Offsetting Behavior in the Workplace

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April 14, 2003

Abstract

This paper examines the effect of workplace safety regulations on worker safety. Studies in this area must overcome the issue that regulations and worker safety are jointly determined and that regulatory resources are likely to focus on the worst offenders. We examine the effects of regulatory enforcement in the 1990s on occupational death rates by state in major industries, and propose an instrumental variables technique to isolate the causal effect of regulatory enforcement on worker safety. We find that more inspections lead to higher death rates at a statistically significant level. This counter-intuitive result suggests that increased worker safety measures induce riskier behaviors on the part of workers.

JEL Classification: J81, J88, K32

KeyWords: OSHA, Safety, Labor Regulation, Offsetting Behavior

1. Introduction

The Occupational Health and Safety Act of 1970 established the first nationwide program that focuses on protecting workers from job-related death, injury, and illness. The act covered virtually the entire labor force of the United States and was referred to as the "most significant legislative achievement" for workers in a decade by then Secretary of Labor James Hodgson (MacLaury 1984).

Under the Act, Hodgson set up the Occupational Safety and Health Administration (OSHA) to administer the legislative directive by setting national safety standards and policing firms' compliance with those standards through investigations and citations. In 2002, OSHA's staff numbered 2,316, including 1,123 inspectors, and its budget amounted to $443 million. In 2001, the agency performed 35,897 inspections, uncovering 78,900 violations resulting in penalties amounting to $82,074,813.[1]

OSHA performs these inspections to carry out its stated mission "to save lives, prevent injuries and protect the health of America's workers."[2] However, the effectiveness of these regulations and their enforcement is in question. Many of the initial studies of their effect on workplace injuries and deaths indicate little or no effect of OSHA activities on safety. Subsequent studies, however, suggested that the previous results might have suffered from endogeneity problems, as firms with inherently more dangerous conditions are the likely targets of inspections. Using panel data, these studies find that OSHA inspections and citations have a positive effect on worker safety (Gray and Scholz 1990, 1993, Gray and Mendeloff 2002).

Although panel data are useful and we employ them in this study, the use of panel data does not

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[1]Data from OSHA website: http://www.osha.gov/as/opa/oshafacts.html .

[2]OSHA Mission: http://www.osha.gov/oshinfo/mission.html .

solve the simultaneity problem if unobserved variables change over time. We examine this issue by examining the effectiveness of safety regulation using an instrumental variables technique. Such technique is useful in isolating the causal effect of regulatory activity (investigations and fines) on worker safety outcomes, such as the occupational death rate. We use the approval of state occupational safety plans as one of our instruments. Approval of state safety plans leads to more investigations but are otherwise unrelated to death rates in the state – a requirement for a valid instrument.

Our data cover 1992 to 2001, and in this time period two states were granted final approval of their state plans, which serves as one of our instruments. Those states were North Carolina (1996) in OSHA Region 4, which includes seven other states, and Nevada (2000) in OSHA Region 9, which includes three other states. Our analysis focuses on these two regions because these states provide a better comparison group than, for example, all remaining forty-eight states in the U.S. The focus on the states in these regions allows us to better control for unobservable factors which could confound the estimation of the marginal effect of worker safety measures. Focusing on a few states within one region provides a better sample to determine the effect of inspections on work place fatalities, because enforcement decisions are handled at the regional level. This means that we are comparing states that are subject to similar enforcement practices and standards.

Our results show that increased safety regulation actually increases the occupational death rate. We attribute this surprising result to an occupational "Peltzman effect" (Peltzman 1975). That is, when workplace safety measures improve, workers substitute to riskier behaviors, or, alternatively, they substitute away from personal safety precautions. In this case, these behaviors more than offset the safety benefits of the increase in regulation. This result suggests that the net benefit of worker safety regulation is limited and may be negative.

We review previous studies of the effectiveness of worker safety regulation in section 2. Section 3 presents a model of workplace safety where a worker's actions determine his safety on the job. Section 4 describes our data, section 5 discusses our identification strategy, and section 6 discusses our results. Section 7 concludes.

2. Previous Analyses of Workplace Safety Regulation

In the years after OSHA's founding, worker injury rates declined steadily, leading to the general perception that workplace safety regulation had a positive impact on working conditions (Viscusi 1979). Researchers, however, questioned this causal interpretation, given that health conditions in general were improving during the period.

Early studies attempting to isolate the effect of OSHA enforcement were not successful in finding significant benefits from OSHA regulation. For example, Viscusi (1986) studies OSHA regulation in manufacturing industries during the period of 1973-1983 and finds little evidence of safety benefits resulting from OSHA enforcement. These results are consistent with other analyses undertaken at the time, such as McCaffrey (1983) and Ruser and Smith (1991).

Exploiting a large plant-level dataset, Scholz and Gray (1990), in contrast, attribute a large reduction in workplace injuries to OSHA enforcement. These results are for the most part replicated in further studies (Gray and Scholz 1993). More recent work using an expanded version of the plant-level dataset suggests that the impact of OSHA enforcement has declined during the 1990s (Gray and Mendeloff 2002).

Likewise, in a political economy model, Bartel and Thomas (1985, 1987) find that OSHA enforcement reduces workplace injuries once the non-random targeting of OSHA inspections is accounted for. In their model, OSHA makes inspection decisions to maximize net political support, as predicted by Peltzman (1976).

Other studies suggest that many environmental factors unrelated to OSHA enforcement led to declining workplace injury and illness rates during the 1990s. Conway and Svenson (1998) suggest that high workers' compensation costs induced firms to implement safety measures independent of OSHA direction. Further, they suggest that a movement of workers from high-risk industries to lower risk sectors lowered the aggregate occupational injury rate. While suggestive, their analysis offers little direct evidence regarding whether OSHA regulations cause a lowering of injury rates.

This brief review of the literature shows that an over-whelming majority of work in this area examines changes in injury and illness rates. However, the literature on workplace hazards and safety regulation has, for the most part, not examined the effects of regulations on workplace fatalities. Occupational fatality rates offer another opportunity to examine the effects of safety regulation and this topic is the focus on this study. Further, our literature review indicates that the previous work does not employ instrumental variables techniques to isolate the causal effect of safety regulation on safety outcomes.[3] This paper contributes to the literature by identifying a causal effect of work place inspections on work related fatality.

[3]The exception is the early work of Bartel and Thomas (1985, 1987) who estimate a simultaneous equation model in order to assess the effect of inspections on lost work days.

3. A Model of Offsetting Behavior in the Workplace

Viscusi (1979) shows that firm-level safety measures, either adopted independently or because of OSHA regulation, affect worker behavior. Specifically, he shows that workplace injury rates are a function of firm behavior and employee behavior. If employees engage insafety precautions, injury rates will decline. Similarly, if firms initiate precautions, injury rates decline, ceteris paribus. However, employee behavior is also likely to be affected by firm behavior. That is, if firms improve safety, employees have an incentive to reduce their own costly precautions, on the margin. It is this insight that motivates our model of offsetting behavior in the workplace.

Let on-the-job safety of a worker (*S*) be a concave function of the safety regulations, and provisions initiated by the employer (*R*), and worker effort dedicated to avoiding harm (*E*). For simplicity, we normalize safety to take the form of an expected probability of death on the job. We assume that the worker's utility decreases linearly in his safety effort. The worker then seeks to maximize his expected utility by choosing *E* to maximize:

$$S\left(R,E\right)\cdot U\left(E\right) \qquad (1)$$

This generates the following first order condition:

$$S\left(R,E\right)\cdot U\left(E\right) \qquad (2)$$

If the firm increases *R*, the effect on worker safety efforts is depicted by:

$$\frac{\P E}{\P R} = -\frac{S_{ER}}{S_{EE}} \qquad (3)$$

Given the concavity of the safety function, the worker effectively substitutes the firm's safety efforts for his own. This substitution away from safety activities, or toward risky activities, has been called the Peltzman (1975) effect.

This implies that the effects of the firm's safety efforts, either those chosen by it or mandated by a regulatory authority, will be at least partially offset in instances where employees can take preventive actions. The magnitude of these offsetting effects is an empirical question and depends on the substitutability of firm-level and worker-level safety efforts. In principle, additional firm-level safety efforts could increase observed safety, leave it unchanged, or decrease safety in cases where worker-level efforts decline to the point where the gains from firm-level efforts are more than completely offset.

Graphically, this indeterminancy is represented in Figure 1 and Figure 2. If a worker chooses between safety and wages, as is the case in the equilibrium of a competitive labor market, he will choose the combination of wages and safety indicated by point A, where his indifference curve is tangent to his effort budget constraint (B1). Effectively, the worker can allocate his efforts between taking safety precautions (which will result in a given level of safety) and improving his work performance (which will increase the marginal product of his labor, resulting in a higher wage).

However, when his employer implements higher safety standards to generate safety level S(C), either because of increasing regulation or through its own volition, the worker is presented with a new effort budget constraint (B2). This new effort budget constraint reduces the maximum wage possible for the employee (i.e., the wage achieved if he expends no effort on safety) and increases the maximum safety he can achieve. Thus, the slope of the effort budget constraint is reduced.

Facing this new effort budget constraint, the worker will to move from point A to point B

(Figure 1) or from A to point C (Figure 2) to achieve the combination of wages and safety that maximize his utility. The exact safety level implied by the new bundle can be equal to the original level of safety, S*, greater than S* as at S(C), or less than S* as at S(B), depending on the shape of the worker's indifference curves.

4. Data

We study the effect of plant inspections and fines on worker safety as measured by the fatality rate in a given industry in a given state. The fatality rate is defined as the number of on-the-job deaths relative to the total number of workers in the industry in the state. OSHA provided us with inspections and fines data for the years 1992-2001. The data were broken down by state and by six industry types, namely construction, finance, manufacturing, mining, services, and trade (wholesale combined with retail).

Because our dependent variable is fatality rate by industry and by state, we weight each observation by the number of workers in the state industry. Our safety regulation measures include the number of inspections performed in the state industry during a calendar year (state and federal inspections combined) and a measure of the dollar amount of fines levied against firms in the state industry during that year.

The model we estimated then takes the following form:

$$rate_{it} = b \cdot fines_{it-1} + d \cdot inspections_{it-1} + \Theta \cdot \mathrm{X} + n_i + u_t + e_{it} \tag{4}$$

where the independent variable *rate* measures the fatality rate in state industry *i* during year *t*.

Inspections represents the total number of state and local safety inspections performed in state industry *i* during year *t-1*. *Fines* represents the dollar amount of the citations levied against firms in state industry *i* during year *t-1*.[4] **O** represents a vector of time-varying covariates measured at the state level.

Equation (4) shows that our inspection and fine measures enter the regression with one year lags. Although all of our results are robust to using current year inspections and fines, as well as current year and one year lag measures, we believe the one year lag specification avoids a potential source of bias. Since our data are aggregated at the annual frequency, we are not able to differentiate between enforcement that comes before or after a particular death. Thus, if an occupational fatality in the early part of the year prompts OSHA to perform an investigation and levy fines later in the year, our results would not be able to capture the effect of enforcement on fatalities. This potential bias is avoided by examining the effect of the prior year's enforcement on current year fatality rates.[5]

In equation (4) we include fixed effects $<_i$ for industry in each state. Thus these state-industry effects subsume state fixed effects. This state-industry effect controls for the possibility that the same industry may have different average fatalities in each state, the presence of idiosyncratic differences in worker attributes by state-industry, that industry practices differ from state to state, and that some

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[4]The use of alternate measures of fines, such as the average fine amount per inspection, did not change our primary results.

[5]We also estimated regressions using a quadratic specification for enforcement measures. These specifications are motivated by Viscusi's (1979) suggestion that the effect of enforcement is non-linear. Essentially, these specifications capture the notion that while expected enforcement can serve as a deterrent, at some level this effect will be offset by changes in worker behavior induced by their expectation that fines will lead to better safety measures in firms. Results from this specification are qualitatively similar to those presented in this paper.

industries are inherently more dangerous than others. Further, we include year fixed effects L_t to control for over-all changes in workplace safety induced by improved technology, changing federal standards, and reporting practices.

We control for several other factors in the vector **X** which might affect fatalities. For example, we allow for per capita income (in the state industry) to affect the death rate. We expect the death rate to increase with income as workers have an incentive to engage in risks to improve their performance if the prevailing wage makes the job quite attractive.[6]

The **X** vector also includes lagged workers' compensation payments by states in order to capture the possibility that high costs attributable to worker accidents might induce firms to initiate better safety procedures (Conway and Svenson 1998). We also include in the **X** vector the state unemployment rate, the state unionization rate,[7] and the general education level of the state population.

Descriptive statistics for all of our variables can be found in Table 1. The table shows that, on average, in a given year and state industry there are 7.5 fatalities per 100,000 workers per industry. Roughly one third of the observations on state industry fatality rates are zero, suggesting that there is significant heterogeneity among state-industries in terms of risk level. In a given year, the average fine for each state industry is approximately $630,000 and there are approximately 365 state and federal

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[6]This is an implication of the model presented in Ippolito (forthcoming). In his model, the presence of rents induces a higher effort level on the part of workers. If a worker can dedicate his time and energy to production or safety inputs, individuals in jobs where large rents are available will choose to invest less in safety inputs, ceteris paribus.

[7]Conway and Svenson (1998) suggest that unions serve an important role in educating their members about safety. Boal (2003) also provides evidence that unionization levels are an important determinant of occupational safety, at least in certain contexts.

inspections per state industry.

5. Correcting for the omitted variable bias

The inspections variable and the fines variable endogenous to the death rate if occupational deaths prompt investigations and fines. Thus omitted variables, such as a hazardous work place environment affects simultaneously the number of inspections and the number of fatalities. In the presence of such omitted variables, inspections and fines are endogenous in the fatality equation, and the point estimates on inspections and fines are biased. Some previous work analyzing workplace injuries has examined first differences of safety measures and regulatory enforcement to overcome this endogeneity (Gray and Mendeloff 2002), while earlier papers (Gray and Scholz 1993) used the 'Chamberlain' (1982, 1984) model to control for simultaneity.

State-industry fixed effects capture the hazard that is specific to a state-industry, and thus go some way in controlling for the endogeneity of inspections. While panel data models that include fixed effects can control for time-invariant idiosyncratic behavior in a state-industry, they do not allow for systematically changing behavior within a state-industry. In our theoretical model, changes in inspection rates change worker behavior within an industry, and thus an industry fixed effects model does not suffice in analyzing worker behaviors. We remedy this deficiency by combining panel data techniques and instrumental variables techniques, using instrumental variables to account for the simultaneity bias.

Our identification strategy relies on finding variables which correlate well with plant inspections and fines but that do not directly influence the occupational fatality rate. Since both fines and inspections may be endogenous in the fatality equation, instrumental variable estimation requires at least two instruments to identify a casual effect. Further, to test for overidentifying restrictions, a third instrument is required. We use three instruments which correlate with inspections and fines, but are uncorrelated with the error in the fatality equation: 1) final approval of the state worker safety and health plan; 2) gross state-industry product; and 3) political control variables.

5.1 Final Approval

Under the Occupational Safety and Health Act of 1970 (29 USC 667 §18), states are encouraged to develop and operate their own occupational health and safety programs. Procedurally, states create a developmental plan and provide assurances to OSHA that, within three years, the state will have developed all of the structural elements that are necessary to protect workers. These elements include the passage of legislation creating regulations and procedures for a standard setting, enforcement of standards, and an appeals process. Further, states must demonstrate that they will have personnel and resources to administer their own safety plan.

After a state demonstrates the necessary elements, OSHA certifies the state plan, but retains regulatory authority. Once the state can enforce standards independently, OSHA and the state enter into an operational status agreement which prohibits OSHA from discretionary federal enforcement in areas covered by the state plan.

The state plan is accredited when OSHA grants final approval of the plan. Final approval can be granted once OSHA has determined that the state provides protection “at least as effective” as that provided by the federal government.[8] Additionally, the state must meet compliance staffing benchmarks and participate in OSHA's inspection data system to receive final approval. When a state assumes responsibility for the regulation of worker safety, it can receive funds from the federal government to cover up to one half of its costs under §23(g) of the Act.

While the state's regulatory framework is in place prior to final approval, funding increases substantially at the time of approval.[9] This infusion of funds provides the mechanism by which this instrument helps us to identify the causal effect of enforcement. This funding increases the state's level of enforcement but does not otherwise affect worker safety rates. Therefore, we use the approval of state-level occupational safety and health plans by the federal OSHA to instrument for enforcement measures. While state plans employ more compliance officers and undertake more inspections than does the federal agency (Finkin, Goldman, Summers, and Dau-Schmidt 2002), evidence also suggests that state agencies impose lower fines for violations (Finkin, Goldman, Summers, and Dau-Schmidt 2002). Given this, we can use state approval as an instrument for workplace inspections and fines, as long as the approval itself does not directly affect the fatality rates.

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[8]There had been some disagreement as to the proper interpretation of "at least as effective as." In *AFL-CIO Industrial Union Department v. Marshall*, 570 F.2d 1030, organized labor attacked the interpretation made by the Department of Labor which suggested that states providing staffing and funding equivalent to the level that would have been provided under federal regulation. Instead, the AFL-CIO claimed that effectiveness be defined as ensuring that normative safety standards are in fact enforced. The court decided that, while federal funding and staffing benchmarks could be considered in the decision to grant initial approval of a state plan, final approval must be based on the belief that the state plan will be able to achieve a level of safety equal or greater than that achieved under federal control.

[9]More specifically, this can be seen as a reduction in the price of enforcement since the federal government now covers up to 50% of the state's costs.

As of 2001, fifteen states had received final approval for their plans. Table 2 describes these states and the dates of their approval. Thirteen of the fifteen states receive final approval prior to 1990. Because our data are limited to the period 1992-2001, we focus on the approval of two state plans: North Carolina, which received final approval in 1996, and Nevada, which gained final approval for its plan in 2000. In our sample, five other states had final approval status for the entire period studied, while the other five states did not have final approval status at any time during the period analyzed.

Since the variation in our instrument is restricted to these two states for the relevant time period, we do not examine death rates in every state. Instead, we restrict our attention to the OSHA regions containing those states. In addition to North Carolina, Region 4 includes Alabama, Florida, Georgia, Kentucky, Mississippi, South Carolina, and Tennessee. Nevada is included in Region 9 along with Arizona, California, and Hawaii. Restricting the observations in this way seems reasonable since enforcement decisions are handled at the regional level and improves our chances of isolating a causal effect of enforcement on the fatality rate.

5.2 Gross State-Industry Product

A second instrument suggested by the work of Bartel and Thomas (1985, 1987) is the gross product of the state-industry. Analyzing the supply side of the political process, their model shows that regulators seek to maximize net political support from various constituencies. Their model predicts that regulators maximize political support by not regulating industries that provide a large share of state income. The intuition behind this result is that if an economy depends heavily on an industry for employment, regulators have a lessened incentive to target these industries.

While the supply side in the political process favors large industries, there are pressures on the demand side that also lead to less regulation of large industries. In particular, industries generating large incomes have more resources to lobby politicians and regulators for beneficial treatment.

5.3 Political Control

The last instrument measures whether both houses of the state legislature are controlled by the Democratic party during the given year.[10] While the theoretical effect of Democratic legislatures on the number of safety inspectors and fines is ambiguous, the data may reveal a systematic difference in the actions of politicians from each party when they are in a majority. Suppose inspections and fines are effective in reducing fatalities of blue collar workers. Since a larger fraction of the Democratic constituency tends to be blue collar than the Republican constituency, legislators from the Democratic party may try to implement more inspections and fines when they are in a majority. However, if inspections and fines are of little consequence for fatalities, Democrats may no use these regulatory policy instruments because they are not effective for their designed purpose, and instead move resources to regulatory instruments that they deem to be more effective. In this case we expect a negative correlation between Democrat control and inspections and fines.

6. Results

[10]While this proved to be the strongest of our political instruments, other political indicators generated qualitatively similar results. Among the indicators we examined were Democratic control of the lower state house, Democratic control of the upper state house, Democratic control of one of the state houses, Democratic governor, and prohibitions on corporate political contributions.

Table 3 reports the results form the OLS regressions. As mentioned previously, the dependent variable is the state-industry fatality rate for the states in OSHA Region 4 and Region 9. In all specifications, the point estimates on inspections and the point estimates on fines are statistically insignificant. Thus, inspections and fines do not appear to have a beneficial effect in reducing fatalities.

The point estimates on the time-varying variables in Table 3 are statistically insignificant. However, the industry fixed effects model explains about 90 percent of the variation in the data, suggesting that much of variation in the fatality rates are generated by industry specific characteristics.

Since both inspections and fines are endogenous in the fatality equation and the point estimates on these variables are subsequently biased. To address this issue we estimate the equation with two-stage least squares (2SLS), using the previously discussed instruments.

Table 4 presents the first stages of the 2SLS results. The first three columns of Table 4 present the estimation of lagged inspections and the second three columns present the estimates of lagged fines. The first stage results show that our instruments are correlated with inspections and fines and that the coefficients on the final approval and the state industry product have the hypothesized signs. Consistent with our predictions, state plans lead to more inspections and a lower level of fines, and all of the coefficients are statistically significant. As for the second instrument, the larger the state industry product (i.e. the larger the potential political influence of the industry), the fewer inspections and fines. The point estimates on inspections are statistically significant while the coefficients on fines are not statistically significant. Lastly, the political indicator instrument is correlated with inspections and fines. States with both houses of the legislature under Democratic control exhibit lower enforcement rates. Safety inspectors perform fewer inspections and fine firms less in the aggregate when acting in a state where Democrats hold a majority in each house of the state legislature. These relationships are robust to many alternative specifications and these negative coefficients are statistically significant. Our uniformly high F statistics for the joint significance of the instruments in explaining inspections and fines suggest that the instruments do well in explaining the variation in the endogenous regressors.

Table 5 presents the second stage results. Regardless of the specification, we find that the effect of inspections on fatalities is consistently positive and statistically significant, suggesting that increased inspections generate higher state industry fatality rates. However, fines do not have a statistically significant effect on fatality rates. The point estimates on inspections lie between 0.000032 and 0.000036,[11] and imply that an additional 100 safety inspections (representing approximately an increase of 1/3 relative to the mean number of inspections) in a state industry of average size (roughly 428,000 workers) generates approximately 1.5 extra death in that industry. In our data set the average number of death per state industry is thirty-two workers per year. This result is robust to a variety of specifications and combinations of the instruments.[12]

These results imply that enforcement activities, on the margin, do little to improve worker safety. For fines, the effect is statistically indistinguishable from zero, suggesting either that firm behavior is not sensitive to fines or, if it is, changes in worker behavior tend to offset the precautions taken by firms. For inspections, the implication is even more clear. The positive and statistically significant coefficient on inspections ins consistent with the theoretical model which predicts that safety

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[11]As noted in the footnote to Table 5, for presentation purpose all coefficient estimates are multiplied by 10^4.

[12]Qualitatively similar results are also estimated if we estimate inspections and the fatality rate as a system of simultaneous equations.

improvements undertaken by firms may be more than offset by riskier worker behavior.

In all specifications, the Sargan test for overidentifying restrictions indicates that our instruments are valid, generating chi-squared statistics with p-values in the range 0.79 to 0.83. That is, the instruments are strongly correlated with lagged workplace inspections but are otherwise orthogonal to the workplace fatality rate.

7. Conclusion

The previous literature on the effect of worker safety regulations on safety outcomes has focused on workplace injury rates, but has not examined occupational fatality rates as a measure of workplace safety. Also, previous studies have not employed instrumental variable estimation to isolate the causal effect of regulation on safety outcomes. In this paper we contribute to the literature on worker safety regulations by using an instrumental variable technique to examine the effect of regulatory enforcement on occupational death rates.

We use the approval of state occupational safety and health plans, gross state industry product, and a state government control indicator to instrument for workplace safety inspections and fines. Approval of state plans is not directly related to death rates and states generally perform more inspections than does the federal OSHA. Further, political considerations induce regulators not to target industries that generate relatively large incomes, and Democratic control of the legislature is related to lower levels of enforcement generally.

Our estimates suggest that these are strong instruments as suggested by the F-statistics from the test for joint significance of the instruments that allow us to isolate the causal effect of regulatory enforcement on worker safety. We find that increasing inspections leads to significantly higher death rates, while fines are not effective in lowering death rates. The theoretical model predicts that this result is generated by workers substituting toward riskier behaviors (or away from individual safety measures) when firm level safety increases. This suggests that there is a limit to the net improvements in worker safety that can be achieved through regulatory enforcement.

Further research needs to be done to determine if this result is robust to non-fatal injury rates. In principle, the theory and identification strategy can be easily applied to these data. Replication of the primary result for this dependent variable would further strengthen the offsetting behavior hypothesis, leading to the conclusion that increased occupational safety regulation is not effective for improving worker safety. Unfortunately, comprehensive industry injury data by state is not available throughout the time period we study.

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Figure 1

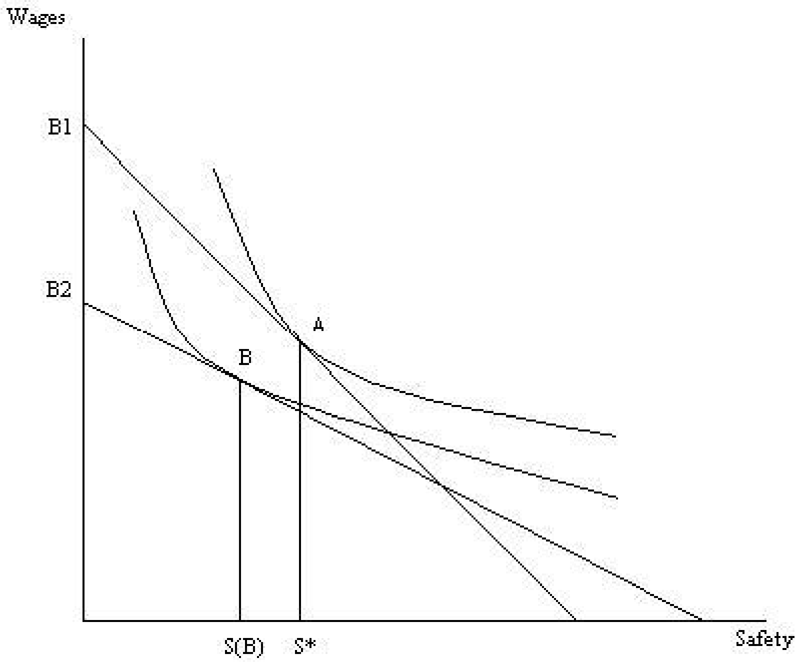

Figure 2

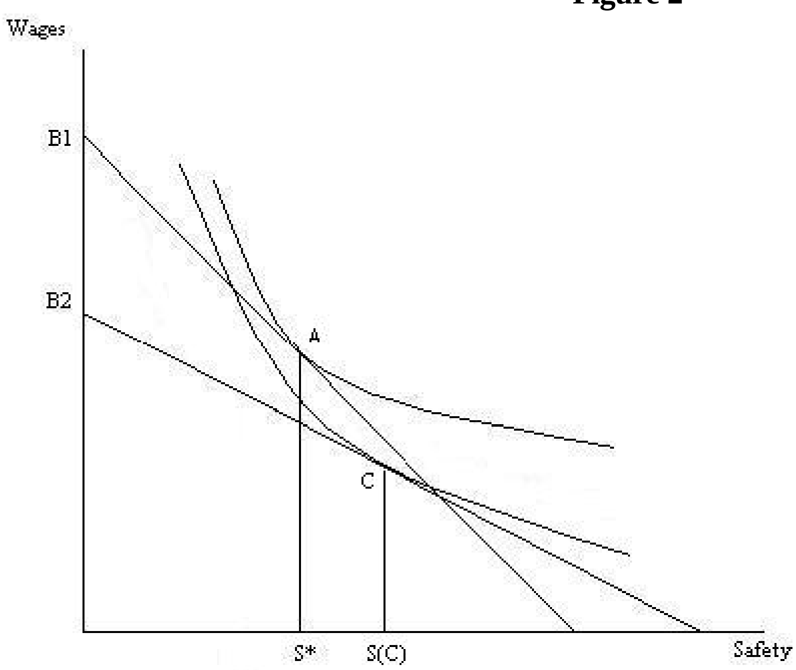

Table 1
Descriptive Statistics

Variable	Description	Mean	Std.dev.	Source
Fatality Rate	On-the-job fatalities in a state-industry per 1,000 workers	0.075	0.133	OSHA BLS
State Plan	Approved (final) state occupational safety and health plan in effect during the year	0.475	0.500	OSHA
Gross State Industry Product	Total state product generated by a given industry (in thousands)	23,428.40	42,876.86	BEA
Both Houses Democrat	Indicator = 1 if both houses in state legislature have Democratic majorities	0.542	0.499	Census
Inspections	Number of plant inspections (state + federal) performed in a state-industry during the year	365.319	577.346	OSHA
Fines	Dollar amount of fines assessed in state-industry during the year (in thousands)	627.676	1,304.554	OSHA
Workers' Compensation	Workers' compensation payments in state (in millions)	1,201.615	1,951.900	Census
Income	Per worker income in the state industry (in thousands)	36.139	11.776	BEA BLS
Unemployment	State Unemployment Rate	5.408	1.246	BLS
College	Percent of state population 25+ with at least a bachelor's degree	20.541	3.089	Census
Union	Union membership as a percent of state labor force	10.978	6.399	Hirsch, *et. al.* (2001)

Table 2
State Plans

State	OSHA Region	Initial Approval	Certification	Final Approval
Alaska	10	1973	1977	1984
Arizona	9	1974	1981	1985
Hawaii	9	1973	1978	1984
Indiana	5	1974	1981	1986
Iowa	7	1973	1976	1985
Kentucky	4	1973	1980	1985
Maryland	3	1973	1980	1985
Minnesota	5	1973	1976	1985
Nevada	9	1973	1981	2000
North Carolina	4	1973	1976	1996
South Carolina	4	1972	1976	1987
Tennessee	4	1973	1978	1985
Utah	8	1973	1976	1985
Virginia	3	1976	1984	1988
Wyoming	8	1974	1980	1985

Table 3
Weighted Least Squares Estimates for State-Industry Fatality Rates
(standard errors in parentheses below coefficient estimates)

	(i)	(ii)	(iii)
$Inspections_{t-1}$	-0.015	-0.008	-0.000
	(0.056)	(0.056)	(0.056)
$Fines_{t-1}$	-0.002	-0.003	-0.003
	(0.023)	(0.023)	(0.024)
Workers'	0.019	0.020	0.018
$Compensation_{t-1}$	(0.034)	(0.034)	(0.034)
Income	2.691	2.729	2.260
	(4.537)	(4.537)	(4.542)
Unemployment	10.990	10.141	6.167
	(17.545)	(17.526)	(17.377)
College	12.335	10.571	–
	(6.921)	(6.706)	
Union	12.033	–	6.873
	(11.694)		(11.358)
State-Industry Effects	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes
Adjusted R^2	0.898	0.898	0.898

Note: The dependent variable is the number of on-the-job fatalities per 1,000 workers in state-industry *i* during year *t*. N=524. Each observation is weighted by the number of workers in the state-industry for the given year. The results are based on data for 1992-2001 for states in OSHA region 4, which includes Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and

Tennessee, and states in OSHA region 9, which includes Arizona, California, Hawaii, and Nevada. For presentation, all coefficients and standard errors have been multiplied by 10^4.

Table 4
Instrumental Variables Estimation (2SLS) of State-Industry Fatality Rates – First Stage Results
(standard errors in parentheses below coefficient estimates)

	$Inspections_{t-1}$			$Fines_{t-1}$		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
State $Plan_{t-1}$	168.282 (42.527)	170.503 (42.507)	176.331 (41.186)	-314.694 (109.899)	-318.573 (109.752)	-301.299 (106.394)
Gross State-Industry $Product_{t-1}$	-0.005 (0.001)	-0.005 (0.001)	-0.005 (0.001)	-0.002 (0.002)	-0.002 (0.002)	-0.002 (0.002)
Both Houses $Democrat_{t-1}$	-88.895 (26.182)	-91.934 (26.068)	-89.606 (26.153)	-183.742 (67.660)	-178.349 (67.306)	-184.925 (67.559)
Workers' $Compensation_{t-1}$	0.141 (0.026)	0.144 (0.026)	0.142 (0.026)	-0.226 (0.068)	-0.231 (0.068)	-0.225 (0.068)
Income	-0.007 (0.004)	-0.007 (0.004)	-0.008 (0.004)	0.027 (0.010)	0.027 (0.010)	0.027 (0.010)
Unemployment	39.301 (16.172)	37.837 (16.134)	36.453 (15.731)	17.749 (41.793)	20.306 (41.658)	13.009 (40.637)
College	4.342 (5.672)	2.597 (5.485)	–	7.225 (14.658)	10.270 (14.162)	–
Union	11.121 (9.273)	–	9.300 (8.959)	-19.415 (23.964)	–	-22.444 (23.143)
State-Industry Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.981	0.981	0.981	0.948	0.948	0.948
F Statistic (for instruments)	30.97 (p=0.000)	32.75 (p=0.000)	34.80 (p=0.000)	5.05 (p=0.002)	4.94 (p=0.002)	5.00 (p=0.002)

Note: The instrumented variable is the total number of plant inspections performed in state-industry *i* during year *t*. N=524. Each observation is weighted by the number of workers in the state-industry for the given year. The results are based on data for 1992-2001 for states in OSHA region 4, which includes Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee, and states in OSHA region 9, which includes Arizona, California, Hawaii, and Nevada.

Table 5
Instrumental Variables Estimation (2SLS) of State-Industry Fatality Rates – Second Stage
(standard errors in parentheses below coefficient estimates)

	(i)	(ii)	(iii)
$Inspections_{t-1}$	0.321	0.325	0.357
(Instrumented)	(0.145)	(0.140)	(0.138)
$Fines_{t-1}$	-0.123	-0.122	-0.140
(Instrumented)	(0.139)	(0.139)	(0.141)
Workers'	-0.055	-0.055	-0.063
$Compensation_{t-1}$	(0.057)	(0.057)	(0.058)
Income	11.395	11.413	12.053
	(6.343)	(6.305)	(6.401)
Unemployment	-28.984	-29.458	-34.463
	(24.956)	(24.565)	(24.042)
College	6.446	6.064	–
	(7.702)	(7.338)	
Union	2.356	–	-1.047
	(13.031)		(12.587)
State-Industry Effects	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes
Adjusted R^2	0.886	0.886	0.883
Overidentifying	0.068	0.063	0.045
Restrictions (Sargan)	(p = 0.794)	(p = 0.801)	(0.832)

Note: The dependent variable is the number of on-the-job fatalities per 1,000 workers in state-industry *i* during year *t*. N=524. Each observation is weighted by the number of workers in the state-industry for the given year. The Overidentifying Restrictions test statistic presented is that for the Sargan N*R-sq test with the associated p value in parentheses. The results are based on data for 1992-2001 for states in OSHA region 4, which includes Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and

Tennessee, and states in OSHA region 9, which includes Arizona, California, Hawaii, and Nevada. For presentation, all coefficients and standard errors have been multiplied by 10^4.