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TECHNICAL REPORT

An Evaluation of the California Injury and Illness Prevention Program

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Sponsored by the Commission on Health and Safety and Workers' Compensation

Center for Health and Safety in the Workplace

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PREFACE

The Injury and Illness Prevention Program (IIPP) requirement has been the most frequently cited standard in California workplace health and safety inspections almost every year since it became effective in July 1991. Every workplace safety inspection must assess compliance with the IIPP. This report is the first evaluation of the IIPP's effects on worker injuries in California. It is intended to inform policy both in California and in the federal Occupational Safety and Health Administration (OSHA) program, which has made the adoption of a similar national requirement a top priority. This work was funded by the California Commission on Health and Safety and Workers' Compensation (CHSWC).

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SUMMARY

Occupational safety and health regulation tends to follow one of two paths: enforcement of compliance with hazard-specific standards, as in the United States, or requirements for procedures that more broadly address safety and health, as in most of the European Union. A frequent shortcoming of the U.S. approach, which is enforced by the Occupational Safety and Health Administration (OSHA), is failing to engage employers at a fundamental and comprehensive level. Top management commitment is essential for a strong safety effort, and involvement of frontline supervisors and other employees is also critical. Training workers to understand can also complement efforts to improve safety. Although OSHA offers some training programs and guidelines, it has no general requirements regarding any of these.

Within the United States, some state agencies that enforce occupational health and safety regulations do require general preventive programs. California, for example, has had an injury and illness prevention program (IIPP) standard since 1991. Although not embodying the risk-assessment approach common among European regulators, the IIPP does focus on overall programs employers should adopt. Under the Barack Obama administration, OSHA has made adoption of a similar program its top priority.

Typical elements of such a program can include encouraging employers to think broadly about risks and encouraging employers and employers to communicate about hazards. Specifically, §3203(a) of the California Code of Regulations requires every employer to "establish, implement, and maintain an effective Injury and Illness Prevention Program." Such a plan must

- identify those responsible for implementing the program
- ensure that "employees comply with safe and healthy work practices"
- ensure that the program is communicated in an understandable form
- have "procedures for identifying and evaluating work place hazards"
- "include a procedure to investigate occupational injury or occupational illness"
- have procedures for correcting hazards when discovered
- "provide training and instruction" as necessary, including when the program is established, to new or newly assigned employees, and when new hazards arise.

The IIPP is the most frequently cited workplace safety standard in California, with violations in about 25 percent of inspections. Given the importance of this issue in California, the current interest of federal OSHA in adopting some form of IIPP, and the absence of rigorous evaluation of existing approaches, the California Commission on Health and Safety and Workers' Compensation asked RAND to assess the California IIPP's impact on injuries. Because of data limitations, we focused our study on general industry, excluding construction and agriculture.

To most safety professionals, the elements of the California IIPP are all obvious ingredients of a good safety program. Despite that agreement, there is surprisingly little good research that confirms their effectiveness. Moreover, it is not at all clear that a mandate to adopt these practices will result in the same outcomes as when they are adopted voluntarily.

Study Approach

Our study addressed the following questions about implementation and effectiveness. The former are as follows:

- Has compliance with specific IIPP provisions improved over the years?
- How does the number of IIPP violations cited vary with the type of establishment and type of inspection?

The questions that attempt to examine effectiveness issues are as follows:

- Did injury and fatality rates decline in California, relative to other states, after the implementation of the IIPP standard?
- Do workplaces that do not comply with the IIPP have worse injury, fatality, and loss performance than compliant firms?
- Did workplaces that had been cited for IIPP violations and then came into compliance improve their injury performance relative to other workplaces?

To answer the last two questions, we relied on three data sources of establishment-level injury or loss data.

Enforcement of the Injury and Illness Prevention Program in California

Inspectors from the California Division of Occupational Safety and Health, better known as Cal/OSHA, are required to assess compliance with the IIPP in almost every inspection. Cal/OSHA inspects about 8,000 to 10,000 establishments per year, out of more than 700,000 establishments in the state. The largest categories of inspections are

planned inspections, which are targeted primarily at high-hazard industries, and inspections responding to complaints and to reports of serious injuries. In about two-thirds of the inspections that cite IIPP violations, the only IIPP section cited is §3203(a), which requires employers to implement an effective IIPP and to have a written IIPP plan. Approximately one-fifth of inspections citing §3203 have violations of the subsections of 3203(a)(1) through (a)(7), and another one-sixth have violations of the requirements to document the hazard survey and the training given to employees. In the great majority of cases, no more than a single section of the IIPP is cited in an inspection.

We found that there is an important difference between inspections citing violations of §3203(a) and inspections citing violations for its specific subsections. The former carry small penalties and are cited primarily in first-time inspections, mainly at quite small, nonunion workplaces. The latter are more likely to be cited in accident investigations and are more often cited at larger sites.

An important point is that, according to Cal/OSHA leaders, its inspectors often failed to inquire beyond whether employers had a written IIPP document. As a result, it is not clear whether the workplaces cited only for §3203(a) had other IIPP deficiencies. In contrast, employers cited for the specific subsections of the IIPP clearly did have some significant problem in implementing its provisions.

When we look at trends over time, we see that, after a decline during the first two years following the effective date of the IIPP, the number of IIPP violations per inspection has remained fairly constant both for §3203(a) and for its specific subsections. Disturbingly, the number of §3203(a) violations in first-time inspections has not decreased over time. Thus, either due to lack of information or lack of deterrence, newly inspected establishments are no more likely to have written programs now than newly inspected establishments were 20 years ago. On the other hand, once an establishment has been cited for an IIPP violation, the likelihood of finding another IIPP violation at that establishment declines substantially.

Tests for Finding the Injury and Illness Prevention Program's Effects on Injuries

We first examined changes in fatality rates to see whether California experienced any improvement relative to other states in the years after the IIPP took effect in 1991. We did not find any improvement. Even if we had, it would have been unclear whether the improvement was due to the IIPP or to other factors. The absence of any evident impact at the state level suggested that, if there were impacts of the IIPP, we would need

to look only at inspected establishments and compare between those cited or not cited for IIPP violations.

In order to assess the impacts of IIPP citations at inspected establishments, we carried out two different tests. The first test was based on the assumption that, if compliance with the IIPP helped to prevent injuries, then establishments with violations of its provisions should, on average, be those with poorer safety performance. We labeled this the "lookback" test.

The second, more direct test was based on the assumption that, if the IIPP were effective, establishments that were cited for noncompliance and then came into compliance would have improvements in injury performance.

In the hope of producing more-robust results, we carried out these tests on data from several different sources:

- Workers' Compensation Information System (WCIS), specifically first-report-of-injury forms insurers and third-party administrators are to submit from employers reporting to them
- OSHA Data Initiative (ODI) statistics, based on reports establishments are required to maintain reporting the number of different types of injuries and illnesses, collected since 1996 and covering establishments with at least 40 employees in manufacturing and a few other industries
- Workers' Compensation Insurance Rating Bureau of California (WCIRB) reports on medical and indemnity claims from single-establishment firms.[1]

Each of the three samples has different measures of performance:

- With data from the WCIS, the numerator of the measure was the total number of first-report-of-injury notices submitted to the California Division of Workers' Compensation by each establishment. We had this figure for each month. We obtained the number of employees during each month at each establishment and calculated the injury rate for the 12 months and 24 months before and after each inspection. The WCIS began collecting reports of injuries in 2000 but became more complete in 2001, which is the first year we use. Although reporting to the WCIS was mandatory, there has

[1] *Establishment*, in our usage, is the same as an individual worksite. A firm may have many different establishments, whether factories or commercial facilities.

been no penalty for failing to report, and substantial gaps remain in reporting.

- With data from the ODI, the measure was the OSHA total recordable injury and illness rate. The ODI sample included rates beginning in 1996 and targeted establishments with more than 40 employees, although some smaller ones were included. The denominator for the ODI's rates are the hours worked, translated into the number of full-time-equivalent (FTE) workers. For the lookback test, we looked at the rates one year and two years before the year of the inspection. We did not use the year of the inspection because many of the inspections were triggered by accidents, which raise the injury rate for that year. For the change test, we used data from one year before and two years after the year of the inspection.
- With data from the WCIRB, the measure was the experience modification factor (ex-mod) of the firm. This sample included only single-establishment firms; the ex-mods were based on injury experience dating back to 1991. For each inspection, we looked at the relationship between the IIPP compliance status and the ex-mod factor for the firm in the policy year two years after the inspection. Because ex-mods are based on three years of injury loss experience beginning one year before the policy year, the ex-mod two years after the inspection seemed to be a reasonable figure to use.

Findings on Injury Impacts

For the lookback test, the WCIRB and ODI samples produced similar results. Employers that were cited for a violation of §3203(a), the basic requirement to have a written IIPP document, actually had better performance (ex-mods or prior injury rates) than firms that had no IIPP violations. In contrast, employers whose only IIPP violations were the specific subsections of §3203(a), especially the requirements to train employees and to investigate accidents, had worse performance than employers that were not cited for any IIPP violation or that were cited only for §3203(a). There were no significant findings with the WCIS data, although the average effect of citing any of the specific requirements came close.

For the change test using the ODI data, we found that citations for noncompliance with the specific subsections of the IIPP were followed by improvements in injury rates. Importantly, we found these decreases both where the inspection citing the subsection was an accident investigation and where it was not. For inspections that were not

triggered by accidents, the average effect of citing the specific provisions §§3203(a)(1)–(a)(7) was a 26-percent decrease in injury rates in the following year. The most consistent finding for the subsections was that a citation for failing to provide appropriate training was linked both to poorer performance prior to the inspection and to improved performance (a 53-percent reduction) after the inspection. With the ODI sample, we found no effect when only the §3203(a) provision was cited. With the WCIS data, we found no evidence of any effects. (Because the ex-mod factor for a firm is based on three years of data and thus changes slowly, we excluded the WCIRB sample from the change test.)

In conclusion, we failed to find any clear impact of the IIPP on the total fatality rate in California. We did find sizable effects when the specific subsections of the IIPP were cited, but this occurred in only 5 percent of inspections.

Using the estimated 26-percent reduction in the total recordable injury rate following a citation for the specific subsections (§§3203[a][1]–[a][7]) of the IIPP, we would find, on average, an annual reduction of 0.29 injuries at a workplace with employees and 0.96 at a workplace with 100 when the employer implements the specific subsections of the IIPP.

Because, except for having fewer small workplaces, our sample was representative of inspected workplaces in California, we think that the results are generalizable to that group. However, we expect that the absolute effects of the program in sectors with low injury rates—sectors that typically get few inspections—would be less.

Policy Implications

If we assume that that the safety effects of the IIPP in California have probably been real but not very large, what are the policy implications for California and for other jurisdictions considering similar policies? The answer depends, in part, on the reasons for those results.

It is plausible that higher penalties for failure to have a written IIPP document would have reduced the number of those violations somewhat. Requirements for some form of employee participation in the implementation of the IIPP would probably have helped as well. More important, we believe, based on interviews with Cal/OSHA leaders, that inspectors did not regularly probe to find out whether employers actually had implemented the more-specific subsections of the IIPP. Variability among inspectors played a role here. However, a more important factor was that, despite Cal/OSHA's

support for the IIPP standard, its enforcement process often failed to look beyond paper compliance with its provisions.

The traditional OSHA enforcement program is focused on detecting and abating hazard-specific standards—e.g., unguarded machines, slippery floors. A quite different enforcement program would rely solely on the implementation of a safety program. OSHA or Cal/OSHA would examine whether the employer had carried out each of the requirements of the IIPP program but would not focus on hazard-specific standards.

Although possibly quite effective, this second approach carries some risks. It assumes that the process can ensure that major hazards are eliminated. But it may be difficult to assess the quality of the process with a great deal of confidence. Employers may be able to create the image of compliance without the substance. In addition, it is difficult to know, for example, just how effective a particular trainer or training program is. And even if the process is carried out properly, it is not fail-safe. To the extent that hazard-specific standards convey useful information to employers and workers about what precautions to take, that contribution would be undermined by a shift away from relying on those standards.

However, there may be another approach that achieves some of the benefits of both strategies, without the drawbacks. Under this approach, Cal/OSHA would still inspect to identify hazard-specific violations. However, when it did so, the inspector would ask managers, "How did your IIPP allow this hazard to appear in your workplace or allow this injury to occur?" In other words, he or she would try to relate the hazards to the program that the employer is required to implement. Detection of hazards would lead not only to the removal of hazards but also to the strengthening of safety programs.

In no small measure, this middle approach is the one used by the Health and Safety Executive (HSE) in the United Kingdom. In that case, the reference is to the employer's mandatory "risk assessment" rather than to an IIPP, but the principle is the same.

It seems plausible that discussing the relevance of the IIPP to injuries and violations would require inspectors to spend more time on-site. Thus, these inspections would need to be more effective in order to compensate for the prospect that fewer would be conducted. The new approach might provide more long-lasting benefits. Currently, analyses of the effects of enforcement typically find effects only in the year or two following an inspection with a penalty. The motivational effects of a serious violation fade over time, and compliance decays. In contrast, it is plausible, but hardly guaranteed, that efforts to support the practices required by a firm's safety and health program could have more-enduring effects.

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We also benefited from attending three stakeholder meetings that federal OSHA held to discuss its plans for a federal safety program standard.

Michelle McMullen played an essential role in preparing the manuscript. We also benefited from the comments of two reviewers and Susan Gates and Paul Heaton.

ABBREVIATIONS

AB	assembly bill
AI	accident investigation
BLS	Bureau of Labor Statistics
Cal/OSHA	California Division of Occupational Safety and Health
CFOI	Census of Fatal Occupational Injuries
CHSWC	Commission on Health and Safety and Workers' Compensation
DART	days away, restricted, or transferred
DIR	California Department of Industrial Relations
E-code	code for external cause of injury
EDD	Employment Development Department
ex-mod	experience modification factor
FEIN	Federal Employer Identification Number
FTE	full-time equivalent
HSE	Health and Safety Executive
IIPP	injury and illness prevention program
IMIS	Integrated Management Information System
LBR	RAND Law, Business, and Regulation
NIOSH	National Institute for Occupational Safety and Health
NTOF	National Traumatic Occupational Fatality
ODI	Occupational Safety and Health Administration Data Initiative
OSHA	Occupational Safety and Health Administration
SB	senate bill
SIC	Standard Industrial Classification
SOII	Survey of Occupational Injuries and Illnesses
VPP	Voluntary Protection Program
WC	workers' compensation
WCIRB	Workers' Compensation Insurance Rating Bureau of California
WCIS	Workers' Compensation Information System

1. INTRODUCTION

The modern era in U.S. occupational safety and health regulation began more than 40 years ago, when the Occupational Safety and Health Act of 1970 became law and created the Occupational Safety and Health Administration (OSHA). Although OSHA sponsors consultation and education programs, it has relied primarily on enforcing a set of safety and health standards governing specific hazards through inspections and penalties. The act transferred most authority for workplace safety and health regulation from the states to the federal government; however, it allowed states to enforce the law as long as their programs were "as effective as" the federal OSHA program. California is one of the 21 states that chose to retain a state program.[2]

The focus on compliance with hazard-specific standards is often contrasted with approaches practiced in other nations that emphasize the employer's responsibility to develop a plan to protect employees. Regulations in those countries are more likely to require certain procedures, such as assessing the risks in the workplace, which address safety and health in the broadest sense. Such systems place the regulatory agency more in the role of monitoring that these processes are, in fact, being carried out and less in the role of detecting specific hazards addressed by the standards.

Some argue that a key OSHA shortcoming is that it fails to engage employers at a more fundamental and comprehensive level. There is widespread agreement that top management's commitment is essential for a strong safety effort. Many also view the involvement of both frontline supervisors and other employees in that effort as critical. Training workers to understand the risks they face is a complement to the presence of an environment in which they are encouraged to report and correct unsafe practices and conditions.

But OSHA has no general requirements related to any of these issues. Some of the specific OSHA standards do have requirements for training, but there is no general requirement to provide it to all workers. And, although OSHA gives a discount on

[2] Twenty-one states operate OSHA programs in both the private and public sectors. A few other states enforce the law only in state and local government, which federal OSHA does not cover. Section 18(b) of the act (state jurisdiction and state plans) includes the provisions for continuing state authority.

penalties to employers who show "good faith," this is treated a minor issue, not a central one.

In Europe, regulators have moved toward what they describe as a "risk-based" approach to occupational safety and health regulation (Walters, 2002). It requires employers to identify the risks at their workplaces, to develop plans to eliminate those risks, and to create the conditions (through its safety culture and through training and information) for continued high performance.

It is not obvious whether the trade-offs that would be required by the shift to a more risk-based approach would be worthwhile. One element in such regimes is a greater willingness to trust the regulated entities to carry out their responsibilities. When that trust is unwarranted, firms may be able to evade their responsibilities for a longer time than they would under a regime that focuses on detecting noncompliance.

In its operations, California has ventured into several areas that federal OSHA has, to date, avoided. One of these is the adoption of an injury and illness prevention program (IIPP) standard that, although not embodying the risk-assessment approach, does go beyond hazard-specific standards and focuses directly on the overall program that the employer needs to put in place. It seems clear that that the following are desirable:

- encouraging managers to think broadly about the most-important risks that their employees face
- encouraging employees and employers to communicate about hazards
- investigating injuries or near misses that occur, in order to learn how to prevent them
- surveying the workplace to identify hazards
- training employees about the hazards they face.

These and other measures are part of the safety programs that leading firms have adopted as they implement safety management systems to try to ensure that these functions are being carried out. But some critics of regulation argue that it is one thing to support the voluntary adoption of these measures but another to believe that they should be mandated by government (U.S. House of Representatives, 2000). Such mandates, they argue, are "one-size-fits-all" requirements that either specify the rules in too much detail or leave too much discretion in the hands of inspectors.

Under the Barack Obama administration, OSHA and its chief, David Michaels, have made the adoption of some type of similar program their top priority for setting new standards. They refer to their plan as *I2P2*. Several organizations of safety and health professionals have endorsed the goal of adopting such a standard at the federal level.

Although it seems clear that such programs can potentially improve safety for many employers, it is much less clear *how much* of a difference they can make.

STUDY PURPOSE

Given the importance of this issue at both the national and state levels and the absence of rigorous evaluations of existing programs, the California Commission on Health and Safety and Workers' Compensation (CHSWC) asked the RAND Corporation to conduct of study of California's IIPP impact on injuries. Our purpose was to determine how the IIPP standard had been implemented in California and whether there is evidence that it had led to reductions in injuries.

RESEARCH APPROACH

One potential test of the IIPP's impact on injuries is to compare the changes in injury rates in California after the new regulation took effect in July 1991 with the changes in rates in other states. We do make this comparison in Chapter Seven, but we do not put much evidentiary weight on it. The major reason is that changes in injury rates are subject to many influences. One of the best known is changes in workers' compensation (WC) programs. Since 1993, the WC program in California has been one of the most volatile in the country (Dixon, Macdonald, and Barbagallo, 2009).

We place more weight on measuring differences or changes in injury rates that are related to the status of an *establishment's* compliance with the IIPP. Thus, we examine only inspected workplaces because they are the only ones for which we know the IIPP compliance status. With this focus, we addressed the following descriptive and causal questions. The descriptive questions are as follows:

- Has compliance with specific IIPP provisions improved over the years?
- How does the number of IIPP violations cited vary with the type of establishment and type of inspection?

The questions that attempt to examine causal issues are the following:

- Did injury and fatality rates decline in California, relative to other states, after the implementation of the IIPP standard?
- Do workplaces that do not comply with the IIPP have worse injury, fatality, and loss performance than compliant firms?
- Did workplaces that had been cited for IIPP violations and that came into compliance improve their injury performance relative to other workplaces?

To answer our descriptive questions, we relied on the OSHA inspection database (Integrated Management Information System, or IMIS), which reports which violations were cited in each inspection. We also examined California Division of Occupational Safety and Health (Cal/OSHA) guidelines to inspectors about how to enforce the policy and guidelines to employers about why and how to comply. We supplemented this information by conducting interviews with seven top Cal/OSHA officials to hear their views about how the program was being enforced. We also attended a large meeting in Sacramento, at which federal OSHA heard opinions about the IIPP standard from many California constituencies.[3]

We used regression analysis to address our second and third causal questions. To find out whether workplaces that had violated the IIPP had higher injury rates, we regressed the injury rate in the year before an inspection on the IIPP findings and a set of other variables that have been found to affect injury rate changes. To find out whether getting cited for violations of the IIPP was followed by an improved injury rate, we regressed the change in that rate following an inspection on IIPP compliance and a set of control variables.

A fuller description of our research methods can be found in Chapter Four.

LIMITATIONS IN SCOPE

Although the IIPP requirement applies to all workplaces in California, we restricted our study to a subset of industries: manufacturing, all transportation and public utilities, all wholesale trade, and health care (Standard Industrial Classification [SIC] codes 20–51 and 80). The most-important sectors we excluded were agriculture and construction, two of the most-dangerous industries and ones to which Cal/OSHA devotes significant attention. However, the data for construction do not lend themselves easily to analysis because injury rate data are collected at the firm level, while inspection data apply to particular worksites, and linking inspection data from different worksites to the same firm has been very difficult. Even when such a link is created, the inspections may have covered only a small percentage of all worksites where a firm performed work. We excluded agriculture because some injury data sources (e.g., the OSHA Data Initiative, or ODI) do not collect information in that sector. We also excluded some relatively low-risk

[3] A summary of this meeting and other stakeholder meetings that OSHA held on the I2P2 idea can be found at OSHA (2010).

industries, such as retail trade, finance, and real estate, and service industries, with the exception of health care.

Second, although we examine changes in injury rates, we do not examine other outcomes, such as changes in workplace exposures to toxic chemicals and noise or changes in the number of chronic diseases they can cause. The latter cannot be tracked at all with available data. Acute illnesses, such as dermatitis, are included to the extent they are reported.

Third, we make no attempt to estimate the benefits and costs of the IIPP, although the findings here are important inputs in any attempt to estimate the benefits.

Finally, we have no way to determine whether the injury rates reported by firms are accurate. We do, however, try to address concerns about the accuracy of reporting by looking at other outcome measures that are less subject to underreporting: fatalities and the experience modification factors calculated for each firm by the Workers' Compensation Insurance Rating Bureau of California (WCIRB).

Despite the limitations noted here, we think that the analyses presented in this report advance our understanding of the role that mandated safety and health programs have played in California.

ORGANIZATION OF THIS REPORT

In the next two sections, we examine the implementation questions raised in this chapter. Chapter Two describes the background of the IIPP, its requirements, and the enforcement policies adopted by Cal/OSHA. Chapter Three describes trends in the incidence of IIPP violations, as well as analyses of the types of inspections and establishments where they are cited.

Chapter Four reviews prior research related to the study of the effectiveness of prevention programs. Chapter Five presents the plan of the instant project. It first reviews the key questions about impact raised already and describes some of the difficulties that studies of the IIPP's impact face. Then we describe the data sources we used. The final part of that section describes the specific tests we carried out and the variables that they employed.

Chapters Six through Eight provide the results of the tests. Chapter Six examines changes at the state level, reviewing changes in California and differences between California and other states. Chapter Seven reports on what we refer to as our "lookback" tests: If compliance with the IIPP helps to prevent injuries, then we should expect to find that, other things equal, noncompliant workplaces have worse injury performance than

compliant firms. Chapter Eight presents our "change" tests: Did workplaces that had been cited for IIPP violations and subsequently came into compliance improve their injury performance relative to other workplaces?

Our final section integrates the various findings and clarifies what we know and do not know about the effects of Cal/OSHA.

2. CALIFORNIA'S INJURY AND ILLNESS PREVENTION PROGRAM

California's occupational safety and health program has been in the political spotlight more than most OSHA programs. In January 1987, Governor George Deukmejian eliminated the Cal/OSHA program in order to reduce state spending.[4] Federal OSHA then assumed the enforcement of federal occupational safety and health standards in the state. The federal role lasted only about a year because a referendum (Proposition 97) won voter approval in November 1988, overturning the governor's action and restoring the state's program.

Shortly after the return of Cal/OSHA in 1989, the legislature passed Senate Bill (SB) 198, which required that every employer in California establish an IIPP. New regulations implementing the statute became effective on July 1, 1991. The new regulation faced criticism that its provisions were too costly and that they failed to recognize differences in risk among industries. Many employers, especially small employers, lacked the expertise to develop an effective program. Employers in lower-hazard industries saw little justification for their coverage by the regulation.

In 1992, the Council on California Competitiveness, appointed by Governor Pete Wilson, suggested reforms that the legislature enacted in 1993. These included

- a one-year moratorium on penalties for any new business
- reduced documentation requirements for businesses with fewer than 20 employees
- model programs to provide guidance to employers in low-hazard industries that often allowed them to avoid hiring expensive safety consultants.

For many years prior to 1991, the state had enforced a regulation (the "accident prevention program") requiring some elements of a safety and health program. However, the new provisions expanded the requirements and called for an assessment of the adequacy of the IIPP in every inspection. The inspector is required to ask the employer to show him or her a written IIPP. Then the inspector is supposed to investigate whether the program is "effective." As a result, the number of citations for IIPP violations rose fourfold, making it the most frequently cited violation in every year since 1992.

[4] The account of the IIPP's early history was provided by John Howard, former Cal/OSHA chief in communication with the authors, May 2011.

Cal/OSHA produced two separate IIPP regulations: one for construction (§1509) and one for all other industries (§3203). In large part, §1509 simply incorporates §3203. However, it also requires that "Supervisory employees shall conduct 'toolbox' or 'tailgate' safety meetings, or equivalent, with their crews at least every 10 working days to emphasize safety."

In this chapter, we describe the main provisions of the IIPP and Cal/OSHA's guidelines for enforcing it.[5] In addition, we examine other important ways in which the OSHA program in California differs from the federal program.

PROVISIONS OF THE CALIFORNIA INJURY AND ILLNESS PREVENTION PROGRAM

Section 3203 has three subsections:

- Section 3203(a) lays out the basic requirements.
- Section 3203(b) describes how employers must document their compliance.
- Section 3203(c) is a narrow section describing the characteristics that a joint safety and health committee has to have to be accepted as an adequate fulfillment of the provision (§3203[a][3]) requiring employers to communicate with employees about health and safety. It is important to note, however, that the IIPP has no requirements regarding workers' *participation* in the implementation of the IIPP.

Section 3203(a), the most frequently cited provision, requires every employer to "establish, implement, and maintain an effective Injury and Illness Prevention Program. The program shall be in writing and, shall, at a minimum" do the following:

- "Identify the person or persons with authority and responsibility for implementing the Program" (§3203[a][1]).
- "Include a system for ensuring that employees comply with safe and healthy work practices" (§3203[a][2]). These include recognition of employees who follow safe procedures and disciplinary actions for those who do not.
- "Include a system for communication with employees in a form readily understandable by all affected employees on matters relating to occupational safety and health, including provisions designed to encourage employees to

[5] The legal home of the IIPP provision is Title 8 of the California Code of Regulations.

inform the employer of hazards at the worksite without fear of reprisal" (§3203[a][3]).

- "Include procedures for identifying and evaluating work place hazards including scheduled periodic inspection to identify unsafe conditions and work practices" (§3203[a][4]). It goes on to require that such inspections be carried out when the IIPP is first established, whenever changes are made in the workplace, and whenever the employer recognizes a new hazard.
- "Include a procedure to investigate occupational injury or occupational illness" (§3203[a][5]).
- "Include methods and/or procedures for correcting unsafe or unhealthy conditions, work practices and work procedures in a timely manner based on the severity of the hazard" (§3203[a][6]). These should be corrected "when observed or discovered."
- "Provide training and instruction" when the program is first established, to all new employees, to those given new assignments for which they had not had training, whenever new substances or processes are introduced that "represent a new hazard," and whenever the employer is made aware of a new hazard. Also, supervisors must be trained to become familiar with the hazards faced by the workers they direct (§3203[a][7]).

All these requirements use fairly general language, emphasizing "systems" and "procedures" that must be "included." Thus, the regulation appears to leave a great deal open to interpretation. To some degree, that openness is addressed by §3203(b), which describes what "Records of the steps taken to implement and maintain the Program" the employer must maintain. The required records document the employer's hazard survey and its training program:

- Section 3203(b)(1) requires that records of the hazard surveys required by §3203(a)(4) must be maintained for at least one year. The records must describe who did the survey, the unsafe conditions that were found, and the actions taken to correct them. Employers with fewer than ten workers have to keep the records only until the hazard is corrected.
- Section 3203(b)(2) requires that documentation of training also be maintained for one year and include the training dates, type of training, and the provider. Employers of fewer than ten have to maintain only the set of instructions they give to employees about the hazards "unique to the employee's job assignment

when first hired or assigned new duties." This section also includes supposedly lesser requirements for employers with fewer than 20 employees who are in industries designated by the California Department of Industrial Relations (DIR) as "low hazard" and for firms that are neither high hazard nor low hazard (as designated by the department) and who have fewer than 20 employees and a WC experience modification factor (ex-mod) of 1.1 or less. However, it is difficult to see how the documentation requirements actually differ.

In practice, inspectors often cite §3203(b), which, by itself, says only that employers have to document compliance. It may be cited, according to Cal/OSHA staff, either because inspectors are indicating a general lack of documentation or because they simply are not bothering to distinguish paragraph (b)(1) from paragraph (b)(2).

Our analysis of the inspection data shows that less than 15 percent of Cal/OSHA inspections that cite §3203 violations cite more than one section of the standard. As Table 2.1 shows, even the training requirement and the section requiring documentation of training are cited together less than 10 percent of the time, and the hazard survey requirement and its documentation section are cited together less than 6 percent of the time. Cal/OSHA's usual policy is not to cite lack of documentation if it is already citing failure to conduct the activity.

Table 2.1
Cases in Which Documentation Section Is Cited Along with Hazard Survey or Training Requirement

Inspections with violation of hazard survey requirement, §3203(a)(4)		*701*	
		N	***%***
	Number and percentage of inspections also citing for general failure to document §3203(b)	11	1.6
	Percentage of inspections also citing for failure to document hazard survey, §3203(b)(1)	36	5.1
	Total		6.7
Inspections with violation of training requirement, §3203(a)(7)		*822*	
		N	***%***
	Percentage of inspections also citing for general failure to document, §3203(b)	14	1.8
	Percentage of inspections also citing for failure to document training, §3203(b)(2)	61	7.1
	Total		9.1

VIOLATIONS AND PENALTIES

Cal/OSHA provides guidance to its inspectors about how to enforce the provisions of the IIPP (DIR, 2003). The failure to have any IIPP or to have a written program is cited as a violation of §3203(a). If there is an IIPP but it does not meet each of the required elements of §§3203(a)(1)–(a)(7), a single citation will identify each of those elements. Typically, these violations will be cited as "general" violations rather than as "serious" violations.

Penalties are mandatory for violations classified as "serious." When no penalty is assessed for a general violation of §3203, it could be because the firm was less than one year old and judged to be making a good-faith effort to comply. In addition, there are cases in which the evaluation of the employer's IIPP is limited to "a review of new circumstances and the continuing effectiveness of the IIP Program." These include cases in which an inspection is conducted within 180 days of an earlier inspection that found that the employer was in compliance with the IIPP. It also includes inspections of

employers that participate in one of the high-performer groups—the Voluntary Protection Program (VPP), the Golden State program, and Golden Eagle programs (DIR, 2003).

How the California Division of Occupational Safety and Health Assesses Whether the Injury and Illness Prevention Program Is Effective

Section 3203(a) requires that the employer maintain an "effective" IIPP. The policy and procedure manual provides guidance to inspectors about how to examine whether the IIPP program is effective. Its suggested measures include the following:

- Do workers know the name of the person in charge of the IIPP?
- Are workers aware of methods to communicate with the employer about health and safety, and have they utilized them?
- Have workers been recognized for good safety behavior or disciplined for bad safety behavior?
- Have the procedures for identifying hazards been carried out when the IIPP was first established, when there are changes in workplace, and when the employer is made aware of a hazard?
- Does implementation of injury investigations result in a determination of the cause?
- Have identified hazards been abated in a timely manner?
- Does training result in increased understanding of hazards and safer work practices?

The extent to which inspectors actually examine these issues is not known, but interviews with top Cal/OSHA officials revealed that they believed that many inspectors did not make a major effort. Some judgments about noncompliance are clear-cut. For example, the absence of any written IIPP document leads to a citation for a violation of §3203(a). But, even if the paper trail is adequate, the question of assessing the effectiveness of the program, using the questions above, is a somewhat subjective one and can be difficult. For example, how many workers does the inspector have to talk to in order to find out whether the inspector thinks training was useful? We reviewed the practices of individual Cal/OSHA inspectors with more than 30 nonconstruction inspections and found that the number of IIPP violations per inspection ranged from less than 0.32 for the 25th percentile to 0.56 for the 75th percentile and from 0.22 for the 10th percentile to 0.65 for the 90th. We also found that newer inspectors issued citations less frequently. The finding of substantial variation in citing IIPP violations suggests to us

that either inspectors have been given different guidance about how to assess the IIPP or the subjective element remains quite strong.

KEY DISTINCTIONS BETWEEN CALIFORNIA'S DIVISION OF OCCUPATIONAL SAFETY AND HEALTH AND THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

The IIPP standard is, of course, only one element of Cal/OSHA's overall program. That program differs in some notable ways from federal OSHA's. Knowledge of those differences may aid in understanding some of the results of our study.[6] First, as Table 2.2 shows, the distribution of inspection types for all California inspections gives a far greater emphasis to accident investigations (AIs) than any other state does. Complaint inspections also comprise a larger share of inspections, while programmed inspections are considerably smaller. A large share of the programmed inspections takes place in the construction sector. Programmed inspections are those in which the agency or its inspectors decide which workplaces to inspect. In the samples we gathered for this study, the percentage of programmed inspections is never greater than 15 percent, while AIs range from 33 percent to 48 percent.[7] The residual category of "Other inspections" includes many types; the most prominent are those triggered by a referral from another government agency and follow-up inspections to check on the correction of violations.

The emphasis on AIs in California stems from a state law that requires employers to quickly report not only fatalities but also all cases in which a worker is hospitalized as the result of an acute injury or suffers an amputation.[8] The law also requires Cal/OSHA to investigate all of them, with exceptions for those caused by highway crashes or assaults. Since 1993, a large share of programmed inspections in California have targeted firms with an ex-mod equal to or greater than 125 percent "and/or establishments with Work Class Codes that have higher industry losses as reflected in the Pure Premium

[6] Because this study does not examine construction or agriculture, we ignore the many distinctive programs that California has in these sectors.

[7] Different analyses use samples of inspections from different years; also, the inspections included depend on the presence of injury data before and after to test the effects. That is why the distribution of inspection types differs. In the Workers' Compensation Information System (WCIS) lookback sample, 33 percent are AI, 38 percent complaint, 22 percent programmed, and 10 percent other. In the WCIS sample used with the change models, the comparable percentages were 41 percent, 36 percent, 15 percent, and 8 percent. See Tables C.1, C.2, and C.3 in Appendix C.

[8] Cases in which the hospitalization is for observation only do not need to be reported. The statute requiring the accident investigation is California Labor Code Section 6313(a).

Rates." The first group is expected to request consultation services. If they do not, they become high-priority inspection targets.

Table 2.2
Distribution of Principal Inspection Types, Fiscal Year 2009 (%)

Type of Event	*California*	*Other State Plans*	*Federal OSHA*
Accidents	24	2	2
Complaints	25	12	17
Programmed inspections	40	59	62
Other inspections	11	27	19

SOURCE: OSHA, 2009.

California also has an unusual pattern of citation and penalty numbers. The review commission that hears employer appeals from Cal/OSHA citations had ruled that violations could not be cited as "serious" unless the agency could show that the violation was "more likely than not" to lead to a serious injury. In contrast, federal OSHA and most other states require only that any injuries caused by the violation would probably be serious and ignored the probability that the violation would cause an injury. The result, as shown in Table 2.3, is a lower rate of serious violations in California.[9] However, the state levies substantially higher fines for serious violations than other states do. This greater strictness does not, however, carry over to citing the most-severe types of violations—those for willful, repeat, or failure-to-abate violations—all of which are quite rarely cited by Cal/OSHA.[10]

The net effect is that the average penalty per inspection is slightly higher in California than for federal OSHA and much higher than in other state plan states. It appears, however, that the very high penalty per serious violation, and the prospect of an

[9] Legislation in 2011, Assembly Bill (AB) 2774, required the review commission to adopt something closer to the federal interpretation of the standard of proof for a serious violation.

[10] Penalties can be reduced for the size, good faith, and history of the firm and can be adjusted up or down by 25 percent depending on the number of workers exposed to a hazard and the likelihood of injury. In addition, if abatement is immediate, a 50-percent abatement credit is granted.

employer-friendly appeals board, has led to a much higher rate of contested violations than in other states. In addition, unlike Federal OSHA, Cal/OSHA does not bring lawyers into routine appeals, and some claim that the inspectors are frequently not as effective in presenting their case.

Table 2.3
Comparison of Citation and Penalty Policies Across States, Fiscal Year 2009

Type of Event	*California*	*Other State Plans*	*Federal OSHA*
Percentage of inspections with any violation	54	62	70
Percentage of inspections with serious violations	19	38	61
Average penalty per serious violation ($)	4,930	800	970
Number of willful, repeat, and failure-to-abate violations	83	2,622	3,370
Percentage of inspections with contested violations	40	13	7
Average penalty per inspection ($)	2,657	990	2,468

SOURCE: OSHA, 2009.

This higher rate of contests is consequential. Employers cannot be required to abate the violations until their contests have been resolved. This process usually takes months, which delays whatever protection their abatement would provide. In response, all OSHA programs offer firms steep discounts on fines, usually up to 50 percent, for carrying out abatement regardless of the status of an appeal.[11]

The number of inspections per worker in California in 2009 was roughly equal to the federal OSHA figure but well below the average for other state plan states. In fact,

[11] The percentage of inspections in which the employer contests citations or penalties has been growing steadily in California since the early 1990s, when it was only about 4 percent, according to the IMIS data.

through most of the 1990s, California ranked 19th among the 21 state plan states in the number of inspectors per business in the state. Oregon averaged 7.0, while California's figure was 2.0 and federal OSHA's was 1.5 (Huber, 2007).[12]

From this chapter, we should take away several messages. One is that, in theory, the IIPP is examined in all inspections other than the excepted categories (e.g., when another inspection recently found compliance with the IIPP). Determining compliance with the IIPP, except for §3203(a)'s requirement to have a written program, depends on the effort used to investigate. In practice, inspectors can and probably do vary in the extent to which they probe to find possible noncompliance. As a result, the absence of an IIPP violation for §§3203(a)(1)–3203(a)(7) may not be as valid a measure of compliance as first appeared.

We also saw that the context for enforcement in our data differs substantially from that in other states. From one-third to one-half of the inspections in our sample are AIs. As we discuss later, the enforcement of the IIPP in AIs may differ from the practices in other inspection types.

[12] Other differences are that, unlike federal OSHA, Cal/OSHA does not have a "general-duty" clause that it can cite. However, it can issue "special orders." These mandate hazard abatement, but no penalties can be assessed for the hazard. In addition, California has adopted a standard for repetitive-motion injuries, overcoming some of the barriers that federal OSHA encountered. However, this standard is not cited very often. Also, Cal/OSHA has used the IIPP standard (paragraph [a][6] or [a][7]) as a general-duty clause.

3. INJURY AND ILLNESS PREVENTION PROGRAM IMPLEMENTATION AND TRENDS IN COMPLIANCE

We begin our review of the IIPP's implementation by looking at the frequency with which different provisions of the IIPP have been cited. After reviewing the characteristics of the inspections in which citations occur, we examine what has happened to compliance over time. Because evidence about noncompliance is available only for inspected workplaces and because inspections are not conducted randomly, we cannot draw firm conclusions about noncompliance in the universe of firms in the state. The inspection data do, however, provide some useful insights.

Table 3.1 shows that §3203(a) accounts for about two-thirds of all violations of the IIPP. It is usually the only IIPP provision cited. In about 85 percent of the inspections with an IIPP violation, there is only a single section of the standard cited. Each of the other provisions—those in §3203(b) and in the subsections of §3203(a)—is cited much more rarely, although collectively they account for about one-third of all IIPP violations.

Table 3.1
Number of Violations of Different Sections of Injury and Illness Prevention Program Standard and Percentage Cited as Serious, July 1991 to April 2007, Selected Sectors

Section	*Violation*	*Number*	*Percentage Serious*
3203(a)	Have a written IIPP	9,508	1.5
3203(a)(1)	Have a person in charge	599	2.5
3203(a)(2)	Make employees comply	470	10.3
3203(a)(3)	Communicate with employees	263	5.4
3203(a)(4)	Carry out hazard surveys	701	2.5
3203(a)(5)	Investigate injuries	492	2.5
3203(a)(6)	Correct hazards	N/A	N/A
3203(a)(7)	Provide training	822	25.4
3203(b)	Document either paragraph b(1) or paragraph b(2)	948	<1
3203(b)(1)	Document hazard survey	1,172	<1
3203(b)(2)	Document training	1,391	<1
3203(c)	Labor/management committee to comply with communication requirements	64	<1
Total		16,430	

NOTE: N/A = not available because not enough cases for estimation. Our sample is limited to SICs 20–51 and 80. Citations for violations of §3203(b) left unclear which of the two subsections of that provision was being cited.

DISTINGUISHING SECTION 3203(A) FROM OTHER INJURY AND ILLNESS PREVENTION PROGRAM VIOLATIONS

A review of the inspection data shows that there are notable differences between the contexts in which violations of §3203(a) and violations of other §3203 provisions are cited. The former refers to the employer's lack of a written IIPP. The other provisions are cited when, despite a written program, there are failures to implement its provisions. Importantly, there is only limited overlap between the two groups of violations. When §3203(a) is cited, §§3203(a)(1)–(a)(7) are also cited less than 2 percent of the time. Conversely, §3203(a) is cited no more than 8 percent of the time that any one of those sections is cited.

Table 3.2 shows that the occasions on which §3203(a) is cited are more likely to be the first inspection after the IIPP took effect. Section 3203(a) is much less likely to be cited in AIs, presumably because the connection of this more general provision to the accident is viewed as more tenuous. Noncompliance with it is considerably more likely to be found at very small establishments and considerably less likely at large establishments, compared with the pattern for other §3203 violations. Subsections 3203(a)(1)–(a)(7) are more likely to be cited in AIs. We do not know the extent to which this occurs because these violations contribute more to serious injuries or because inspectors are more likely to cite those provisions if an accident has already occurred. And, as we saw in Table 3.1, violations of §3203(a) are cited as serious only 1.5 percent of the time, while the percentages for some other provisions of §3203 reach up to 20 percent.

We focus on these differences in order to gain a better sense of whether, when we try to look at the impact of noncompliance with the IIPP, it makes a difference which provisions are violated. Section 3203(a) is cited disproportionately at small workplaces that are getting their first inspection. The penalties for these violations are small. Perhaps most importantly, compliance with §3203(a) can be achieved by getting the necessary paperwork in order.

Table 3.2
Differences Between Inspections Citing Section 3203(a) and Inspections Citing Sections 3203(a)(1)–(a)(7) but Not Section 3203(a)

Type of Violation	*Percentage of §3203 Violations Cited in First Inspection*	*Percentage Cited in AI*	*Percentage Cited with <20 Employees*	*Percentage Cited with >99 Employees*	*Percentage Union*
§3203(a)	85	21	55	12	8
§3203 but not §3203(a)	65	48	26	34	22
No §3203 cited	N/A	28	26	43	31

NOTE: N/A = not available because not enough cases for estimation. *First inspection* refers to the first inspection after the IIPP took effect in July 1991. Interpretation: Of all violations of §3203(a), 85 percent were cited in first-time inspections, 21 percent were cited in AIs, and so on.

TRENDS IN NONCOMPLIANCE

Figure 3.1 shows the number of violations cited per inspection since mid-1991, when the IIPP became effective, for three categories: §3203(a), §§3203(a)(1)–(a)(7), and §3203(b).

The numbers for §3203(a) vary between 0.15 and 0.20 for the entire period, without any evident trend. In contrast, the violations of the specific paragraphs of §3203(a) start as high as the first category but then drop sharply. Since 1993, there has been very little change in the number of these violations per inspection. Finally, the §3203(b) violations, dealing with failures to document activities under the IIPP, increased from less than 0.05 to about 0.08 per inspection and then declined.

Figure 3.2 shows the trend in the number of serious violations of §3203 per inspection. After a jump in 1992, it drops steadily until about 2000, reaching fewer than 0.01 serious violations of §3203 per inspection. The numbers increase somewhat, back to about 0.02. As a share of all §3203 violations, the serious violations have ranged from 3 percent to 8 percent.

Our review of citation policy suggests that citations for failure to have a written IIPP are straightforward. Either the employer has the required piece of paper or it does not. Because of this simplicity, the trend in violations of §3203(a) is likely to be an accurate measure of whether employers have the written program. Citations for other sections of the IIPP require deeper scrutiny, and inspectors' diligence will vary. And,

Cal/OSHA practices on whether to cite these violations may shift over time, although we have no evidence that they did. For these reasons, we are less certain that the trends for violations of these other sections are as valid.

Figure 3.1
Number of Violations per Inspection for the Three Major Groups of Injury and Illness Prevention Program Violations

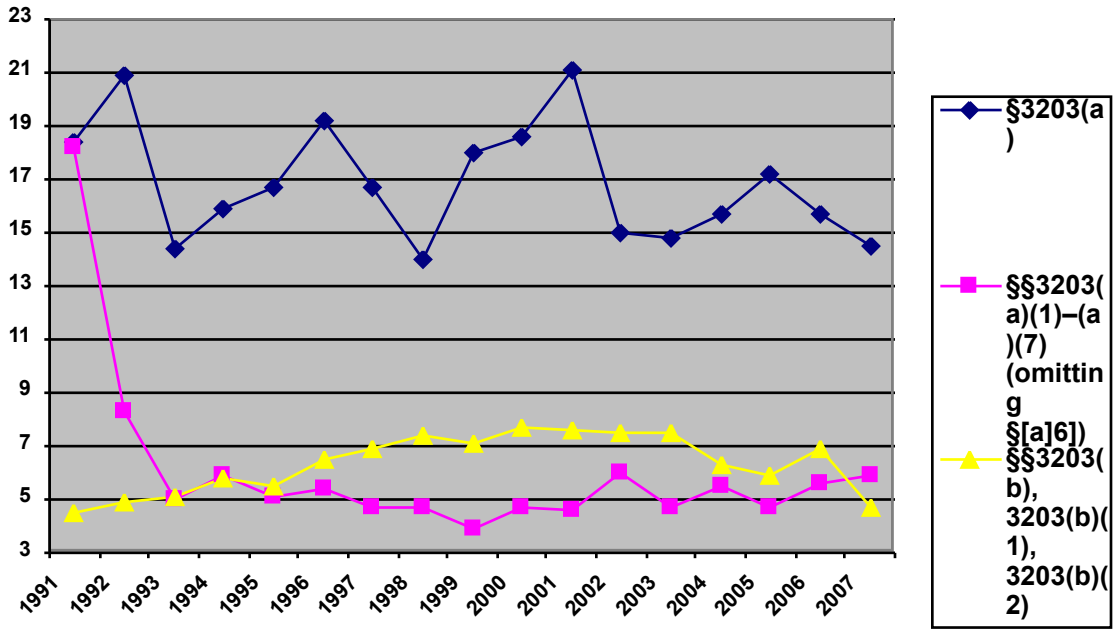
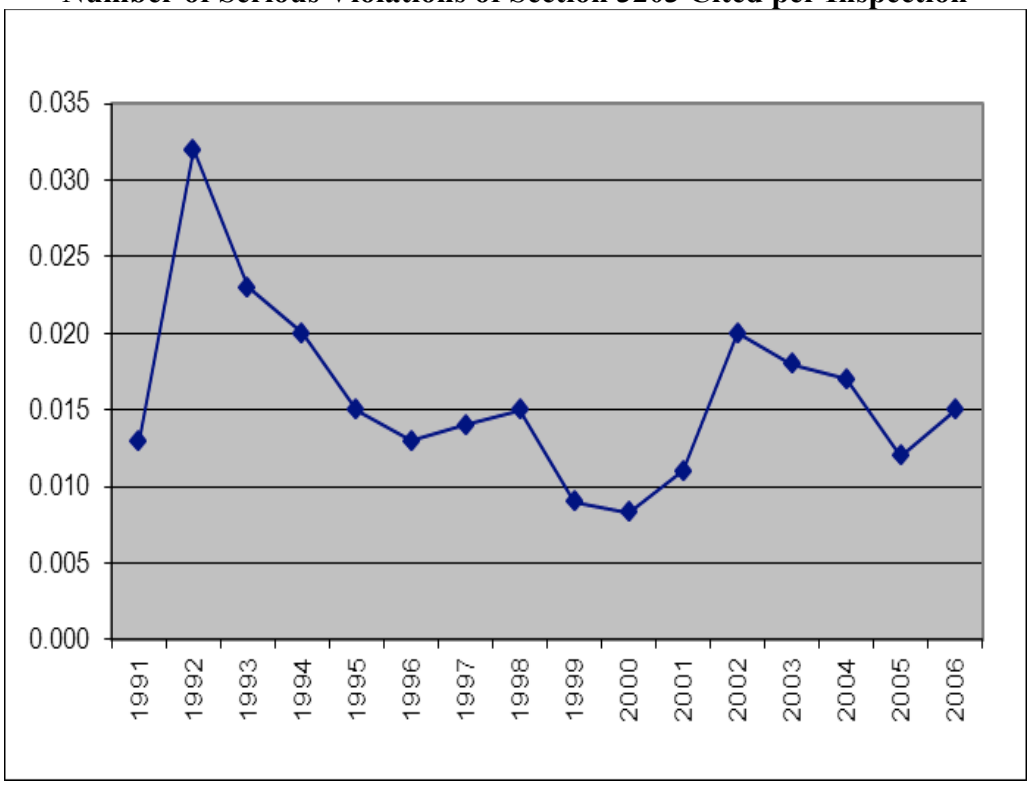


Figure 3.2
Number of Serious Violations of Section 3203 Cited per Inspection



This consistency in overall violations seems to indicate that compliance with §3203(a) has not improved over the years. However, we need to distinguish first-time inspections from later-sequence inspections because the patterns are very different.13 Figures 3.3, 3.4, and 3.5 show that the total number of §3203 violations cited at an establishment decreases for the requirements to have a written program (§§3203[a], [b]) for documentation (§§3203[b], [c]), and to identify a person responsible for the IIPP (§3203[a][1]). This pattern of better compliance in later sequences is typically what we find when we examine reinspected establishments (Ko et al., 2010).

[13] *Establishment*, in our usage, is the same as an individual worksite. A firm may have many different establishments, whether factories or commercial facilities. The sequence figures we report here are the average number of violations per inspection for all first inspections, for all second inspections, and so on. They do not necessarily tell us whether the particular establishments cited in one inspection were free from violations in the next. For example, suppose three of six establishments (50 percent) were cited in the first inspection and that only two (33 percent) were cited in a later inspection. Those two could be two of the three cited in the first inspection, or they could be two others that had not been cited in the first inspection.

However, the other paragraphs of §3203(a) do not show this pattern of decline. Later inspections actually tend to find a somewhat higher number of violations. Part of the reason for this finding is that these paragraphs are much more likely to be cited in AIs. And, although larger establishments are much safer in terms of serious injuries per worker, they do have a large number of serious injuries by virtue of their large employment. Larger establishments are also more likely to have other types of inspections as well. Accidents will often occur after some of these other inspections, generating the pattern in which violations do not decline steadily with inspection sequence. Section 3203(a)(1) is the outlier among §§(a)(1)–(a)(7). It is the easiest of the specific requirements to comply with—all the employer has to do is include the name of a person on a document—which may explain why it decreases so much in later inspections.

Figure 3.3
Section 3203(a) Violations per Inspection, by Inspection Sequence

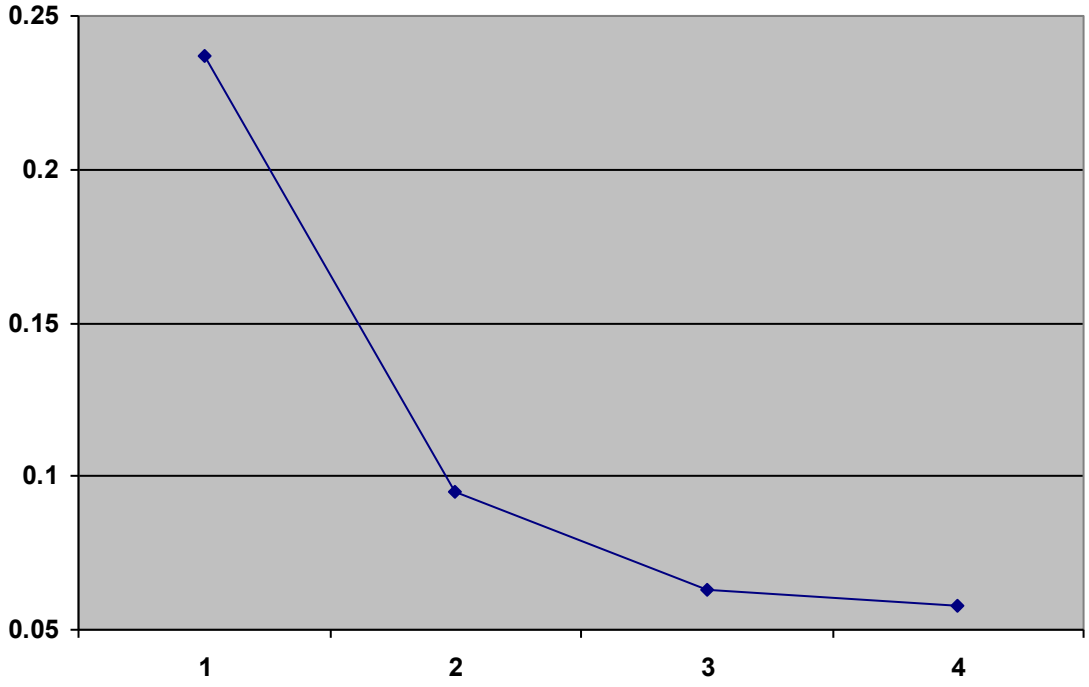


Figure 3.4
Violations of Sections 3203(a)(1)–(a)(7), by Inspection Sequence

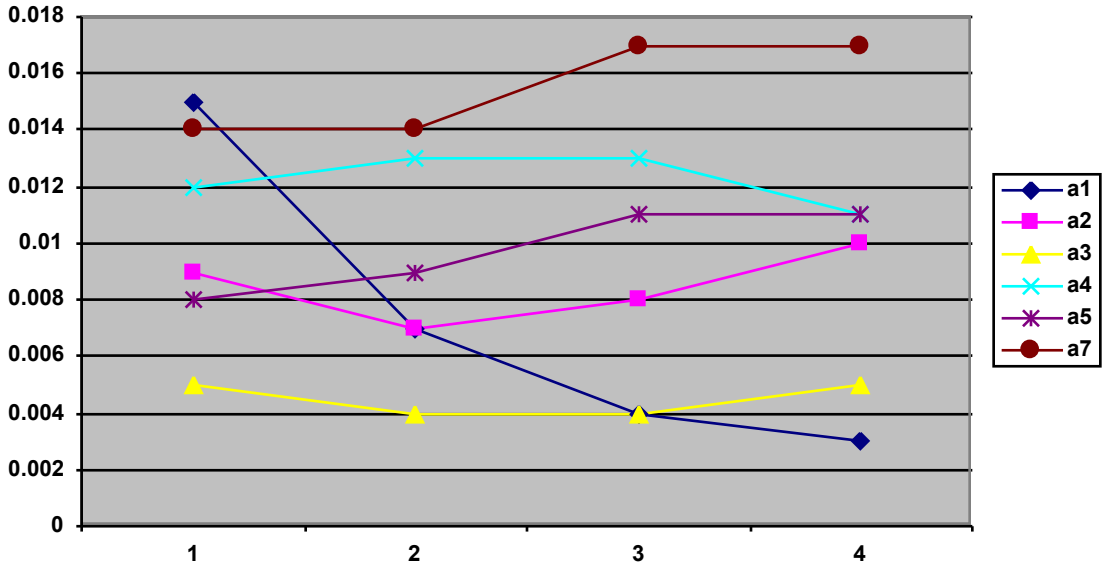
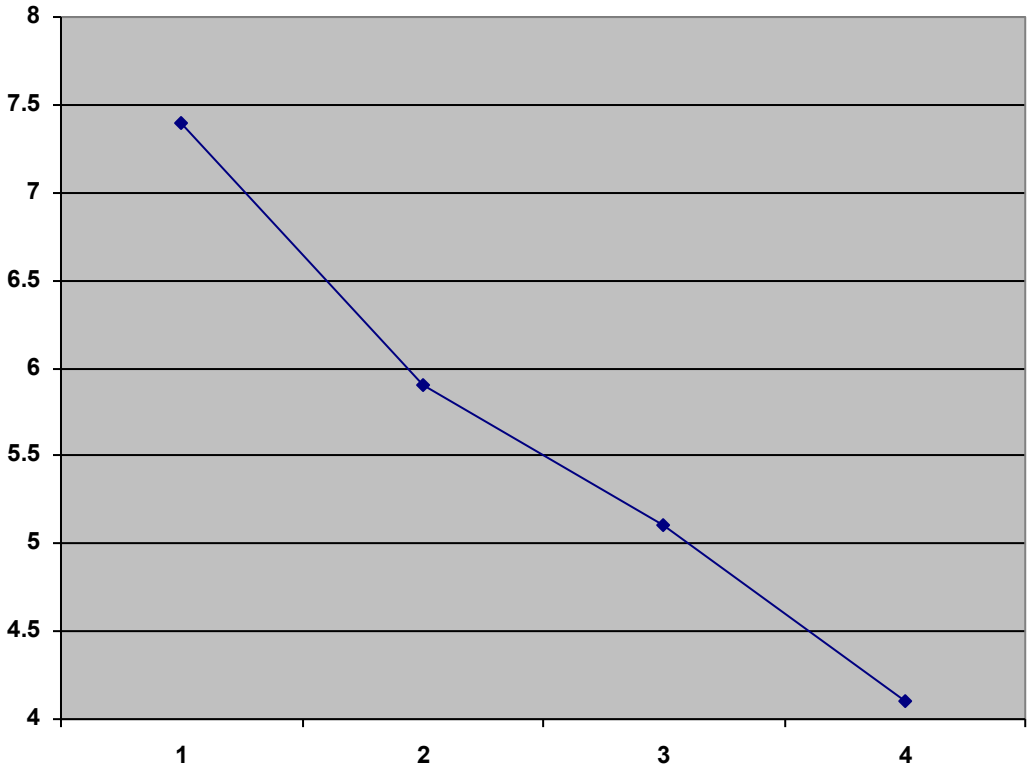


Figure 3.5
Violations of Section 3203(b) per Inspection, by Inspection Sequence



Given the importance of inspection sequence on the number of violations cited, we should also look at the trends for a given sequence. Reading down the Sequence 1 column in Table 3.3, we see that, since 1993, the number of IIPP violations cited in first-time inspections has not changed. This could be interpreted to mean that Cal/OSHA enforcement has not provided a strong general deterrent against noncompliance with the IIPP. If deterrence were operating strongly, we might expect, as more firms became aware of the requirements, that inspectors would find less noncompliance at workplaces being inspected for the first time. One other possibility, explored later, is that the mix of establishments subjected to first-time inspections has changed over time in a way that makes noncompliance more likely. For example, there might be more small establishments in the mix. (We show later that small establishments tend to have worse compliance.)[14]

[14] Another pattern, shown in Table 3.4, is that violations in second inspections have increased since 2001.

The absence of better compliance with the IIPP in first-time inspections could also reflect the generally light penalties for not having a written IIPP. The median fine is around $140, and 10 to 15 percent are not fined at all. Given that penalty policy and the low probability of inspection, most employers have little reason to fear being cited for a violation of §3203(a). Overall, the evidence suggests that compliance has not improved. Without random surveys of workplaces, however, we cannot be certain of this finding.

Table 3.3
Average Number of Injury and Illness Prevention Program Violations per Inspection, by Year and Inspection Sequence

	Sequence Number				
Year	**Total**	**1**	**2**	**3**	**4**
1991	0.38	0.45	0.21	0.14	0.19
1992	0.39	0.47	0.24	0.20	0.15
1993	0.29	0.36	0.17	0.17	0.08
1994	0.31	0.39	0.18	0.17	0.09
1995	0.31	0.40	0.21	0.12	0.16
1996	0.35	0.44	0.23	0.21	0.12
1997	0.32	0.41	0.20	0.18	0.18
1998	0.30	0.38	0.20	0.23	0.19
1999	0.32	0.42	0.22	0.15	0.17
2000	0.34	0.43	0.22	0.22	0.23
2001	0.37	0.46	0.28	0.24	0.14
2002	0.34	0.41	0.25	0.23	0.25
2003	0.32	0.39	0.29	0.24	0.16
2004	0.31	0.39	0.27	0.16	0.20
2005	0.32	0.40	0.26	0.21	0.16
2006	0.32	0.40	0.21	0.29	0.21

NOTE: *Sequence 1* refers to all first-time inspections at establishments since the IIPP took effect in July 1991. *Sequence 2* refers to all second inspections at establishments, and so on.

Another pattern is that establishments that get inspected more frequently—which tend to be larger ones in more-hazardous industries—had better compliance with the IIPP in their first inspection after it became effective. Reading down the Sequence 1 column in

Table 3.4, we see that the number of IIPP violations per inspection declines from 0.41 for those establishments that had only two inspections from 1991 through 2006 to 0.18 for those that had ten or more inspections. This finding probably reflects the greater attention these firms have given to safety, due to several factors: because they are inherently riskier; because earlier (pre-IIPP) Cal/OSHA inspections had sensitized them to compliance; and because they have more organizational resources to devote to safety.

Table 3.4
Average Number of Injury and Illness Prevention Program Violations Cited, by Inspection Sequence and Total Number of Inspections at an Establishment

	Inspection Sequence Number			
Number of Inspections	**1**	**2**	**3**	**4**
1	0.37			
2	0.41	0.19		
3	0.36	0.26	0.2	
4	0.29	0.23	0.2	0.17
5	0.26	0.19	0.16	0.19
6	0.23	0.19	0.15	0.13
7	0.22	0.2	0.13	0.14
8	0.24	0.13	0.14	0.17
9	0.23	0.13	0.14	0.17
10+	0.18	0.13	0.17	0.13
Total	0.37	0.2	0.18	0.16

NOTE: *Number of Inspections* refers to the number of times an establishment was inspected between July 1991 and April 2007

THE RELATIONSHIP OF NONCOMPLIANCE TO ESTABLISHMENT CHARACTERISTICS

As we suggested earlier, establishment size is strongly related to compliance. Bigger ones tend to have more staff with safety expertise and knowledge about what the regulations require. Table 3.5 shows the relationship between noncompliance and establishment size for all sectors. The lower percentage of violations at establishments with fewer than ten workers may arise because the regulations impose fewer requirements on that size group. Above that level, the drop in the percentage of inspections citing §3203 violations is continuous and steep. Again, however, the specific provisions of §3203(a) do not follow this pattern.

Table 3.5
Percentage of Inspections Citing Sections of 3203, by Establishment Size

	Size Category								
Section	**1–9**	**10–19**	**20–49**	**50–99**	**100–249**	**250–499**	**500–999**	**1,000+**	**Total**
3203(a)	27	30	22	13	8	5	4	3	17.1%
3203(a)(1)–(a)(7) (omitting [a][6])	5	5	7	9	7	7	5	6	6
3203(b), (b)(1), (b)(2)	4	9	10	8	7	4	3	2	6

We also examined the size patterns in several different sectors. For all of them—manufacturing, utilities, transportation, wholesale trade, and medical services—we found that violations per inspection were three to four times higher in workplaces with ten to 19 workers than in those with more than 500.

Also, as we saw earlier, workplaces subject to repeated inspections show improved compliance with the IIPP standard over time. However, we did not see any clear sign of a general deterrence effect; e.g., we did not find that compliance in first-time inspections

was better at establishments in industries with relatively high inspection frequency than in those with low frequency.[15]

Overall, noncompliance with some §3203 provision is found in 34 percent of nonunion establishments in our sample and in 15 percent of the unionized establishments. The percentage of inspected establishments with unions varies across our samples, from a low of 11 percent to a high of 38 percent.[16] In the next section, we examine whether unionization is still associated with better compliance once we control for establishment size.

THE RELATIONSHIP OF NONCOMPLIANCE TO INSPECTION CHARACTERISTICS

Are some categories of inspections more likely to cite violations of §3203 than others? We have information on the inspection type, which identifies what triggered the inspection; the scope of the inspection, which tells us whether it covered the entire workplace or was limited; and whether the focus of the inspection was health or safety. We analyzed whether any of these factors was related to noncompliance.

As noted earlier, Cal/OSHA devotes an unusually high percentage of its inspections, 20 percent to 25 percent in different years,[17] to investigating accidents and an unusually low percentage to what are termed *programmed inspections*, which means those that are targeted by the agency and not reactive. Inspections in response to complaints make up about 25 percent of all Cal/OSHA inspections. In our analyses, we lump all other inspection types, about 10 percent of the total in our sample, in the "other" category.

In general, AIs and complaint inspections are limited in scope, focusing on the accident or the subject of the complaint, while programmed inspections are comprehensive. Health inspections are typically carried out by industrial hygienists, frequently involve obtaining measures of worker exposures in the course of a workday,

[15] We examined inspection frequency at the two-digit industry level as inspections per 100,000 employees. We found no difference between the average compliance with §3203(a) between the industries in the top one-third in frequency and the bottom one-third.

[16] The low figure is for the WCIRB sample; the higher one, for the reduced WCIS sample. For the ODI sample, the figure was 28 percent. For all inspections in these industries from July 1991 through May 2007, the figure was 26 percent.

[17] The high number of AIs is not surprising because, as noted, California law requires employers to quickly report to Cal/OSHA all events leading to the hospitalization of even a single worker, as well as fatalities.

and usually require more time on-site. About 20 percent of the inspections in our sample are health inspections. In Table 3.6, we show odds ratios from a logistic regression that allows us to look at the effects of inspection and establishment characteristics together.

Table 3.6
Odds Ratios for Factors Affecting Whether an Inspection Cited Injury and Illness Prevention Program Violations, 1991–2007

Factor	*§3203(a) Violations*	*§§3203(a)(1)–(a)(7) Violations*
Constant	0.00	0.37 (0.87)
Year	1.02	0.999 (0.77)
Size class	0.74	0.99 (0.27)
Inspection sequence	0.83	0.98
Union	0.39	0.74
AI	0.50	3.04
Complaint inspection	0.64	1.81
Other inspection	0.33	1.18 (0.03)

NOTE: N = 57,697, SICs 20–51 and 80. The p value is given in parentheses and is significant at 0.001 unless otherwise noted. Odds ratios greater than 1.00 indicate that the variable was associated with more violations; those less than 1.00, with fewer violations. Programmed inspections are the excluded category in inspection type. Inspections with §3203(a) violations included a small number of §§3203(a)(1)–(a)(7) violations.

The year coefficient shows that there was a small upward trend in the probability of §3203(a) violations over time but none for other §3203 violations. This finding allows us to dismiss the idea that changes in the mix of inspections accounts for the increased number of violations over time. Larger size, the presence of a union, and later inspection sequence all reduced the odds of violations, and all were considerably more important for §3203(a) violations than for §§3203(a)(1)–(a)(7) violations. The greatest difference was for inspection type. The odds of citing §§3203(a)(1)–(a)(7) were much higher in AIs than in other inspection types. In contrast, for §3203(a) violations, AIs, complaint inspections, and "other" types were much less likely to cite §3203(a) than programmed inspections were.

Cal/OSHA staff confirm that inspectors are more willing to cite firms for the specific provisions of §3203(a) and to cite the violations as "serious" in the context of an investigation of a serious accident. The inspectors often feel more pressure to find violations to cite in those cases, so they may probe more deeply to find out whether all the requirements of the IIPP had been met. The existence of a serious injury makes it easier for them to justify classifying the violation as "serious."

HAS THE INJURY AND ILLNESS PREVENTION PROGRAM STANDARD INCREASED THE TIME REQUIRED FOR INSPECTIONS?

It seems plausible that inspections would take more time if inspectors add a new requirement to evaluate the IIPP in each inspection. It takes time to elicit answers to the questions to "measure effectiveness." And it takes time to review the records that employers are required to keep to document compliance. Cal/OSHA leaders, however, suggested to us that the presence of the written program and the documentation helped the inspector identify issues more quickly. If the employer has a document showing which hazards had been identified and which had been corrected, the job of the inspector could be easier.

At the same time, however, the Cal/OSHA director during most of the past decade told us that inspectors relied too heavily on ascertaining that the employer had the written IIPP plan and too little time inquiring about how the program actually worked.[18] Moreover, the Cal/OSHA leadership says that the traditional inspection practices remain in place. Unless inspectors had become more trusting of employers, they would still, in theory, have needed to audit the accuracy of the employers' report and also look for other hazards that might not have been reported.

We ran a regression to test whether the length of time that the inspector was on-site had changed over time. We controlled for the number of employees, the inspection type, the number of serious violations cited, and the scope of the inspection.[19] All these variables did have a statistically significant impact on the length of time on-site, but the coefficient on the year variable was –0.08 with a statistically insignificant p value of 0.42. Thus, it does not appear that the length of inspections has increased over time.

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[18] Personal communication with Len Welsh, former director, Cal/OSHA, August 19, 2011.

[19] We did not control for whether the inspection was for safety or health because, in California, the average length of time on-site is the same for the both.

However, because other policies and procedures can affect changes in the length of time on-site, this is not a definitive test of the IIPP's possible effect on this measure.[20]

SUMMARY

This chapter set out to examine trends in compliance with the IIPP and to understand how noncompliance varied with establishment type and inspection type. The requirement for having a written IIPP plan (§3203[a]) accounts for about two-thirds of all IIPP violations in the industries in our data set. We argued that it was useful to distinguish between violations of this provision and those of the paragraphs of §3203(a). They differed substantially in the circumstances in which they were cited and in the probability that they would be cited as serious violations.

The frequency with which the violations are cited has not changed much since 1993. However, §3203(a) violations became much less likely to be cited after the first inspection of a workplace. That was not true for the subsections.

Perhaps most importantly, the trend in first-time inspections showed no decline in IIPP violations over time. Newly inspected workplaces were no more likely to have a written IIPP in 2005 than they had been a decade earlier. It is not certain to what extent this lack of improvement reflected limited success in informing firms of their obligations or the weak deterrent threat for noncompliance with §3203(a).

Larger establishments were much less likely to be cited for violations of §3203(a), and unionized workplaces were much less likely to be cited for any type of IIPP violation. The §§3203(a)(1)–(a)(7) violations were far more likely than §3203(a) violations to be cited in accident investigations. However, the finding that the former are cited far more often in AIs than in other inspections should not necessarily be taken to mean that the violations caused accidents. They may have; however, inspectors are more likely to search for violations when serious accidents have occurred, which may account for some of the disparity.

[20] This regression looked at inspections from 1990 through early 2007. The adjusted R^2 was 0.066.

4. LIMITATIONS OF PREVIOUS RESEARCH

Overall, the research base on the effects of safety programs is thin, especially for mandatory programs. Safety magazines are replete with articles with titles like "How We Reduced Our Injuries by 80 Percent," but the representativeness of these reports is suspect because successes are much more likely to be written up and published than failures.

A "regression to the mean" bias also often plagues these studies. This bias refers to the fact that new safety initiatives are often adopted as a response to an unusually bad year for injuries. Because the number of injuries at a workplace has a substantial random component, we expect unusually bad years to be followed by better years and unusually good years to be followed by worse ones. As a result, reductions in injuries are sometimes incorrectly attributed to the intervention.

A RAND report (LaTourrette and Mendeloff, 2008) reviewed evidence relating to the effects that safety and health programs have on injuries. The studies they assessed came from four sources:

- Reports on the firms participating in OSHA's VPP, which requires that firms have both good safety programs and low injury rates. There is evidence (Simon, Wells, and Abraham, 2005) that firms that obtained VPP status did improve their injury rates in the years leading up to that award, although there was no evidence that the rates improved further after the award. It is certainly plausible that firms were making changes during those pre-award years that improved safety, although clear links have not been established. For our purposes, the concern is that VPP status requires major efforts, well beyond what is required in the IIPP or any likely mandatory program. Thus, although there is evidence that voluntary programs can reduce injuries, the generalizability of that judgment to mandatory programs is suspect.
- Comparisons between participants and nonparticipants in a state's safety program (OSHA, 1998). These sometimes show that workplaces that are required to participate in the programs improve more than other firms. The studies tend to be subject to regression-to-the-mean bias because they target firms with especially bad performance or, if there is a voluntary component to participation, to selection bias. *Selection bias* refers to the prospect that firms that volunteer have a stronger

commitment to improve than those that do not and that it is this commitment, rather than the program itself, that leads to improvements.

- Comparisons of state-level injury rates in states with and without mandatory safety and health programs, such as the analysis conducted by OSHA in 1998 that found that most states with safety and health program requirements experienced larger injury rate reductions in the years after their introduction than states without the programs (OSHA, 1998). Although this analysis is certainly relevant, it faces the difficulty that many factors affect changes in injury rates. One important one is changes in state WC programs. For example, OSHA's 1998 report observed that the California injury rate fell substantially after the IIPP's introduction in 1991. However, it did not mention the legislative changes in WC adopted in 1993, which substantially cut back benefits for many injured workers.[21] Although some of these features can be readily identified and modeled (e.g., the waiting period before indemnity payments can be received), others cannot be. For example, states vary in their coverage of psychiatric disorders, chiropractic, and drugs and in the procedures through which they require claimants to go to qualify for benefits.
- Studies (e.g., Smitha et al., 2001) that look at the difference in a single year between injury rates in states with and without mandated safety programs. This approach requires a model that can control for the various factors that can affect those rates and that differ among states.

One problem with these studies is that they disagreed, in nontrivial ways, about which states actually required safety programs for most or all firms. One major reason for disagreement was that several of the states with relevant statutes had no evidence of efforts to enforce them. Also, the Smitha et al. study, like all the others, used nonfatal injury rates as the measure of effectiveness. The risk from using the *level* of nonfatal injury rates has been highlighted by a recent study showing that, in construction, the states that had the lowest reported fatality rates had the highest reported nonfatal injury rates and vice versa (Mendeloff, Burns, et al., 2011). There is little reason to doubt that the same pattern occurs in other industries. In consequence, the Smitha et al. study may

[21] John Burton, a noted WC scholar, ranks California having a reduction in program liberality from 1991 to 1993 that was matched by only one other state. See Burton (2011).

have actually found the opposite of what it claimed to find: a higher, not a lower, risk in states with safety and health program mandates.

A similar error, but with the opposite impact, occurred in 1998 in the course of an earlier federal OSHA initiative to develop a safety program rule. The Republican chair of the House committee holding hearings on the proposal challenged OSHA to explain why, if safety programs were so effective, three of the key states with such programs—Washington, Hawaii, and California—had injury rates that were among the highest in the nation (U.S. House of Representatives, 2000). It went unsaid that these three states all had fatality rates that were among the lowest.[22]

Of course, all studies have weaknesses, and the potential for bias is not the same as the existence of bias. Nevertheless, the evidence from earlier studies does not allow us to arrive at a clear conclusion about whether mandatory safety and health programs have reduced injury and illness rates. Ideally, of course, we would like to have IIPP-like programs randomly implemented in different states. We do not have that. However, we can make greater use of some of the individual establishment data about compliant and noncompliant firms. The next chapter discusses how we propose to do that.

[22] Another fact that may confuse comparisons among states is that they vary markedly in the share of lost-workday (days away, restricted, or transferred, or DART) cases that involved days away from work versus the cases that involved only restricted work activity or job transfer. In New York in 2003, the former outnumbered the latter by more than five to one; in a dozen other states, the latter were more numerous.

5. EVALUATION DESIGN: THE CHALLENGE OF ESTABLISHING CAUSALITY

Many factors, in addition to the presence of a given safety and health program, affect the number of injuries that occur. Other major influences on reported injury rates include the following:

- financial incentives to report injuries and to prevent them—both are influenced by the features of the WC program and by other factors
- shifts in the percentage of inexperienced workers—reflecting economic and demographic trends
- changes in technologies
- management practices—lots of overtime, more pressure on production, labor–management relations.

Even if all these factors remained unchanged from one year to the next, we would still not expect the number of injuries among, e.g., 1,000 workers to be the same from one year to the next. We have to take consider whether any changes we see are larger than we would expect to see by chance alone.

Focusing on safety and health program mandates, many factors can affect the impact of an IIPP. Here are some examples:

- Some firms, especially larger ones, may already have been doing what the standard required.
- Some firms never come into compliance with the standard.
- Some firms come into compliance but then become noncompliant again.
- Compliance with the standard may not actually do much to prevent injuries.

If a random survey of employer practices had been conducted before the standard took effect in 1991, we could assess the baseline compliance, and a later survey could estimate the net change in compliance. Studies of inspected and reinspected workplaces could estimate the probability that firms are noncompliant and how long it takes for their status to change.

Some firms will come into compliance with the IIPP as part of a general policy of compliance, but the extent of noncompliance is affected by the employer's perception of the expected penalty. It is not very costly for firms to create a written injury and illness

program. Inspectors report that employers could buy "off-the-shelf" IIPPs from vendors that involved little or no thought by the employer.[23] The extent of compliance will reflect the aggressiveness of enforcement. If inspectors talk to a large number of workers and review all the relevant documentation and set a high standard for what constitutes an "effective" program, the effect of the program will likely be greater.

One reason that it is hard to be more confident in estimating the effect of a program, such as the IIPP, is that there have been few studies that evaluated safety programs or their elements—e.g., safety training—in a rigorous fashion.

Where might we expect to find effects? Several hypotheses seem plausible. For example, there may have been a larger response to the IIPP in its earlier years, simply because fewer firms had such programs back then.

TESTS OF STATEWIDE IMPACTS

An obvious question to ask when exploring whether the IIPP has been effective is whether injuries and deaths declined in California and whether they declined relative to other states after the IIPP began to be enforced.

To address this question, we need to investigate some others: What pattern of effects should we expect? Should there be a one-time drop after the regulation is issued, or should we expect a gradual impact as the enforcement process makes the requirement better known? Should we expect a decline in all industries or only in those that have more-regular contact with Cal/OSHA inspectors?

Can we isolate the potential impact of the IIPP from the other factors that affect injuries? This question poses a particular challenge. The IIPP does not focus on the prevention of any particular type of injury, which might have allowed us to see whether that type had declined relative to others. Another large problem is that major changes in the state's WC program occurred in 1993. According to John Burton, who has tracked WC changes better than anyone, the size of the decline in liberality in the California program from 1990 to 1993 was matched by only two other states (Burton, 2011). For this reason, we would expect that reported injuries in California would have declined relative to most other states.

In addition, injury rates have been affected by the business cycle, rising when economic growth draws new and inexperienced workers into the labor market at high

[23] Len Welsh, personal communication, August 2011.

rates and falling as hiring falls. The early 1990s saw a significant recession, but it was considerably worse in California due to the decline of defense spending at the end of the Cold War. From 1990 to 1993, California had the largest absolute and percentage increase in the unemployment rate of any state. For that reason, we might have expected California's injury rate to decline relative to that of other states.

We are skeptical of our ability to create a model that could accurately account for these factors and provide a prediction of what the injury rates would have been because of them. If we had such predictions, we could see whether the actual rate was above or below the predicted rate. If it was below, then perhaps the IIPP might claim a role.

One strategy to reduce the noise introduced by the factors described above is to focus on only the most-serious injuries. These are more likely to be reported regardless of WC changes or return-to-work programs. It is less clear whether fatality rates are affected by the business cycle. One California study concluded that, unlike nonfatal injury rates, fatality rates were not (Robinson and Shor, 1989). However, that study relied on the date when the death was designated as occupational by the California Workers' Compensation Appeals Board. For about half of the deaths, that designation occurred in a later year than the death itself. If we simply look at the national death rates reported by the Census of Fatal Occupational Injuries (CFOI) since 1992 and the national unemployment rates, we find a correlation of +0.55 but a correlation of only +0.14 when we look at the annual changes in the rates. Therefore, it does not seem as if the difference in unemployment changes in California compared to the rest of the nation would necessarily bias a comparison of the change in fatality rates. We do compare the trends in fatality rates in California with those in other states.

For the IIPP standard to have a major effect on injuries and deaths, many more workplaces need to have implemented it than were actually inspected. To expand the IIPP's impact beyond the establishments that were actually inspected, the impact of general deterrence would have had to be large or the information disseminated by Cal/OSHA very influential. Cal/OSHA inspects around 8,000 to 9,000 workplace per year. Since 1991, the number of establishments in California has grown from more than 600,000 to over 700,000. Although inspected establishments employ a higher-than-average number of workers, many of the inspections go to small workplaces. Twenty-five percent of all Cal/OSHA inspections in the industries we examined took place at workplaces with ten or fewer employees. Another 9 percent took place at establishments with 11 to 20 employees. In the construction sector, which we did not study, the establishments are considerably smaller.

Looking at the effect of the IIPP at only inspected workplaces will tend to give an underestimate of its impact. That approach assumes that there were no impacts except at those firms. Nevertheless, we think that this approach is necessary to provide a somewhat more rigorous evaluation. In the next section, we discuss tests that compare changes in injuries at inspected workplaces where IIPP violations were cited and inspected workplaces where they were not.

THE LOOKBACK AND CHANGE TESTS FOR INSPECTED ESTABLISHMENTS

Our first test involving inspected establishments is to ask whether workplaces that were cited for IIPP violations were those with higher reported injury rates. The reasoning is that, if IIPPs prevent injuries, then we should expect to find that establishments in compliance have lower injury rates than those not in compliance. We refer to these tests as relying on lookback models. The reason is that we look at the association of IIPP compliance in an inspection with the injury rate in that establishment in the previous period. For the WCIS data, we have monthly data and look at the injury rate in the 12-month and 24-month periods prior to the inspection, beginning the month prior to the inspection. We do not use the month of the inspection because so many inspections were investigating accidents. The occurrence of these accidents would clearly inflate the injury rate if it covered the month of the inspection. With the ODI sample, we lack monthly data and therefore look at the rates one year and two years prior to the year of the inspection. With the WCIRB data, we look at the ex-mod for the policy year two years after the year of the inspection. (The ex-mod is based on injury experience for the three years ending the year before the policy year, so the comparison overlaps the year of the inspection.)

Of course, it is not possible for noncompliance in one year to cause higher or lower injury rates in the year *before*. Our test relies on the assumption that the compliance status of the workplace in the year of the inspection reflects the status in the previous year or two. This assumption seems very plausible with respect to compliance with §3203(a); it seems unlikely that an employer would lack a written safety and health program in year t but have had one in years t – 1 and t – 2.

The other test relies on the change model. The test here is that, if the IIPP is effective, we should see that establishments that are cited for noncompliance with it will tend to show improvement in their injury rates in the following period. This prediction assumes that these employers will come into compliance; given the high rate of

compliance (more than 90 percent) found in Cal/OSHA follow-up inspections, this assumption seems reasonable.

Each of these approaches to testing the impact of the IIPP highlight some problems. We examine them next and discuss how we will address them.

With both the lookback and change models, there is a prospect that the relationships between injury rates and IIPP violations are really a proxy for other violations that are being cited at the same time. Table 5.1 shows that, on average, inspections with IIPP violations have considerably more violations than inspections without IIPP violations. Although some of this excess is due to the IIPP violations themselves, most is not. In order to control for the possibility that the number of non-IIPP serious violations is what is driving the injury rate, we control for whether the inspection cited a serious violation other than for an IIPP standard.[24]

[24] Studies of federal OSHA inspections have found that, for the most part, they reduced injuries only when penalties were assessed (Gray and Scholz, 1993; Gray and Mendeloff, 2005; Haviland et al., forthcoming). Federal OSHA often assessed no penalties for "other-than-serious" violations, so there was a high correlation in federal data between the assessment of penalties and citation of a serious violation. It is not clear whether this same pattern applies in California because Cal/OSHA cites many fewer serious violations per inspection but levies considerably higher fines for each one.

Table 5.1
Number of Violations Cited per Inspection When Section 3203 Provisions Are Cited

Section	*Number of Serious Violations When This IIPP Section Is*		*Number of Total Violations When This IIPP Section Is*	
	Cited	**Not Cited**	**Cited**	**Not Cited**
3203(a)	1.01	0.59	5.62	2.29
3203(a)(1)	0.62	0.41	5.69	2.86
3203(a)(2)	0.83	0.41	5.72	2.87
3203(a)(3)	0.76	0.41	6.16	2.88
3203(a)(4)	1.27	0.40	5.96	2.85
3203(a)(5)	1.00	0.41	5.70	2.87
3203(a)(6)[a]				
3203(a)(7)	1.21	0.40	4.61	2.87

NOTE: Data are for July 1991–April 2007; SICs 20–51 plus 80. For example, in inspections in which §3203(a) was cited, an average of 1.01 serious violations was cited. In inspections in which it was not cited, an average of 0.59 serious violations was cited.

[a] When the matching procedure was carried out at the Employment Development Department (EDD) between its employment data, the WCIS injury data, the OSHA inspection data, the code for 3203(a)(6) was mistakenly omitted. Data for this provision are available for the other two data sets we examine.

Another question is whether the IIPP violations are cited *because* the inspection found a large number of other violations. Inspectors might reason that, because there was a large number of violations, the establishment's IIPP must be inadequate. However, we find a large difference even for violations of §3203(a). Citation of this section is not very discretionary. As one Cal/OSHA official put it, "You either have your piece of paper or you don't." Thus, we can be confident that citations for §3203(a) were not affected by the number of non-IIPP violations found in the inspection. The implication is that workplaces with §3203(a) violations did have more hazards, or at least more violations, than those establishments without §3203(a) violations.

In carrying out these establishment-level tests, we look separately at the effects of each provision of the IIPP. As noted earlier, Cal/OSHA's implementation of the IIPP has

relied heavily on certifying that the employer has the required written program. Very often, according to agency leaders, inspectors cite a violation for this failure—§3203(a)—but make no further effort to determine what the employer is actually doing to comply. Agency policy is to not issue citations for the IIPP other than §3203(a) unless one of the other IIPP violations is classified as "serious."[25] Therefore, there is often little incentive for the inspector to spend the time to dig deeper. If the inspector does, he or she will often cite no additional IIPP violations but spend more time on the inspection, perhaps reducing the number of inspections that he or she carries out, which is an important measure of productivity.

Earlier studies of federal OSHA inspections have shown that some violations appear to have greater effect on injuries than others (Mendeloff and Gray, 2005; Haviland et al., 2010). In particular, two studies found that injuries declined after citations for violations of the standard on personal protective equipment; however, citations of several other standards had no significant effect. Our knowledge of which standards do and do not have much impact is very limited. Other things equal, we might expect that inspections citing more violations would have more impact than those citing fewer. However, to date, there is no evidence that the number of violations or the size of penalties does make a difference.

As we have seen, there is a rationale for distinguishing between IIPP violations cited in AIs and those cited in other inspection types. Some evidence indicates that, following a death or serious injury, the injury rate at a workplace declines (Mendeloff, 2008). Safety professionals often suggest that the reason is not regression to the mean but rather the possible increase in management attention to safety triggered by the death or serious injury. To the extent that this is true, improvements in injury rates following AIs—and the IIPP violations they cite—may be attributable to the reaction to the accident rather than to compliance with the IIPP. For this reason, we carry out separate analyses of IIPP violations cited in AIs and those cited in other inspection types.

Another quite significant point is that reporting biases may mask a preventive effect of the IIPP. Suppose that workplaces with poor compliance with the IIPP also do a worse job of recording injuries. Then, it may look as if IIPP violations are linked to lower, not higher, injury rates. Similarly, if noncompliant employers improve their

[25] See California Department of Industrial Relations (2003, Procedures, D). This policy of not citing other IIPP provisions unless they are categorized as "serious" is one that should probably be changed.

reporting after being cited for IIPP violations, then it may look as if IIPP citations are followed by injury increases, not decreases.

DATA SOURCES AND MATCHING METHODS

In this section, we describe the different data sets used for the analysis and briefly review the matching methods. For detailed description of the matching methods, see Appendix A. Our data sources fall into three categories:

- information about Cal/OSHA inspections
- information about statewide changes in fatal and nonfatal injury rates
- information about injury or loss rates at inspected establishments.

Inspection Data: Occupational Safety and Health Administration Integrated Management Information System

OSHA's IMIS contains inspection data from 1972 onward from all states in which federal OSHA operates the inspection program. Since 1990, it has also included continuous inspection data from all of the states where inspections are conducted by states (including California) under §18(b) of the Occupational Safety and Health Act of 1970. IMIS variables include the establishment name and address, employment, union status, and industry, as well as the opening date of the inspection, the nature of the inspection (health or safety, comprehensive or limited), and what triggered it (e.g., programmed, complaint, accident, follow-up). It also includes information about the degree of severity of any cited violations and the corresponding penalty. Because follow-up inspections focus on reexamination of a prior intervention, we excluded them from our analysis. Because the IMIS lacks a unique establishment (or firm) identifier, inspections that occurred at the same establishment were linked with a matching program designed by Gray (1996). For the entire period from 1988 to May 2007, there were 64,354 inspections in the IMIS in the industries in our study, representing 40,238 establishments.

State-Level Fatality Data: Census of Fatal Occupational Injuries and National Traumatic Occupational Fatalities

The state-level fatality data we examine are from CFOI and the National Traumatic Occupational Fatality (NTOF) system. Initiated in 1992 and run by the Bureau of Labor Statistics (BLS), CFOI collects information from multiple sources on traumatic work fatalities. It includes deaths of the self-employed and of employees. It includes deaths due to highway motor vehicle crashes and to assaults, as well as those due to other workplace

hazards. Although it inevitably will miss some cases, CFOI has been viewed as providing a fairly accurate measure of this category of fatalities.

The National Institute for Occupational Safety and Health (NIOSH) established NTOF to identify death certificates that listed work-related causes of death. The first year of this series is 1980. We obtained data from a special request for fatalities (excluding E-codes [those for external causes of injury] for motor vehicle deaths, 810–829, and homicides, 960–969) for each state, by sector. Data were missing from some states for some years because of the rule that cells with fewer than four observations could not be disclosed. However, data were available for California in each year from 1980 to 1995.

Data for Establishment-Level Injury and Loss Rates

We used several sets of data for analyzing changes that occurred at inspected establishments. There are two chief reasons for that. One is that each data set allows coverage of a different set of firms in different time periods. The WCIS data are available only from 2000 and cover workplaces of all sizes. The ODI data go back to 1996 and generally cover establishments with more than 40 employees in manufacturing and a few other industries. The WCIRB provides experience modification factors for about 20 percent of California firms (those for which premiums exceed a threshold amount); electronic records are available from policy year 1993. The ex-mods for that year are based on injury losses that go back to 1991. A second reason is that each data set is subject to various limitations: incomplete reporting to the WCIS and the need to match its reports to another source of employment data, underreporting of injuries to the ODI, and a firm ignoring the requirement to purchase WC coverage for the WCIRB. Thus, similar findings across data sets would increase our confidence in the results.

Occupational Safety and Health Administration Data Initiative

The first source was the ODI. The ODI is OSHA's annual collection, since 1996, of about 80,000 OSHA-300 forms that most establishments are required to maintain under OSHA regulations. These report the numbers of different types of injuries and illnesses, as well as the employment and hours worked at the establishment. A different sample of OSHA-300 logs is collected by BLS for its Survey of Occupational Injuries and Illnesses (SOII). However, access to the injury rate data collected by BLS is very difficult. In contrast, OSHA has made the records it collects more easily available.

For this study, we used the total recordable rate reported through the ODI because it was available to us for a larger number of years than the lost-workday or DART rate.

The category includes all injuries with one or more days lost from work or injuries resulting in job restrictions, as well as cases with only medical treatment. Controversy exists about the extent to which employers fully report cases on the OSHA logs. We did not try to adjust for possible misreporting. For this study, our only changes in the data sets were related to excluding data that were clearly wrong or extraneous. Appendix B describes the modifications we made in the data.

The ODI data are available beginning in 1996. We included establishments in our sample for the lookback model if we had ODI rates for the two years prior to the year of the inspection and the two years after. We included inspections in the change model if we had ODI data for the year before the inspection and the two years after the inspection. We did not use the inspection year itself because of the high number of inspections that were AIs. Our ODI sample included 2,708 observations in the lookback analysis. For the change analysis, there were 441 establishments in the AI sample and 475 in the non-AI sample.

Workers' Compensation Insurance Rating Bureau

All employers that are not self-insured submit reports on medical and indemnity claims to the WCIRB. The WCIRB recommends insurance premium rates for different class codes (a mix of industry and occupational categories) and assigns ex-mods to about 20 percent of all insured firms, those that exceed a threshold premium amount. These ex-mods reflect the extent to which the indemnity and medical payments by the firm varied from the average amount for firms with the same amount of exposure in that classification. They are based on the losses over a three-year period ending two years prior to the current policy year. The ex-mods are calculated in such a way that the frequency of losses is weighted more heavily than their severity.

We use the WCIRB data in a lookback model. We use the ex-mod two years after the year of the inspection to capture the firms' loss performance. Ex-mods greater than 1.0 indicate above-average losses, while those less than 1.0 indicate below-average losses.

Data from the WCIRB are at the firm level. As a result, we limited our analysis using them to single-establishment firms. We sent the WCIRB a list of firms that Cal/OSHA had inspected from 1991 through 1995 that we had identified as single-establishment firms. We identified them on the basis of whether the OSHA information

system had the same figure for establishment employment and firm employment.[26] The WCIRB linked the establishments in more than 5,000 inspections to the WCIRB policy number, which allowed us to link the firm's ex-mod to the inspection. Thus, instead of asking whether firms cited for IIPP violations had high prior injury rates, we asked whether firms cited for IIPP violations had high ex-mod factors.

Because it is based on several years of data, the ex-mod is likely to better capture the average performance of a firm better than the other measures do. However, for the same reason, it changes slowly and is not as responsive to changes in performance as those other measures are. For that reason, we did not use the WCIRB data in a change model.

For the lookback model, we had 5,205 observations in the WCIRB sample.

Workers' Compensation Information System

Spurred by the growth of electronic reporting of injuries to WC insurers, DIR began in 2000 to require insurers and third-party administrators to submit first-report-of-injury forms that employers send them to the department. Reporting increased substantially in 2001 and has remained roughly at that level since then. For that reason, we use the WCIS data beginning in 2001. Submission of first reports to DIR is mandatory; however, there are no sanctions in place for nonreporting. Although there is no formal study of underreporting, WCIS officials suggest that about 25 percent of the required first reports are not submitted.[27]

With the WCIS injury reports, unlike with the ODI and WCIRB data, we had no employment or exposure data to calculate injury or loss rates. Therefore, we submitted a list of inspected workplaces from 1999 through 2008 to the EDD.[28] The EDD provided monthly employment for each of the establishments to which it was able to link and sent the file back to us with all identifiers removed.[29] These employment data were used as the denominator for injury rates.

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[26] We are aware that the OSHA data on firm size are not always accurate; as a result, our data may include some firms that have other establishments in addition to the one that was inspected.

[27] Personal communication, Martha Jones, director of the WCIS, July 2010.

[28] As all states do, California implements a tax on employers to fund unemployment insurance payments. The employers' tax payment is based on the first $7,000 in wages paid to each employee. To determine the appropriate tax, employers must regularly report these employment figures to the EDD.

[29] To link the EDD employment data with the Cal/OSHA inspection data, the EDD used a matching program prepared by Gray (1996).

For linking, we used a t-score > 11 as the minimum score to recognize a match. (See Appendix A for a discussion of matching.) Later, for the results presented here, we limited the sample to those with a t-score > 18 and employment > 20. The rationale was to include observations only when we were sufficiently confident about the match. Using these criteria, the lookback sample size was reduced from 1,895 to 1,181.[30]

LOOKBACK AND CHANGE MODELS AND VARIABLES

Lookback Models

Table 5.2 shows the variables that we use to examine the association between the compliance with the IIPP in an inspection and the injury performance of the establishment in the prior period. For each variable, we also show the sign of the effect that we believe that it has on IIPP compliance. We think that, if implementation of an IIPP is effective in preventing injuries, we should find that, on average, workplaces cited for IIPP violations had worse performance. As we noted earlier, we assume that the compliance status found in the inspection applied in the prior years and thus can be viewed as one factor affecting that performance.

The variables of central interest here are those measuring safety performance. These differ somewhat depending on the sample.

To assess the relationship between compliance and injury performance, we do need to try to control for other factors that increase the likelihood of IIPP violations. A few of these variables were in the model as controls; we had no prediction for the sign of the effect or whether they would have an effect. These variables included the two-digit SIC industry dummy variables and the year dummy variables. As we saw earlier, there has been no clear trend in the number of violations. We know that violations, especially for sections of §3203 other than §3203(a), are higher in AIs.

We included inspection scope because we thought that more-comprehensive inspections would, holding inspection type constant, be more likely to cite IIPP violations than less comprehensive inspections. We also thought that safety inspections would be more likely than health inspections to cite them. The citing of serious violations for non-IIPP standards could make it more likely that inspectors would think that IIPPs were inadequate. We know that unions are associated with much lower IIPP violation rates.

[30] Of those dropped, 263 had employment of 11–19 workers; 374 had a t-score below 19; and 77 had both characteristics.

First-time inspections are especially likely to cite §3203(a) violations. The number of inspections to date is obviously negatively correlated with first-time inspections. We also thought that having been cited for an IIPP violation in a prior inspection would make an establishment more likely to have one again. Employment size again has been shown to be negatively related to IIPP violations. Finally, the last variable assesses whether establishments with higher rates within their industry are more likely to have IIPP violations; we assume they are.

Table 5.2
Lookback Sample Variables

Variable and Expected Sign	*ODI*	*WCIRB*	*WCIS*
Industry: 2-digit SIC dummies[a]	X	X	X
Year: dummies	X	X	X
Inspection type	X	X	X
Inspection scope: limited, negative	X	X	X
Health or safety inspection: health, negative	X	X	X
Any serious violation? Yes, positive	X	X	X
Union presence: Yes, negative	X	X	X
Number of inspections to date since July 1991: negative	X	X	X
Had employer been cited for §3203 in a previous inspection? Yes, positive	X	X	X
Was this the first inspection since July 1991? Yes, positive	X		X
Employment size dummies			X
Employment: negative	X		
Premium size: negative		X	
Ratio of 2-year average injury rate to industry rate in year before inspection: positive	X		X

[a] The WCIRB sample had five sectors.

Change Models

The premise behind this test is that, if IIPP implementation is effective in preventing injuries, we should find that workplaces that are cited for and abate IIPP violations improve their safety performance relative to other inspected workplaces, holding other

factors constant. To test this prediction, we use the change in the log of injuries as the dependent variable. We did not use the WCIRB data for these analyses because ex-mods are designed to change slowly.

To look at changes after inspections, we examined AIs and other inspection types separately. Separate regressions allow us to test whether there is an interaction between inspection type and the impact of citing certain IIPP provisions on the change in injury rates. The rationale for looking at them separately is that it is plausible that, following serious accidents, firms give extra attention to safety. Thus, for AIs, it will be more difficult to determine whether any subsequent injury rate reductions were due to this "rebound" effect or to the inspection itself. In consequence, we give more weight to the results of the findings for the sample of "other inspections" than we do for the AI sample.

The key independent variable in this analysis is whether an IIPP violation was cited. We run separate regressions for each of the specific sections: 3203(a), 3203(a)(1), 3203(a)(2), 3203(a)(3), 3203(a)(4), 3203(a)(5), 3203(a)(6), and 3203(a)(7). In addition, we have a regression for any citation of §§3203(a)(1)–3203(a)(7) but not 3203(a), which we call 3203notA, and a regression for any 3203 violation, which we call 3203. Because other models that had examined the impact of inspections found reductions in injury rates only when penalties had been assessed, we included this as a dummy variable. Because earlier studies had found effects only for workplaces with fewer than 250 employees, we also interacted the penalty variable with employment size dummy variables—less than 100, between 100 and 250, and more than 250.[31]

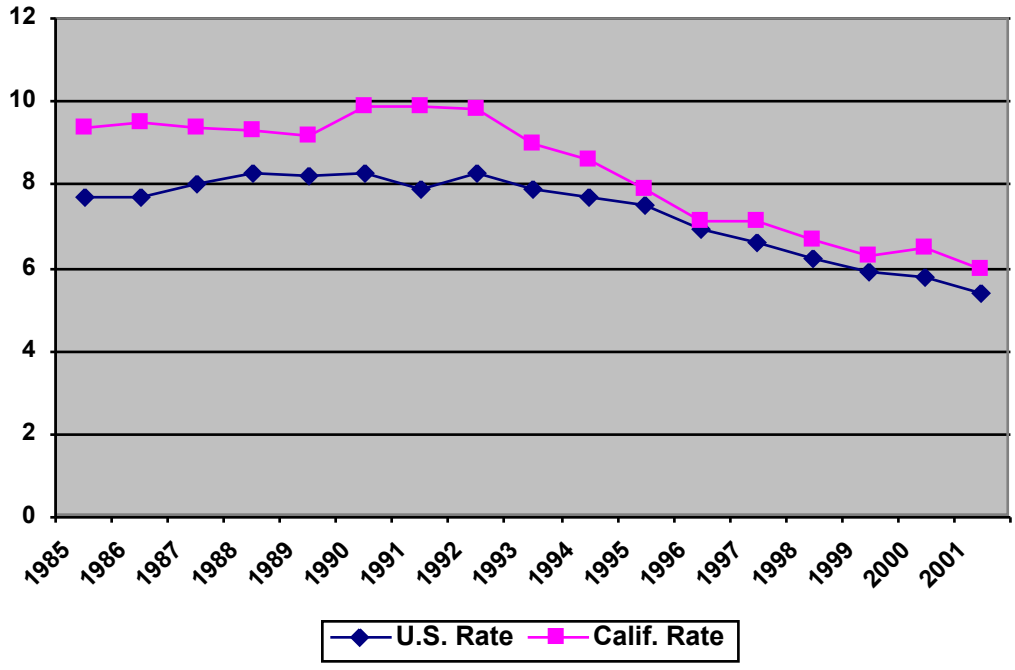
As additional controls, we included industry and year dummies and, for the "other inspection" sample, the inspection type (programmed, complaint, other). The excluded categories for these variables were the food industry (SIC 20), 1995, and programmed inspections, respectively.

[31] The other studies include Gray and Scholz (1993), Gray and Mendeloff (2005), and Haviland et al. (forthcoming).

6. STATE-LEVEL IMPACT

We stated earlier that nonfatal injury rates are too heavily influenced by changes in WC program changes to be a valid indicator of changes in risk. Nonetheless, we present in this chapter the rates for the total recordable rates for California and the United States for 1985 to 2001 from the BLS SOII. It shows an increase in the California rate in 1990 with almost no change in 1991 and 1992, the first years the IIPP was introduced. The California rate declines sharply after 1992, more sharply than the national rate, but a substantial share of that is probably due to the restrictions on WC benefits enacted in California in 1993.

Figure 6.1
California and U.S. Total Recordable Injury and Illness Rates, 1985–2001

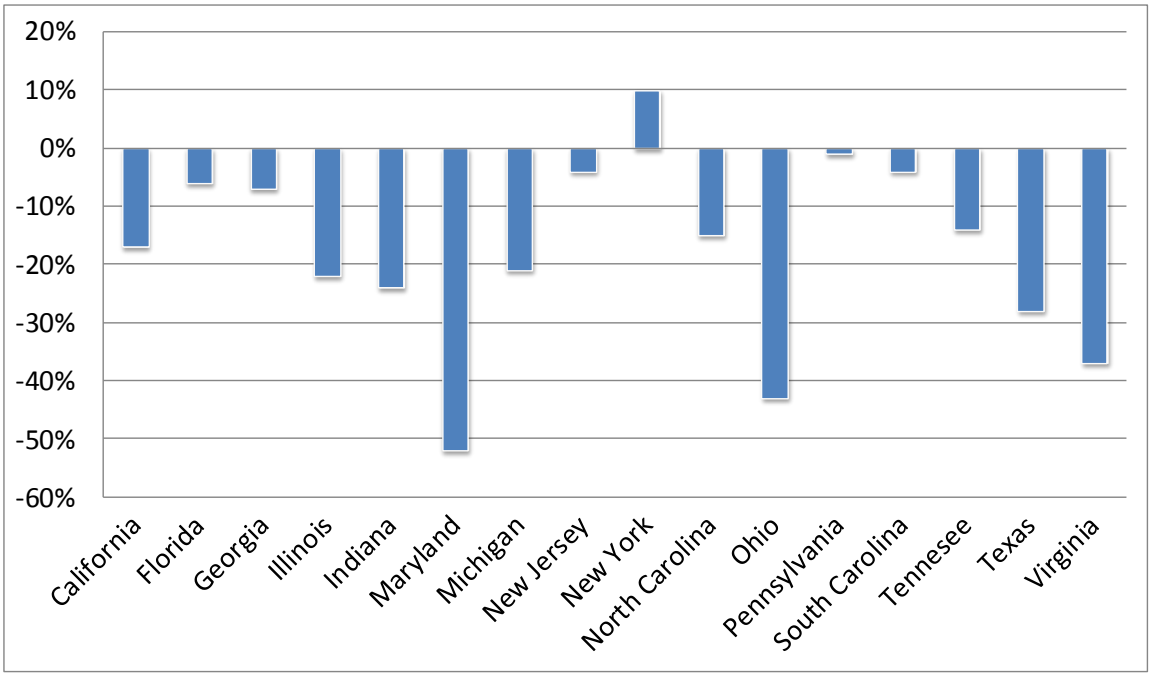


SOURCE: BLS SOII.

When we compare the change in fatality rates in California with the changes in other states, we find that California's pattern is unexceptional. Figure 6.2, based on NTOF data, shows that, in construction, the sector with the most deaths, California

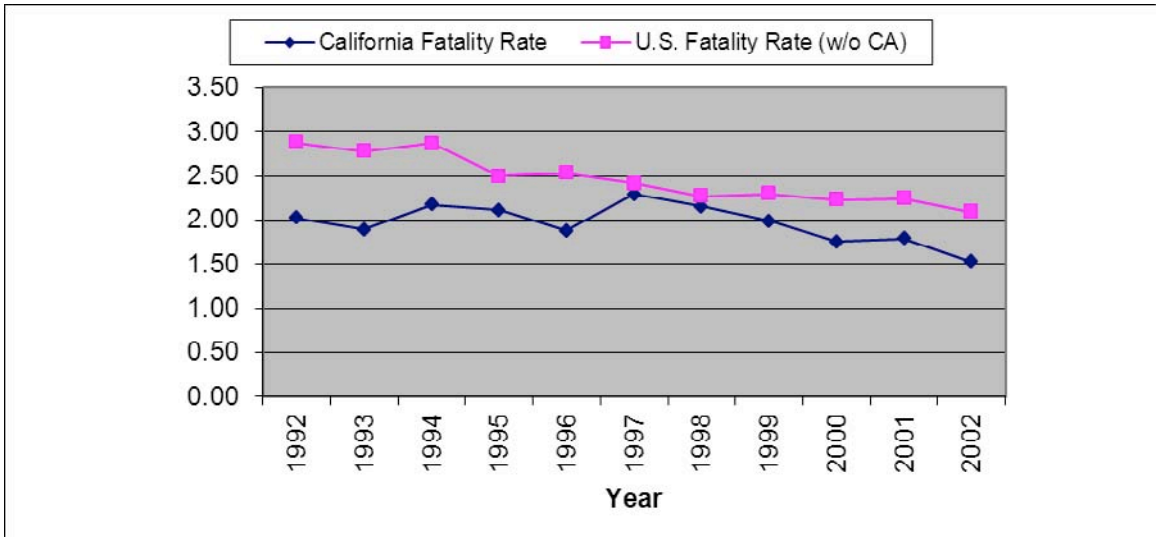
ranked in the middle of the pack (among the largest states) in terms of the percentage decline in the fatality rate from the average for 1986–1990 to the average for 1991–1995.

Figure 6.2
Percentage Change in the Construction Fatality Rates for States with the Most Deaths, from 1986–1990 to 1991–1995



A different data source (CFOI) provides fatality rates since 1992, and Figure 6.3 shows that the overall fatality rate in California increased relative to the U.S. rate during the years immediately following the introduction of the IIPP (although it decreased after 1998). Thus, we do not find evidence at the state level that supports the view that the implementation of the IIPP increased safety in the state. Although fatality rates describe only one dimension of risk, it is the most reliable measure we have. At a minimum, it seems reasonable to conclude that, if the IIPP did reduce risks in California, the effect was not a large one. To investigate further, we need to examine the experience of inspected establishments.

Figure 6.3
Since 1992, the Fatality Rate in California Declined Less Than the Fatality Rate in the Rest of the United States



Another point that may be relevant is that the number of inspections conducted annually in California has been decreasing (as it has been nationally). In the first full year of the IIPP (1992), there were 4,718 inspections in the sectors covered by our sample. In 2006, after a steady decline, the number was 2,645. Over the entire period, the manufacturing sector accounted for 61.5 percent of the inspections. Although the number of establishments in that sector declined by 18 percent, the number of inspections there declined by 53 percent.[32] Thus, to the extent that deterrence is affected by the probability of inspection, we might have expected to find some statewide decrease in deterrence in these sectors.

[32] The number of California establishments is taken from the BLS Quarterly Census of Employment and Wages, which is based on the number with unemployment insurance coverage.

7. INJURY PERFORMANCE OF COMPLIANT AND NONCOMPLIANT FIRMS: THE LOOKBACK MODELS

In this chapter, we look at whether firms that had high injury rates within their industry were more likely to be noncompliant with the IIPP standard. Ideally, we would like to know whether noncompliance with the IIPP contributes to higher injury rates. Necessary, but not sufficient, conditions for that causal role are (1) that noncompliance and the injury rate are positively related and (2) that the noncompliance status precedes or occurs simultaneously with the injury rate. In the model we test here, we examine the relation between measures of injury performance and the status of IIPP compliance.

In all cases, however, we look at the measure of compliance and relate it to injury rates in the preceding years. The reason that we do not look at the injury rate in the same year as the measure of compliance is that the major cause of inspections in our data set is the occurrence of a serious injury. As a result, injury rates in the year of the inspection are biased upward.

If we looked at the injury rates in the year or two following the determination of compliance, we encounter a different problem. If we expect the inspection and citation to have an impact, then the injury performance after the inspection may reflect that improvement and not the injury rates associated with the IIPP violation.

For our analysis, we are assuming that the compliance status of the IIPP found in the inspection applies to the prior period and can be viewed, in part, as a cause of the injury performance during that period. This assumption will, of course, not be valid for every case, but we think that it is plausible as a general description.

FINDINGS

We show here the findings for our three different data sets: the WCIS, the ODI, and the WCIRB. The lookback models controlled for many other influences on injury rates.[33]

The analyses in the lookback models all relied on logistic regression, in which the dependent variable was whether a violation of §3203 was cited in the inspection. Because

[33] The full lookback regressions for the WCIRB sample are found in Table C.6 in Appendix C, for the ODI samples, in Table C.5, and, for the WCIS sample, in Table C.7. Variable means for the WCIRB sample are in Table C.1 and, for the WCIS sample, in Tables C.2, C.3, and C.4.

of the apparent important difference between inspections citing §3203(a) and inspections with citations for the other sections of the IIPP standard but not for §3203(a), we also used violations of §3203(a) and subsections of §3203 other than §3203(a)—referring to (a)(1) through (a)(7)—as dependent variables.

Table 7.1 shows the findings for the ODI and WCIRB samples. In several cases, there were not enough observations in the ODI sample to allow estimates. For the cases in which we do have estimates, there is substantial agreement between the two samples. At establishments in which §3203(a)—the requirement to have a written IIPP—was violated, the injury performance in the prior period was relatively good, failing to conform to our initial expectation that performance there should always be worse when IIPP violations were cited.

However, when we turn to the specific subsections of the IIPP, we find that, for those for which we have estimates, the signs are positive and they are usually statistically significant. The coefficient for the entire 3203notA category was not statistically significant at the 0.10 level, but it did have a p value of 0.13. The association between IIPP violations and poor performance is strongest for §3203(a)(5), the requirement to investigate accidents, and §3203(a)(7), the requirement to train employees. The coefficient for the former violation in the ODI sample may be less robust because it is based on only 29 inspections with that violation.

The WCIRB sample had five times as many observations as the ODI sample and appears to provide strong evidence that the violations for failure to conduct AIs, failure to correct hazards that had been identified, and failure to train employees were all related to poorer performance.

In contrast, the analysis with the 2001–2007 WCIS data found no evidence that citations of any of the three categories of IIPP violations were associated with higher or lower reported injury rates in the two prior years. We looked separately at AIs and all other inspections and still found no statistically significant effects in any analysis.[34]

Because of concerns about poorer reporting to this data set and the possibility of poorer matches, we also constructed a sample that was limited to matches with a t-score greater than 18 (instead of greater than 12) and an employment size greater than 20 (instead of greater than ten). These steps reduced the sample size substantially, down to

[34] We ran different regressions for AIs because the "before" periods started a month earlier for them in order to avoid overlapping with the month of the inspection.

1,181. Here, we found that the citation of 3203notA came considerably closer to a statistically significant positive result with a p value of 0.12. That makes its effect more in line with the effects found in the ODI and WCIRB samples.

One other point to note here is the finding in Table 5.1 in Chapter Five that inspections with citations of *any* section of the IIPP had a much larger number of violations—both serious and total—of other standards than did inspections without IIPP violations. Finding that this is true even when §3203(a) is cited by itself is important. Otherwise, we might worry that inspectors cited the IIPP *because* there was more noncompliance at the workplace. Citations for §3203(a), however, are based simply on the absence of the required document and thus cannot be influenced by the number of other violations cited. That means that places without a written IIPP did have more violations than places with one.

Table 7.1
Did Workplaces with Injury and Illness Prevention Program Violations Have Worse Safety Performance Than Those Without Them?

	WCIRB Sample	*ODI Sample*
Standard	**Ex-Mod Coefficient**	**Prior Total Recordable Injury Rate Coefficient**
3203(a)	–0.003**	–0.03*
3203notA	0.002	0.015*
Any 3203	–0.001	
3203(a)(1)	0.006*	N/A
3203(a)(2)	0.002	N/A
3203(a)(3)	0.008*	N/A
3203(a)(4)	0.005	N/A
3203(a)(5)	0.01***	0.041***
3203(a)(6)	0.01***	N/A
3203(a)(7)	0.007***	0.01*

NOTE: *** = significant at 0.01. ** = significant at 0.05. * = significant at 0.10. N/A = not available because not enough cases for estimation.

Overall, we find a dichotomy between the associations when §3203(a) is cited and when the specific subsections are cited. One interpretation is that the absence of a written IIPP, by itself, does not really tell us anything about safety at a workplace. But that would explain why the violation is not related to poor performance, but not why it is associated with *better* performance. One possible explanation involves the relationship between establishment size and injury reporting. There is strong evidence that small establishments report nonfatal injuries less completely than larger establishments (Mendeloff, Nelson, et al., 2006; Oleinick, Gluck, and Guire, 1995). We saw in Table 3.2 in Chapter Three that 55 percent of §3203(a) violations were cited in establishments with fewer than 20 employees, compared with 26 percent of §§3203(a)(1)–(a)(7) violations.

This difference in size might account for the finding that §3203(a) violations are associated with low, not high, injury rates in the ODI sample; however, the WCIRB data seem least susceptible to underreporting, but the positive association is found there as well. That fact does not preclude an underreporting explanation, but it does not support it.[35] On the other hand, we found earlier (reported in Table 5.1 in Chapter Five) that, if we use the number of violations (instead of injury rates) as the measure of safety, establishments that were cited for §3203(a) were less safe. Those establishments had about twice as many violations (both serious and total) as those that were not cited for §3203(a) violations.

Other analyses have found that the relationship between the number of violations per 100 employees and the number of injuries per 100 employees across all inspected establishments in manufacturing is positive but weak (with a correlation of about 0.1). These results again are in line with the suspicion that underreporting at smaller workplaces could explain the positive association. Thus, underreporting remains a likely, but not certain, explanation for the finding that violations of the §3203(a) provision are linked to better, not poorer, performance.[36]

We do find evidence that violations of the several specific subsections of the IIPP are related to worse performance in the prior years. The evidence is strongest for training and injury investigations, but some can also be found for failing to designate a person to whom to report and failing to set up methods to communicate with employees.

[35] We do have a control variable for establishment size. It is significant and positive for §§3203(a), 3203(a)(1), and 3203(a)(3) and significant and negative for 3203notA. It was not significant for §§3203(a)(4)–(a)(7). The first three subsections are more similar to §3203(a) in that they deal more with the management of the program—appointing someone responsible, communicating with employees, giving recognition to worker compliance and noncompliance—than with the direct hazard-prevention activities.

[36] There are three possibilities for the IIPP in our models: §3203(a) is cited, §3203 but not §3203(a) is cited, or no §3203 is cited. Note that the first includes cases in which other §3203 violations are cited along with §3203(a). When we include only one of these in our models, we are testing whether (1) citing §3203(a) has an effect compared with citing 3203notA *or* with not citing §3203 at all, (2) citing 3203notA has an effect compared with citing §3203(a) *or* with not citing §3203 at all, or (3) citing any §3203 has an effect compared with not citing it. This is not really of independent interest.

8. EFFECTS OF INJURY AND ILLNESS PREVENTION PROGRAM VIOLATIONS ON CHANGES IN INJURIES: THE CHANGE MODELS

The other issue we examined was whether citations for an IIPP violation were followed by reductions in injury rates. As explained earlier, prior studies have usually found that OSHA inspections that levied penalties were followed by reductions in injuries (Gray and Scholz, 1993; Gray and Mendeloff, 2005; Haviland et al., forthcoming). All those studies were carried out in the manufacturing sector in states where federal OSHA was responsible for enforcement. None of them had included AIs in the inspections they studied. In those states, AIs made up only 2 percent of all inspections, compared with 20 to 25 percent in California.

We look at AIs separately from other inspections because of evidence that employers frequently respond to them by trying to improve their safety programs. Thus, it can be difficult to separate the impact of this "rebound effect" from the effect of the inspection.

Table 8.1 shows the results of our regression analysis for the ODI sample for both AI inspections and non-AI inspections. (The full regressions are shown in Tables D.3 and D.4 in Appendix D, respectively. The means for the ODI sample are in Tables D.1 and D.2, respectively.)[37]

Table 8.1
Changes in Injury Rates Following Injury and Illness Prevention Program Violations: Occupational Safety and Health Administration Data Initiative Sample

Section	Non-AI Inspections	AI Inspections
3203 any	–0.07 (0.48)	–0.05 (0.57)
3203(a)	0.15 (0.26)	0.09 (0.55)
3203notA	–0.22 (0.07)*	–0.10 (0.31)
3203(a)(4)	0.02 (0.98)	–0.65 (0.01)**
3203(a)(5)	–0.27 (0.38)	–0.07 (0.83)
3203(a)(7)	–0.44 (0.08)*	–0.27 (0.07)*

NOTE: The p values are in parentheses. ** = significant at 0.05. * = significant at 0.10.

[37] As with the lookback models, we did not have enough observations to estimate effects for §§3203(a)(1), 3203(a)(2), and 3203(a)(3), and we did not have §3203(a)(6) in this data set.

In the more germane non-AI sample, we find that the effect of citing a violation of §3203(a) is positive but not significant ($p = 0.26$). In contrast, the average result of citing any 3203notA violation is –0.22 with a $p = 0.07$. That coefficient translates into a 26-percent reduction in total recordable injuries. The only specific provision that had a statistically significant effect was the training requirement, §3203(a)(7), whose coefficient was –0.44 with a p value of 0.08. That translates into an injury reduction of 53 percent.

When we look at the effect of IIPP violations in AIs in the ODI sample, the results turn out to be similar. The effect of citing §3203(a) is positive but not significant ($p = 0.55$). All the coefficients for the inspections with 3203notA cited are negative. For §3203(a)(4), the coefficient is –0.65 ($p = 0.01$); for §3203(a)(7), it is –0.27 ($p = 0.07$).

One point to note is that the coefficient for §3203(a)(4) was nowhere near statistical significance in the non-AI sample. The finding that it becomes so significant in the AI sample suggests that it may have been cited, at least in part, because an accident had occurred. In contrast, the effects of the training violation are fairly similar in both the AI and the non-AI samples.

With the WCIS sample, we again find no significant coefficients for the IIPP citation variables. (The full regressions are reported in Table D.5 for AIs and Table D.6 for non-AIs, both in Appendix D.)

It would have been valuable to explore whether the effects of citing 3203notA violations varied across establishments of different sizes. However, our ODI sample was not large enough to allow these tests.

OTHER VARIABLES

In the ODI sample, the presence of a penalty was negative in 11 of the 12 regressions, but the coefficient was never significant, with p values ranging from 0.11 to 0.36. One explanation for this could be differences in inspection practice between Cal/OSHA and federal OSHA. Cal/OSHA levies penalties in a larger percentage of cases, although most of the penalties are small. Therefore, the marginal effect of having a penalty is likely to be less in California.

The one other statistically significant finding in the ODI sample was limited to the non-AI subsample. The year variable was negative and significant ($p = 0.02$ or 0.03) with all the IIPP violations. The size of the coefficient was –0.03, indicating that the average injury rate at workplaces with non-AIs was declining at about 3 percent per year during

the period from 2000 to 2006. This rate of decline is similar to the findings of the BLS SOII for California for that period.

Generalizability

The samples used in our regression analyses—for both the lookback and change models—were those establishments that had inspections for which we had "before" and "after" data. Are the establishments that met this criterion different from other inspected establishments? If so, is there any reason to think that the difference would bias the results? The only difference concerns establishment size. Recall that the ODI data are usually limited to establishments with 40 or more employees. Thus, the ODI sample includes relatively few small establishments. A similar pattern applies to the WCIRB data because very small establishments are less likely to have the ex-mods that inclusion in our sample required. Beyond that, there is no reason to think that the availability of data in these years has anything to do with the impact of the inspections. Therefore, our sample is representative of all inspected establishments, except for having fewer small establishments.

On the other hand, the inspected establishments are not representative of all workplaces in California. By far, the biggest difference is that inspections are much less likely in the low-hazard sectors of the economy. Because low-hazard sectors have lower injury rates, it is plausible that the absolute size of the disparity in rates between cited and noncited workplaces would be smaller than for inspected workplaces. Thus, the magnitude of the benefits would be lower there even if we found the same effects in percentage terms. Whether we would, in fact, find the same percentage effects in those sectors is not clear.

9. CONCLUSIONS: THE IMPACT OF THE CALIFORNIA INJURY AND ILLNESS PREVENTION PROGRAM STANDARD

As we asked earlier, "Isn't it obvious that carrying out the activities required by the California IIPP will lead to improvements in safety?" We think that the vast majority of safety professionals would answer "Yes." It is certainly very plausible that they are correct. However, there is little evidence from the strongest types of evaluation to support that conclusion. Studies that randomly assign treatments, such as hazard surveys, worker training, and AI, to create treatment and control groups are extremely rare.

Establishing that the elements of a safety and health program are indeed effective is an important task, especially if it provides better estimates of the magnitude of the impacts and the differential effects of various ways of conducting the activities.

In the meantime, regulators face the question of whether to mandate activities that the great majority of safety professionals believe are worthwhile. The effect of a mandate will be reduced to the extent that (1) establishments already comply or (2) establishments that do not comply at the baseline do not come into compliance. For California, we lacked any study of compliance among all firms. We have to make do with the findings from inspected firms.

Even in the initial years of the implementation of the IIPP in 1991 and 1992, the majority of inspected workplaces were not cited for any violations of the IIPP. This is as close to a baseline estimate of compliance as we can get. We are relying on the assumption that Cal/OSHA was adhering to its policy to investigate compliance with the IIPP in every inspection. Much less confidently, we are relying on the assumption that, if violations of the IIPP existed, they would have been detected and cited. As we have reported, Cal/OSHA officials suggest that many inspectors often did not do more than determine whether the employer had a written document describing its prevention program. So the figures on violations of §3203(a) should be accurate.

We have also seen that (1) findings in subsequent inspections indicate that compliance with the requirements to have a written IIPP document (and to document hazard surveys and employee training) improves substantially after the first inspection and (2) compliance in first-time inspections has not improved over the years. The failure to see improved compliance in first-time inspections suggests that outreach programs have not been as effective as hoped or that the deterrent posed by current inspections is not very strong, or both. The median penalty for violation of the requirement for a written

IIPP has been $140, and the annual probability of inspection, never more than 5 percent in manufacturing (the most intensively inspected sector), has declined by almost half since 1991. We do not know how frequently employers were unaware of the IIPP requirement.

EFFECTS ON INJURIES

We examined changes in fatality rates to see whether California experienced any improvement relative to other states in the years after the IIPP took effect in 1991. We did not find any improvement. Even if we had, it would have been unclear whether the improvement was due to the IIPP or to other factors. We did not place much weight on changes in statewide *injury* rates because of concerns that injury reporting changes could make comparisons among states untrustworthy measures of changes in risk. Instead, we focused on differences between inspected establishments that were cited for IIPP violations and those that were not.

We carried out two different tests. The first was based on the assumption that, if compliance with the IIPP helped to prevent injuries, then establishments with violations of its provisions should, on average, have poorer safety performance. We labeled this the *lookback test*.

For the second test, the intuition was that, if compliance with the IIPP improved safety, then employers that were cited for IIPP violations and corrected them would improve their safety performance in the year or two after the inspection. Although the lookback test examines a key assumption behind the policy, this test, to which we refer as the *change test*, more directly examines whether compliance with the IIPP provisions improves performance.

In an effort to assess the robustness of our results, we carried out these tests with data from three different sources. Each of the three samples involved different measures of performance:

- With data from the WCIRB, the measure was the ex-mod of the firm. This sample included only single-establishment firms; the ex-mods were based on injury experience dating back to 1991. For each inspection, we looked at the relationship between the IIPP compliance status and the ex-mod for the firm in the policy year two years after the inspection. Because ex-mods are based on three years of injury loss experience beginning one year before the policy year, the ex-mod two years after the inspection seemed to be a reasonable figure to use.

- With data from the ODI, the measure was the OSHA total recordable injury and illness rate. The ODI sample included rates beginning in 1996 and targeted establishments with more than 40 employees, although smaller ones were included. The denominator for the ODI's rates are the hours worked, translated into the number of full-time-equivalent (FTE) workers. We looked at the rates one year and two years before the year of the inspection. We did not use the year of the inspection because many of the inspections were triggered by accidents, which raise the injury rate for that year.
- With data from the WCIS, the numerator of the measure was the total number of first-report-of-injury notices submitted to the California Division of Workers' Compensation by each establishment. We had this figure for each month. We obtained the number of employees during each month at each establishment and calculated the injury rate for the 12 months and 24 months before and after each inspection. The WCIS began collecting reports of injuries in 2000 but became more complete in 2001, which is the first year we use. Although reporting to the WCIS was mandatory, there has been no penalty for failing to report, and substantial gaps remain in reporting.

With the WCIRB and ODI samples, we found similar results for the lookback test. Employers that were cited for a violation of §3203(a), the basic requirement to have a written IIPP document, actually had better performance (ex-mods or prior injury rates) than firms that had no IIPP violations. In contrast, employers that were cited for violations of the subsections of §3203(a), especially the requirements to train employees and to investigate accidents, had worse performance than employers that were not cited for any IIPP violation or that were cited only for §3203(a). The first of these results seems anomalous, but we think that underreporting by small establishments, which have a disproportionate number of §3203(a) violations, may account for it. In addition, it is possible that the absence of a written program is not necessarily a sign of a poor safety program at a small workplace. On the other hand, we did find that, on average, workplaces with §3203(a) violations had more than twice as many violations as those not cited for IIPP violations. The firms cited for §§3203(a)(1)–(a)(7) clearly did have shortcomings in their safety programs.

With the change test, the ODI sample revealed no effect when §3203(a) was cited but substantial improvements after the specific subsections were cited. The average effect

was a 26-percent reduction in the total recordable rate in the following year. Importantly, this result came from the subsample of cases in which these subsections were cited in non-AIs.

The training requirement appeared to have the greatest impact on injuries. It was also the violation that triggered the highest penalties. A recent study that attempted to survey the literature on the effectiveness of training found only a handful of studies, mostly in hospitals, that relied on random assignment (Robson et al., 2010). However, another study, this time of a voluntary Pennsylvania program in which compliance was audited by state officials, found that training members of a safety committee was the strongest predictor of improvements in injury rates among about 500 firms randomly chosen for audit (Liu et al., 2010). The findings in the current study also indicate that failures to carry out employee training can be linked to higher injury rates.[38] How many injuries has the IIPP prevented? The answer to this is uncertain. One approach is to first estimate the number of total recordable injuries occurring at inspected establishments and then subtracting 26 percent, our estimate of the average effect of 3203notA violations

Because, unlike §3203(a) violations, 3203notA violations are not more frequent at smaller establishments, we can multiply the average California injury rate (in 2010) of 3.7 per 100 FTEs times the average number of workers in inspected establishments. The average number could vary depending on inspection strategies. For simplicity, we could use low and high figures of 30 and 100 employees. In that case, the average number of injuries occurring would be 1.1 and 3.7, respectively. A 26-percent reduction in those injuries would total 0.29 and 0.96 injuries per inspection, respectively. However, this reduction would apply only to the 5 percent of inspections that cite 3203notA violations. If, for the moment, we limit the analysis to the sectors in our study, the total of 2,500 inspections per year generates about 125 inspections with 3203notA violations. Multiplying 125 times either 0.29 injuries or 0.96 injuries gives us a reduction of 36 or 120 injuries per year at the inspected establishments, depending on the average size.

[38] One fear that employers have expressed about the OSHA I2P2 proposal is that the required identification of hazards could be used to make it easier for OSHA to cite "willful" violations, which depend on establishing employer knowledge of a hazard. Willful violations are feared not only because of the high penalties they carry but also because they sometimes expose the firm to civil litigation. This concern was largely absent regarding the IIPP because Cal/OSHA very rarely cited willful violations—only 31 times in more than 55,000 inspections over 17 years in the sectors we examined.

This number may not seem very large, but several points need to be considered. First, only 125 establishments had to make changes in order to gain these reductions. Second, it counts only those workplaces that make changes after citations. Because most inspections do find compliance with the IIPP, we should assume that the many employers that come into compliance with the 3203notA provisions without a citation also realize this 26-percent reduction in injuries. As our study has made clear, we do not really know what percentage of the employers that are not cited actually comply with the training, hazard survey, and AI requirements. It seems likely that the number is in the thousands if not in the tens of thousands. As we noted in Chapter Eight, our results are likely to be generalizable to the high-hazard sectors of the economy, on which Cal/OSHA concentrates its inspections, but not necessarily to the low-hazard sectors.

However, for understanding the merits of the IIPP, we do not need to know the total number of injuries prevented. For benefit-cost purposes, the key issue is the value of preventing these injuries compared with the cost of preventing them. For illustration, assume that the average inspected workplace has 100 employees and thus that compliance with the 3203notA provisions prevent 0.96 injuries as calculated earlier. What monetary value can be assigned to that outcome? Here, we get into controversial territory about valuing health and safety. Viscusi (1992) estimated that employees were willing to pay about $30,000 to prevent a lost-workday injury. About half of total recordable injuries are lost-workday injuries, so the value would presumably be considerably lower. Suppose it were valued at $10,000 to $15,000.[39] Then, the issue would be whether this annual benefit exceeded the cost of complying with 3203notA.

This study was not intended to present a benefit-cost analysis of the implementation of the IIPP standard in California. To do so would require a much more thorough analysis than presented in the past few paragraphs. We have attempted, however, to provide some sense of how our analysis might contribute to such an analysis.

POLICY IMPLICATIONS

If we assume that the safety effects of the IIPP in California have probably been real but not very large, what are the policy implications for California and for other

[39] Of course, that figure would have to be adjusted upward to account for higher incomes since that time.

jurisdictions considering similar policies? The answer depends, in part, on the reasons for those results.

It is plausible that higher penalties for failure to have a written IIPP document would have reduced the number of those violations somewhat. Requirements for some form of employee participation in the implementation of the IIPP would probably have helped as well. More important, based on interviews with Cal/OSHA leaders, we believe that inspectors did not regularly probe to find out whether employers actually had implemented the more-specific subsections of the IIPP. Variability among inspectors played a role here. However, a more important factor was that, despite Cal/OSHA's support for the IIPP standard, its enforcement process often failed to look beyond paper compliance with its provisions.

The traditional OSHA enforcement program is focused on detecting and abating hazard-specific standards—e.g., unguarded machines, slippery floors. A quite different enforcement program would rely solely on the implementation of a safety program. OSHA or Cal/OSHA would examine whether the employer had carried out each of the requirements of the IIPP but would not focus on hazard-specific standards.

Although possibly more effective, this second approach carries some risks. It assumes that the process can ensure that major hazards are eliminated. However, it may be difficult to assess the quality of the process with a great deal of confidence. Employers may be able to create the image of compliance without the substance. In addition, it is difficult to know, for example, just how effective a particular trainer or training program is. And, even if the process is carried out properly, it is not fail-safe. To the extent that hazard-specific standards convey useful information to employers and workers about what precautions to take, that contribution would be undermined by a shift away from relying on those standards.

However, there may be another approach that achieves some of the benefits of both strategies described here without the drawbacks. Under this approach, Cal/OSHA would still inspect to identify hazard-specific violations. However, when it did so, the inspector would ask managers, "How did your IIPP allow this hazard to appear in your workplace or allow this injury to occur?" In other words, he or she would try to relate the hazards to the program that the employer is required to implement. Detection of hazards would lead not only to the removal of hazards but also to the strengthening of safety programs.

In no small measure, this middle approach is the one used by the HSE in the United Kingdom.[40] In that case, the reference is to the employer's mandatory "risk assessment," rather than to an IIPP, but the principle is the same.

It seems plausible that discussing the relevance of the IIPP to injuries and violations would require inspectors to spend more time on-site. Thus, these inspections would need to be more effective in order to compensate for the prospect that fewer will be conducted. The new approach might provide more long-lasting benefits. Currently, analyses of the effects of enforcement typically find effects only in the year or two following an inspection with a penalty.[41] The motivational effects of a serious violation fade over time, and compliance decays. In contrast, it is plausible, but hardly guaranteed, that efforts to bolster the practices used in a firm's safety and health program could be more enduring because they become part of the firm's standard operating procedures.

[40] Interviews with Kevin Myers, deputy chief executive, and David Ashton, director of field operations, HSE, Liverpool, UK, April 28, 2011.

[41] See Gray and Mendeloff (2005) and Haviland et al. (forthcoming).

APPENDIX A.
CONSTRUCTION OF THE DATA SETS

Our inspection data come from OSHA's IMIS database, from which we extracted inspections of California establishments in SIC industries 20–51 and 80 over the time period 1988 to 2007. This gave us a total of 64,354 inspections from 40,238 distinct establishments (name-address matching and OSHA backward linkages were used to link together inspections of same plant over time).

For the ODI matching, the relevant records for California establishments were extracted from the ODI and IMIS data sets. These records were then linked together at the facility level, based on each facility's identifying characteristics, including name, address, city, ZIP Code, industry, and employment. The matching techniques used here were initially developed in Fellegi and Sunter (1969), and the programs used to implement them were described in Gray (1996). The programs compare the two records on the whole set of characteristics, with positive weights for agreement and negative weights for disagreement. The magnitudes of these weights are larger for characteristics that are more convincing—e.g., exact agreement on facility name counts for more than partial agreement, disagreement on three-digit ZIP Code counts for more (negatively) than disagreement on five-digit ZIP Code. The sum of the weights is called the t-score, and it summarizes the degree of agreement or disagreement: A negative t-score means that the records are almost certainly not from the same facility, while nearly identical values on all characteristics results in a high positive t-score.

We identified all inspections taking place in the industries in our sample between 1997 and 2006. We excluded those with fewer than 11 employees and then matched them to ODI injury data. Those for which we had injury rates for years just before and after the inspection were included in the data set. This included 2,708 establishments in the ODI lookback analysis. For the ODI change model for AIs, the sample was 441; for non-AIs, it was 475.

We were sent 6,271,623 WCIS records for 2000–2008, containing information on WC injury claims. We linked these records to the 15,259 establishments with inspections in 2000 or later, using the name-address matching program described earlier. Of the establishments, 6,478 had no links to WCIS injury records, and the average establishment had 34 injury records (the median value was 2). For our analysis, we needed to find inspections for which we had injury data before and after the inspection.

To get injury rates for the WCIS data, we linked OSHA inspection data to EDD employment data among those establishments that had an inspection in 2000 or later. We had a total of 21,001 inspections that happened in 2000 or later, with 15,259 distinct establishments—those were the establishments linked to EDD data. For this linking process, we prepared a series of SAS programs that were run by the EDD staff to carry out the name-address matching between our inspected establishments and their establishment list. We tested various combinations of matching variables and cutoff values, eventually settling on a less strict matching cutoff (t-score > 11), which resulted in 13,967 establishments being matched to some EDD record. Later, because of concerns about the quality of matches, we raised the minimum t-score to 19 and excluded establishments with fewer than 21 employees. This left us with a sample of 1,181 for the lookback analysis (including all inspection types), 546 for the AI subset of the change sample, and 778 for the non-AI subset of the change sample.

For linking OSHA inspection data with WCIRB injury records, we needed to look at firms with a single establishment because the WCIRB data are kept at the firm level but inspections happen at the establishment level. We limited the inspection data to single-plant firms, using two criteria: (1) the "total controlled by firm" employment number did not exceed the establishment employment and (2) the firm name at this establishment did not link closely with the firm name at some other establishment with a distinct address. We also limited the sample to inspections that occurred in the 1991–1994 period. This resulted in a total of 6,067 inspections at a total of 5,205 distinct single-establishment firms. We sent name-address information for these firms to the WCIRB and included the firm's Federal Employer Identification Number (FEIN) value when we were able to link our inspection data to WCIS data (the FEIN was not available often, only for 732 firms). The WCIRB linked our 5,205 firms to its data, using its own methods (which involved manual comparisons of firm identifiers). We then sent it our research data set of OSHA and WCIS data, which it then edited to remove any identifiers and returned to us, along with the linked WCIRB data for those establishments. Our WCIRB sample for the lookback analysis includes all 5,205 establishments or firms.

APPENDIX B.
MODIFICATIONS TO THE WORKERS' COMPENSATION INFORMATION SYSTEM AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION DATA INITIATIVE DATA

WCIS lookback data:

1. Dropped SCOPE = C or D
2. Dropped SIC = missing
3. Dropped YEAR < 2003
4. Split into ACCIDENT and NON-ACCIDENT
    a. if TYPE=A then output data: LookBack Accident
    b. else output data: LookBack Non-Accident

WCIS change data:

1. Dropped SCOPE = C or D
2. Drop AREA in 35000, 50663, 50664
3. Time points for calculating change:
    a. Accident data required 12 consecutive months of employment and injury data beginning two months before the month of the index event and the same going forward starting the following month after the index event month.
    b. Nonaccident data required 12 consecutive months of employment and injury data beginning one month before the month of the index event and the same going forward starting the following month after the index event month.
4. Outcome variable defined two ways:
    a. Original (lninjchga1b1): $\log\left(\frac{12 \text{ months after rate} + 1}{12 \text{ months before rate} + 1}\right)$
    b. Version 2, trimmed: set lninjchga1b1 > 1 to 1 and lninjchga1b1 < –1 to –1
5. Drop if sum of monthly employment for preceding or post 12 months is 120 or less
6. Drop if the preceding or post rate is <0 or >100
7. Drop if inspector has fewer than ten inspections in our data

ODI lookback data:

1. Dropped SCOPE = C or D

2. Use inspection data only in one to two years prior to ODI: 1994–1995, 1997–1998, 2000–2001, 2003–2004
3. ODI data: 1996, 1999, 2002, 2005
4. Keep only one-to-one matches of Dun and Bradstreet's Data Universal Numbering System (DUNS):zACT and multi-DUNS to 1 – zACT matches.
5. Model 5: ran only when the ODI before rate was <50

ODI change data (changemod_odi_subset):

1. Dropped SCOPE = C or D.
2. Use inspection data only if have one to two years prior *and* one to two years post-ODI: 1994–1995, 1997–1998, 2000–2001, 2003–2004, 2006–2007.
3. ODI data: 1996, 1999, 2002, 2005
4. Drop if employer size <11.
5. We ran two models using only inspections whose inspector had three or more inspections. They were run in 1eChangeModels_ODI_Set3 using the data: changemod_odi_inspector3plus. (The final models we ran, including the splits by accident/nonaccident, did not drop inspections whose inspector had fewer than three inspections.)

APPENDIX C. LOOKBACK ANALYSES

Table C.1:
Workers' Compensation Insurance Rating Bureau of California: Variable Means

Variable	Label	N	Mean	Standard Deviation
v3203a_any	Flag if inspection had any v3203a violation	5,211	0.2320	0.4222
V3203notA	Flag if ever any v3203 violation *not* including v3203a_any	5,211	0.1249	0.3307
V3203any	Flag if any v3203 violation	5,211	0.3569	0.4791
v3203a1_any	Flag if inspection had any v3203a1 violations	5,211	0.0217	0.1457
v3203a2_any	Flag if inspection had any v3203a2 violations	5,211	0.0180	0.1331
v3203a3_any	Flag if inspection had any v3203a3 violations	5,211	0.0090	0.0946
v3203a4anysub	Flag if ever any version of v3203a4 violations	5,211	0.0190	0.1365
v3203a5_any	Flag if inspection had any v3203a5 violations	5,211	0.0106	0.1022
v3203_a4b1	Flag inspections with any A4 or B1 violations	5,211	0.0424	0.2015
v3203_a7b2	Flag inspections with any A7 or B2 violations	5,211	0.0503	0.2185
v3203a6anysub	Flag if ever any version of v3203a6 violations	5,211	0.0081	0.0894
v3203a7anysub	Flag if ever any version of v3203a7 violations	5,211	0.0326	0.1777
xmod	Ex-mod of the employer	5,211	100.5661	26.2926
totexposure	Exposure (payroll) × rate (policy)	5,211	26,071,171.639	175,276,895.42
totexp_q1	1st quartile dummy for totexposure (lowest)	5,211	0.2500	0.4331
totexp_q2	2nd quartile dummy for totexposure	5,211	0.2500	0.4331
totexp_q3	3rd quartile dummy for totexposure	5,211	0.2500	0.4331
totexp_q4	4th quartile dummy for totexposure (highest)	5,211	0.2499	0.4330
health	Health inspection flag	5,211	0.3360	0.4724
limited	Scope of inspection = limited	5,211	0.4709	0.4992
numinsp2dt	Total number of inspections to date at time of inspection	5,211	2.0497	2.3632

Variable	Label	N	Mean	Standard Deviation
viol_s	Flag if any serious violation cited	5,211	0.1462	0.3534
prior3203	Flag if any prior inspection had §3203 violation	5,211	0.2629	0.4403
UNION	Union = 1, nonunion = 0	5,211	0.1082	0.3107
typeprog	Programmed inspection	5,211	0.1242	0.3298
typeacci	AI	5,211	0.2397	0.4269
typecomp	Complaint inspection	5,211	0.5229	0.4995
typeothr	Other-type inspection	5,211	0.1132	0.3169
empin_sm	Small company size: <100	5,211	0.7929	0.4052
empin_md	Medium company size: 100<>250	5,211	0.1288	0.3350
empin_lg	Large company size: >249	5,211	0.0783	0.2687
sic_mfg	SICs in manufacturing industry	5,211	0.7333	0.4423
sic_transpo	SICs in transportation industry	5,211	0.0804	0.2719
sic_whlsale	SICs in wholesale industry	5,211	0.0952	0.2935
sic_hlth	SICs in health care industry	5,211	0.0912	0.2879
yr95_98	Inspection year 1995–1998	5,211	0.1305	0.3369
yr99_02	Inspection year 1999–2002	5,211	0.0679	0.2517
yr03_07	Inspection year 2003–2007	5,211	0.0468	0.2113
y1992	Inspection year 1992	5,211	0.2161	0.4116
y1993	Inspection year 1993	5,211	0.1919	0.3938
yr94_07	Inspection year 1994–2007	5,211	0.4826	0.4997

Table C.2
WCIS LookBack_ACCI Data: Where t-score > 18 and emp ≥ 20 (empin1~=1 and empin2~=1)

Variable	Mean	Standard Deviation	N
V3203A_ANY	0.0952381	0.2938127	546
V3203A7_ANY	0.0201465	0.1406302	546
V3203notA	0.1391941	0.3464664	546
injr_p1	0.0701504	0.2040742	546
injr_p2	0.0554144	0.1757491	546
SIC1000pool	88.3171551	34.6696584	546
empin3	0.2857143	0.4521682	546
empin4	0.1465201	0.3539512	546
empin5	0.2564103	0.4370513	546
empin6	0.0934066	0.2912682	546
empin7	0.0750916	0.2637807	546
empin8	0.1428571	0.3502480	546
inspone	0.4615385	0.4989757	546
health	0.0622711	0.2418688	546
limited	0.9523810	0.2131541	546
numinsp2dt	7.6959707	17.3933200	546
viol_s	0.2362637	0.4251756	546
prior3203	0.2838828	0.4512941	546
UNION	0.2985348	0.4580349	546
y2003	0.2417582	0.4285412	546
y2004	0.2893773	0.4538892	546
y2006	0.1996337	0.4000916	546
y2007	0.0641026	0.2451602	546

Table C.3
LookBack_NonACCI Data: Where t-score > 18 and emp ≥ 20 (empin1~=1 and empin2~=1)

Variable	Mean	Standard Deviation	N
V3203A_ANY	0.1131105	0.3169316	778
V3203A7_ANY	0.0064267	0.0799603	778
V3203notA	0.0706941	0.2564780	778
injr	0.0443870	0.1550624	778
injr_p1	0.0413574	0.1493379	778
injr_p2	0.0400666	0.1524178	778
SIC1000pool	83.5961868	45.3066186	778
empin3	0.3329049	0.4715560	778
empin4	0.1401028	0.3473170	778
empin5	0.2300771	0.4211527	778
empin6	0.0745501	0.2628330	778
empin7	0.0475578	0.2129657	778
empin8	0.1748072	0.3800464	778
typecomp	0.5899743	0.4921544	778
typeothr	0.1426735	0.3499646	778
inspone	0.4691517	0.4993685	778
health	0.4190231	0.4937166	778
limited	0.7712082	0.4203251	778
numinsp2dt	10.1362468	22.0299772	778
viol_s	0.1169666	0.3215872	778
prior3203	0.2236504	0.4169585	778
UNION	0.4138817	0.4928447	778
y2003	0.2802057	0.4493885	778
y2004	0.2185090	0.4135004	778
y2006	0.2082262	0.4063007	778
y2007	0.0899743	0.2863290	778

Table C.4
LookBack: Nonaccident *and* Accident Data—Where t-score > 18 and emp ≥ 20 (empin1~=1 and empin2~=1)

Variable	Mean	Standard Deviation	N
V3203A_ANY	0.1049958	0.3066778	1,181
V3203A7_ANY	0.0076207	0.0870000	1,181
V3203notA	0.0889077	0.2847311	1,181
injr	0.0518493	0.1714565	1,181
injr_p1	0.0423627	0.1517077	1,181
injr_p2	0.0428831	0.1578315	1,181
SIC1000pool	85.0942704	42.1167214	1,181
empin3	0.3099069	0.4626509	1,181
empin4	0.1414056	0.3485871	1,181
empin5	0.2421677	0.4285767	1,181
empin6	0.0804403	0.2720889	1,181
empin7	0.0533446	0.2248150	1,181
empin8	0.1727350	0.3781781	1,181
typecomp	0.3886537	0.4876509	1,181
typeothr	0.0939881	0.2919358	1,181
typeacci	0.3412362	0.4743254	1,181
inspone	0.4640135	0.4989146	1,181
health	0.2997460	0.4583407	1,181
limited	0.8340390	0.3722033	1,181
numinsp2dt	9.6960203	21.2827190	1,181
viol_s	0.1566469	0.3636215	1,181
prior3203	0.2447079	0.4300960	1,181
UNION	0.3827265	0.4862583	1,181
y2003	0.2760373	0.4472248	1,181
y2004	0.2337003	0.4233630	1,181
y2006	0.2040644	0.4031870	1,181
y2007	0.0863675	0.2810249	1,181

REGRESSION RESULTS FOR LOOKBACK MODELS

Table C.5
Summary of Occupational Safety and Health Administration Data Initiative Lookback Models

	v3203a_any			v3203notA			v3203a7anysub		
Variable	**a_Estimate**	**a_SE**	**a_Prob**	**nota_Estimate**	**nota_SE**	**nota_Prob**	**a7_Estimate**	**a7_SE**	**a7_Prob**
Intercept	–5.30431	0.82811	0	–7.2274	1.07394	0	–9.67232	1.52068	0
odi1b4	–0.02337	0.01437	0.10372	0.01423	0.00754	0.05913	0.00572	0.01206	0.63542
odi2b4	–0.00239	0.00888	0.78824	–0.00202	0.00916	0.8257	0.0124	0.00688	0.07144
SIC1000pool	0.00044	0.00232	0.8487	0.00173	0.00179	0.33461	–0.00021	0.00283	0.94208
empin2	–1.4651	1.04744	0.16189	0.20717	0.56097	0.7119	1.16509	0.90641	0.19866
empin4	–0.06541	0.24318	0.78793	–0.22461	0.23108	0.33106	0.46076	0.47208	0.32905
empin5	–0.43143	0.24659	0.08019	–0.17843	0.22157	0.42066	0.57273	0.4557	0.20882
empin6	–0.57833	0.31234	0.06408	–0.37363	0.25757	0.14689	0.55116	0.49062	0.26127
empin7	–1.12464	0.5166	0.02948	–0.37826	0.32451	0.24376	0.42818	0.58547	0.46457
empin8	–0.9904	0.52183	0.0577	0.04406	0.32704	0.89283	0.76246	0.60841	0.21013
inspone	3.50363	0.72167	0	4.67956	1.00688	0	3.35206	1.02073	0.00102
health	0.4158	0.18983	0.02849	0.18018	0.16475	0.27409	0.19032	0.28712	0.50741
limited	–0.54766	0.19713	0.00547	–0.134	0.17249	0.43725	0.11306	0.2937	0.70028
numinsp2dt	–0.12735	0.0393	0.00119	–0.06205	0.01757	0.00041	–0.0688	0.02812	0.01442
viol_s	0.28338	0.19007	0.13598	0.28489	0.14911	0.05606	0.89956	0.21162	0.00002
prior3203	3.74221	0.71857	0	5.2681	1.00395	0	4.08099	1.00939	0.00005
UNION	–0.14069	0.20281	0.48788	–0.10737	0.1521	0.48024	0.01497	0.23879	0.95002
typeacci	0.52173	0.2919	0.07388	1.35799	0.30139	0.00001	2.99053	1.0361	0.0039
typecomp	0.5022	0.29031	0.08365	0.6424	0.30846	0.03729	1.85827	1.05319	0.07766
typeothr	–0.37037	0.4564	0.41707	0.70345	0.37033	0.05749	2.37162	1.0875	0.0292
y1998	0.06137	0.31588	0.84597	0.12989	0.23855	0.58611	0.15955	0.33987	0.63875
y2000	0.4968	0.29183	0.08869	–0.08344	0.21987	0.70433	–0.04523	0.36597	0.90165
y2001	0.2611	0.36424	0.47347	–0.32077	0.29233	0.27252	–0.46665	0.45129	0.30111
y2003	0.41947	0.2919	0.1507	–0.10535	0.22526	0.64	0.19205	0.35317	0.58659
y2004	0.05742	0.35992	0.87324	0.086	0.26274	0.74342	–0.0119	0.40983	0.97683
y2006	0.43151	0.30398	0.15574	–0.21365	0.23816	0.36967	–0.65287	0.43436	0.13283
y2007	0.40492	0.41233	0.32609	–0.7128	0.40078	0.07532	–0.80768	0.66092	0.22169

Table C.6
Summary of Workers' Compensation Insurance Rating Bureau of California Lookback Models Without Premium Size as a Predictor

	V3203a_any			V3203NotA			V3203any		
Variable	**a_Estimate**	**a_SE**	**a_Prob**	**nota_Estimate**	**nota_SE**	**nota_Prob**	**any_Estimate**	**any_SE**	**any_Prob**
Intercept	–0.65847	0.23	0.0043	–2.42464	0.26182	0.0000	–0.20867	0.1822	0.2522
xmod	–0.00243	0	0.0856	0.00234	0.00154	0.1278	–0.00053	0.0012	0.6493
health	0.33768	0.08	0.0000	0.15316	0.10581	0.1478	0.3371	0.0715	0.0000
limited	–0.10393	0.08	0.1683	–0.14905	0.09418	0.1135	–0.16487	0.066	0.0125
numinsp2dt	–0.33192	0.06	0.0000	–0.15578	0.0377	0.0000	–0.22037	0.0355	0.0000
viol_s	–0.29075	0.11	0.0084	0.15628	0.11679	0.1808	–0.12122	0.0902	0.1791
prior3203	0.63551	0.12	0.0000	0.93237	0.12149	0.0000	0.87877	0.0966	0.0000
UNION	–0.3262	0.14	0.0229	–0.25378	0.15444	0.1003	–0.35589	0.1142	0.0018
typeacci	–0.7363	0.12	0.0000	1.32039	0.1813	0.0000	0.04034	0.11	0.7139
typecomp	–0.56806	0.1	0.0000	0.6054	0.17196	0.0004	–0.28759	0.0952	0.0025
typeothr	–1.49558	0.16	0.0000	0.09593	0.22359	0.6679	–1.23212	0.1401	0.0000
empin_sm	0.89665	0.15	0.0000	–0.33552	0.12507	0.0073	0.34429	0.1022	0.0008
empin_lg	–0.00687	0.25	0.9777	–0.20808	0.19723	0.2914	–0.15912	0.1658	0.3373
sic_transpo	0.02237	0.13	0.8606	–0.01866	0.15855	0.9063	0.00236	0.1121	0.9832
sic_whlsale	–0.01005	0.12	0.9326	–0.28905	0.15848	0.0682	–0.14245	0.1055	0.1767
sic_hlth	0.10529	0.12	0.3755	–0.12429	0.16522	0.4519	0.05035	0.1096	0.6458
yr95_98	–0.65997	0.16	0.0000	–0.464	0.15746	0.0032	–0.75873	0.1226	0.0000
yr99_02	–0.40379	0.21	0.0577	–0.51249	0.20955	0.0145	–0.64881	0.1628	0.0001
yr03_07	–0.30279	0.24	0.2027	–0.22113	0.22858	0.3333	–0.40876	0.1822	0.0248
y1992	.	.	.	.	.	.	.	.	.
y1993	.	.	.	.	.	.	.	.	.
yr94_07	.	.	.	.	.	.	.	.	.

Table C.6—Continued

	V3203a1_any			V3203a2_any			V3203a3_any		
Variable	**a1_Estimate**	**a1_SE**	**a1_Prob**	**a2_Estimate**	**a2_SE**	**a2_Prob**	**a3_Estimate**	**a3_SE**	**a3_Prob**
Intercept	–4.96666	0.775	0.0000	–3.22761	0.717	0.0000	–5.35569	1.053	0.0000
xmod	0.00575	0.003	0.0937	0.00159	0.004	0.6753	0.00839	0.005	0.0739
health	0.05291	0.222	0.8116	–0.71326	0.309	0.0210	–0.3975	0.404	0.3254
limited	–0.10169	0.21	0.6274	–0.36031	0.236	0.1271	0.01602	0.323	0.9604
numinsp2dt	–0.49138	0.259	0.0574	–0.06549	0.08	0.4132	0.08613	0.089	0.3329
viol_s	–1.0017	0.429	0.0194	0.23353	0.287	0.4165	0.26081	0.416	0.5305
prior3203	0.41846	0.419	0.3182	0.48686	0.301	0.1057	0.26263	0.434	0.5448
UNION	–2.23218	1.01	0.0271	0.10485	0.345	0.7614	–0.86716	0.746	0.2453
typeacci	0.78517	0.417	0.0595	1.03461	0.469	0.0273	0.33597	0.604	0.5781
typecomp	0.70342	0.366	0.0547	0.28447	0.461	0.5371	–0.20433	0.582	0.7256
typeothr	0.29398	0.508	0.5631	–0.31148	0.632	0.6223	–0.77729	0.809	0.3366
empin_sm	0.99801	0.519	0.0545	–0.00779	0.339	0.9817	1.25859	0.659	0.0562
empin_lg	0.59693	0.773	0.4398	–0.07572	0.526	0.8855	.	.	.
sic_transpo	0.08663	0.322	0.7879	–0.58266	0.475	0.2202	0.23601	0.497	0.6350
sic_whlsale	–0.03408	0.309	0.9121	0.24842	0.317	0.4334	0.33172	0.434	0.4449
sic_hlth	–0.17103	0.338	0.6124	0.74115	0.392	0.0586	0.07647	0.654	0.9070
yr95_98	–2.14756	1.042	0.0393	.	.	.	.	.	.
yr99_02	–0.11227	0.675	0.8680	.	.	.	.	.	.
yr03_07	–0.05428	0.801	0.9460	.	.	.	.	.	.
y1992	.	.	.	–1.16216	0.302	0.0001	–1.3902	0.399	0.0005
y1993	.	.	.	–1.14666	0.31	0.0002	–1.50705	0.433	0.0005
yr94_07	.	.	.	–1.74204	0.312	0.0000	–2.4207	0.463	0.0000

Table C.6—Continued

	V3203a4anysub			V3203a5_any			V3203a7anysub		
Variable	**a4_Estimate**	**a4_SE**	**a4_Prob**	**a5_Estimate**	**a5_SE**	**a5_Prob**	**a7_Estimate**	**a7_SE**	**a7_Prob**
Intercept	–3.42176	0.646	0.0000	–5.62104	0.904	0.0000	–5.15528	0.524	0.0000
xmod	0.0044	0.003	0.2037	0.01303	0.004	0.0007	0.00686	0.002	0.0051
health	0.83261	0.241	0.0005	0.65251	0.358	0.0680	0.68927	0.21	0.0010
limited	0.08211	0.22	0.7089	0.18065	0.293	0.5372	0.49452	0.182	0.0065
numinsp2dt	–0.20902	0.11	0.0564	–0.41923	0.24	0.0806	–0.07392	0.044	0.0940
viol_s	–0.09374	0.302	0.7564	0.47522	0.355	0.1802	0.30383	0.197	0.1236
prior3203	0.47307	0.296	0.1096	0.812	0.474	0.0865	0.5173	0.209	0.0134
UNION	–0.06649	0.367	0.8561	0.00871	0.492	0.9859	0.05852	0.24	0.8072
typeacci	0.59923	0.387	0.1215	1.99302	0.573	0.0005	1.76225	0.414	0.0000
typecomp	–0.15855	0.358	0.6582	0.85323	0.553	0.1228	0.30762	0.414	0.4571
typeothr	–0.62564	0.51	0.2196	.	.	.	0.53506	0.468	0.2531
empin_sm	–0.28737	0.298	0.3353	0.0063	0.439	0.9886	–0.42763	0.215	0.0466
empin_lg	–0.47313	0.525	0.3672	–1.33175	1.082	0.2184	0.17854	0.287	0.5343
sic_transpo	–0.44822	0.433	0.3011	0.13919	0.456	0.7604	0.431	0.264	0.1029
sic_whlsale	–0.48286	0.402	0.2298	–0.78184	0.609	0.1992	–0.09836	0.293	0.7373
sic_hlth	–0.965	0.48	0.0446	0.25431	0.486	0.6010	–0.02115	0.332	0.9492
yr95_98	.	.	.	.	.	.	–0.46752	0.271	0.0840
yr99_02	.	.	.	.	.	.	–0.32665	0.324	0.3126
yr03_07	.	.	.	.	.	.	–0.60703	0.397	0.1261
y1992	–0.68051	0.317	0.0321	–1.50113	0.393	0.0001	.	.	.
y1993	–0.83359	0.338	0.0138	–1.67874	0.427	0.0001	.	.	.
yr94_07	–0.88202	0.305	0.0038	–1.76324	0.379	0.0000	.	.	.

NOTE: A dot alone in a cell indicates a variable that was not included in the estimates for that model.

Table C.7
Summary of Workers' Compensation Information System **Lookback Models**

Accident Models	**v3203a_any**			**v3203notA**		
Variable	**a_Estimate**	**a_SE**	**a_Prob**	**nota_Estimate**	**nota_SE**	**nota_Prob**
Intercept	–1.66631	0.86314	0.05354	–2.04322	0.82636	0.01342
injr_p1	–1.09634	1.3089	0.40225	0.26455	0.77089	0.73146
injr_p2	–0.0156	1.44723	0.9914	0.06197	1.04936	0.95291
SIC1000pool	0.00128	0.00451	0.77687	0.00676	0.00403	0.09368
empin4	–0.96008	0.48765	0.04898	–0.23004	0.40623	0.57119
empin5	–0.67258	0.40557	0.09724	0.33125	0.33732	0.3261
empin6	–1.31824	0.7734	0.08829	0.68494	0.46561	0.14127
empin7	–1.59873	1.06875	0.13468	–1.51778	1.05653	0.15084
empin8	–1.07746	0.64072	0.09264	–0.88039	0.66286	0.18412
inspone	0.72022	0.46089	0.11813	0.72887	0.43568	0.09434
health	0.21046	0.59052	0.72155	0.68905	0.51763	0.18314
limited	–0.8263	0.52216	0.11355	–0.4936	0.51207	0.33508
numinsp2dt	0.00336	0.01348	0.80321	–0.0733	0.03788	0.053
viol_s	0.11477	0.35175	0.7442	–0.61077	0.3392	0.07176
prior3203	0.11126	0.52896	0.83341	1.31523	0.44562	0.00316
UNION	–0.02323	0.41195	0.95503	–0.80584	0.38352	0.03563
y2003	0.081	0.49079	0.86892	–0.11172	0.3903	0.77469
y2004	0.28318	0.46098	0.53902	–0.56535	0.39739	0.15484
y2006	0.43376	0.46907	0.35511	0.23624	0.38524	0.53972
y2007	0.11574	0.72151	0.87255	–0.28002	0.62381	0.65351
Nonaccident Models	**v3203a_any**			**v3203notA**		
Variable	**a_Estimate**	**a_SE**	**a_Prob**	**nota_Estimate**	**nota_SE**	**nota_Prob**
Intercept	–2.03005	0.82049	0.01335	–3.34509	0.7837	0.00002
injr	1.40627	1.21471	0.24699	0.45442	1.36949	0.74003
injr_p1	–0.38481	1.35502	0.77642	–0.18465	1.36161	0.89213
injr_p2	–0.77676	1.41693	0.58355	–0.67734	1.45715	0.64205
SIC1000pool	–0.0097	0.00374	0.00946	0.00466	0.00411	0.25753
empin4	–0.27099	0.37246	0.46688	–0.93703	0.56532	0.09742
empin5	–0.3286	0.36902	0.37322	0.17379	0.36516	0.63413
empin6	–0.68812	0.79185	0.38485	–0.32512	0.67122	0.62812
empin7	0.34406	0.84984	0.68558	–0.72379	1.08027	0.50285
empin8	0.03053	0.61067	0.96013	–1.14903	0.79015	0.14589
typecomp	–0.64516	0.33312	0.05278	1.02845	0.46991	0.02863
typeothr	–0.59098	0.52408	0.25946	0.29945	0.69913	0.66842
inspone	2.05279	0.66023	0.00188	0.42662	0.46531	0.35922
health	0.24963	0.2869	0.38425	0.4002	0.3103	0.19715

limited	0.01701	0.31664	0.95716	–0.58342	0.40016	0.14485
numinsp2dt	–0.1276	0.08656	0.14045	–0.16335	0.0789	0.03842
viol_s	–0.19422	0.41758	0.64185	0.13408	0.50709	0.79147
prior3203	2.19386	0.68778	0.00142	1.00514	0.50551	0.04677
UNION	–1.53136	0.4292	0.00036	0.05309	0.34491	0.87767
y2003	–0.04943	0.37954	0.89638	0.23144	0.45173	0.6084
y2004	0.01701	0.39144	0.96535	0.25252	0.46259	0.58514
y2006	0.13151	0.39182	0.73714	0.18206	0.48773	0.70894
y2007	0.40621	0.46496	0.38232	0.21347	0.60033	0.72214
All Data Models (Accident and Nonaccident)	**v3203a_any**			**v3203notA**		
Variable	**a_Estimate**	**a_SE**	**a_Prob**	**nota_Estimate**	**nota_SE**	**nota_Prob**
Intercept	–2.12792	0.58902	0.0003	–3.51085	0.61451	0
injr	0.91749	0.83963	0.27451	1.10187	0.70683	0.11902
injr_p1	–1.36637	1.20407	0.25646	–0.4477	0.90535	0.62095
injr_p2	–0.44426	1.14026	0.69682	–0.24035	0.90864	0.79138
SIC1000pool	–0.00815	0.00303	0.0072	0.00563	0.00313	0.07247
empin4	–0.46219	0.309	0.13472	–0.62429	0.36275	0.08525
empin5	–0.32552	0.28874	0.25958	0.06981	0.27592	0.80025
empin6	–0.67446	0.55917	0.22775	0.34235	0.40029	0.39241
empin7	–0.58218	0.77468	0.45235	–0.81032	0.77014	0.29272
empin8	–0.4028	0.45748	0.3786	–1.20773	0.56645	0.033
typecomp	–0.39039	0.31293	0.21221	0.86731	0.43439	0.04587
typeothr	–0.33626	0.49217	0.49447	0.01478	0.66579	0.98229
typeacci	–0.44452	0.31938	0.16398	1.38941	0.43773	0.0015
inspone	1.91697	0.44738	0.00002	0.73803	0.347	0.03343
health	0.19538	0.25798	0.44884	0.35161	0.27848	0.20674
limited	–0.26149	0.28143	0.35281	–0.42707	0.33971	0.20869
numinsp2dt	–0.01173	0.01439	0.41483	–0.07809	0.03382	0.02096
viol_s	0.16942	0.28278	0.54909	–0.53805	0.33403	0.10723
prior3203	1.61717	0.48912	0.00095	1.1639	0.3665	0.00149
UNION	–1.36282	0.34037	0.00006	–0.30403	0.27197	0.26362
y2003	–0.03026	0.3167	0.92389	0.04671	0.3156	0.88235
y2004	0.18972	0.31477	0.5467	–0.29042	0.34081	0.39414
y2006	0.19815	0.32189	0.53816	0.283	0.33155	0.39334
y2007	0.38883	0.39481	0.3247	–0.11246	0.45317	0.804

APPENDIX D. REGRESSION RESULTS FROM CHANGE MODELS

Table D.1
Change Models Occupational Safety and Health Administration Data Initiative Set
4v3acci Means: Accident

Variable	N	Standard Deviation	Mean	Minimum	Maximum
YEAR	441	2.6301163	2,000.54	1,997.00	2,004.00
health	441	0.2597114	0.0725624	0	1.0000000
limited	441	0.3201635	0.8843537	0	1.0000000
manf	441	0.3679463	0.8390023	0	1.0000000
PENf	441	0.4604431	0.6961451	0	1.0000000
v3203a_any	441	0.2559335	0.0702948	0	1.0000000
V3203notA	441	0.3895009	0.1859410	0	1.0000000
V3203any	441	0.4370494	0.2562358	0	1.0000000
v3203a4anysub	441	0.1490366	0.0226757	0	1.0000000
v3203a7anysub	441	0.2670490	0.0770975	0	1.0000000

Table D.2
Change Models Occupational Safety and Health Administration Data Initiative Set
4v3acci Means: Nonaccident

Variable	N	Mean	Standard Deviation	Minimum	Maximum
YEAR	475	2,000.35	2.5231770	1,997.00	2,004.00
health	475	0.4294737	0.4955229	0	1.0000000
limited	475	0.7600000	0.4275334	0	1.0000000
manf	475	0.6610526	0.4738510	0	1.0000000
PENf	475	0.5115789	0.5003929	0	1.0000000
v3203a_any	475	0.0694737	0.2545260	0	1.0000000
V3203notA	475	0.0989474	0.2989061	0	1.0000000
V3203any	475	0.1684211	0.3746343	0	1.0000000
v3203a4anysub	475	0.0042105	0.0648201	0	1.0000000
v3203a7anysub	475	0.0189474	0.1364829	0	1.0000000

Table D.3
Summary of Occupational Safety and Health Administration Data Initiative Change Models: Accident Models

	v3203a_any			v3203notA			v3203any		
Variable	**a_Estimate**	**a_SE**	**a_Prob**	**nota_Estimate**	**nota_SE**	**nota_Prob**	**any_Estimate**	**any_SE**	**any_Prob**
Intercept	29.9091	29.8643	0.31714	31.516	29.9025	0.29249	29.7749	29.8573	0.3192
YEAR	–0.015	0.0149	0.31518	–0.0158	0.0149	0.29095	–0.0149	0.0149	0.31741
health	0.0467	0.1512	0.75768	0.0427	0.1511	0.77743	0.0485	0.1511	0.74836
limited	–0.0115	0.1214	0.92472	–0.0235	0.1216	0.84683	–0.0199	0.1218	0.8702
PENf	–0.1213	0.0858	0.15822	–0.0997	0.0859	0.24652	–0.1025	0.0872	0.24083
V3203any	.	.	.	.	.	.	–0.0518	0.0915	0.57109
V3203notA	.	.	.	–0.1036	0.1014	0.30715	.	.	.
v3203a4anysub	.	.	.	.	.	.	.	.	.
v3203a5_any	.	.	.	.	.	.	.	.	.
v3203a7anysub	.	.	.	.	.	.	.	.	.
v3203a_any	0.0905	0.1529	0.55436	.	.	.	.	.	.
manf	–0.1286	0.1066	0.22851	–0.1307	0.1065	0.22038	–0.1261	0.1065	0.23701

Table D.3—Continued

	v3203a4anysub			v3203a5_any			v3203a7anysub		
Variable	**a4_Estimate**	**a4_SE**	**a4_Prob**	**a5_Estimate**	**a5_SE**	**a5_Prob**	**a7_Estimate**	**a7_SE**	**a7_Prob**
Intercept	31.9262	29.6476	0.28214	28.7225	29.8745	0.33687	31.5887	29.7581	0.28905
YEAR	–0.016	0.0148	0.28027	–0.0144	0.0149	0.33491	–0.0158	0.0149	0.28745
health	0.0362	0.1501	0.80931	0.0487	0.1513	0.74777	0.0459	0.1505	0.76066
limited	0.0031	0.1207	0.97979	–0.0157	0.1217	0.89758	–0.0134	0.1209	0.9121
PENf	–0.1006	0.0845	0.23415	–0.1137	0.0849	0.18143	–0.0996	0.085	0.24175
V3203any	.	.	.	.	.	.	.	.	.
V3203notA	.	.	.	.	.	.	.	.	.
v3203a4anysub	–0.6495	0.2586	0.01238	.	.	.	.	.	.
v3203a5_any	.	.	.	–0.0659	0.3103	0.83193	.	.	.
v3203a7anysub	.	.	.	.	.	.	–0.2653	0.145	0.06799
v3203a_any	.	.	.	.	.	.	.	.	.
manf	–0.1321	0.1058	0.21254	–0.1263	0.1066	0.23683	–0.1339	0.1062	0.20804

NOTE: A dot alone in a cell indicates a variable that was not included in the estimates for that model.

Table D.4
Summary of Occupational Safety and Health Administration Data Initiative Change Models: Nonaccident Models

	v3203a_any			v3203notA			v3203any		
Variable	**a_Estimate**	**a_SE**	**a_Prob**	**nota_Estimate**	**nota_SE**	**nota_Prob**	**any_Estimate**	**any_SE**	**any_Prob**
Intercept	60.8938	27.0655	0.02492	60.0709	27.0089	0.02662	61.0319	27.087	0.02471
YEAR	–0.0306	0.0135	0.02442	–0.0301	0.0135	0.02609	–0.0306	0.0135	0.02424
health	0.0244	0.0692	0.72419	0.0275	0.069	0.68996	0.0307	0.0692	0.65799
limited	–0.0302	0.0811	0.70954	–0.0257	0.0809	0.75103	–0.0341	0.081	0.67447
PENf	–0.1137	0.0708	0.10917	–0.0645	0.0722	0.37218	–0.0828	0.074	0.26322
V3203any	.	.	.	.	.	.	–0.0684	0.0962	0.47747
V3203notA	.	.	.	–0.2176	0.1177	0.06501	.	.	.
v3203a4anysub	.	.	.	.	.	.	.	.	.
v3203a5_any	.	.	.	.	.	.	.	.	.
v3203a7anysub	.	.	.	.	.	.	.	.	.
v3203a_any	0.1524	0.136	0.26286	.	.	.	.	.	.
manf	–0.0403	0.0722	0.57685	–0.0396	0.072	0.58263	–0.0451	0.0722	0.53262

Table D.4—Continued

	v3203a4anysub			v3203a5_any			v3203a7anysub		
Variable	**a4_Estimate**	**a4_SE**	**a4_Prob**	**a5_Estimate**	**a5_SE**	**a5_Prob**	**a7_Estimate**	**a7_SE**	**a7_Prob**
Intercept	61.2431	27.1	0.02429	62.1227	27.0953	0.02231	59.6552	27.0243	0.02777
YEAR	–0.0307	0.0136	0.02382	–0.0312	0.0135	0.02187	–0.0299	0.0135	0.02724
health	0.0291	0.0692	0.67465	0.0291	0.0692	0.67447	0.0241	0.069	0.72763
limited	–0.035	0.0811	0.66678	–0.035	0.081	0.66538	–0.0321	0.0808	0.69172
PENf	–0.1003	0.07	0.15296	–0.0934	0.0702	0.18437	–0.0867	0.0701	0.21654
V3203any	.	.	.	.	.	.	.	.	.
V3203notA	.	.	.	.	.	.	.	.	.
v3203a4anysub	0.0156	0.5251	0.97633	.	.	.	.	.	.
v3203a5_any	.	.	.	–0.2709	0.3051	0.37511	.	.	.
v3203a7anysub	.	.	.	.	.	.	–0.4423	0.2494	0.07685
v3203a_any	.	.	.	.	.	.	.	.	.
manf	–0.0448	0.0723	0.53566	–0.0456	0.0722	0.5282	–0.0421	0.072	0.55862

NOTE: A dot alone in a cell indicates a variable that was not included in the estimates for that model.

Table D.5
Summary of Workers' Compensation Information System Change Models: Accident Models

	v3203a_any			v3203notA			v3203any		
Variable	**ac_a_Estimate**	**ac_a_SE**	**ac_a_Prob**	**ac_nota_Estimate**	**ac_nota_SE**	**ac_nota_Prob**	**ac_any_Estimate**	**ac_any_SE**	**ac_any_Prob**
Intercept	23.6317	7.93805	0.00294	23.7317	7.93646	0.00281	23.848	7.94359	0.0027
YEAR	–0.0118	0.00396	0.00297	–0.0118	0.00396	0.00284	–0.0119	0.00396	0.00273
health	0.0367	0.02794	0.18859	0.0367	0.02793	0.18875	0.037	0.02794	0.18491
limited	–0.0014	0.02295	0.95073	–0.0005	0.0229	0.98133	–0.0015	0.02289	0.94774
V3203A_ANY	–0.0032	0.01874	0.86578	.	.	.	.	.	.
V3203any	.	.	.	.	.	.	–0.0092	0.0145	0.52712
V3203notA	.	.	.	–0.0106	0.01748	0.54549	.	.	.
PENf	0.0116	0.02601	0.6567	0.0129	0.02609	0.62162	0.0134	0.02618	0.60817
empin_sm	–0.0297	0.02787	0.28672	–0.0294	0.02788	0.29161	–0.0293	0.02788	0.29257
empin_lg	–0.0038	0.03105	0.90244	–0.0039	0.03104	0.89908	–0.0041	0.03105	0.89395
PENf_empin_sm	–0.0156	0.03275	0.63322	–0.016	0.03269	0.62485	–0.015	0.03272	0.64686
PENf_empin_lg	–0.0139	0.03798	0.71415	–0.0141	0.03798	0.71116	–0.0141	0.03798	0.71141
manf	–0.0172	0.01259	0.17212	–0.017	0.01258	0.17623	–0.0171	0.01258	0.17324

NOTE: A dot alone in a cell indicates a variable that was not included in the estimates for that model.

Table D.6
Summary of Workers' Compensation Information System Change Models: Nonaccident Models

	v3203a_any			v3203notA			v3203any		
Variable	**na_a_Estimate**	**na_a_SE**	**na_a_Prob**	**na_nota_Estimate**	**na_nota_SE**	**na_nota_Prob**	**na_any_Estimate**	**na_any_SE**	**na_any_Prob**
Intercept	13.5776	6.50253	0.03686	13.6505	6.50334	0.03588	13.5801	6.50334	0.03684
YEAR	–0.0068	0.00324	0.03705	–0.0068	0.00325	0.03606	–0.0068	0.00325	0.03703
health	0.0058	0.01078	0.59218	0.0052	0.0108	0.63137	0.0059	0.01081	0.58503
limited	–0.0104	0.01224	0.39455	–0.0105	0.01224	0.39012	–0.0104	0.01224	0.39416
V3203A_ANY	–0.0177	0.01649	0.28314	.	.	.	.	.	.
V3203any	.	.	.	.	.	.	–0.0096	0.01377	0.48498
V3203notA	.	.	.	0.0054	0.01931	0.78127	.	.	.
PENf	0.049	0.02345	0.03667	0.0469	0.02355	0.04651	0.0496	0.02359	0.03556
empin_sm	–0.0159	0.02103	0.44903	–0.016	0.02103	0.44556	–0.0159	0.02103	0.44972
empin_lg	0.0193	0.02376	0.41543	0.0198	0.02376	0.40542	0.0195	0.02376	0.41211
PENf_empin_sm	–0.0432	0.02742	0.11544	–0.0452	0.02736	0.09873	–0.0444	0.02739	0.10507
PENf_empin_lg	–0.0629	0.03404	0.06482	–0.0624	0.03405	0.06696	–0.063	0.03405	0.06425
manf	–0.0152	0.01062	0.15284	–0.0151	0.01063	0.15582	–0.0149	0.01062	0.16078

NOTE: A dot alone in a cell indicates a variable that was not included in the estimates for that model.

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