to external finance to cushion the shock.[5]

We attempt to rule out specific alternative explanations for these results. For example, for the AJCA and debt maturity experiments, which represented one-time shocks, we show that the results are unlike to be explained by pre-existing trends. For the AJCA experiment, we address the possibility that the result is driven by investment of repatriated capital in safer lines of business by showing that firms with foreign profits if anything shift headcount slightly towards operations in more dangerous industries immediately after 2004. For the oil experiment, we use state-year fixed effects to account for the possibility that firms with oil-producing operations experience investment opportunity shocks in their non-oil businesses that are correlated with oil prices because they are located in oil-producing regions.

The paper's results suggest that a financing shortfall can impose costs on employees through higher risk of workplace injury. While employees bear these costs ex post, shareholders bear them ex ante if employees require extra compensation in expectation of higher injury risk (Titman, 1984).[6] Indeed, the industrial relations literature has shown that employees require a compensating wage differential for risk exposure, with estimates in 2000

[5] As the third experiment already focuses on a firm's debt structure, we do not have predictions about how its effect should differ with leverage.

[6] A firm may also bear some costs of poor workplace safety ex post due to increased workman's compensation premia, employee lawsuits, production disruptions, and sanctions. However, these costs are likely to occur over time, while the savings from cuts to safety-related activities increase available cash in the short-run, when it is most valuable to a firm facing a financing shortfall. In addition, there is evidence that workman's compensation insurance premia are poorly correlated with actual injury risk (Pouliakas and Theodossiou, 2013).

dollars of \$20,000 - \$70,000 per expected non-fatal injury and \$9 million per expected fatal injury (Viscusi and Aldy, 2003). Perhaps more importantly, expectations of high on-the-job injury risk are likely to make it difficult for a firm to attract talented employees. Thus our results have potentially important implications for firm financial policy.

Testing the effect of workplace safety on firm value directly is difficult. We do so in a limited fashion using Q regressions of the type commonly used in the corporate finance literature. Specifically, we regress Tobin's Q on lagged injury rate, controlling for other firm characteristics as well as firm fixed effects. We find a negative relation between Tobin's Q and injury rates in these regressions, consistent with a high injury rate proving costly to a firm. However, we are careful not to over-interpret these results due to numerous endogeneity concerns.

In related papers, Rose (1990) and Dionne, Gagné, Gagnon, and Vanasse (1997) find that operating margins are negatively correlated with the likelihood of serious accidents in the airline industry. Dionne, Gagné, Gagnon, and Vanasse (1997) find some evidence that leverage impacts the likelihood of airline accidents, but only for carriers with negative equity. Beard (1992) studies a small sample of trucking companies and finds that roadside inspection violations are decreasing in equity valuation. These studies are limited to a small handful of firms in specific industries and have little to say about the direct impact of leverage on employee safety. The closest work to ours is a study by Filer and Golbe (2003). They find that firms with more debt have *fewer* OSHA safety violations, a conclusion seemingly inconsistent with ours. However, their sample is small, they measure inspection violations rather than actual injuries, and they do not account for establishment fixed effects. They also do not examine the effect of exogenous cash flow shocks.

Other papers have examined the effect of financing on employees by studying firm employment decisions. Gordon (1998) shows that higher firm debt levels are associated with reductions in employment that are not fully attributable to performance. Benmelech, Bergman, and Seru (2011) show that employment levels are sensitive to free cash flow and that this sensitivity is greater for firms with higher leverage. Agrawal and Matsa (2012) present evidence that firms increase leverage in response to exogenous increases in unemployment benefits, suggesting that they at least partly internalize the cost of unemployment risk. Our study extends this literature by linking leverage to negative employee outcomes beyond job loss. It also complements the literature on capital structure and labor bargaining, including work by Bronars and Deere (1991) and Matsa (2010) showing that firms appear to use financial leverage in order to gain bargaining power over their unions.[7]

1 How Firms Implement Workplace Safety

Workplace safety is important to employee well-being. Indeed, poor safety conditions were a major driver of the early unionization movement in the U.S. While catastrophic incidents make headlines, most injuries occur in the day-to-day operations of a company and are less visible externally. For example, the most common form of workplace injury in the U.S. in 2012, as classified by OSHA, was a sprain, strain or tear (OSHA 2012).[8]

Firms expend resources on a number of different activities that reduce the risk of on-the-job injury. Some of these activities involve the direct expenditure of resources on the physical assets involved in a firm's operations. These include maintaining existing equipment, replacing old and worn parts and machines, buying equipment with better safety features (such as automatic kill switches), and automating dangerous tasks. The physical assets involved can include both sophisticated machinery as well as simpler assets. As an example

[7] Other related papers include those by Bae, Kang, and Wang (2011), who find that firms with more debt score lower on a third party rating of employee friendliness, and Brown and Matsa (2012), who show that firms in financial distress have fewer and lower quality job applicants.

[8] Recent examples of catastrophic incidents include the 2005 explosion at the Texas City Refinery in Texas City, Texas, which killed 15 employees and injured 170, the 2010 Upper Big Branch mine collapse in West Virginia, which killed 29, and the 2010 Deepwater Horizon oil platform explosion, which killed 11 and injured 16.

of the latter, in industries such as shipping that involve hoisting heavy objects, replacing steel cable with (more expensive) synthetic fiber cable can reduce injury risk by decreasing the likelihood of breakage, and the amount of recoil and incidence of sharp edges upon breakage.

Firms also expend considerable resources on less visible but in many cases equally important activities relating to organizational structure and policies. These activities include organizing work processes to reduce the likelihood of incidents, for example physically spreading out production to prevent accidental interference across processes. They also include establishing, implementing, and enforcing policies and procedures that reduce injury risk. Many firms use lockout-tagout procedures to prevent faulty equipment from being used before it is repaired. Alcoa introduced a speed limit of four miles per hour for forklifts on the production floor at one of its plants in order to reduce the incidence of collisions. While such policies may seem mundane, 18.2% of all private injury industries in 2012 were caused by floors, walkways, and ground surfaces (OSHA 2012). Many plants establish safety committees comprised of employees from different levels in the organization who meet regularly to devise safety improvements.

Just as improving the safety characteristics of physical assets does, these structural and policy activities consume resources, though they do so more indirectly. For example, physically spreading out production to reduce unintended interactions may require larger production facilities. Practices such as lockout-tagout for broken equipment may lengthen the amount of time that productive equipment is out of operation. Allocating employee time to work on safety committees requires hiring more employees or paying overtime to maintain a given level of production. The same holds for training employees. Moreover, policies are only effective if they are actively enforced. Thus firms must devote time to monitoring and auditing operational processes to ensure that employees follow proscribed practices and disciplining them when they do not.

While safety-related activities are generally implemented at the establishment level, firm-level policies can impact safety greatly through several channels. The budgetary channel is the most direct. An establishment may cut spending on safety in order to meet short-run budgeted cost targets. As an extreme example, the Chemical Safety Board (CSB) blamed the explosion at the Texas City Refinery in 2005 at least partly on repeated decisions not to replace a worn valve due to cost-cutting pressures at the refinery.

Firms also impact the safety of their establishments through their own policies and practices. These include, for example, hiring safety consultants to work with plant managers to implement best safety practices. They also include setting explicit safety targets and holding establishments accountable for meeting them. Some of these practices are less tangible and involve establishing a culture within the firm that prizes employee safety. For example, promoting plant managers with better safety records creates incentives to focus on safety. Managers are also likely to take safety more seriously if headquarters refrain from punishing them for failing to meet production quotas if doing so would expose employees to excessive safety risk.

A lack of financial resources at the firm level can impact safety at the establishment level through any of these channels. A firm facing a financing shortfall may cut establishment level budgets in order to increase cash flow in the short-run. Safety-related expenditures are especially vulnerable to such cuts, as their benefits are often difficult to quantify or even track. A firm facing a cash shortfall may also find it difficult to follow through on commitments to reward safety at the expense of productivity, and to allow an establishment to shut down production temporarily when faced with a high safety risk. Auditing safety practices in order to hold establishments accountable directly consumes financial resources and may be curtailed to conserve cash.

A lack of financial resources may also inhibit actions that incidentally improve workplace safety. For example, an establishment might wish to replace an old piece of machinery with a newer version because the newer version is more productive. Newer equipment also tends to have more safety features that reduce the injury risk faced by employees using it. Hence the replacement is likely to have positive effects on workplace safety, even though this is not its direct intent. However, it might forgo this investment if its budget is tight due to a lack of resources at the firm level.

2 Data

In this section, we describe the data that we use in the paper. We also present summary statistics for our sample.

2.1 Description

Our data on workplace injuries comes from the Bureau of Labor Statistics (BLS) Survey of Occupational Injuries and Illnesses (SOII). Through a joint effort with the Occupational Health and Safety Administration (OSHA), the BLS gathers data for hundreds of thousands of establishments each year in a stratified sampling process in order to produce aggregate statistics on the state of occupational risk in various industries in the United States. Employers covered under the Occupational Safety and Health Act and employers selected to be part of the BLS survey are required to maintain a log recording any injuries that, at a minimum, require first aid treatment. These employers must make their injury logs available to OSHA inspectors and supply the data contained in the log to the BLS.

This data is recorded each year at the establishment level, with a unique identifier for each establishment. Each record contains information about an establishment's name, location, SIC code, number of recorded injuries, number of injuries resulting in days away from work ("lost-time" injuries), average number of employees, and the total number of hours worked at the establishment during the year. It also includes, for the period 2002-2009, the employer identification number (EIN) of the establishment's parent company. We use the EIN to match the establishment level data to firm level data in Compustat. Because EINs are available in the BLS data only for 2002-2009, our sample period is limited to these years. Each firm in Compustat may contain multiple establishments.

We calculate several firm-level financial variables using the Compustat data. Our measure of financial leverage is $Debt/Assets$, which is book debt (the sum of Compustat items *dlc* and *dltt*) divided by total book assets (*at*). $Log(assets)$ is the natural log of total book assets. $AssetTurnover$ is total sales (*sale*) divided by lagged total book assets. $MarketToBook$ is the market value of assets divided by total book assets. The market value of assets is defined as the sum of the market value of common equity (the product of shares outstanding, $cshpri$, and the firm's stock price, $prcc\_f$), preferred stock (*pstkl*) and book debt, minus the book value of deferred taxes (*txdb*). We set the value of preferred stock or deferred taxes to zero if the relevant item is missing in Compustat. $TangibleAssetRatio$ is net property, plant and equipment (*ppent*) divided by total book assets. $Capex/Assets$ is capital expenditures (*capx*) divided by lagged total book assets. We winsorize all of the financial variables at the 1st and 99th percentiles to reduce the possible influence of outliers.

We exclude from our sample any observations for which any of the firm-level Compustat variables descried above is missing. We also exclude all establishments belonging to financial firms (SIC code 6000-6999) or regulated utilities (4900-4999) from our sample. This leaves us with a primary sample consisting of 44,244 establishment-year observations for 26,451 unique establishments, which belong to 2,398 unique firms.

2.2 Sample

Table 1 presents summary statistics for the sample. Panel A shows the number of establishment-level observations in the sample by year. The number of observations is fairly stable across years.

— Insert Table 1 here —

Panel B presents establishment-level summary statistics calculated from the BLS data. Consistent with the BLS's confidentiality policy, we show only means and standard deviations and do not show statistics such as medians and individual percentiles that would present data for individual establishments. The average establishment in our sample has 355 employees, though this number varies widely across the sample. The average employee works 1,720 hours in a year, or approximately 43 forty-hour work-weeks. On average, approximately one out of every 25 employees is injured during a given year, with slightly less than one in three injuries resulting in lost work time.[9]

Panel C presents firm-level summary statistics for our sample. The average firm in our sample has book leverage (debt-to-total assets) of approximately 0.238, similar to average book leverage for Compustat firms as a whole. There is substantial variation in book leverage, with firms at the 10th percentile having no debt and firms at the 90th percentile having book leverage of 0.538. The summary statistics for the other variables are in line with those for Compustat firms as a whole as well.

An interesting and useful feature of the data is the identification of industry at the establishment level rather than the firm level. This allows us to assign each establishment a unique industry rather than pooling them over a potentially inaccurate firm-level industry classification. Table 2 shows injury rates (per hour worked and per average number of employees) for our sample across establishments in different industries. We define industries using the 48 industry classifications of Fama and French (1997), and assign each establishment to one of these industries based on its SIC code as reported in the BLS data. Two industries, Tobacco Productions and Non-metallic and Industrial Metal Mining, are omitted because the relatively small number of establishments in our sample in these industries risks

[9] The BLS uses stratified sampling in conducing its injury survey, and oversamples establishments in which injury rates are likely to be higher. Thus the injury rates we report for our sample are not representative of injury rates in the economy as a whole.

revealing the identity of individual establishments. Injury rates are highest in Candy & Soda, Fabricated Products, and Transportation. Not surprisingly, they are lowest in white collar industries such as Banking, Insurance, Trading, and Computers.

— Insert Table 2 here —

To get a sense of the relative variation of injury occurrence in our sample, we report the between and within variation for three groupings. Table 3 shows the variance breakdown of injury rates grouped by establishment, firm, and industry. This provides a reference for the relative differences in injury occurrence in the cross section and the time series, as well as the within and between variation according to firm and industry.

— Insert Table 3 here —

The within establishment standard deviation is approximately one third that of the between and overall standard deviation. The within firm variation is much larger, suggesting that there may be substantial variation from establishment to establishment within the same firm. Since the between firm variation is actually smaller, this suggests there may be substantial heterogeneity within the establishments at the same firm adding noise to estimations which involve regressors that are constant across firm year groups.

2.3 Count estimation methodology

Our injury data naturally presents itself as annual count data. Our analysis therefore consists primarily of estimating a series of count models. The dependent variable in these models is the number of injuries at an establishment in a given year. Naturally, injury counts are likely to be higher in larger establishments. Specifying an exposure variable, which reflects the amount of exposure that a unit has to the event in question occurring, accounts for these differences in exposure. We use the number of hours worked at the establishment during the year as the exposure variable, since an employee's conditional likelihood of being injured in any time interval should naturally be driven by the number of hours she works during that interval.[10]

The two most commonly-used count models are the Poisson model and the negative binomial model. The Poisson model imposes the assumption that the mean and variance of the arrival rate are the same. The negative binomial model is a generalization of the Poisson model that does not impose this assumption, and is written:

$$\begin{aligned} y_i &\sim Poisson(\lambda_i^*) \\ \lambda_i^* &= \exp(x_i\beta + \text{exposure}_i + \epsilon_i) \\ e^{\epsilon_i} &\sim \text{Gamma}(1/\alpha, \alpha) \end{aligned}$$

The validity of the Poisson model assumption that $\lambda = \text{E}(\lambda) = \text{Var}(\lambda)$ can be tested directly using the estimate of α obtained from the negative binomial model. An α statistically different than zero is evidence of over-dispersion in the data (i.e., that the variance of the arrival rate is greater than the mean). We find that α is highly statistically significant in all of our tests.

One important limitation of the negative binomial model, however, is that it cannot readily accommodate establishment fixed effects. Thus it cannot account for unobserved heterogeneity at the establishment level that affects both injury rates and capital structure measures. The Poisson model, on the other hand, can account for such fixed effects. That is, it allows each establishment to have a separate baseline injury arrival rate $\lambda_{i,t}$, which is specified as:

$$\lambda_{i,t} = \exp(c_i + \beta x_{i,t})$$

[10] We reach the same conclusions in the paper using average number of employees at an establishment for the year as the exposure variable.

Because injury rates are likely to differ substantially with the nature of work performed at an establishment in ways that are difficult to measure, and this variation could also be related to parent firm financial structure and condition, our analysis focuses primarily on estimating fixed effects Poisson models. We note though that, in addition to being unable to allow for over-dispersion, which may significantly reduce efficiency if the data is over-dispersed, the fixed effects Poisson model also requires that an establishment have at least two (and possibly more) unique observations for it to be used in the estimation, which reduces the available sample size.

One possible alternative to estimating count models would be estimating OLS regressions using an establishment's annual injury rate (injuries divided by number of hours worked or number of employees) as the dependent variable. However, an OLS model would be badly misspecified in this context for two reasons. First, the distribution from which an establishment's injury rate is drawn is not truly continuous because of the discrete nature of the number of injuries. Second, as Figure 1 shows, there is a mass in injury rates at zero percent.

— Insert Figure 1 here —

This massing of injury rates at zero percent suggests another alternative. One could estimate a Tobit model in which an establishment's targeted injury rate is treated as a latent variable that can take on negative as well as positive values, with observed injury rates truncated on the left at zero. However, there is no straightforward way to account for establishment fixed effects in a Tobit model, making it difficult to account for heterogeneity in injury rates across establishments.

3 Injury Rates and Leverage

In this section, we present analysis testing the effect of financial leverage on workplace injury rates. We first examine the simple bivariate relation between injury rates and leverage graphically. We then present estimates from a series of count model regressions of injury rate on leverage, controlling for a number of observable firm and establishment characteristics, variation within industry and state over time, and establishment fixed effects. Finally, we conduct additional cross-sectional and time series analysis to gain further insight into how to interpret the results from these regressions.

3.1 Injury rates and leverage - graphical depiction

We begin by graphically analyzing the bivariate relation between an establishment's injury rates and parent firm leverage. Figure 2 presents a kernel-weighted local polynomial smooth of the relation between $Cases/Hour$ and $Debt/Assets$ using the epanechnikov kernel and a bandwidth of 0.1.

— Insert Figure 2 here —

Figure 2 shows that the injury rate at an establishment changes little with parent firm $Debt/Assets$ up a level of 0.35, and then increases steadily with $Debt/Assets$ beyond this level. This is consistent with what one would expect if leverage imposes constraints on investment in safety. Leverage impacts a firm's ability to raise capital by creating debt overhang, exacerbating adverse selection, and exhausting collateral. Across a range of low levels of leverage, these frictions are unlikely to be apparent. However, once leverage reaches a certain level, these frictions begin to surface, impacting the firm's ability to raise capital. Further increases in leverage beyond this level worsen the frictions, making it still more difficult to raise capital. Thus one would expect these frictions to produce the convex relation between injury rates and leverage observed in Figure 2.

Of course, we are not controlling for any other factors that could also be related to injury rates at this point. We therefore next turn to multivariate regression analysis.

3.2 Injury rates and leverage - multivariate regression analysis

As discussed in Section 2.3, our multivariate analysis takes the form of a series of count models, where the dependent variable is the number of injuries at an establishment in a given year, and hours worked at the establishment during the year is specified as an exposure variable. The explanatory variable of interest is $Debt/Assets$. The other explanatory variables are firm and establishment characteristics. Firm-level flow variables ($CashFlow/Assets$, $AssetTurnover$, $Capex/Assets$) are measured here and in all later regressions contemporaneously, while stock variables ($Debt/Assets$, $Log(Assets)$, $MarketToBook$, $TangibleAssetRatio$) are measured as of the end of the prior year. Establishment-level controls ($Log(Employees)$, $Hours/Employee$) are always measured contemporaneously.

Table 4 presents estimates from several count models. Each model includes an intercept, which is omitted from the table, and year dummies to control for aggregate changes in injury rates over time. z-statistics are reported below each coefficient, and are based on standard errors clustered at the firm level both here and in other tables presenting count model estimates to follow.

— Insert Table 4 here —

Columns (1) through (3) shows estimates from negative binomial models, which allow for overdispersion in the data but do not allow us to account for establishment fixed effects. The only explanatory variable is $Debt/Assets$. The coefficient on $Debt/Assets$ is positive and statistically significant at the one percent level. This confirms the graphical representation of the bivariate relation between injury rates and leverage shown in Figure 2, and is again consistent with leverage leading to reduced investment in safety-related activities.

In column (2), we add several control variables to account for other observable characteristics that might be correlated with injury rates. We also add industry and state dummies to account for unobserved time-invariant industry and state characteristics. Accounting for industry is important because some industries are inherently more dangerous than others. As Table 2 shows, injury rates vary substantially across different industries. Controlling for an establishment's state accounts for cross-state differences in tort law, workplace regulations, unionization, and regional economic factors that could all affect injury rates. We define industries using Fama and French's 48 industry classifications. Note that the industry and state dummies capture the industry and state of the establishment as reported in the BLS data, and not the parent firm's industry classification or headquarters state.

The coefficient on $Debt/Assets$ becomes slightly larger in magnitude when we include these controls, and remains statistically significant at the one percent level. The positive significant coefficient on $AssetTurnover$ is consistent with higher injury rates at firms that produce more per factor unit. The positive significant coefficient on $TangibleAssetRatio$ is consistent with higher injury rates in firms in which production relies more on physical assets. The negative coefficient on $Capex/Assets$ is consistent with injury rates declining as firms replace old production equipment with newer equipment that must meet higher safety standards. The negative coefficient on $Hours/Employee$ could indicate that injury rates are higher when a firm has more part-time and temporary employees, who are likely to have received less training than full-time employees.

While we are also interested in the sensitivity of injury rates to cash flow, we refrain from interpreting the coefficient on $CashFlow/Assets$ assets in column (2) and in later columns because of a potential mechanical relation between cash flow and injuries. Conceptually, expenditures on safety, which are presumably intended to reduce injury rates, directly reduce current period cash flow. Indeed, this is why firms might seek to cut investment in safety when they face a financing shortfall. In principle, if expenditures on safety were accounted for as investment, then we might still be able to interpret the coefficient $CashFlow/Assets$, as it captures operational cash flow. However, many expenditures on safety are expensed and therefore directly reduce even traditional operational measures of cash flow. Because the endogeneity problem here arises from an almost mechancial relation between injury rates and cash flow, we cannot address it by simply controlling for other factors that might be related to both cash flow and injury rates.

Column (3) is the same as column (2), except that we replace the separate year, industry, and state dummies with year-industry and year-state dummies. This allows us to account not only for time-invariant industry and state characteristics related to injury rates, but also for time-varying characteristics. This is important if, for example, technological change in an industry affects both injury risk and optimal capital structure. All of the coefficients are almost identical to those in column (2), suggesting that changes in injury risk at the industry or state level over time are not driving any of the relations.

In all three models presented so far, the alpha parameter is highly statistically significant, indicating that the data is over-dispersed. This suggests that estimates from a Poisson model are inefficient. Nevertheless, a Poisson model admits establishment fixed effects, which allow us to account for any time-invariant establishment-level factors that drive the relation between injury rate and leverage.

Columns (4) through (6) of Table 4 show results from estimating Poisson count models. To allow for a comparison, we first show estimates from a Poisson model without establishment fixed effects in column (4). The explanatory variables are the same as in column (3), including year-industry and year-state dummies. A few of the estimates change when we switch from a negative binomial model to a Poisson model. For example, the relation of injury rate to capital expenditures gets much stronger. The injury rate also becomes negatively and statistically significantly related to cash flow. While this is consistent with a dependence of investments in safety on internal cash flow, we again do not attempt to interpret this coefficient because of the possible mechanical relation between injury rate and cash flow. However, most of the coefficients are similar, and the coefficient on *Debt/Assets* remains statistically significant at the one percent level.

We next introduce establishment fixed effects into the model. Column (5) shows estimates from an establishment fixed effects Poisson model, where *Debt/Assets* is the only explanation variable (along with year dummies). Note that the number of observations falls from 44,244 to 25,396 when establishment fixed effects are included, as an establishment must appear at least twice in the data in order to be used in an establishment fixed effects estimation. These observations are distributed over 8,019 unique establishments, implying slightly more than three observations per establishment on average. In addition to the reduced sample size, Table 3 shows that within-establishment injury rate variation is only about 1/3 of the between-establishment variation in injury rates in our sample. Thus reliance on only time series variation within establishment to identify coefficients substantially reduces power. Nevertheless, the coefficient on *Debt/Assets* is positive and of a similar magnitude to those in the first five columns, and is statistically significant at the five percent level.

Finally, column (6) shows results from estimating an establishment fixed effects Poisson model with control variables. A number of coefficients lose magnitude and statistical significance relative to column (4). Unobserved firm and establishment characteristics then appear to partly explain the relation of injury rates to some variables, though the loss of significance could also be due to a loss of power. However, the coefficient on *Debt/Assets* shrinks only slightly, and remains positive and statistically significant at the five percent level.

The economic magnitude of the estimates in Table 4 can be analyzed by transforming the β coefficients into incidence rate ratios e^{β}. Since β is the difference in the log of the expected counts, the exponential gives the percentage increase in the expected count for a unit increase in the associated independent variable. The coefficients on *Debt/Assets* in Table 4 are generally between 0.3 and 0.4. This corresponds in a range of incidence rate ratios of 1.35 to 1.49. Therefore, a 10% increase in *Debt/Assets* corresponds to a roughly an increase in the annual accident rate of between 3.4% and 4.9% ($10\% \times (\beta - 1)$). For comparison, the average predicted number of injuries per year evaluated at the median of *Debt/Assets* (0.189) is approximately 14.0 across the various models. Keeping all else equal, an establishment belonging to a firm with leverage at the 90th percentile (0.538) would have about two more predicted injuries per year (a 14% increase).

The robust positive relation between injury rate and leverage is consistent with more indebted firms investing less in safety-related activities. However, it is difficult to draw strong conclusions from this relation because leverage is an endogenous choice variable. We next conduct cross-sectional and time series analysis to further guide our interpretation.

3.3 Injury rates and leverage - cross-sectional variation with asset tangibility

While safety is potentially an important issue in all firms, investments in safety are likely to be more important in a manufacturing plant or a distribution center than in a retail firm. More generally, they are likely to be more important in settings in which employees come into more contact with physical assets such as production equipment, forklifts, etc. We test whether this is the case using cross-sectional variation in the nature of an establishment's operations. We proxy for the degree of contact employees have with physical assets using asset tangibility. Other things being equal, employees come into contact more with physical assets when these assets represent a bigger portion of the firm's total asset base. While other possible proxies may exist, asset tangibility seems the most direct measure available of the physicality of work in an establishment.

Rather than use variation in asset tangibility at the firm level in our tests, we use variation at the industry level. This allows us to assign each establishment in a firm its own asset tangibility measure rather than assuming that asset tangibility is the same for all establishments belonging to a firm. However, we obtain almost identical results if we use firm-level variation instead. We measure industry asset tangibility as the mean $TangibleAssetRatio$ across all firm-years in our sample for each of the Fama and French 48 industries. We then divide the sample into establishments in industries with below and above median industry asset tangibility (0.276), and estimate Poisson models with establishment fixed effects separately for each of the two resulting subsamples. Table 5 shows the results.

— Insert Table 5 here —

As Table 5 shows, an establishment's injury rate is much more sensitive to its parent firm's $Debt/Assets$ when the establishment is in an industry characterized by high asset tangibility. We do note that the number of observations for establishments with above median industry asset tangibility is about three times as large as the number with below median industry asset tangibility. This is not surprising, as the BLS injury survey oversamples establishments in industries with more physical production processes. We obtain similar results if we split the sample at a higher percentile of industry asset tangibility so that the number of establishments above and below the cutoff is similar. It is comforting that the sensitivity of injury rates to leverage is stronger in cases where investment in safety is likely to have a bigger effect on injury risk.

3.4 Injury rates and leverage - lead-lag patterns

Our final tests in this section focus on patterns in the relation between injury rates and leverage along the time series dimension of our panel. Specifically, we examine lead-lag relations between injury rates and leverage by estimating a panel vector autoregression (panel VAR) model. A panel VAR is similar to a traditional purely time series VAR, except that it allows each cross-sectional unit to have its own fixed effect. See Holtz-Eakin, Newey, and Rosen (1988) for a detailed discussion of panel VAR. Formally, the model is:

$$Cases/Hour_{i,t} = \alpha^C_{0,t} + \sum_{l=1}^{m} \alpha^C_{l,t} Cases/Hour_{i,t-l} + \sum_{l=1}^{m} \delta^C_{l,t} Debt/Assets_{i,t-l} + \gamma^C_t c^C_i + u^C_{i,t},$$

$$Debt/Assets_{i,t} = \alpha^D_{0,t} + \sum_{l=1}^{m} \alpha^D_{l,t} Debt/Assets_{i,t-l} + \sum_{l=1}^{m} \delta^D_{l,t} Cases/Hour_{i,t-l} + \gamma^D_t c^D_i + u^D_{i,t},$$

where m is the number of lags of $Cases/Hour$ and $Debt/Assets$ included as explanatory variables. This model is estimated using GMM after first de-meaning the data to remove individual effects. Only observations for which both $Debt/Assets$ and $Cases/Hour$ are both observed in the data for each of the m prior years can be used in estimating the model with m lags. Because of the sparse nature of our panel (due to the face that not all establishments are surveyed every year), the number of observations is greatly reduced. Table 6 presents the estimates from this model.

— Insert Table 6 here —

Column (1) shows estimates using only the first lag of the variables ($m = 1$). Year t $Cases/Hour$ are positively related to year $t-1$ $Debt/Assets$, but year t $Debt/Assets$ is actually negatively related to year $t-1$ $Cases/Hour$. Thus leverage positively predicts injury rates over the next year, but injury rates do not positively predict leverage at the end of the next year. While we are cautious about placing too much stock on this Granger (1969) causality, it lends further credence to the hypothesis that leverage affects workplace safety.

In column (2), we estimate the model using the first two lags of the variables ($m = 2$). Both of the first two lags of $Debt/Assets$ positively predict $Cases/Hour$, but the effect is much stronger in the first lag than in the second. Again, lags of $Cases/Hour$ do not positively predict $Debt/Assets$.

We further analyze these results graphically by plotting impulse functions based on the panel VAR estimates. Figure 3 shows the predicted response of $Cases/Hour$ to a positive shock to $Debt/Assets$ (top portion) and the predicted response of $Debt/Assets$ to a positive shock to $Cases/Hour$ (bottom portion).

— Insert Figure 3 here —

This figure yields the same conclusion that Table 6 does. The top part of the figure shows that a positive shock to $Debt/Assets$ in on year predicts an increase in $Cases/Hour$ that persists over two to three years. The bottom portion of the figure shows that a positive shock to $Cases/Hour$ predicts a subsequent decrease in $Debt/Assets$.

4 Injury Rates and Cash Flow

In this section, we investigate the sensitivity of injury rates to cash flow. As already discussed, examining correlations between injury rates and total operating cash flow is unlikely to be informative, as many investments in workplace safety directly reduce current period operating cash flow. To surmount this and other concerns about the endogenous nature of cash flow, we study three separate quasi-natural experiments involving plausibly exogenous shocks to a firm's investable cash flow. All three of these experiments have been used in the literature to study the effects of cash flow shocks on capital investment.

4.1 Tax-driven profit repatriation

The first of our quasi-natural experiments exploits a 2004 tax holiday that allowed firms with foreign subsidiaries to repatriate foreign profits at a drastically reduced tax rate. The

American Jobs Creation Act (AJCA) of 2004 permitted corporations with foreign subsidiaries to repatriate foreign earned income on a one-time basis at a rate of just 5.25%, with an effective tax rate as low as 3.7%, down from the standard corporate tax rate of 35%. Firms responded by repatriating large quantities of cash that had previously been tied up oversees. For a firm with previously unrepatriated profits, the act represented a substantial one-time shock to cash available to spend domestically on activities that affect workplace safety. We therefore test whether this shock impacted injury rates at a firm's establishments, noting that all of the establishments in our data are in the U.S.[11]

We use foreign profits in the years immediately prior to the 2004 act as a measure of cash available to be repatriated from foreign subsidiaries during the tax holiday. If firms are constrained in their ability to invest in safety-related activities by the availability of cash, firms with foreign profits in the years prior to the act should see a decline in injury rates immediately after the act relative to firms lacking such profits. Thus we employ a difference-in-differences approach to test for evidence that the shock to available cash relaxes constraints on investment in activities that contribute to workplace safety.

To focus on the period right around the AJCA of 2004, we limit the sample we use in these tests to establishment-year observations in the years 2002, 2003, 2005 and 2006 (i.e., the two years before and two years after the shock). For each firm with an establishment in the sample, we compute the firm's cumulative foreign profits over the years 2001-2003 (i.e., the three years prior to the shock), where foreign profits are defined as Compustat variable *pifo*. While the period over which we cumulate foreign profits is somewhat arbitrary, a three-year window is long enough to reliably measure recent foreign profitability while avoiding foreign profits from the distant past that may no longer reside in a foreign subsidiary. Our results are robust to both alternative windows around the tax change and alternative windows for

[11] In some cases, a firm can repatriate cash resulting from foreign profits and hold it in the U.S. without triggering federal income tax on the underlying foreign profits. However, the firm cannot use this cash in its business or pay it out to shareholders without triggering taxation.

cumulating foreign profits. Any noise in our measure of accumulated foreign profits due to our approach should bias against finding results.

We compute a dummy variable $FrgnProf > 0$ that is equal to one if the sum of a firm's foreign profits from 2001 through 2003 is positive, and zero if it is zero or negative. We also construct a dummy variable $Post2004$ that is equal to one if an observation occurs in 2005 or 2006 and zero if it occurs in 2002 or 2003. We then estimate establishment fixed effects Poisson models in which the dependent variable is injury count, and the primary explanatory variables of interest are $FrgnProf > 0$, $Post2004$, and especially the interaction of the two. Table 7 presents the results from these tests.

— Insert Table 7 here —

In column (1), $FrgnProf > 0$, $Post2004$, and the interaction of the two are the only explanatory variables. The negative coefficient on $Post2004$ indicates that the mean injury arrival rate has fallen across the board in the post-2004 period. The coefficient on $FrgnProf > 0$ is statistically insignificant. The coefficient on the interaction of the two variables - the coefficient of interest - is negative, indicating that establishments of firms with foreign profits in the years prior to the tax shock see a larger decrease in injury rates after the tax shock than those with no available profits to repatriate. However, this coefficient is also statistically insignificant.

In column (2), we add firm- and establishment-level control variables. The coefficient on $Post2004$ remains negative and statistically significant. The coefficient on $FrgnProf > 0$ is now negative and statistically significant. This indicates that the establishments of firms with positive foreign profits in the years prior to the tax shock experience lower injury rates in the pre-2004 period. The coefficient on the interaction of the two remains negative, and is now statistically significant at the ten percent level. Thus the results at least wekaly support a negative sensitivity of injury rates to a positive cash flow shock.

Other things being equal, an extra dollar of cash flow should have a greater effect on a firm's investment in workplace safety if the firm cannot easily raise additional external capital. The results in the previous section suggest that high leverage represents such an impediment. We would therefore expect injury rates to be more sensitive to a cash flow shock when leverage is high. We test this prediction by repeating the estimation in columns (1) and (2), but adding the interactions of $Debt/Assets$ with $Post2004$, $FrgnProf > 0$, and the interaction of these two variables as explanatory variables. This triple interaction is the variable of interest, as it captures how the sensitivity of injury rates to cash flow varies with leverage. While $Debt/Assets$ is an endogenous variable, we can treat it as exogenous here as long as firms did not choose leverage before 2004 in anticipation of the AJCA.

Columns (3) and (4) show the results from these regressions. In both columns, the coefficient on the triple interaction is negative and statistically significant at the one percent level. This supports the hypothesis that cash flow has a larger negative effect on injury rates when the firm has high leverage and therefore reduced access to external sources of capital.

One concern with this set of tests is that pre-existing differential trends in injury rates between firms with and without foreign profits could drive the results. For example, injury rates at firms with foreign profits may have already been trending downward relative to those at firms without foreign profits throughout the 2000s. To verify that differential trends are not driving our results, we plot trends in the portion of injury rates not explained by other observables separately for firms with and without foreign profits over time.

Recall that our sample period begins in 2002 because there are no firm identifiers in the BLS data before 2002. We backfill the sample to 2001 so that we can observe the trends for a slightly longer period pre-AJCA (2004). For each 2001 establishment observation in the BLS data, we find the next year the it appears again in the BLS data, and assume that the parent firm in 2001 is the same as in that year. We are able to identify an establishment's parent firm in 80% of cases in this way.

For the full sample, we regress *Cases/Hour* (pre-multiplied by 1,000) on firm- and establishment-level characteristics (excluding the firm's foreign profit status) as well as establishment fixed effects using OLS. The residuals from this regression represent the portion of injury rate not explained by other firm and establishment characteristics. Figure 4 presents the mean residual for each year from 2001 through 2009 separately for firms with and without foreign profits as of 2004.[12]

— Insert Figure 4 here —

Injury rates pre-2004 are higher for firms with foreign profits as of 2004 than for those without. However, the trends in injury rates across the two groups pre-2004 are almost identical. The rate continues to trend upwards in 2004 for firms without foreign profits. However, for firms with foreign profits, the rate falls dramatically in 2004, reversing the upward trend. From 2004 through 2008, the rates for both groups are fairly constant, and are actually slightly lower for firms without foreign profits than with. In 2009, the injury rate residuals rise for firms with foreign profits and fall for firms without, so that the difference between the two is similar to the level pre-2004. These patterns are consistent with positive cash flow shocks due to the AJCA relaxing financing constraints and leading to lower injury rates for a number of subsequent years.

One specific alternative explanation for the results in Table 7 and Figure 4 is a differential shift in the profile of establishments following the AJCA. For example, a cash constrained firm experiencing a positive cash flow shock as a result of the AJCA may use the additional cash to expand productive activities associated with lower injury rates, perhaps because returns to investment in those activities happen to be higher. This would lead to a relative decrease in observed injury rates post-AJCA for firms with previously unrepatriated profits, even if existing jobs do not become any safer. We cannot test this explanation directly

[12]The conclusions are the same if we plot raw *Cases/Hour* instead of the portion not explained by other variables.

as we do not observe growth in specific activities within an establishment. However, for a subsample of firms, we can measure differences in growth (in number of employees) *across* establishments. We therefore test whether firms with foreign profits shift employment from establishments with higher injury risk to those with lower injury risk after the AJCA.

To do so, we form a sample of all establishments that are in the data at least once in each of the pre- and post-AJCA periods. For each establishment, we compute the annualized percent change in employment from the pre- to post-AJCA period. For pre-AJCA employment, we use an establishment's 2003 employment if it is available and 2002 if is not. For the post-AJCA period, we use 2005 employment if it is available and 2006 if it is not. We then divide establishments into more or less dangerous establishments depending on whether an establishment's industry mean injury rate is above or below the median industry mean injury rate for all of the parent firm's establishments in the sample. Table 8 presents the mean percent change in employment around the AJCA in more and less dangerous establishments separately for firms with and without cumulative foreign profits over 2001-2003.

— Insert Table 8 here —

For firms with foreign profits, employment actually declines slightly more in less dangerous establishments than in more dangerous establishments after the AJCA. This is inconsistent with the decrease in injury rates in these firms around this time being driven by changes in the composition of productive activities within firm. Moreover, firms without foreign profits actually experience an increase in employment in less dangerous establishments and a decrease in more dangerous establishments. Thus, as the rightmost column of the table shows, the relative fall in employment in less dangerous establishments for firms with foreign profits is even larger when compared to the change for firms without foreign profits. That column also shows that this difference in differences is not statistically significant at the ten percent level.

4.2 Oil price shocks

Our second quasi-natural experiment exploits time-series variation in oil prices. Over the course of our sample, 2002-2009, oil prices have undergone dramatic and largely unexpected changes. From 2002 to early 2008, average oil prices rapidly increased from around $25 per barrel to well over $120 per barrel, driving record profits for established producers like ExxonMobil. Prices subsequently saw a radical decrease at the end of 2008 and into 2009. These fluctuations in oil price had a dramatic impact on the cash flow of firms involved in petroleum exploration and production.

Lamont (1997) examines the impact of an oil price shock, the collapse of crude oil prices in 1985, on the investment of non-oil segments belonging to conglomerates whose cash flow was exposed to the price of oil through oil-producing segments that they also owned. In the same spirit, we examine whether injury rates at non-oil establishments change in response to oil price movements in firms that are involved in oil exploration or production. We employ a similar difference-in-differences approach as the one in the AJCA test - comparing firms with and without oil establishments in this case - to account for any correlation between aggregate injury rates and oil prices. If cash constraints limit investment in activities that affect workplace safety, then the relation between injury rates and oil prices should be negative at non-oil establishments of firms that have oil business, relative to those that don't. As we are examining injuries only in those establishments that are not involved in the business of petroleum exploration and production, we eliminate any direct effect that may result from the rapid expansion and growth in the exposed establishments.

We first identify every establishment in the full sample that has a 2-digit SIC code of 13 (Oil and Gas Extraction), and remove these establishments from our sample. This reduces our sample size from 44,244 to 43,973. Then, for all remaining establishment-years, we create an indicator variable $OilExposed$ that takes a value of one if the establishment's parent firm has an establishment in 2-digit SIC code 13 at any time during the sample period, and zero otherwise.[13] The *OilExposed* variable takes a value of one for 798 establishment-years, representing 97 unique firm-years across 16 unique firms. We also construct a variable *OilPrice* that is equal to the average annual oil price for a given year as reported by the US Energy Information Agency.

We then estimate establishment fixed effects Poisson models in which the dependent variable is injury count, and the primary explanatory variables of interest are *OilExposed* and especially the interaction of *OilExposed* and *OilPrice*. One concern that has been voiced regarding Lamont's (1997) tests is that the assignment of oil-producing establishments to firms is not random. The non-oil establishments of these firms are disproportionately likely to be in states with a lot of oil production (e.g., Texas). As oil prices have a big impact on the economies of these states, investment opportunities in non-oil establishments in these states are likely to vary with oil prices. We include year-state dummies in all of the regressions to account for this possibility. *OilPrice* does not appear directly in the regressions as it is cross-sectionally invariant and therefore fully explained by the year-state dummies. Table 9 presents the results of these tests.

— Insert Table 9 here —

Column (1) reports the baseline results. The coefficient on *OilExposed* is negative, indicating that establishments belonging to firms with oil producing arms have a lower baseline injury rate than establishments whose parent companies do not have oil producing arms. More importantly, the coefficient on the interaction of *OilExposed* and *OilPrice* is negative and significant at the one percent level. This indicates that injury rates at an establishment fall more when oil prices rise if the establishment belongs to a firm with an oil-producing establishment than if it does not. This is consistent with increased parent firm

[13] We define firms with oil establishments as those that have an oil establishment in any year in the sample rather rather than in the same year as an observation because the BLS surveys only a subset of establishments in any given year.

cash flow relaxing cash constraints and having a positive effect on investment in activities that improve workplace safety. Additional firm- and establishment-level controls are included in column (2), and the results remain qualitatively similar.

As in the AJCA analysis, we again test whether the sensitivity of injury rates to cash flow shocks is greater for firms with more leverage. We do so by interacting *Debt/Assets* with *OilExposed*, *OilPrice*, and the interaction of the two. The triple interaction captures variation in the sensitivity of injury rates to cash flow with leverage and is the variable of interest. The results are shown in columns (3) and (4), without and with controls, respectively. The coefficient on the triple interaction is negative in both cases. It falls just short of statistical significance at the ten percent level in the absence of controls and at the five percent level with controls. Consistent with the findings of the AJCA test, the negative coefficient indicates that injury rates are more sensitive to cash flow when leverage is high.

One concern with the analysis is that it encompasses the period of the financial crisis, which could be a contaminating factor. We address this by re-estimating the regressions in columns (2) and (4) for 2002-2007 (i.e., excluding the crisis period). The results are shown in columns (5) and (6). A comparison of columns (2) and (5) shows that the sensitivity of injury rates to oil prices for firms with oil establishments is the same whether we include 2008 and 2009 or not. A comparison of columns (4) and (6) shows that the differential with *Debt/Assets* is actually stronger and has a higher level of statistical significance when we exclude 2008 and 2009.

4.3 Debt maturity entering the financial crisis

Our third quasi-experiment exploits the maturity structure of firms' debt entering the financial crisis. Credit markets tightened dramatically at the onset of the financial crisis, making it difficult for firms to roll over maturing debt. Failure to roll over maturing debt is effectively a negative cash flow shock. Almeida, Campello, Laranjeira, and Weisbenner

(2012) show that firms with a lot of debt maturing over the next year as of the end of 2007 reduced investment in capital assets in 2008. Identification comes from the fact that debt maturity schedules are typically set in advance, and it is unlikely that firms anticipated the financial crisis when setting maturity schedules in the preceding years. Thus we can treat the fraction of a firm's debt that is maturing at the onset of the crisis as exogenous, and examine its effects on injury rates in the subsequent years.

Our approach is similar to that of Almeida, Campello, Laranjeira, and Weisbenner (2012). As they do, we begin with all firms whose 2007 fiscal year end falls between September 2007 and January 2008. This excludes the 20% of firms with 2007 fiscal year ends prior to the onset of the crisis in late 2007. The 2007 balance sheets of included firms show their debt maturity structure immediately after the onset of the crisis. We define $DebtDue$ as debt maturing within the next year (Compustat $DD1$) as of fiscal year end 2007 as a fraction of total assets. We define $HighDebtDue$ as an indicator variable equal to one if $DebtDue$ is at or above the 75th percentile for the sample (0.0304) and zero otherwise. This cutoff is arbitrary, but the results are not sensitive to the exact cutoff.

We restrict the sample period to 2006-2008 to focus on the time right around the onset of the crisis. We define $Crisis$ as an indicator variable equal to one if an observation occurs in 2008 and zero if it occurs before 2008. We then estimate an establishment fixed effects Poisson model in which the dependent variable is number of injuries (with hours worked as the exposure variable again), and the primary explanatory variables are $Crisis$, $HighDebtDue$, and the interaction of the two. As were the tests based on the other two quasi-natural experiments, this is effectively a difference-in-differences test. The interaction term captures the change in injury rate from before to during 2008 for firms with a lot of debt maturing at fiscal year end 2007 relative to those that don't. Table 10 presents the results of these tests.

— Insert Table 10 here —

Columns (1) and (2) show the results. Only *Crisis*, *HighDebtDue*, and the interaction of the two are included as explanatory variables in column (1). The positive coefficient on *HighDebtDue* indicates that the establishments of firms with a large quantity of debt maturing during 2008 have higher injury rates even before 2008. More importantly, the coefficient on the interaction of *Crisis* and *HighDebtDue* is positive and statistically significant at the five percent level. Thus firms with a lot of debt maturing at the onset of the crisis experience an increase in injury rates relative to firms without a lot of debt maturing. This is consistent with firms becoming cash constrained because of difficulty in rolling over a large quantity of debt during a period of tight capital markets reducing investment in workplace safety.

In column (2), we control for firm and establishment characteristics. Importantly, these include *Debt/Assets*. This accounts directly for the fact that firms with a large quantity of debt maturing at any point in time are likely to have a lot of debt in general. The coefficient on the interaction of *Crisis* and *HighDebtDue* remains positive and statistically significant at the five percent level.

Columns (3) and (4) repeat the tests in columns (1) and (2) with the sample period extended one year further back (to 2005). The results, if anything, become slightly stronger when we lengthen the sample period in this way. For example, the coefficient on the interaction term is statistically significant at the one percent level in column (4). Unlike in the AJCA and oil price tests, we do not test whether the effect is stronger for more leveraged firms here. The interpretation of such a test would be unclear, as the explanatory variable *HighDebtDue* already captures information about a portion of the firm's debt.

As in the case of the AJCA experiment, we examine trends in injury rates for firms with and without high debt due at the onset of the crisis to ensure that the results are not driven by differential trends. We again compute the unexplained injury rate by regressing *Cases/Hour* (pre-multiplied by 1,000) on firm and establishment characteristics using OLS with establishment fixed effects and capturing the residuals. Figure 5 plots the mean residual for firms with and without high debt due at the onset of the crisis for each year from 2005 through 2009.

— Insert Figure 5 here —

There appear to be differential pre-existing trends in unexplained injury rates across the two groups of firms pre-2008. Rates are declining during this period for firms with high debt due and rising for firms without high debt due. The fact that pre-existing trends differ between the groups is a concern, but the results shown in Table 10 are clearly not driven by a simple continuation of these trends. While unexplained injury rates continue to trend slightly upwards in 2008 and beyond for firms without high debt due at the onset of the crisis, the trend for firms with high debt due reverses sharply and becomes positive in 2008. This suggests that the effect of having debt maturing when it is difficult to roll over overwhelms the trend towards improvements in workplace safety in this set of firms in prior years.

Overall, the results across all three quasi-natural experiments studied in this section are consistent. Establishments of firms receiving a plausibly exogenous positive (negative) cash flow shock subsequently experience decreases (increases) in injury rates. This suggests that cash constrained firms reduce investment in activities that improve workplace safety. Moreover, the effect of these cash flow shocks is larger in firms with greater financial leverage. This is consistent with an additional dollar of cash flow having a bigger effect on investment in safety when a firm is likely to have greater difficulty raising external capital due to higher existing debt loads.

5 Firm value and injury rates

In this section, we examine the relation between workplace safety and firm value. Our results thus far suggest that a firm's ability to finance investment affects the safety of its workplaces. While employees bear some of the costs of a less workplace, employers are likely to bear much of them directly or indirectly. Higher injury risk is likely to impact firm value directly through more frequent injury-related lawsuits, reduced productivity due to low employee morale, and greater difficulty attracting talented employees. Firms are also likely to bear some of the cost employees face from higher injury risk indirectly through a compensating wage differential. The industrial relations literature finds evidence of such a wage differential. If workplace safety affects firm value, then our results could have important implications for firms' financing decisions.

We test the connection between firm value and workplace safety by regressing a firm's Tobin's Q on injury rate, controlling for firm characteristics and firm fixed effects. Tobin's Q is the traditional measure of scaled firm value in corporate finance, and is defined as the sum of the market value of equity and book value of debt less deferred taxes, divided by total assets. We compute firm-level $Cases/Hour$ by dividing the number of injuries at all of a firm's establishments in the data in a given year by the sum of employment in those establishments. Note that this is a potentially noisy measure of firm injury rates, as establishments participating in the BLS survey vary from year to year. If anything, this added noise should make it more difficult to find a relation between Tobin's Q and the injury rate. Table 11 presents the results from this test.

— Insert Table 11 here —

Both regressions shown in the table include firm and year fixed effects. Column (1) presents results where firm-level $Cases/Hour$ is the only explanatory variable. The negative coefficient indicates that firms with higher injury rates are less valuable as measured by Tobin's Q. Column (2) includes several firm characteristics as control variables. The coefficient on firm-level $Cases/Hour$ remains negative and is statistically significant at the five percent level. While ascribing causality is difficult here, the results are consistent with higher injury rates lowering firm value through higher wages, more injury-related lawsuits, and reduced productivity.

6 Conclusion

In summary, this paper has presented evidence that a firm's financial structure and condition can impact the safety of its workplaces. Specifically, injury rates increase with leverage, controlling for a number of other factors including establishment fixed effects. They increase (decrease) in response to plausibly exogenous negative (positive) cash flow shocks based on three quasi-natural experiments, especially in more leveraged firms. The relation between injury rates and leverage is stronger in firms where investments in safety are more important, and leverage positively predicts future injury rates but not vice versa. We interpret these results as evidence that firms cut investment in activities that enhance workplace safety when facing financing constraints. This represents a previously unexplored channel through which a firm's financial circumstances can impact the well-being of its employees, an important set of non-financial stakeholders in the firm. We also present brief evidence that firm value is related to injury rate, suggesting that firms should take into account the effect of their financial circumstances on workplace safety when setting financial policy.

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Table 1: Summary statistics

This table presents summary statistics for the data used in this study. Panel A shows the number of establishment-year observations by year, where an establishment refers to a single location of a company as identified by the Bureau of Labor Statistics. Panel B shows summary statistics for the 44,244 establishment-year observations that we study. *HoursWorked* is the number of hours worked by employees of an establishment during a year. *AverageEmployment* is the average number of employees working at an establishment during a year. *Hours/Employee* is the ratio of the two. *Cases* is the number of recorded injuries for an establishment in a year. *LTCases* is the number of lost-time injuries recorded for an establishment in a year. Each of these injury counts is also reported per hour worked and per average number of employees. The per hour rates are multiplied by 1,000 to make them easier to read. Panel C shows summary statistics for the parent-level firm-year observations in our sample. *Debt/Assets* is book debt divided by book assets. *CashFlow/Assets* is the sum of income before extraordinary items and depreciation, divided by lagged assets. *Assets* are total reported assets. *AssetTurnover* is sales divided by lagged assets. *MarketToBook* is the ratio of the market value of equity to the book value of equity. *TangibleAssetRatio* is net plant, property and equipment divided by total assets. *Capex/Assets* is capital expenditures divided by lagged assets.

Panel A: Observations by year

Year	Observations	Percent
2002	5,476	12.38
2003	5,642	12.75
2004	5,234	11.83
2005	5,145	11.63
2006	6,148	13.90
2007	5,857	13.24
2008	5,743	12.98
2009	4,999	11.30

Panel B: Establishment summary statistics

	Mean	Std. Dev.
HoursWorked	656,136	2,430,868
AverageEmployment	355	1,260
Hours/Employee	1,720	418
1,000 × Cases/Hour	0.0247	0.0322
Cases/Employee	0.0413	0.0529
1,000 × LTCases/Hour	0.0077	0.0153
LTCases/Employee	0.0128	0.0249

Panel C: Firm summary statistics

	Mean	Std. Dev.	10th pctile	Median	90th pctile
Debt/Assets	0.234	0.213	0.001	0.210	0.458
CashFlow/Assets	0.102	0.146	0.012	0.112	0.195
Log(Assets)	6.525	1.918	4.004	6.544	9.052
AssetTurnover	1.372	0.890	0.492	1.171	2.505
MarketToBook	1.449	1.156	0.566	1.137	2.640
TangibleAssetRatio	0.273	0.212	0.057	0.215	0.602
Capex/Assets	0.055	0.068	0.011	0.035	0.115

Table 2: Injury rates by industry

This table shows various mean annual establishment-level injury rates across different industries from 2002 through 2009. An establishment refers to a single location of a company as identified by the Bureau of Labor Statistics. Each industry depicted represents one of the Fama-French 48 industries. Two industries (Tobacco Products and Non-Metallic and Industrial Metal Mining) are omitted because the small number of establishments in these industries risks revealing the identity of an individual establishment or firm. Industries are sorted from highest *Cases/Employee* to lowest. See Table 1 for definitions of the injury rate variables.

Industry	Cases/Employee	1,000 × Cases/Hour	LTCases/Employee	1,000 × LTCases/Hour
Candy & Soda	0.0829	0.0418	0.0219	0.0111
Fabricated Products	0.0822	0.0405	0.0214	0.0106
Transportation	0.0771	0.0454	0.0456	0.0271
Automobiles and Trucks	0.0685	0.0353	0.0154	0.0081
Steel Works Etc	0.0656	0.0313	0.0153	0.0074
Food Products	0.0613	0.0298	0.0137	0.0065
Construction Materials	0.0567	0.0280	0.0125	0.0062
Real Estate	0.0549	0.0272	0.0174	0.0090
Rubber and Plastic Products	0.0535	0.0267	0.0133	0.0066
Almost Nothing	0.0533	0.0283	0.0184	0.0095
Electrical Equipment	0.0515	0.0260	0.0097	0.0048
Machinery	0.0506	0.0253	0.0105	0.0053
Apparel	0.0501	0.0305	0.0110	0.0072
Consumer Goods	0.0494	0.0255	0.0094	0.0048
Agriculture	0.0491	0.0251	0.0120	0.0064
Recreation	0.0465	0.0248	0.0085	0.0043
Beer & Liquor	0.0447	0.0248	0.0118	0.0064
Restaraunts, Hotels, Motels	0.0431	0.0313	0.0099	0.0074
Shipbuilding, Railroad Equipment	0.0429	0.0216	0.0103	0.0053
Business Supplies	0.0415	0.0205	0.0118	0.0059
Personal Services	0.0408	0.0252	0.0133	0.0081
Healthcare	0.0406	0.0251	0.0108	0.0065
Retail	0.0403	0.0286	0.0113	0.0081
Shipping Containers	0.0380	0.0184	0.0068	0.0033
Wholesale	0.0374	0.0235	0.0103	0.0064
Construction	0.0352	0.0173	0.0112	0.0056
Textiles	0.0336	0.0172	0.0054	0.0026
Business Services	0.0329	0.0179	0.0098	0.0054
Medical Equipment	0.0323	0.0166	0.0085	0.0043
Printing and Publishing	0.0316	0.0183	0.0090	0.0052
Utilities	0.0309	0.0152	0.0090	0.0042
Communication	0.0308	0.0162	0.0143	0.0076
Pharmaceutical Products	0.0301	0.0150	0.0072	0.0036
Aircraft	0.0242	0.0120	0.0048	0.0024
Petroleum and Natural Gas	0.0239	0.0118	0.0077	0.0038
Measuring and Control Equipment	0.0219	0.0112	0.0053	0.0027
Defense	0.0213	0.0106	0.0050	0.0025
Chemicals	0.0201	0.0097	0.0047	0.0022
Electronic Equipment	0.0183	0.0093	0.0043	0.0022
Insurance	0.0151	0.0090	0.0018	0.0010
Entertainment	0.0140	0.0120	0.0031	0.0025
Computers	0.0119	0.0060	0.0031	0.0016
Trading	0.0116	0.0062	0.0010	0.0005
Banking	0.0110	0.0055	0.0027	0.0014

Table 3: Panel Variance Statistics

This table presents a summary of the relative variation between and within the establishment, firm, and industry groups. The first two rows report the mean and standard deviation of the variable for the full sample. The second two rows report the standard deviation across different establishments controlling for the time series mean and within each establishment controlling for the establishment mean. The third two rows report the standard deviation between and within different firms. The fourth two rows report the standard deviation between and within each of 48 Fama-French industry categories.

	Cases/Hour x 1,000	Cases/Employee
Overall Mean	0.024	0.041
Overall Std. Dev.	0.032	0.053
Between Establishment	0.033	0.053
Within Establishment	0.013	0.020
Between Firm	0.021	0.037
Within Firm	0.027	0.044
Between Industry	0.010	0.019
Within Industry	0.031	0.050

Table 4: Leverage and injury rates

This table presents estimates from a series of count models in which the dependent variable is the number of injuries reported at an establishment in a given year. The exposure variable is the number of hours worked at the establishment during the year. The explanatory variables are all measured at the establishment's parent firm level except for $Log(employees)$ and $Hours/employee$, which are measured at the establishment level. All explanatory variables are lagged one year except $CashFlow$, which is contemporaneous. See Table 1 for definitions of these variables. All regressions include an intercept term, which is not reported. Columns (1) through (3) show estimates from negative binomial models. Columns (4) through (6) show estimates from Poisson models. The models in columns (5) and (6) include establishment fixed effects. z-statistics based on standard errors clustered at the firm level are reported in parentheses below each point estimate. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on a two-tailed z-test.

	(1)	(2)	(3)	(4)	(5)	(6)
Debt/Assets	0.338***	0.397***	0.394***	0.336***	0.358**	0.269**
	(2.90)	(3.19)	(3.28)	(3.11)	(2.32)	(2.26)
CashFlow/Assets		-0.009	-0.036	-0.161**		0.072
		(0.08)	(0.33)	(2.36)		(1.10)
Log(Assets)		-0.052**	-0.056***	-0.063***		0.033
		(2.46)	(2.64)	(3.62)		(0.77)
AssetTurnover		0.188***	0.187***	0.225***		0.088**
		(3.77)	(3.86)	(4.90)		(2.14)
MarketToBook		-0.029	-0.031	-0.023		-0.030**
		(1.32)	(1.44)	(0.86)		(2.26)
TangibleAssetRatio		0.893***	0.888***	1.000***		-0.084
		(4.36)	(4.29)	(5.57)		(0.37)
Capex/Assets		-0.794*	-0.762*	-2.237***		-0.741**
		(1.90)	(1.74)	(4.79)		(2.52)
Log(Employees)		-0.028	-0.029*	-0.038**		-0.121**
		(1.55)	(1.71)	(2.31)		(2.53)
Hours/Employee		-0.230***	-0.234***	-0.565***		-0.418***
		(3.86)	(3.98)	(7.79)		(7.47)
Model	Neg Bin	Neg Bin	Neg Bin	Poisson	Poisson	Poisson
Year dummies	Yes	Yes	No	No	Yes	Yes
Industry dummies	No	Yes	No	No	No	No
State dummies	No	Yes	No	No	No	No
Year $\times$ Industry dummies	No	No	Yes	Yes	No	No
Year $\times$ State dummies	No	No	Yes	Yes	No	No
Establishment fixed effects	No	No	No	No	Yes	Yes
Observations	44,244	44,244	44,244	44,244	25,396	25,396
Log pseudo likelihood	-115,952	-114,866	-114,314	-228,945	-56,497	-55,184
Neg Bin α						

Table 5: Leverage and injury rates: variation with production asset intensity

This table presents estimates from Poisson models with establishment fixed effects in which the dependent variable is the number of injuries reported at an establishment in a given year. The exposure variable is the number of hours worked at the establishment during the year. The explanatory variables are all measured at the establishment's parent firm level except for $Log(employees)$ and $Hours/employee$, which are measured at the establishment level. All explanatory variables are lagged one year except $CashFlow$, which is contemporaneous. See Table 1 for definitions of these variables. All regressions include an intercept term, which is not reported, as well as year dummies. A firm is classified as having low (high) asset tangibility if its industry mean tangible asset ratio (net plant, property and equipment divided by total assets) is below (above) the median for the sample. z-statistics based on standard errors clustered at the firm level are reported in parentheses below each point estimate. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on a two-tailed z-test.

	Low Asset Tangibility	High Asset Tangibility
Debt/Assets	0.029	0.422***
	(0.19)	(3.02)
CashFlow/Assets	-0.054	0.069
	(0.42)	(1.04)
Log (assets)	-0.011	0.102
	(0.20)	(1.57)
Asset turnover	0.086	0.051
	(1.31)	(1.20)
Market-to-Book	-0.041***	-0.017
	(2.57)	(1.23)
Tangible asset ratio	-0.090	0.088
	(0.21)	(0.39)
Capex/Assets	0.087	-0.971***
	(0.15)	(2.88)
Log (employees)	-0.022	-0.154***
	(0.47)	(2.62)
Hours/employee	-0.255***	-0.479***
	(2.84)	(7.80)
Observations	6,535	18,660

Table 6: Panel VAR estimates of lead-lag relation between leverage and injury rates

This table presents estimates from panel vector autoregression (VAR) models of the form:

$$Cases/Hour_{it} = \alpha_{0t}^{C} + \sum_{l=1}^{m} \alpha_{lt}^{C} Cases/Hour_{it-1} + \sum_{l=1}^{m} \delta_{lt}^{C} Debt/Assets_{it-1} + \gamma_t^C c_i^C + u_{it}^{C},$$

$$Debt/Assets_{it} = \alpha_{0t}^{D} + \sum_{l=1}^{m} \alpha_{lt}^{D} Debt/Assets_{it-1} + \sum_{l=1}^{m} \delta_{lt}^{D} Cases/Hour_{it-1} + \gamma_t^D c_i^D + u_{it}^{D},$$

where l is the number of lags of $Cases/Hour$ and $Debt/Assets$ included as explanatory variables. This model is estimated using GMM after first de-meaning the data to remove individual effects. Only observations for which both $Debt/Assets$ and $Cases/Hour$ are both observed in the data for each of the m prior years can be used in estimating the model with m lags. Column (1) shows estimates using the first lag of each variable ($m = 1$). Column (2) shows estimates using the first two lags ($m = 2$). t-statistics are reported in parentheses below each point estimate. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on a two-tailed t-test.

	(1)	(2)
DepVar = Cases/Hour$_t$		
Debt/Assets$_{t-1}$	0.081***	0.062***
	(4.16)	(2.72)
Debt/Assets$_{t-2}$		0.012***
		(3.46)
Cases/Hour$_{t-1}$	0.211***	0.292***
	(8.96)	(6.16)
Cases/Hour$_{t-2}$		0.121***
		(4.10)
DepVar = Debt/Assets$_t$		
Cases/Hour$_{t-1}$	-0.252***	-0.409**
	(3.51)	(2.18)
Cases/Hour$_{t-2}$		-0.289**
		(2.58)
Debt/Assets$_{t-1}$	0.263**	0.092
	(2.55)	(0.59)
Debt/Assets$_{t-2}$		-0.030
		(1.25)
Observations	7,645	3,835

Table 7: Workplace injuries and the American Jobs Creation Act

This table presents estimates of the effect of the American Jobs Creation Act of 2004 on injury rates, based on Poisson count models with establishment fixed effects. The dependent variable in each model is the number of injuries reported at an establishment in a given year. The exposure variable is the number of hours worked at the establishment during the year. Only observations in 2002, 2003, 2005 and 2006 are included in the tests in this table. *Post*2004 is an indicator variable taking a value of one in years 2005 and 2006 and zero in years 2002 and 2003. $FrgnProf > 0$ is an indicator taking a value of one if the parent firm's cumulative reported foreign profits in 2001-2003 were positive, and zero otherwise. The other explanatory variables are all lagged one year except for *CashFlow/Assets*, which is contemporaneous. See Table 1 for definitions of these variables. All regressions include an intercept term, which is not reported. z-statistics based on standard errors clustered at the firm level are reported in parentheses below each point estimate. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on a two-tailed z-test.

	(1)	(2)	(3)	(4)
Post2004	-0.232***	-0.262***	-0.319***	-0.379***
	(4.67)	(7.20)	(6.34)	(7.28)
FrgnProf>0	-0.072	-0.281***	-0.121	-0.320***
	(1.46)	(3.80)	(1.27)	(3.04)
Post2004 * FrgnProf>0	-0.066	-0.078*	0.210***	0.176**
	(1.29)	(1.65)	(2.73)	(2.35)
Debt/Assets		0.467***	0.469**	0.333**
		(4.32)	(2.51)	(2.48)
Debt/Assets * Post2004			0.369**	0.417***
			(2.12)	(2.69)
Debt/Assets * FrgnProf>0			-0.089	-0.037
			(0.26)	(0.12)
Debt/Assets * Post2004 * FrgnProf>0			-1.133***	-1.099***
			(4.10)	(4.20)
CashFlow/Assets		0.028		0.015
		(0.56)		(0.34)
Log(Assets)		0.039		0.069
		(0.63)		(1.05)
AssetTurnover		0.031		-0.004
		(0.43)		(0.07)
MarketToBook		-0.016		-0.026
		(0.95)		(1.52)
TangibleAssetRatio		-0.558**		-0.518**
		(2.23)		(2.23)
Capex/Assets		-0.327		-0.333
		(0.81)		(0.81)
Log(Employees)		-0.194***		-0.193***
		(4.01)		(4.15)
Hours/Employee		-0.000***		-0.000***
		(5.51)		(5.46)
Observations	8,913	8,913	8,913	8,913
Log Likelihood	-19,213	-18,464	-18,849	-18,156

Table 8: Injury risk profile changes around the American Jobs Creation Act

The table shows the mean percent change in employment in more and less dangerous establishments from 2002-2003 (pre-AJCA) to 2005-2006 (post-AJCA) separately for firms with and without foreign profits at the time of the AJCA. We form a sample of all establishments that are in the data at least once in each of the pre- and post-AJCA periods. For each establishment, we compute the annualized percent change in employment from the pre- to post-AJCA period, using 2003 employment if it is available and 2002 if is not, and using 2005 employment if it is available and 2006 if it is not. We divide establishments into more or less dangerous establishments depending on whether an establishment's industry mean injury rate is above or below the median industry mean injury rate for all of the parent firm's establishments in the sample. Those with rates equal to the median of their parent firm are removed from the sample. Differences in percent changes for firms with and without foreign profits are shown to the right. Below them is the difference in these differential changes, with a t-statistic shown in parentheses.

	Employment change %		
	More Dangerous Establishments	Less Dangerous Establishments	Difference
ForProf>0	-0.3%	-1.1%	0.8%
ForProf≤0	-2.4%	1.9%	-4.3%
Difference			5.1%
			(1.52)

Table 9: Workplace injuries and oil price shocks

This table presents estimates the effect of oil price shocks on injury rates, based on Poisson count models with establishment fixed effects. The dependent variable in each model is the number of injuries reported at an establishment in a given year. The exposure variable is the number of hours worked at the establishment during the year. Establishments are divided into oil-related (2-digit SIC code of 13 in the BLS data) and non-oil (all other SIC codes) establishments. The sample consists of non-oil establishments. *OilExposed* is an indicator variable taking a value of one if an establishment's parent firm has an oil-related establishment in any year during the sample period. *OilPrice* is the price of oil. The other explanatory variables are all lagged one year except for *CashFlow/Assets*, which is contemporaneous. See Table 1 for definitions of these variables. All regressions include an intercept term, which is not reported. The estimates in columns (1) through (4) are obtained using the full sample (2002-2009), while the estimates in columns (5) and (6) are obtained using only observations in 2002-2007. z-statistics based on standard errors clustered at the firm level are reported in parentheses below each point estimate. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on a two-tailed z-test.

	(2002-2009)				(2002-2007)	
	(1)	(2)	(3)	(4)	(5)	(6)
OilExposed	-0.222	-0.291	0.042	-0.000	-0.326	-0.167
	(0.86)	(1.19)	(0.10)	(0.00)	(1.24)	(0.30)
OilExposed * OilPrice	-0.007***	-0.007***	-0.002	-0.001	-0.007***	0.004
	(3.99)	(3.55)	(0.83)	(0.30)	(2.67)	(0.72)
Debt/Assets			0.208	0.041		-0.036
			(1.17)	(0.27)		(0.20)
Debt/Assets * OilExposed			-0.550	-0.378		0.415
			(0.53)	(0.36)		(0.27)
Debt/Assets * OilPrice			0.002	0.004*		0.006*
			(0.89)	(1.76)		(1.83)
Debt/Assets * OilExposed * OilPrice			-0.028	-0.032*		-0.064**
			(1.62)	(1.95)		(2.38)
CashFlow/Assets		0.065		0.067	0.052	0.051
		(1.11)		(1.18)	(0.97)	(1.01)
Log(Assets)		0.041		0.047	0.030	0.048
		(1.00)		(1.16)	(0.64)	(1.08)
AssetTurnover		0.044		0.040	-0.008	-0.022
		(1.43)		(1.34)	(0.21)	(0.65)
MarketToBook		-0.036***		-0.036***	-0.035***	-0.036***
		(2.95)		(3.05)	(2.58)	(2.68)
TangibleAssetRatio		-0.035		-0.006	-0.025	0.016
		(0.18)		(0.03)	(0.11)	(0.07)
Capex/Assets		-0.750***		-0.787***	0.297	-0.290
		(2.96)		(3.08)	(1.04)	(1.02)
Log(Employees)		-0.115***		-0.115***	-0.178***	-0.176***
		(3.03)		(3.05)	(4.30)	(4.25)
Hours/Employee		-0.000***		-0.000***	-0.000***	-0.000***
		(10.11)		(10.22)	(9.51)	(9.60)
Observations	25,260	25,260	25,260	25,260	17,257	17,257
Log Likelihood	-54,205	-52,954	-54,042	-52,826	-35,067	-34,951

Table 10: Workplace injuries and debt maturity during the financial crisis

This table presents estimates of the effect of having a large quantity of debt maturing at the onset of the financial crisis on injury rates, based on Poisson count models with establishment fixed effects. The dependent variable in each model is the number of injuries reported at an establishment in a given year. The exposure variable is the number of hours worked at the establishment during the year. *Crisis* is defined as an indicator variable taking a value of one in 2008 and zero in preceding years. *HighDebtDue* is an indicator variable taking a value of one if a firm's debt maturing within one year as of fiscal year end 2007 as a percentage of assets exceeds the 75th percentile for the sample (3.064%) and zero otherwise. Only firms whose 2007 fiscal year end fell between August 2007 and January 2008 are included in the sample. The other explanatory variables are all lagged one year except for *CashFlow/Assets*, which is contemporaneous. See Table 1 for definitions of these variables. All regressions include an intercept term, which is not reported. The sample period is 2006-2008 in columns (1) and (2) and 2005-2008 in columns (3) and (4). z-statistics based on standard errors clustered at the firm level are reported in parentheses below each point estimate. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on a two-tailed z-test.

	— 2006 - 2008 —		**— 2005 - 2008 —**	
	(1)	(2)	(3)	(4)
Crisis	-0.120***	-0.129***	-0.135***	-0.129***
	(5.26)	(5.59)	(5.85)	(5.67)
HighDebtDue	0.640***	0.648***	0.626***	0.713***
	(28.08)	(8.95)	(27.22)	(9.17)
Crisis * HighDebtDue	0.084**	0.094**	0.121**	0.111***
	(2.31)	(2.55)	(2.20)	(2.70)
Debt/Assets		-0.135		0.244*
		(1.12)		(1.77)
CashFlow/Assets		-0.055		0.106
		(0.61)		(1.06)
Log(Assets)		0.047		-0.034
		(1.04)		(0.74)
AssetTurnover		-0.009		0.047
		(0.20)		(1.00)
MarketToBook		-0.015		-0.027
		(0.84)		(1.28)
TangibleAssetRatio		0.300		0.083
		(1.25)		(0.38)
Capex/Assets		-0.889		-0.696
		(1.49)		(1.33)
Log(Employees)		-0.113		-0.099
		(1.53)		(1.17)
Hours/Employee		-0.270***		-0.256
		(4.70)		(3.10)
Observations	6,877	6,877	8,940	8,940
Log Likelihood	-11,324	-11,210	-17,038	-16,798

Table 11: Firm value and workplace injuries

This table presents estimates of the effect of injury rates on firm value from firm fixed effects OLS models. The dependent variable in each model is a firm's Tobin's Q for the give year, where Tobin's Q is calculated as the sum of the market value of equity and book value of debt less deferred taxes, divided by total assets. $Cases/Hour$ is the number of injuries per hour worked across all of a firm's establishments in the BLS data in a given year, multiplied by 1,000. See Table 1 for definitions of all of the other explanatory variables. The explanatory variables are all lagged one year except for $CashFlow/Assets$, which is contemporaneous. Both regressions include an intercept term, which is not reported. t-statistics based on standard errors clustered at the firm level are reported in parentheses below each point estimate. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively, based on a two-tailed t-test.

	(1)	(2)
Cases/Hour	-2.639***	-2.254**
	(2.78)	(2.38)
Debt/Assets		0.768*
		(0.72)
CashFlow/Assets		0.003
		(0.00)
Log(Assets)		-0.600***
		(4.87)
AssetTurnover		0.169
		(1.33)
TangibleAssetRatio		-1.325***
		(2.67)
Capex/Assets		1.376***
		(2.71)
Observations	4,898	4,898
Adjusted R-squared	0.0236	0.0171

Figure 1: Distributions of injury rates and injury counts

This figure presents histograms showing the distribution of *Cases/Employee* (top portion of the figure) and number of cases (bottom portion). It does not show values on the x-axis to avoid the risk of revealing information about specific establishments.

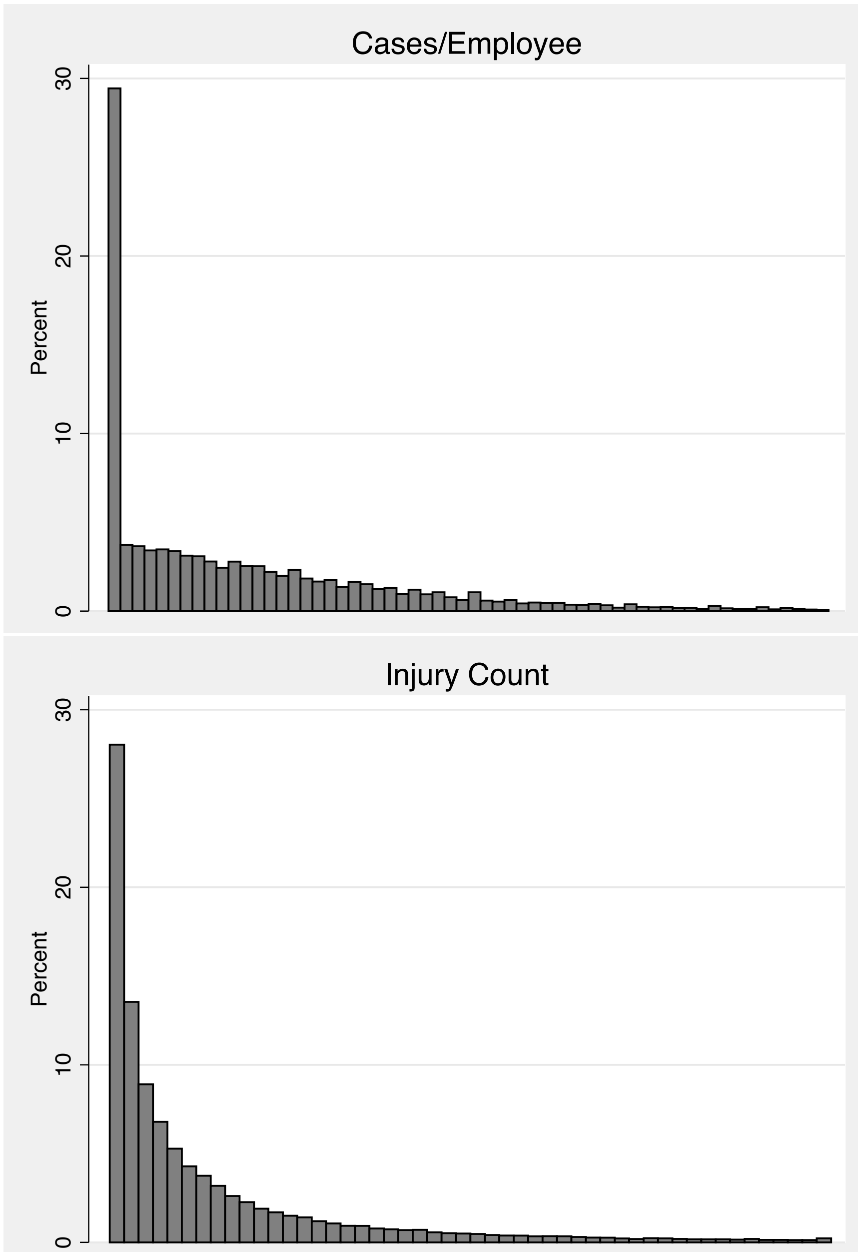

Figure 2: Kernel regression of injury rate on leverage

This figure plots kernel-weighted local polynomial smooths of the relation between $Cases/Hour$ and $Debt/Assets$ using the epanechnikov kernel and a bandwidth of 0.1. Cases where $Debt/Assets \leq 1$ are excluded for ease of interpretation.

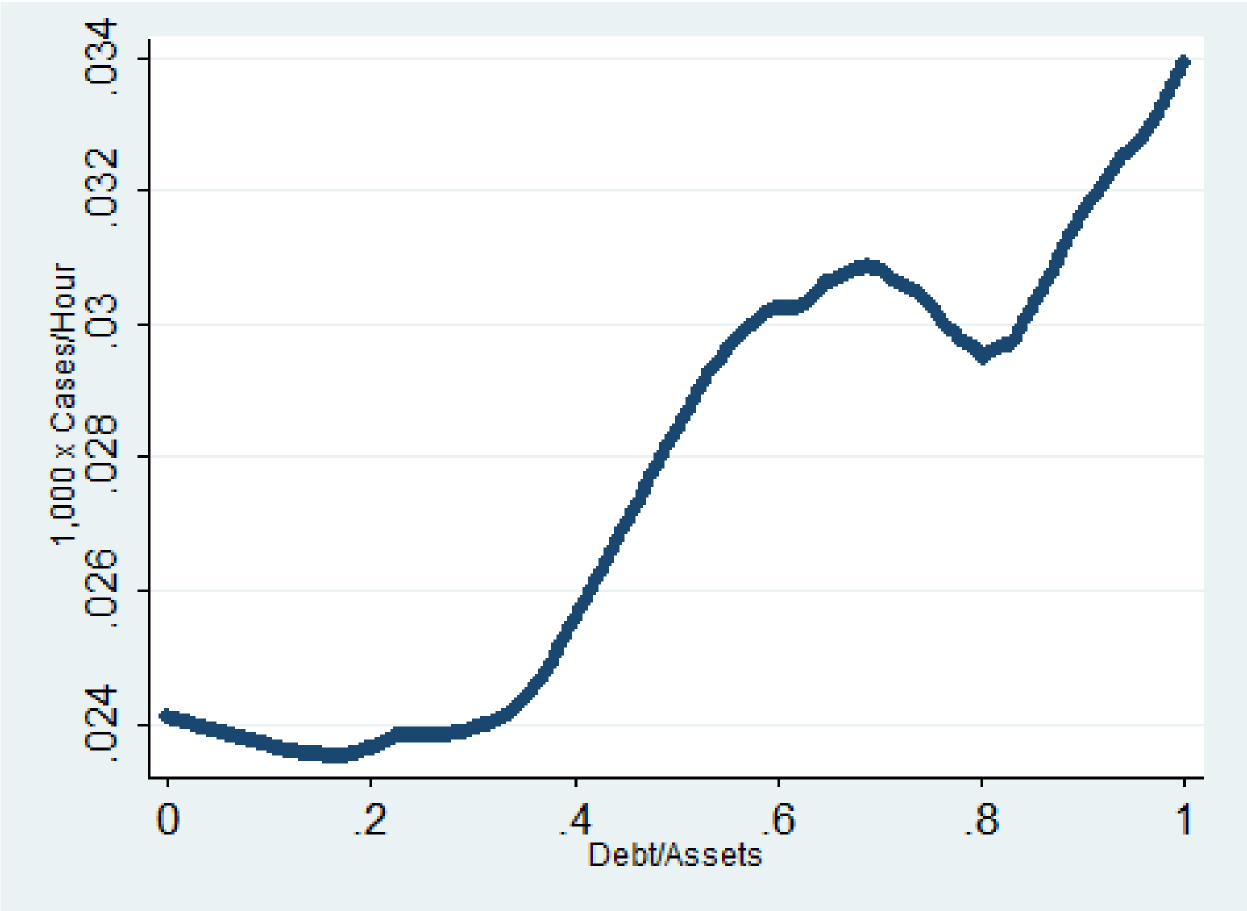

Figure 3: Panel VAR impulse functions

This figure presents the impulse functions based on the Panel VAR estimates shown in column (1) of Table 6. The top part of the figure shows the predicted effect of a shock to *Debt/Assets* on future *Cases/Hour*. The bottom shows the predicted effect of a shock to *Cases/Hour* on future *Debt/Assets*.

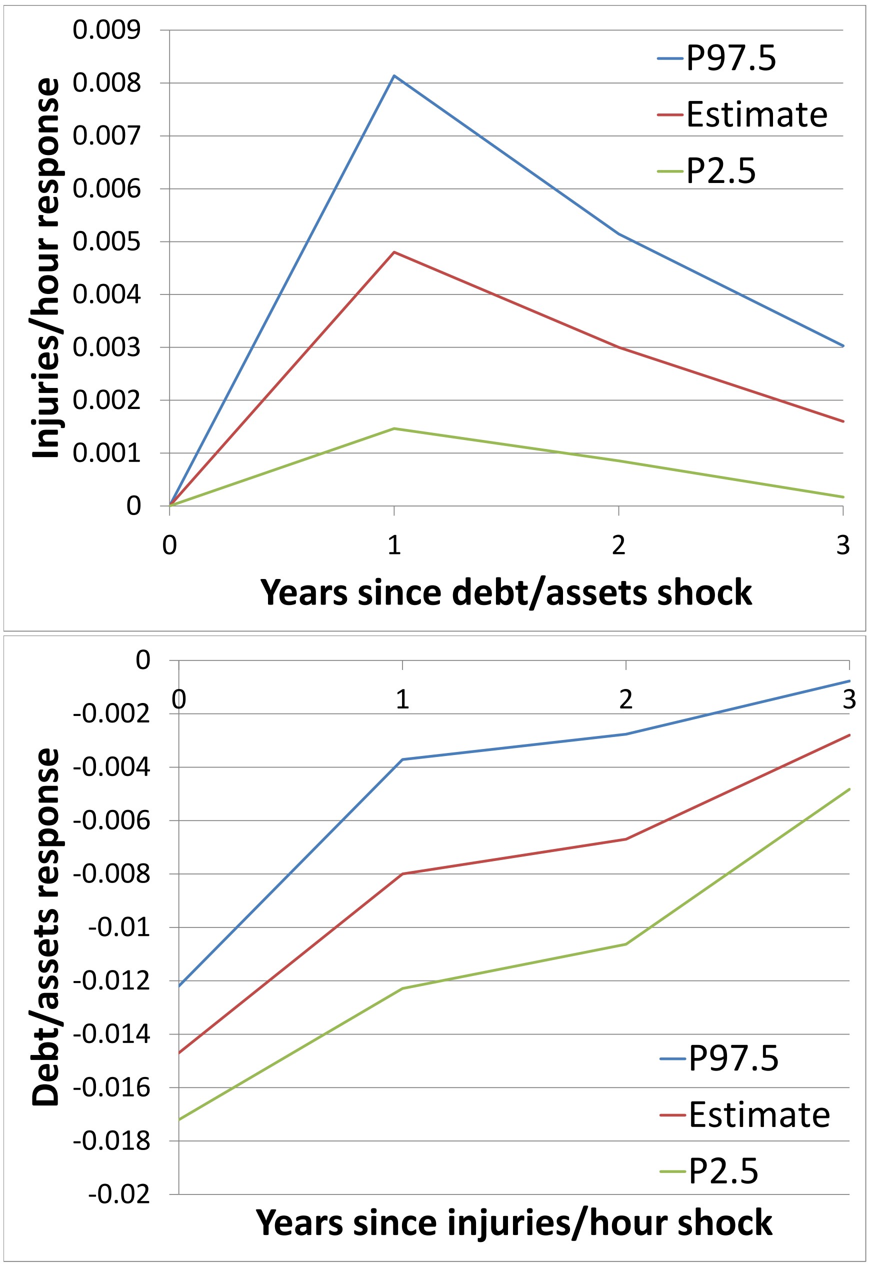

Figure 4: Injury rates over time by foreign profit status

This figure shows the portion of injury rates not explained by other observable firm- and establishment-specific variables over time for firms with and without foreign profits as of the AJCA (2004). These unexplained injury rates are the residuals from an OLS regression of $Cases/Hour$ (times 1,000) on various firm and establishment characteristics. The green line shows the mean unexplained injury rate for establishments belonging to firms reporting positive cumulative foreign profits over the period 2001-2003. The blue line shows the mean unexplained injury rate for establishments belonging to firms reporting zero or negative cumulative foreign profits over this period.

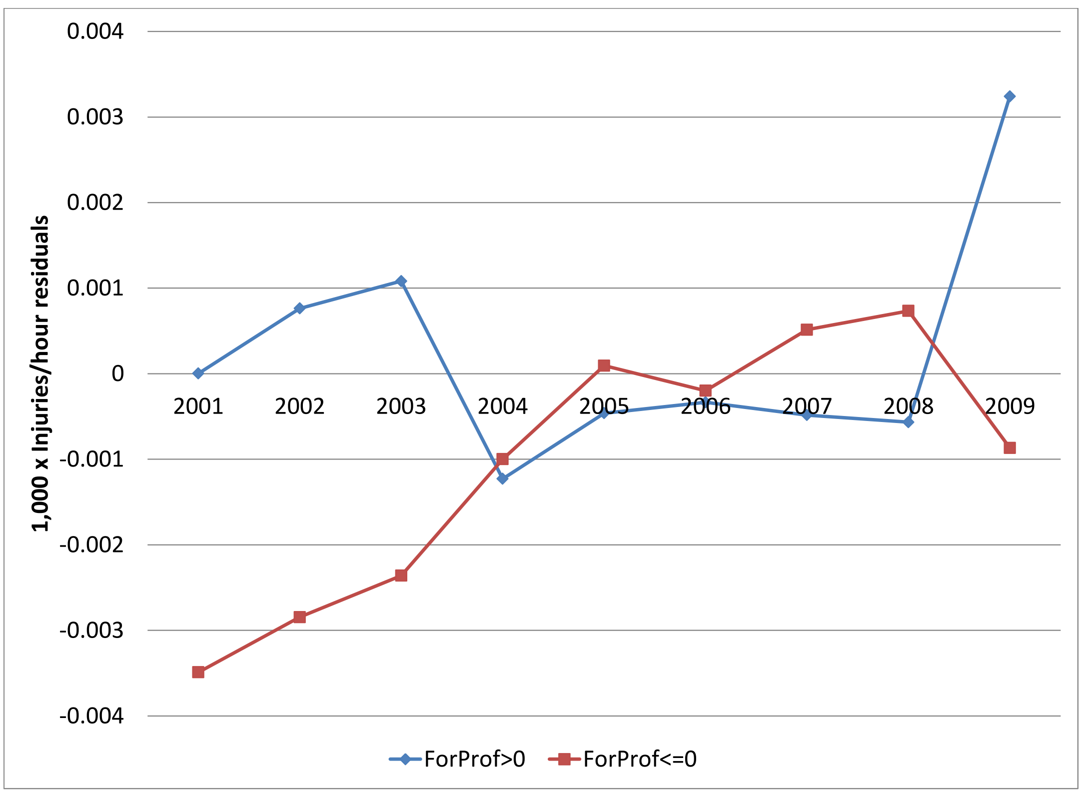

Figure 5: Injury rates over time by debt maturity status

This figure shows the portion of injury rates not explained by other observable firm- and establishment-specific variables over time for firms with and without a large quantity of debt maturing within one year as of fiscal year end 2007. These unexplained injury rates are the residuals from an OLS regression of $Cases/Hour$ (times 1,000) on various firm and establishment characteristics. A firm is defined as having a large quantity of debt due within the next year if debt due within one year as of fiscal year end 2007 as a percentage of assets exceeds the 75th percentile for the sample (3.064%). The green line shows the mean unexplained injury rate for establishments belonging to firms with a large quantity of debt maturing within the next year. The blue line shows the mean unexplained injury rate for establishments belonging to firms with little debt maturing within the next year.