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PAPER

Are There Unusually Effective Occupational Safety and Health Inspectors and Inspection Practices?

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Several studies of federal OSHA inspections have shown that, under some conditions, they reduce injuries at manufacturing establishments by approximately 20% over the two years following the inspection. Research about the factors that determine whether inspections are effective or ineffective in preventing injuries is still in its early stages. One issue that has not been well explored is whether the characteristics of the inspector matter. In addition, we are interested in the possible impact of different inspection practices. Are there unusually effective (or ineffective) inspectors? If so, why are they more effective? What can we learn from studying these variations that might help in the design of recruitment, training and the policies that inspectors should follow in the field?

There are four main research questions that this study addresses:

1) How much do inspectors vary in the way that they carry out inspections in terms of practices that might have an impact on inspection effectiveness?
2) How much of the variation in inspection outcomes can be explained by which inspector carried out the inspection?
3) How much of the variation in inspection outcomes can be explained by which Cal-OSHA district the inspector was associated with?
4) Are certain inspection practices associated with better inspection outcomes?

The inspection data we use to explore these questions is from the California OSHA program (Cal-OSHA). We identified the inspections which each Cal-OSHA inspector carried out from 1991 through mid-2007. We interviewed inspection supervisors to get suggestions about what elements in the data might have a relationship to inspector effectiveness. We examined the variations among inspectors (and among Cal-OSHA District offices) on a number of different inspection practices. We also constructed regression models to estimate whether some inspectors were unusually effective or ineffective.

The chief conclusions of this exploratory study are the following:

There is a substantial amount of variation among inspectors in many inspection practices, even when the type of inspection is the same. Some of this variation probably represents other differences in the inspection environment rather than variation in how different inspectors would behave in the same situation. However, the finding that the extent of the variation is almost as large even when we look only at inspectors with at

least 60 inspections of a given type suggests that differences among inspectors play a role. Whether the degree of variability that we found provides a valid reason for concern is an issue that agency managers and other policymakers need to determine, but this information should be useful to them in identifying the patterns.

We also found substantial variation in inspection practices among the 23 Cal-OSHA districts that we examined despite the fact that most districts had well over 1,000 inspections in that sample.

When we used regression models with fixed effects for inspectors, we found that the identity of the inspector explained about 3% of the variation in injury rate changes subsequent to the inspections. There were 7 to 14 more inspectors with significantly strong or weak impacts than the number we would have expected (7) due to chance. That result hints that some real inspector outliers do exist, but also that they don't have much impact on the effectiveness of the total inspection program. We also saw that inspector experience was related to larger preventive effects.

The finding that inspections by inspectors with more experience tended to reduce injury rates more than inspections by others echoes the finding in the earlier study conducted with a national sample of federal OSHA inspectors. With this agreement between studies, we have greater confidence in this relationship. Experience is not, of course, a variable that is easily subject to policy manipulation. The finding may, however, suggest the importance of retaining experienced personnel or perhaps hiring people who already have some experience elsewhere. However, the value of this finding depends heavily on developing an understanding of what it is that makes more experienced inspectors, on average, more effective. Further work on this topic is justified even though it appears that the identity of the inspector explains only a small part of the variation in effectiveness.

When we used a regression model with fixed effects for Cal-OSHA districts, we did find 1 or 2 districts that appeared to have less effective inspections. This number, however, is similar to what we would have expected to find by chance. Therefore, we cannot have much confidence in the accuracy of those identifications.

Nevertheless, we did investigate whether inspections practices in those two Districts differed from those in the other Districts. Most of the differences were not very large. Lastly, we ran a linear regression (with no fixed effects) to see whether the practices we have been examining had any effect on whether injuries declined following inspections. None of them did. The practices included having an employee accompany the inspector, citing a wide range of different standards, and finding at least some violations in most

inspections. The closest to an exception was that the practice of widening the scope of complaint and accident investigations was significant at a 'p' value of 0.11; however, its coefficient was positive (i.e., higher injury rates), not negative as expected.

Despite the small effects related to inspectors and the lack of clear ties to the practices we have examined, we believe that further investigation is warranted. Hiring new inspectors is costly; if we can gain new knowledge about how effective different practices are, we might be able to prevent more injuries without adding as many new resources.

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ACRONYMS

Acronym	Definition
Cal-OSHA	California Occupational Safety and Health Program
DIR	Department of Industrial Relations
EDD	Employment Development Department
IIPP	Injury and Illness Prevention Program
IMIS	Integrated Management Information System
ODI	OSHA Data Initiative
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
SIC	Standard Industrial Classification
WCIS	Workers' Compensation Insurance System

1. INTRODUCTION

Several studies of federal Occupational Safety and Health Administration (OSHA) inspections indicate that, under some conditions, they reduce injuries and illnesses[1] at manufacturing establishments by approximately 20 percent over the two years following the inspection (Gray and Scholz 1993; Gray and Mendeloff 2005; Haviland et al. 2011). The most consistent finding has been that reductions are found only when the inspection results in a fine.

The findings of effectiveness in these situations (and ineffectiveness in others) should lead to efforts to understand other factors, besides penalties, which affect whether inspections have an impact. One path these efforts has taken involves looking at the particular standards that are cited in inspections (Mendeloff and Gray 2005; Haviland et al. 2010). This research suggests that compliance with some standards has a good deal more impact on injury reduction than compliance with others. Another direction for research is to explore whether the characteristics of the inspector matter. Are there unusually effective (or ineffective) inspectors? If so, why are they more effective? What can we learn from studying these variations that might help in the design of recruitment, training and the policies that inspectors should follow in the field?

There is a substantial literature on the behavior of inspectors and their use of discretion[2], but very little that has tried to link those behaviors to measures of outcomes. One relevant topic concerns the influence of political factors on inspection practices. It is clear that changes in the chief executive or the party in power can generate changes in enforcement policy. (Wood and Waterman 1994). Several studies have argued that federal OSHA enforced less strictly in more conservative states and Congressional Districts. (Scholz and Wei 1986; Scholz, Twombley, Headrick 1991). Huber (2007), however, argues convincingly that the differences that exist, at least at federal OSHA, reflect the political climate in an area, but do not represent changes in behavior by

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[1] The great majority of the events are injuries not illnesses, so we will use the term "injuries" to apply to both categories. These illnesses are acute events. Chronic illnesses are very poorly captured by current data sets.

[2] See, for example, Bardach and Kagan (1982), Hutter (1989), and Kagan (1994).

inspectors in response to local political pressures. Thus, for example, high unemployment in an area will dampen worker enthusiasm for tougher enforcement, while a stronger union presence or a stronger Democratic Party voting edge will tend to make workers more willing to request inspections.

The most relevant study for our purposes is a dissertation (Guo 1999) that examined federal OSHA inspectors who had conducted more than 10 inspections and found that compliance officers with more experience were more effective at preventing injuries. He also found that those citing more violations were more effective, except for the group citing the highest number of violations, who were less effective. Gray and Mendeloff (2005) found that health inspections were more effective than safety inspections at preventing injuries. This unexpected finding may reflect the fact that health inspections involve more time on-site than safety inspections do and thus give the compliance officer more time to observe the workplace. Also, health inspections are conducted by industrial hygienists, who have more professional training. However, it is of limited value to know that more experienced staff or industrial hygienists are more effective unless there is a way to transform the experience level or background of the staff. It would be better to try to find out what skills experience helps to produce and examine whether there are other ways to speed up the learning process for these skills.[3]

There are four main research questions that this study addresses:

1. How much do inspectors vary in the way that they carry out inspections in terms of practices that might have an impact on inspection effectiveness? In order to examine the relationship, if any, between variation in practices and injury prevention, we first need to establish whether there is variation.
2. How much of the variation in inspection outcomes can be explained by which inspector carried out the inspection?
3. How much of the variation in inspection outcomes can be explained by which Cal-OSHA district the inspector was associated with?
4. Are certain inspection practices associated with larger reductions in injury rates?

As these questions indicate, we are interested both in the role that the inspectors' identity plays and in identifying the practices that make inspectors and inspections more

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[3] The finding that experience is associated with better outcomes could also arise if less effective inspectors don't stay in the job as long. In that case, the link could reflect this differential attrition rather than the learning that comes with experience.

effective. In addressing the last 3 research questions, we measure effectiveness in terms of reductions in injury and illness rates that occur at the inspected establishment following inspections. We use this measure, rather than a measure of violations cited, because injury prevention is the basic rationale for OSHA's existence. Injury prevention is an outcome measure and violations are an output. If we knew that preventing a certain number of violations prevented a certain number of injuries, we could use violations cited as a proxy outcome measure. But although we have found that, on average, the abatement of some types of violations reduce injuries (Haviland et al. 2010; Mendeloff and Gray 2005), the number of violations cited has not been shown to have an effect on the size of post-inspection reductions in injuries.

Our focus on injury rate reductions demonstrates that our objective is not to develop a performance measure to assess individual inspectors, but rather to gain a better understanding of inspection effectiveness. As inspectors often emphasize, they have only a limited influence over how many injuries occur at an establishment. If we want effective performance measures in order to motivate people, it is important that they be based on some measure that people believe clearly reflects their efforts (Behn, 2009).

What Are the Characteristics of Effective Inspectors?

When we spoke with officials who supervise inspectors, we asked: What are the characteristics of an effective inspector? How do those characteristics help them do a better job? The most common answers were:

- They are knowledgeable. They know the regulations, the hazards that are found at different workplaces and what sort of remedies are good ones.
- They are well prepared.
- They focus on important issues, not picayune ones.
- They are skillful at eliciting information that they can use to understand the workplace and its shortcomings.
- They are persuasive. They are intelligent enough and attuned enough to figure out what sort of arguments will get people to make changes.
- They arrange to speak with relatively high-level establishment officials.
- They are firm and self-confident. They are not easily intimidated and don't compromise just to avoid conflict.
- They are reasonable and don't antagonize people.

Not surprisingly, these answers overlap with those that psychologists have identified as the personality traits most predictive of job performance (Hurtz and Donovan 2000).

The "big five" traits are conscientiousness, emotional stability, agreeableness, extraversion, and openness to experience.[4] It is also evident that these traits are not easily detectable through the variables that exist in the OSHA inspection data base. One research strategy that might be used is to ask supervisors to identify inspectors who have these characteristics to varying degrees and then look to see whether an analysis of inspection outcomes reflects the ratings on those qualities.

However, because of the sensitivity of the issue, in this study we chose not to follow a more intrusive approach that would ask supervisors to rate individual inspectors or that would identify the inspectors who looked effective (or not) in the data. As an alternative, we asked supervisors to identify measures of inspector performance that would be discernible in the inspection data. We talked with the Directors of two of OSHA's regional offices, with the prior Chief of Cal-OSHA, and with panels of staff at an OSHA regional office and at Cal-OSHA.

We received a number of suggestions. These measures might be better described as ways to identify inspectors who are not ineffective rather than as a method to identify top performers.

- They do not have a lot of inspections where they cite zero violations.
- They cite a diverse set of standards across inspections.
- They cite the Injury and Illness Prevention Program standard in a relatively large number of inspections.[5]

We also looked at whether the identity of the Cal-OSHA *district* conducting the inspection could explain any of the variation in injury outcomes. Many if not most inspectors stay with within one district during their careers and thus get much of their training and professional socialization within the district. To the extent that there is a district "inspection style" which has an effect on inspection outcomes, this analysis may be able to detect it.

In the rest of the paper, we first describe the data sources that we used to construct our sample of inspections, inspectors, and districts. Second, we carry out the descriptive

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[4] The relevance of different traits for job performance varies, to some degree, with the type of job. In the case of inspectors, "agreeableness," may not be a useful trait, at least with respect to relations with employers.

[5] The Injury and Illness Prevention Program is a California requirement for firms to carry out activities like worker training, hazard surveys and accident investigations. Cal-OSHA is supposed to check for compliance in each inspection.

analysis of variations among inspectors and among districts. Third, we examine whether some inspectors or districts appear to be unusually high or low in their impact on the changes in injury rates following inspections. Fourth, we describe whether the two Cal-OSHA districts which appeared to be less effective are characterized by any particular cluster of practices. Fifth, we examine whether the characteristics identified in the fourth step are significant in a regression analysis on inspection impacts. The final section of the paper reviews the implications of our findings for research and policy.

We need to emphasize that the variations we show here surely reflect, to some degree, differences in the conditions that inspectors find rather than differences in their choices. We present these figures not as conclusive evidence of variations among inspector in their practices, but rather as data that should be examined as a first step in learning about how much variation is attributable to differences in inspectors' choices.

The other important point to note again is that we do not necessarily propose here that one practice is better than another. We include the measures here because they appeared to be possible indicators of style differences, some of which might be important in influencing the quality of the inspection and the outcomes that flow from it.

2. Data Sources and Methods

Inspection Data: OSHA Integrated Management Information System (IMIS)

We use a sample of Cal-OSHA inspections limited to manufacturing, utilities and transportation, wholesale trade and health services. (These are SIC codes 20-51 plus 80.) The inspections occurred between January, 1990 and May, 2007. We excluded construction because of the difficulty of relating inspections at particular worksites to the injury rate of the construction firm, which is usually a product of work at many different worksites. We also excluded establishments with fewer than 11 employees because of the very high variability in their injury rates.

OSHA's IMIS contains inspection data since 1972 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 section 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 (programmed, complaint, accident, follow-up, etc.). It also includes information about the degree of severity of any cited violations and the corresponding penalty. Because follow-up inspections focus on re-examination of a prior intervention, we excluded them from our analysis. Because the IMIS lacks a unique establishment (or establishment) identifier, inspections that occurred at the same establishment were linked with a matching program designed by Gray (1996).

Inspections were grouped by inspector and all inspectors with at least 20 inspections were retained in the analysis data set. In some analyses all of an inspector's inspections were considered together and in others inspections from five mutually exclusive categories were considered separately: Programmed Inspections, Complaint Inspections – Safety, Complaint Inspections – Health, Accident Inspections – Safety, and Other Inspections. An inspector had to have at least 20 inspections in an inspection type category to be included in analyses for that category.

Workers' Compensation Insurance System (WCIS)

For our analysis of the impact of inspections on injury rates, we relied on the California Workers' Compensation Insurance System (WCIS) for counts of injuries at each workplace. In 2000 the California Department of Industrial Relations (DIR) began to

require insurers and third-party administrators to forward the First Report of Injury forms that employers send to them to the DIR. 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 the DIR is mandatory; however, there are no sanctions in place for non-reporting. Although there is no formal study of underreporting, WCIS officials suggest that about 25 percent of the required First Reports are not submitted (Jones, 2011). This missing data contributes to measurement error. In a recent study that used 3 different sets of injury rate data, including the one used here, the other two showed a stronger relationship to inspection findings (Mendeloff et al. 2012).

With the WCIS injury reports, 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 California Employment Development Department (EDD).[6] EDD provided monthly employment for each of the establishments that it was able to link to and sent the file back to us with all identifiers removed.[7] This employment data was used as the denominator for injury rates. Unfortunately, the efforts to match often failed and over 50 percent of the inspected firms for which we had injury data could not be confidently linked to the employment data and had to be dropped from the sample. The matching problems arise because firm names and addresses are often entered differently in different data systems and other potential identifiers are often not available.

Appendix A provides a discussion of our method for matching cases from different data files. The method allows us to set the requirements for declaring a match.

VARIABLES ON INSPECTION PRACTICES

Experience and Inspection Attributes:

Years inspector is in data: If all of an inspector's career to date is in the data, this variable will capture an inspector's years of experience. If an inspector's career started prior to the coverage of the data, this variable will capture the number of years of experience since the start of the data.

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6 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.

7 To link the EDD employment data with the Cal-OSHA inspection data, EDD used a matching program prepared by Gray (1996)

Average time inspector is on site of the inspection (hours): For each inspector, this variable is the average time spent on site across all the inspector's inspections (or each category of the inspector's inspections).

Percent of non-union inspections where a worker accompanied inspector[8]: For each inspector, this variable is the percent of the inspector's inspections of non-unionized employers (or such inspections in each category of inspections) in which a worker accompanied the inspector during the inspection.

Percent of union inspections where a worker accompanied inspector: For each inspector, this variable is the percent of the inspector's inspections of unionized employers (or such inspections in each category of inspections) in which a worker accompanied the inspector during the inspection.

Percent of accident/complaint inspections which were comprehensive: For each inspector, this variable is the percent of the inspector's accident and/or complaint inspections (or such inspections in each category of inspections) that were comprehensive.

Citing of Violations:

Percent with no violations cited: For each inspector, this variable is the percent of the inspector's inspections (or each category of inspections) in which no violations were cited.

Average number of violations cited: For each inspector, this variable is the average over all the inspector's inspections (or each category of inspections) of the number of violations cited.

Average number of serious violations cited: For each inspector, this variable is the average over all the inspector's inspections (or each category of inspections) of the number of serious violations cited.

Percent with IIPP cited: For each inspector, this variable is the percent of the inspector's inspections (or each category of inspections) in which at least one IIPP standard was cited as a violation.

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8 We distinguish union and non-union workplaces for this variable because the extent to which workers accompany inspectors varies so markedly between the two.

Range of Standards Cited:

Average number of unique standards cited: For each inspector, this variable is the average over all the inspector's inspections (or each category of inspections) of the number of unique standards cited. Standards are considered unique if the first four digits are distinct from those of any other standards within the same inspection.

Total number of unique standards cited: For each inspector, the variable is the count of the number of unique standards this inspector has ever cited in any of their inspections (or each category of inspections). Standards are considered unique if the first four digits are distinct from those of any other standards the inspector has cited across all their inspections (or each category of inspections).

*Percent of all standards cited that are 'top 10' standard*s: For each inspector, we first calculated which how frequently each standard they ever cited was cited across all their inspections and classified the ten most frequent as the inspector's 'top 10'. This variable is a measure of how concentrated the standards are that an inspector cites. It is the fraction (percent) of all standards an inspector has ever cited that are one of their 'top 10' most cited.

Percent of all standards cited that are 'top 5' standards: For each inspector, we first calculated which how frequently each standard they ever cited was cited across all their inspections and classified the five most frequent as the inspector's 'top 5'. This variable is a measure of how concentrated the standards are that an inspector cites. It is the fraction (percent) of all standards an inspector has ever cited that are one of their 'top 5' most cited.

Penalties Levied:

Average penalty per violation: For each inspector, this variable is the average of the penalty amounts levied. These amounts are first averaged within the inspector's inspectors (across multiple penalties) and then across all the inspector's inspections (or each category of inspections).

Average total penalty amount: For each inspector, this variable is the average of the total penalty amount levied in their inspections. The total penalty is calculated for each inspection and then averaged across all inspections (or each category of inspections).

Average penalty per non-serious violation: For each inspector, this variable is the average of the penalty amounts levied for violations that were deemed less than serious. These amounts are first averaged within the inspector's inspections (across multiple penalties) and then across all the inspector's inspections (or each category of inspections).

Average total penalty amount for non-serious violations: For each inspector, this variable is the average of the total penalty amount levied in each inspection for violations deemed to be less than serious. The total penalty associated with non-serious violations is calculated for each inspection and then averaged across all inspections (or each category of inspections).

The analysis involved examining the distribution of these inspector level summaries across all inspectors. For instance, if we consider the 'Percent with no violations cited' summary measure, we calculated the mean of these inspector level percentages along with the tenth percentile, median, and ninetieth percentile or the 25th percentile (first quartile), median, and 75th percentile (third quartile). These values were calculated using all inspection types for each inspector and separately using each category of inspection types for each inspector.

VARIABLES FOR REGRESSION MODELS

Outcome Variable: The outcome variable is a measure of the change in an establishment's injury rate from the year prior to an inspection to the year after an inspection. This measure is operationalized as the change in the log of the injury rate pre-inspection to post-inspection. We add one to all injury rates to avoid taking the log of zero. This specification is used to address the otherwise problematic distribution of the injury rate (data skew and a point mass at zero) and to be consistent with prior literature (e.g. Haviland et al. 2010).

Independent Variables: The predictors of interest are individual indicator variables for each inspector with at least 20 inspections present in the matched data. Several establishment characteristics are included as control variables: establishment size (11-19, 20-249, and over 249), an indicator of whether the establishment is in the manufacturing industry, and an indicator of whether some or all of the establishment's employees are unionized. Inspection characteristics that are included as control variables are: whether it is a safety or health inspection; whether the inspection is a complaint, accident, programmed or other type of inspection; an indicator for complaint and accident inspections specifying whether the inspection was comprehensive or limited in scope; and an indicator for whether a worker accompanied the inspector. The final inspection

attribute included as a control in some models is whether any penalties were levied in the inspection.[9]

A single inspector characteristic, years of experience, is included as an additional predictor of interest in some models. This measure, defined above, is specified using both linear and quadratic terms to allow additional years of experience to have different effects at different stages in an inspector's career. The final set of independent variables includes district fixed effects – individual indicators for each district with a sufficient number of inspectors who have at least 20 inspections in the matched data. The coefficients of these variables are of interest to determine whether some districts seem to be more or less effective at reducing injury rates through inspections, controlling for establishment and inspection characteristics that may differ among districts.

Models

The statistical modeling involves three stages of fixed effect regression models. The unit of analysis is the inspection and the outcome is a measure of the change in injury rates at the inspected employer from the year prior to the inspection to the year after the inspection. The primary set of predictors of interest in these models is the inspector fixed effects. This set of variables is included in order to assess the extent to which individual inspectors may be associated with inspected establishments being more likely to have reduced injury rates (or see greater reductions in injury rates) following an inspection. This is quantified through a rho statistic (ρ) which indicates the proportion of the variance in establishments' injury rate changes following an inspection that can be explained by knowing which inspector carried out the inspection. Even when this is low, there may be some individual inspectors who appear to be more or less effective in reducing injury rates through their inspections. The individual fixed effect coefficients are examined to determine if this happens more often than would be expected by chance alone.

In addition to inspector fixed effects, Model 1 includes only one control variable, the year of the inspection. In Model 2, establishment and inspection control variables are added to the inspection year controls and inspector fixed effects present in Model 1. These are added in order to discern whether the estimated effects of inspectors change

[9] Although inspectors may have some control over whether penalties are levied, the most important factors are whether there are any serious violations cited or high-gravity general violations.

once employer and inspection characteristics that may vary between inspector's inspections are accounted for. The inspector variable is included to determine whether differences in inspectors' apparent effectiveness may be systematically associated with how much experience they have. In Model 3, fixed effects for districts are added and inspector fixed effects are removed, allowing us to assess whether some districts appear to be more or less effective at reducing injury rates through inspections.

3. FINDINGS

VARIANCE IN INSPECTOR PRACTICES

We examined the variations in inspection practices separately for each of the type of inspections for which we had the most data. : Programmed Inspections, Complaint Inspections –Safety, Complaint Inspections – Health, Accident Inspections – Safety, and Other Inspections. An inspector had to have at least 20 inspections in an inspection type category to be included in analyses for that category. By looking at each type separately, we eliminate some possible features that could lead to differences in the practices. We found, however, that the extent of variation across the 5 inspection types was fairly similar. Inspectors who have completed 20 inspections of a given type will usually have at least 1 year of experience. In case some would view this as too few inspections, we also examined the variation for inspectors with at least 60 inspections of each type.

When considering all inspection types combined, there are 464 inspectors with 20 or more inspections of any type that are included in the analysis. When considering the categories of inspections, there are considerably fewer inspectors with at least 20 inspections of a particular type and the number of inspectors included in each of these analyses are: Programmed Inspection, n=91; Complaint Inspections – Safety, n=144; Complaint Inspections – Health, n=114, Accident Inspections – Safety, n=148, Other Inspections, n=378.

Here we show only the results for safety (not health) inspections in response to complaints. On most measures, this inspection type has the smallest amount of variation. (Results for the other inspection types and some added practices can be found in Appendix B.) Table 1 shows the variation for this type of inspection, based on the 144 inspectors with at least 20 inspections.

Table 1:
Variation in Inspection Practices in Complaint Inspections, Safety

	Mean	10th Percentile	Median	90th Percentile
Percent of non-union inspections where a worker accompanied inspector	14%	0%	4%	55%
Percent of union inspections where a worker accompanied inspector	46%	10%	42%	89%
Percent of complaint inspections which were comprehensive	41%	2%	41%	73%
Percent with no violations cited	37%	17%	35%	61%
Average number of violations cited	2.84	1.05	2.47	4.81
Average number of serious violations cited	0.37	0.04	0.28	0.74
Percent of all standards cited that are 'top 5' standards	41%	30%	39%	52%
Average penalty per violation	$230	$65	$115	$217
Average total penalty amount	$2,026	$196	$417	$1,044

NOTE: Limited to Cal-OSHA inspectors with at least 20 inspections of this type

To show that this variation is not a function of small numbers of inspections, we also calculated the same figures for only the 88 inspectors with 60 or more inspections of that type. In Table 2 the first column of figures (from Table 1above) shows the range from the 10th percentile to the 90th percentile for inspectors with at least 20 inspections. In the second column we show the range with the sample limited to inspectors with more than 60 inspections. Except for the first measure in Table 2, there is no reduction in variation when we limit the sample to inspectors with at least 60 inspections of that type.

Returning to Table 1, the first two measures show variations in whether an employee accompanies the inspector during the inspection. The Occupational Safety and Health Act requires that employees be given the opportunity to accompany the inspector; but, in any event, the inspector is required to, at least, interview employees. The first measure shows that employee accompaniment is very rare at non-union workplaces. For half of the inspectors, it occurred in no more than 4 percent of their inspections of this type. On the

other hand, for 10 percent of the inspectors, this accompaniment occurred in more than 55 percent of the inspections at non-union workplaces.

Table 2:
The Range in Inspector Practices for Samples with at Least 60 Inspections per Inspector versus the Range with a Minimum of 20

	10th Percentile—90th Percentile	
	Inspectors with a Minimum of:	
	20 Inspections	60 Inspections
Percent of non-union inspections where a worker accompanied inspector	0–55%	0–35
Percent of union inspections where a worker accompanied inspector	10–89%	9–82
Percent of complaint inspections which were comprehensive	2–73%	3–73
Percent with no violations cited	17–61%	17–59
Average number of violations cited	1.1–4.8	1.1–4.8
Average number of serious violations cited	.04–.74	.05–.72
Percent of all standards cited that are 'top 5' standards	30–52%	30–50
Average penalty per violation	$65–217	48–421

Accompaniment is much more common at workplaces with unions. For 10 percent of inspectors, it occurred in no more than 10 percent of their inspections. At the other extreme, 10 percent of inspectors had employees accompany them in at least 89 percent of their inspections. Some Cal-OSHA inspectors suggested to us that the distinction between having an employee accompany the inspector and having the inspector interview employees is not very meaningful. However, an analysis by Huber (2007) of federal OSHA inspections found that programmed inspections with a worker accompanying the inspector cited almost 1 more violation (a substantial 28 percent increase) than similar inspections without the worker playing that role.[10] Based on this finding, it does seem valid to conclude that whether an employee actually accompanied the inspector is worth paying attention to.

[10] Huber did not find this effect in complaint inspections, where the inspector already knows what they are going to look at. That difference led him to conclude that the effect was due to the extra information provided by the worker accompanying the inspector, not by employee or union pressure.

The third practice shown in Table 1is whether the inspector expanded a complaint or accident inspection into a comprehensive inspection. The IMIS describes inspections as either limited or comprehensive in scope. The rules call for these inspection types to generally be "limited," focusing on the subject of the complaint or the cause of the accident. However, inspectors are allowed to expand the scope when they see conditions that they believe merit the broader scope. It seems plausible to us that inspectors who are more likely to expand the scope are somewhat more aggressive or activist in their interpretation of their role. Here the range is from 2 percent or less for the lowest decile to 73 percent or more for the highest decile.

The next three measures in Table 1all report information about the violations cited by the inspector. We noted above that a very high rate of inspections citing no violations had been suggested to us as a troubling indicator about an inspector's effectiveness. Here the 10th and 90th percentiles are 17 percent and 61 percent, while the median inspector cited zero violations in 35 percent of inspections of this type.

The average number of all violations ranged almost 5-fold between the 10th and 90th percentiles. For serious violations, the inspector at the 10th percentile cites a serious violation in no more than 1inspection out of 25. Inspectors in the 90th percentile cite an average of 1 serious violation or more per inspection.

Another practice noted by supervisors as a possible sign of ineffectiveness was the tendency to cite the same group of standards over and over. [11] The assumption was that this practice reflected a degree of laziness. The measure in Table 1 is the percentage of all standards the inspector cited in this type of inspection that were among the 5 standards that he or she cited most frequently. The range from the 10th percentile to the 90th percentile is from 30 percent or less of all cited standards in the "top 5" to 52 percent or more. The ratio of these two figures is considerably lower than for the other measures in Table 1. We cannot, however, conclude from this fact that the difference in this practice is any less important than the larger differences we find for the other measures.

The final measures in Table 1are the average penalty per violation and the average total penalty per inspection. Admittedly, the use of these measures as possible indicators of differences among inspectors has some clear weaknesses. Because penalties can vary greatly, the averages here could be driven by one or two very large penalties. Thus it

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[11] Standards here were defined at the 4-digit level, e.g., 3314. Any citation of any subsection within this 4-digit standard was counted in the totals.

seems less clear that the figures here may tell us about the typical behavior of different inspectors. More generally, measures of the average value —like the average size of penalties or the average number of violations cited—are more prone to giving a misleading impression of typical behavior than measures that are based on the percentage of times that something was done or that some threshold was exceeded.

Variations in Practices Among *Districts*

Our analysis also examined the variations in practices at the Cal-OSHA District level. One reason to explore this issue is that, if inspector practices tend to vary depending on the district within which they do most of their work, it suggests that some of the factors that shape inspector behavior arise at the district level and might be addressed at that level (if one wanted to change practices).

Table 3 shows the variations in practices at the District Level. For the simplicity of exposition, we again limit the analysis to complaint inspections for safety issues. Most of the measures in Table 3 are the same ones used in Table 1, but a few are added. Another difference is that instead of the 10th and 90th percentiles, we present the figures for the first quartile (25th percentile) and fourth quartile (75th percentile). With only 23 districts, quartiles are more appropriate.

Table 3:
District Differences in Inspection Practices, Safety Complaint Inspections

	Mean	1st quartile	Median	4th quartile
Average time inspectors are on site of the inspection (hours)	5	3.4	3.9	5
Percent of non-union inspections where a worker accompanied inspector	21%	11%	16%	29%
Percent of union inspections where a worker accompanied inspector	51%	36%	46%	64%
Percent of accident/complaint inspections which were comprehensive	35%	19%	36%	52%
Percent with no violations cited	37%	28%	37%	45%
Average number of violations cited per inspection	3.01	2.21	2.81	3.1
Average number of serious violations cited per inspection	0.6	0.25	0.37	0.54
Percent with IIPP cited	40%	32%	39%	48%
Average penalty per violation	$683	$114	$244	$352
Average total penalty amount per inspection	$5,238	$1,374	$1,961	3,053

Note: Based upon inspectors with at least 20 inspections in this inspection type.

The degree of variation across districts, most with over 1,000 inspections over the years, persists when we look at particular categories of inspections.

FIXED EFFECT REGRESSIONS FOR INSPECTORS AND DISTRICTS

There were 5,728 inspections between 2002 and June 2007 for which the inspector and inspector's district could be identified and where we had before and after injury rate data for the inspected establishment. Table 4 shows the descriptive statistics for variables describing characteristics of the inspections and the establishments. Just over half of the inspected employers in this matched data were manufacturing establishments, almost 60 percent were small establishments, fewer than 20 percent were large establishments, and nearly a quarter were unionized.

Almost three quarters of the inspections were safety, not health inspections; and complaint and accident inspections (34 percent and 42 percent) were much more common than programmed inspections (14 percent). While most complaint and accident inspections are limited in scope, about 8 percent of all inspections are complaint or accident inspections that are comprehensive in scope. A worker accompanied the inspector during the inspection in about 35 percent of inspections and penalties were assessed in 66 percent of all inspections.

Inspectors have an average of seven years of experience and their inspections are fairly evenly spaced across years.

Table 4:
Descriptive Statistics For Regressions

Variable	Percent or Mean (SD) N = 5,728
Employer Characteristics	
Manufacturing	53.4%
Small Establishment—11-99	57.6%
Medium Establishment—100-249	22.3%
Large Establishment—250+	19.1%
Union	24.5%
Inspection Characteristics	
Worker Accompanies Inspector	33.8%
Health Inspection (vs. Safety)	25.8%
Programmed Inspection	14.2%
Complaint Inspection	35.2%
Accident Inspection	42.4%
Other Inspection Type	8.2%
Comprehensive Accident or Complaint Inspection	8.4%
Penalty Assessed	66.7%
Inspector Characteristic	
Years of Experience	7.2 (4.7)
Calendar Year	
2002	19.2%
2003	19.6%
2004	18.5%
2005	18.7%
2006	17.2%
2007	6.9%
Outcome Variable	
Injury Change Measure	-.0002 (.311)

Model 1 (see Table 5) includes controls only for the year of the inspection and fixed effects for each inspector with at least 20 inspections, a total of 140. In this model specification we see that inspectors explain very little of the variation, less than 3 percent, in establishments' injury rate improvements following an inspection (rho = 0.026). Twenty one of the 140 inspectors are associated with an effect on the injury rate that is different at a statistically significant level ($p<0.05$) than the reference inspector. This is about three times the number we would expect to differ significantly from the reference by chance.

(With p = 0.05 and 140 inspectors, we expect 7 significant effects to arise by chance.) That number suggests that among these 21, at least some of these inspectors truly are more or less effective than the average inspector. The coefficients on the year control variables show that the injury rate increase in 2004 reached statistical significance, as did the declines in 2006 and 2007. (The reference group here was 2002.)

Model 2 adds to Model 1 by including establishment and inspection control variables in addition to year effects and the inspector fixed effects. In this specification, inspectors continue to explain only a small share of the variation in establishments' injury rate improvements following an inspection (rho = 0.36). However, inspector experience has a significant association with injury rate improvement following an inspection. When inspections are carried out by more experienced inspectors, establishments are more likely to have subsequent injury rate reductions rates compared with otherwise similar inspections carried out by less experienced inspectors (at p = 0.016 this association has strong statistical significance). After accounting for inspector experience and establishment and inspection characteristics, 17 of the 140 inspectors are associated with more or less improvement in injury rates than the reference inspector ($p < 0.05$). This is more than twice the number we would expect to differ significantly from the reference by chance (at p = 0.05 we expect 7 significant effects out of 140 by chance) suggesting that at least some of these inspectors truly are more or less effective than the average inspector. Other statistically significant predictors of changes in injury rates from this model specification are that injury rates are more likely to fall for small establishments than medium or large establishments (p = 0.018) and, consistent with Model 1, establishments were more likely to have injury rates increase after an inspection in 2004 ($p < 0.001$).

Table 5:
Results from Regression Models with Fixed Effects

	Model 1	Model 2	Model 3*
Years			
2003	NS	NS	NS
2004	↑	↑	↑
2005	NS	NS	NS
2006	↓	NS	↓
2007	↓	NS	↓‡
Establishment Characteristics			
Small Establishment	NA	↓	↓
Manufacturing Industry	NA	NS	↓‡
Inspection Characteristics			
Comprehensive C/A	NA	↑‡	NS
Inspector Characteristics			
Experience	NA	↓	NS
Experience Squared	NA	↑‡	NS
Districts			
Region 3, District 7	NA	NA	↑
Region 4, District 3	NA	NA	↑‡
Inspector Effects			
Rho	0.026	0.036	NA-
Model R^2	0.029	0.034	0.016

Variables included but not statistically significant are listed as NS. NA indicates that the variable was not in that regression.

↓ indicates a statistically significant ($p < 0.05$) negative association between the predictor variable and the outcome, indicating an improvement (reduction) in injury rates following an inspection.

↑ indicates a statistically significant ($p < 0.05$) positive association between the predictor variable and the outcome, indicating an increase in injury rates following an inspection.

‡ indicates that the coefficient is marginally statistically significant with $0.1 > p > 0.05$

Model 3 deletes inspector fixed effects and substitutes fixed effects for the 23 Cal-OSHA districts that were present over the entire time period. Model 3 continues to control for year, establishment characteristics, inspection characteristics, and inspector experience. Consistent with the earlier models, injury rates tended to increase in 2004 relative to the other years ($p < 0.001$) and to decrease in small relative to larger establishments ($p = 0.038$). Inspections in Region 3, District 7 and Region 4, Districts 3 were not as likely to be followed by reductions in injury rates as they were in other

districts ($p < 0.042$ and $p=.072$, respectively). The reference District was District 1 in Region 2. However, the joint test of all the district variables is not significant. Thus we can't reject the hypothesis that all the districts have the same injury changes.

In this model, the individual inspector's experience was no longer a significant variable, probably in part because some of its effect was picked up by the differences in experience by district. Injury rates declined more after inspections in manufacturing industries than they did in other industries ($p=.091$).

Comparing Districts Which May Be Less Effective with Other Districts

The two districts we identify above as possibly having less effective inspections could easily have been identified due to chance, rather than due to their actual performance. Nonetheless, we went on to examine how the practices in those two districts compared to the practices in the other districts. The results are shown in Table 6. We can see that the "less effective" districts were characterized by:

- Fewer comprehensive inspections for complaints and accidents
- A lower percentage of inspections with zero violations
- A higher percentage of all standards cited among the 5 most frequently cited by the inspector
- A higher percent citing IIPP violations
- A lower percent citing personal protective equipment violations
- Higher median penalties
- Fewer inspections with very high penalties

For a more sophisticated review, we carried out regressions parallel to those reported in Table 5. We find that inspections in Region 3, District 7 were more likely to have a worker accompany the inspector in both unionized ($p < 0.001$) and non-unionized ($p < 0.01$) employers; and a higher number of violations were likely to be cited ($p < 0.001$). In inspections in Region 4, District 3 a higher number of violations was also likely to be cited ($p < 0.001$); however, there it was less, not more, likely to have a worker accompany the inspector at both unionized ($p < 0.001$) and non-unionized ($p = 0.06$) employers. We find marginally fewer complaint/accident inspections that were comprehensive in Region 3, District 7 ($p = 0.09$) and no statistically significant differences between the two districts of interest and the reference district on percent of inspections

with no violations or penalty amounts.[12] Control variables were year, industry, employer size, health versus safety inspection, and inspection type.

Thus the only variable in the regression analysis that distinguishes both of these districts from the others is a higher total number of violations cited per inspection. This pattern does not match the one we suggested earlier. There, we suggested that a lower percentage of inspections with zero violations and a higher percentage of inspections with IIPP violations should be associated with better inspector (and district) performance, not worse.[13]

In light of the lack of strong evidence that inspections in the two districts really were less successful in reducing injuries, we don't think that the findings here about the practices linked to those districts should be taken too seriously. An exception might be the finding that citing a large number of violations is not positively related to inspection effectiveness.

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[12] We could not use this analytic strategy for checking the proportion of all standard cited that were among an inspectors top 5 and did not have the data set up to check IIPP violation or personal protective equipment violations.

[13] The great majority of citations for the IIPP standard are only for failing to have a written IIPP program. Therefore, this citation may not be a mark of an especially vigilant inspector or one who focused on the employers' overall program.

Table 6
Variation in Mean Levels of Inspection Behaviors: the Two "Less Effective" Districts versus the Others

	Means	
	Two "less effective" districts	All other districts
Av. hours on site	5.6	5.7
% walk at unionized	0.47	0.50
% walk at non-union	0.27	0.23
% comprehensive w. complaint/accident	0.19	0.28
% INSP with zero violations	0.31	0.38
Violations per INSP	3.2	2.9
% of all standards cited in top 5	0.51	0.45
Serious violations per INSP	0.64	0.66
% INSP citing IIPP	0.47	0.42
% INSP citing personal protection	0.037	0.044
Average total $ penalty per inspection	6,572	15,506
Average $ penalty for all violations	2,264	2,310
Years of experience	9.6	7.2

However, the association of the other variables with better performance does seem plausible. Inspectors who choose to expand complaint and accident investigations into comprehensive inspections may be good at detecting problems and aggressive in pursuing them. Inspectors who do not tend to cite the same standards over and over again may be more knowledgeable and conscientious. Given that earlier studies found that citations for personal protective equipment violations seemed to be especially valuable in preventing injuries, inspectors who cite it more often may be more effective. It also appeared that the inspectors in the "less effective" districts were more likely to levy penalties, but less likely to levy very high ones.

REGRESSION ON INSPECTION PRACTICES

In order to examine whether any of the practices identified in the above comparison of the two "less effective" districts with other districts did indeed contribute to reductions in

injuries across inspections, we ran a new regression which included the establishment and inspection characteristics used earlier with model 2, but no fixed effects for inspectors or districts. Along with these variables, we included most of the other characteristics identified above as possibly contributing to prevention:

- Per cent of inspections with zero violations
- Per cent of standards cited that were in the "top 5"
- Average penalty per violation
- Average penalty per inspection
- Average hours on-site
- Years of experience
- Years of experience squared
- Per cent of accident and complaint inspections that were "comprehensive"

The full results are shown in Appendix Table 46. Of these variables, the only practice whose coefficient was close to statistical significance was the last one. Its 'p' value ranged from .09 to.11, depending on the specification. However, its sign was positive, contrary to expectations, indicating that the expansion of an inspection's scope was associated with a smaller reduction in injuries..

Thus, this analysis of the role of specific inspection practices did not find any impacts on injury rates.

4. Conclusions and Implications

The chief conclusions of this exploratory study are the following:

There is a substantial amount of variation among inspectors in many inspection practices, even when the type of inspection is the same. Some of this variation undoubtedly reflects other differences in the inspection environment rather than variation in how different inspectors would behave in the same situation. However, the finding that the extent of the variation is almost as large even when we look only at inspectors with at least 60 inspections of a given type suggests that differences among inspectors play a major role. This conclusion is stronger for behaviors which we measure in terms of the percentage of inspections in which the inspector did something, rather than the measures of the average count (e.g., of violations or penalties). The count averages can be heavily influenced by 1 or 2 extreme values.

We also found substantial variation in inspection practices among the 23 Cal-OSHA districts that we examined despite the fact that most districts had well over 1,000 inspections in that sample.

When we used regression models with fixed effects for inspectors, we found that the identity of the inspector explained about 3 percent of the variation in injury rates subsequent to the inspection. There were 7 to 14 more inspectors with significantly better or worse outcomes than the number we would have expected (7) due to chance. That result hints that real inspector outliers do exist, but also that they don't have a large impact on the effectiveness of the total inspection program.

When we used a regression model with fixed effects for Cal-OSHA districts, we did find 1 or 2 districts that appeared to have less effective inspections. This number, however, is similar to what we would have expected to find by chance. Therefore, we cannot have much confidence in the accuracy of those identifications.

Nevertheless, we did investigate whether inspections practices in those two Districts differed from those in the other Districts. Most of the differences were not very large. The chief exception was that the two Districts had a higher number of total violations per inspection than the others.

Lastly, we ran a linear regression (with no fixed effects) to see whether the practices we have been examining had any effect on inspection outcomes. None of them did. The closest to an exception was that the practice of widening the scope of complaint and

accident investigations was significant at a 'p' value of 0.10; however, its coefficient was positive (i.e., higher injury rates), not negative as expected. We might speculate that those workplaces where inspectors expand the scope of the inspection tend to have more hazards (and perhaps be less safe) than other establishments; but that would not explain why the change in injury rates would be any smaller there.

Despite the small effects related to inspectors and the lack of clear ties to the practices we have examined, we believe that further investigation is warranted. If gains in effectiveness, even small ones, could be achieved without having to hire additional inspectors, that would be a very useful result.

The finding in Model 2 in Table 5 that inspections by more experienced inspectors tend to have greater effects on injuries echoes the finding in the earlier study that Guo (1999) conducted with a national sample of federal OSHA inspectors. With this agreement between studies, we have greater confidence in this relationship. Experience is not, of course, a variable that is easily subject to policy manipulation. It may suggest the importance of retaining experienced personnel or perhaps hiring people who already have some experience elsewhere. However, the value of this finding depends heavily on developing an understanding of what it is that makes more experienced inspectors, on average, more effective. It seems likely that the finding reflects a process of learning-by-doing. However, as we noted, it could also arise if less effective inspectors tend to leave the inspectorate more quickly.

To further understanding of those factors, more extensive discussions with both inspection supervisors and inspectors should be undertaken. Talking with recently retired inspectors may also provide a method to obtain responses that are not affected by concerns about the acceptability of their views.

The quantitative analyses we have carried here can be improved upon. Some of the variables (e.g., industry) are measured crudely and more precise categories might provide better estimates. We also noted the problems of incomplete reporting of injuries and difficulties in matching employment data with the injury data. Using Federal OSHA inspections would provide some a larger number of observations. Also, in each inspection, Federal OSHA inspectors collect the establishment's injury and illness rates for the 3 prior years. These rates are available to serve as the "before" figure for computing the change in injury rates. Another data source available for either a California-level analysis or a Federal OSHA study is the OSHA Data Initiative (ODI). The ODI is an annual collection where OSHA tells about 80,000 establishments (generally those in fixed-site workplaces with more than 40 employees) to submit injury and hours worked data

from their OSHA logs. Although the size restriction would limit the number of establishments included, the much larger size of the Federal OSHA data base would still allow a larger sample to be developed. Although there are also significant deficiencies in the OSHA recordkeeping and reporting system (Boden and Ozonoff 2008; Rosenman et al. 2006; Oleinick and Zaidman 2010), we think that there is probably enough stability in reporting by establishments to allow for useful estimates of the changes in their rates. We base this statement on the fact that a number of studies have made credible findings from this data. Another prospect is to put together another sample within California. A recent California statute now allows the State to penalize insurers and other firms which do not submit the forms that they are required to submit. That change should create a more complete and accurate set of injury data.

APPENDIX A. CONSTRUCTION OF THE DATA SETS

Our inspection data comes from OSHA's IMIS (Integrated Management Information System) 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 WCIS matching, the relevant records for California establishments were extracted from the IMIS dataset. 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 – exact agreement on facility name counts for more than partial agreement, disagreement on 3-digit zip code counts for more (negatively) than disagreement on 5-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 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 WCIS injury data.

We were sent 6,271,623 WCIS records for 2000-2008, containing information on workers' compensation injury claims. We linked these records to the 15,259 establishments with inspections in 2000 or later, using the name-address matching program described above. 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 which 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 (tscore>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 tscore to 19 and also 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 accident inspection subset of the Change sample, and 778 for the non-accident subset of the Change sample.

APPENDIX B. VARIATION IN INSPECTION PRACTICES, INSPECTOR LEVEL, BY INSPECTION TYPE

Appendix Table 1:
Inspector Experience and Choices

	All Inspection Types			
	Mean	10th	Median	90th
Years Inspector is in data	8	2	7	16
Average time Inspector is on site of the inspection (hours)	5.7	2.8	5	9
Percent of non-union inspections where a worker accompanied inspector	23%	0%	8%	79%
Percent of union inspections where a worker accompanied inspector	49%	7%	48%	94%
Of accident/complaint inspections, percent which were comprehensive	28%	0%	22%	68%

Appendix Table 2:
Inspector Experience and Choices

	Programmed Inspections			
	Mean	10th	Median	90th
Years Inspector is in data	11	5	11	20
Average time Inspector is on site of the inspection (hours)	5.4	2.2	4.8	9.7
Percent of non-union inspections where a worker accompanied inspector	21%	0%	7%	69%
Percent of union inspections where a worker accompanied inspector	53%	0%	50%	100%

Appendix Table 3:
Inspector Experience and Choices

	Complaint Inspections, Safety			
	Mean	10th	Median	90th
Years Inspector is in data	10	4	9	18
Average time Inspector is on site of the inspection (hours)	4	2.3	3.8	5.7
Percent of non-union inspections where a worker accompanied inspector	14%	0%	4%	55%
Percent of union inspections where a worker accompanied inspector	46%	10%	42%	89%
Percent of complaint inspections which were comprehensive	41%	2%	41%	73%

Appendix Table 4:
Inspector Experience and Choices

	Complaint Inspections, Health			
	Mean	10th	Median	90th
Years Inspector is in data	11	4	10.5	20
Average time Inspector is on site of the inspection (hours)	6.4	4.1	6.2	9.3
Percent of non-union inspections where a worker accompanied inspector	17%	0%	5%	63%
Percent of union inspections where a worker accompanied inspector	46%	6%	47%	84%
Percent of complaint inspections which were comprehensive	30%	0%	27%	59%

Appendix Table 5:
Inspector Experience and Choices

	Accident Inspections, Safety			
	Mean	10th	Median	90th
Years Inspector is in data	11	5	10	19
Average time Inspector is on site of the inspection (hours)	0.55	0.28	0.48	0.86
Percent of non-union inspections where a worker accompanied inspector	21%	0%	5%	70%
Percent of union inspections where a worker accompanied inspector	42%	4%	40%	89%
Percent of accident inspections which were comprehensive	18%	0%	9%	51%

Appendix Table 6:
Inspector Experience and Choices

	Other Inspections			
	Mean	10th	Median	90th
Years Inspector is in data	9	3	9	18
Average time Inspector is on site of the inspection (hours)	0.49	0.17	0.38	0.85
Percent of non-union inspections where a worker accompanied inspector	21%	0%	5%	75%
Percent of union inspections where a worker accompanied inspector	43%	0%	33%	100%
Percent of accident inspections which were comprehensive	18%	0%	0%	60%

Appendix Table 7:
Inspector Differences in Citing of Violations

	All Inspection Types			
	Mean	10th	Median	90th
Percent with no violations cited	38%	19%	36%	63%
Average number of violations cited	2.81	0.99	2.41	4.87
Average number of serious violations cited	0.64	0.13	0.45	1.4
Percent with IIPP cited	42%	18%	42%	64%

Appendix Table 8:
Inspector Differences in Citing of Violations

	Programmed Inspections			
	Mean	10th	Median	90th
Percent with no violations cited	25%	5%	22%	49%
Average number of violations cited	4.75	1.53	4.39	8.8
Average number of serious violations cited	1.31	0.31	0.92	2.78
Percent with IIPP cited	47%	12%	26%	81%

Appendix Table 9:
Inspector Differences in Citing of Violations

	Complaint Inspections, Safety Grp 1			
	Mean	10th	Median	90th
Percent with no violations cited	37%	17%	35%	61%
Average number of violations cited	2.84	1.05	2.47	4.81
Average number of serious violations cited	0.37	0.04	0.28	0.74
Percent with IIPP cited	42%	24%	40%	62%

Appendix Table 10:
Inspector Differences in Citing of Violations

	Complaint Inspections, Health			
	Mean	10th	Median	90th
Percent with no violations cited	35%	17%	34%	57%
Average number of violations cited	3.26	1.42	2.84	5.83
Average number of serious violations cited	0.49	0.13	0.35	0.95
Percent with IIPP cited	45%	27%	46%	61%

Appendix Table 11:
Inspector Differences in Citing of Violations

	Accident Inspections, Safety			
	Mean	10th	Median	90th
Percent with no violations cited	31%	14%	28%	50%
Average number of violations cited	2.2	0.94	1.84	3.88
Average number of serious violations cited	0.67	0.25	0.55	1.43
Percent with IIPP cited	48%	26%	47%	71%

Appendix Table 12:
Inspector Differences in Citing of Violations

	Other Inspections			
	Mean	10th	Median	90th
Percent with no violations cited	50%	19%	50%	80%
Average number of violations cited	2.04	0.33	1.66	4.19
Average number of serious violations cited	0.53	0	0.34	1.2
Percent with IIPP cited	45%	11%	45%	76%

Appendix Table 13:
Inspector Differences in Range of Standards Cited

	All Inspection Types			
	Mean	10th	Median	90th
Average number of unique standards cited per inspection (at the 4-digit level)	3.06	1.8	2.75	4.65
Total number of unique standards cited	69	22	67	118
Percent of all standards cited that are 'top 10' standards	61%	47%	59%	78%
Percent of all standards cited that are 'top 5' standards	46%	31%	43%	63%

Appendix Table 14:
Inspector Differences in Range of Standards Cited

	Programmed Inspections			
	Mean	10th	Median	90th
Average number of unique standards cited per inspection (at the 4-digit level)	3.97	2	3.43	6.98
Total number of unique standards cited	965	56	92	147
Percent of all standards cited that are 'top 10' standards	55%	45%	54%	71%
Percent of all standards cited that are 'top 5' standards	40%	29%	38%	56%

Appendix Table 15:
Inspector Differences in Range of Standards Cited

	Complaint Inspections, Safety			
	Mean	10th	Median	90th
Average number of unique standards cited per inspection (at the 4-digit level)	3.17	1.88	2.9	4.57
Total number of unique standards cited	88	43	83.5	142
Percent of all standards cited that are 'top 10' standards	56%	46%	54%	67%
Percent of all standards cited that are 'top 5' standards	41%	30%	39%	52%

Appendix Table 16:
Inspector Differences in Range of Standards Cited

	Complaint Inspections, Health			
	Mean	10th	Median	90th
Average number of unique standards cited per inspection (at the 4-digit level)	3.35	2.17	3.01	5.04
Total number of unique standards cited	80.45	38	76	127
Percent of all standards cited that are 'top 10' standards	64%	51%	62%	78%
Percent of all standards cited that are 'top 5' standards	49%	36%	49%	65%

Appendix Table 17:
Inspector Differences in Range of Standards Cited

	Accident Inspections, Safety			
	Mean	10th	Median	90th
Average number of unique standards cited per inspection (at the 4-digit level)	2.32	1.45	2.04	3.4
Total number of unique standards cited	95	54	91.5	145
Percent of all standards cited that are 'top 10' standards	55%	45%	54%	64%
Percent of all standards cited that are 'top 5' standards	40%	30%	40%	50%

Appendix Table 18:
Inspector Differences in Range of Standards Cited

	Other Inspections			
	Mean	10th	Median	90th
Average number of unique standards cited per inspection (at the 4-digit level)	2.8	1.33	2.5	4.64
Total number of unique standards cited	78	34	75	127
Percent of all standards cited that are 'top 10' standards	59%	46%	57%	76%
Percent of all standards cited that are 'top 5' standards	44%	31%	42%	60%

Appendix Table 19:
Inspector Differences in Penalties Levied

	All Inspection Types			
	Mean	Q1	Median	Q3
Average penalty per violation	$2,326	$170	$380	$1,311
Average total penalty amount	$12,770	$521	$1,566	$8,697
Average penalty per non-serious violation	$1,389	$107	$189	$854
Average total penalty amount for non-serious violations	$4,018	$275	$653	$2,432

Appendix Table 20:
Inspector Differences in Penalties Levied

	Programmed Inspections			
	Mean	Q1	Median	Q3
Average penalty per violation	$999	$205	$312	$543
Average total penalty amount	$12,396	$1,023	$2,038	$8,591
Average penalty per non-serious violation	$658	$115	$156	$717
Average total penalty amount for non-serious violations	$2,884	$415	$786	$2,431

Appendix Table 21:
Inspector Differences in Penalties Levied

	Complaint Inspections, Safety			
	Mean	Q1	Median	Q3
Average penalty per violation	$230	$65	$115	$217
Average total penalty amount	$2,026	$196	$417	$1,044
Average penalty per non-serious violation	$348	$71	$109	$181
Average total penalty amount for non-serious violations	$1,155	$186	$334	$614

Appendix Table 22:
Inspector Differences in Penalties Levied

	Complaint Inspections, Health			
	Mean	Q1	Median	Q3
Average penalty per violation	$356	$101	$152	$276
Average total penalty amount	$2,650	$405	$923	$2,185
Average penalty per non-serious violation	$388	$104	$151	$273
Average total penalty amount for non-serious violations	$1,566	$343	$650	$1,077

Appendix Table 23:
Inspector Differences in Penalties Levied

	Accident Inspections, Safety			
	Mean	Q1	Median	Q3
Average penalty per violation	$5,725	$600	$1,072	$2,913
Average total penalty amount	$19,171	$1,523	$3,391	$15,684
Average penalty per non-serious violation	$1,779	$210	$325	$1,413
Average total penalty amount for non-serious violations	$3,304	$383	$694	$3,269

Appendix Table 24:
Inspector Differences in Penalties Levied

	Other Inspections			
	Mean	Q1	Median	Q3
Average penalty per violation	$2,003	$60	$247	$779
Average total penalty amount	$8,542	$179	$967	$3,092
Average penalty per non-serious violation	$1,186	$77	$162	$293
Average total penalty amount for non-serious violations	28.67	1.81	4.28	9.18

Appendix Table.1 shows that these inspectors had an average of 8 years of experience with 10 percent with at most 2 years of experience and 10 percent with at least 16 years of experience. While the average inspector spends almost 6 hours per inspection, 10 percent spend less than 3 hours and 10 percent spend 9 hours or more. We also investigated differences across inspectors in having a worker accompany them during their inspection, separately for unionized and non-unionized employers. While on average inspectors have a worker accompany them 23 percent of the time at non-union employers and 49 percent of the time at union employers there is great variability inspector to inspector. Half of all inspectors have a worker accompany them 8 percent of the time or less and10 percent never have a worker accompany them at non-union employers. At the other end of the spectrum, the inspectors in the top ten percent have a worker accompany them 79 percent of the time or more. At union employers half of inspectors have a worker accompany them less than half the time and the other half more than half the time. At the low end, 10 percent of inspectors have workers accompany them 7 percent of the time or less and at the high end, 10 percent of inspectors have workers accompany them 94 percent of the time or more. On the final measure of this set, with accident and complaint inspections inspectors may do either a comprehensive or a limited inspection and on average, inspectors do a comprehensive inspection 28 percent of the time. This percentage also varies considerably by inspector with at least 10 percent of inspectors never carry out a comprehensive accident/complaint inspection and the top ten percent carrying out comprehensive accident/complaint inspections 68 percent of the time or more.

As shown in Appendix Tables 2 through 6, the inspectors with at least 30 inspections of each of these types, who are subsets of the inspectors with 30 inspections of any type, are on average more experienced than the full set of inspectors. The time spent

at inspection sites is considerably shorter for Complaint Safety inspections and for each type of inspections there remains considerable inspector to inspector variation in their average amounts of time spent.

Appendix Table 3 shows that Complaint Safety inspections at non-union employers are less likely to have a worker accompany the inspector but more likely to be comprehensive inspections regardless of union status. While there are few other consistent differences in this set of measures by inspection type, wide variation persists within inspection type across inspectors. For example, in Accident Safety inspections, 10 percent of inspectors never do comprehensive inspections, half carryout comprehensive inspections less than 9 percent of the time, but ten percent carry out comprehensive inspections at least half the time. On Complaint Health inspections, while on average a worker accompanies the inspector at union employer about half the time, 10 percent of inspectors have a worker accompany them only about 5 percent of the time and 10 percent of inspectors have a worker accompany them more than 80 percent of the time.

Citing of Violations

When considering all inspection types at once, the average inspector cites no violations in about 40 percent of their inspections. However, the ten percent of inspectors who cite violations most often cite no violations less than 20 percent of the time and the ten percent who cite violations least often cite no violations more than 60 percent of the time. When violations are cited the average inspector cites about three separate violations per inspection while this varies from inspectors tending to cite only one violation up to inspectors who tend to cite five or more violations per inspection. The number of serious violations cited is about one every other inspection for the average inspector but ranges from about one in ten inspections for some inspectors to two every three inspections for other inspectors. We also consider citing of violations of two specific sets of standards that are of particular interest: IIPP standards and personal protective equipment (PPE). IIPP standards are of current policy interest in CA and nationally. The average inspector cites IIPP in about 40 percent of their inspections with considerable inspector to inspector variation. At the low end, about one in ten inspectors cite IIPP less than 20 percent of the time and at the other extreme another one in ten cites IIPP more than 60 percent of the time.

As shown in Appendix Table 8, the percent of programmed inspections with no violations cited is considerably lower than for other inspection types with higher average number of violations cited and higher average number of serious violations cited. For

programmed inspections and the other specific inspection types, there remains considerable inspector to inspector variation in the citing of violations with inspectors citing the most violations citing four to eight times more than the inspectors that are citing the least violations. The distribution of inspectors' inspections in which they cite IIPP or PPE is fairly consistent across inspection types. As with the other summary measures, the probability of citing IIPP varies considerably from inspector to inspector within inspection category.

Range of Standards Cited

Across all inspection types, the average inspector cites about three unique standards (at the four digit level) per inspection and cites nearly seventy unique standards over all of their inspections. The number of unique standard types that inspectors cite varies across inspectors with some inspectors citing fewer than 25 unique standards and other citing more than 100 unique standards across all of their inspections. To further investigate the extent to which inspectors tend to cite the same standards repeatedly versus citing a wide range of standards, we considered the proportion of all the standards an inspector cited that were (at the four digit level) one of each inspector's five or ten most cited standards. For the average inspector, more than 60 percent of all standards they cite are one of their 'top 10' most cited standards and 46 percent of all standards they cite are one of only five standards that they cite most often. Equivalently, fewer than 40 percent of the standards the average inspector cites are standards other than their 10 most cited standards and only 54 percent of the standards the average inspector cites are standards other than their 5 most cited standards. The degree to which inspectors cite the same standards repeatedly versus citing many different standards varies across inspectors with the proportion of standards that are among an inspector's 'top 5' ranging from 30 to 50 percent and the proportion of standards that are among an inspector's 'top 10' ranging from 45 to 65 percent.

Appendix Tables 14 through 17 demonstrate that the number of unique standards cited is higher when considering each category of inspections, likely due at least in part to inspectors with at least 30 inspections in a category having more experience on average than inspectors with at least 30 inspections of any type. The inspector to inspector variability in their standard type concentration or variety persists within inspection categories. For instance, in Programmed inspections, ten percent of inspectors cite a wide range of standards with 45 percent or fewer of their standards among their 'top 10' while the ten percent of inspectors who cite the narrowest range of standards have more than

70 percent of their standards among their 'top 10'. Or among Accident Safety inspections, the least variable inspectors cite fewer than 55 unique standards and the most variable inspectors cite nearly 150 unique standards.

Penalties Levied

The distribution of penalty amounts is highly skewed as most penalties are relatively small and only a small proportion of penalties are large or very large. This skew causes the average across inspectors of the penalty variables to be much higher than the median or even the 75th percentile of the inspector values on these variables. Due to the strong influence of very high penalties, we focus here on the percentile results rather than the averages. At the low end of the distribution, a quarter of inspectors levy penalties (on average) of $170 or less per violation and at the high end of the distribution a quarter of inspectors levy penalties of $1,311 or more per violation. Overall, half of inspectors levy penalties of less than $380 per violation. Inspector average total penalties levied *per inspection* vary substantially with a quarter of inspectors levying average penalties per inspection of $521 or less and a quarter of inspectors levying average penalties per inspection of more than $8,500. There is somewhat less inspector to inspector variability when only penalties for violations deemed less than serious are considered. For the average penalty per non-serious violation, half of inspectors levy penalties of less than $200 and a quarter levy penalties of more than $850. In terms of the total penalties for non-serious violations at the inspection level, half of inspectors levy penalties of less than $700 and a quarter levy penalties of more than $2,400.

As shown in Appendix Table 20, the average penalties per violation (all violations or non-serious violations only) are somewhat lower in programmed inspections but, consistent with the higher number of violations shown in Appendix Table 8, the total penalties per inspection are higher. Based on the median inspector, penalty amounts (per violation and per inspection) tend to be lower in Complaint inspections, both Safety and Health, and tend to be higher in Accident Safety inspections. Within each inspection category the inspector to inspector variation in penalty amounts levied continues to vary tremendously: inspectors in the top 25 percent levy penalties two to 10 times larger than the lowest 25 percent.

The inspector level statistics suggest that there is a great deal of variability from one inspector to another in the characteristics of their inspections, the extent to which they cite violations and the variety of different standards they cite, and the penalties that are levied for the violations cited. While we have considered that some of these inspector

differences may be due to different inspectors specializing in different types of inspections that would naturally have different characteristics and results, we find that the differences between inspectors persist when we focus on particular inspection types.

However, there are a number of reasons that inspector's inspections may look quite different that could be due to differences in the establishments they are inspecting rather than inspector specific factors. As inspectors are not randomly assigned to establishments to inspect, there likely are differences in the mix of establishments and attention to safety and health by the establishments at which each inspector carries out his/her inspections.

APPENDIX C. VARIATION IN INSPECTION PRACTICES, DISTRICT LEVEL, BY INSPECTION TYPE

Variations in District Practices

Appendix Table 25:
District Differences in Inspection Attributes

	All Inspection Types			
	Mean	Q1	Median	Q3
Average time inspectors are on site of the inspection (hours)	6.1	4.5	5.2	6.3
Percent of non-union inspections where a worker accompanied inspector	22%	12%	19%	29%
Percent of union inspections where a worker accompanied inspector	48%	39%	43%	58%
Percent of accident/complaint inspections which were comprehensive	28%	17%	24%	39%

Appendix Table 26:
District Differences in Inspection Attributes

	Programmed Inspections			
	Mean	Q1	Median	Q3
Average time inspectors are on site of the inspection (hours)	7.5	2.8	4.3	8.4
Percent of non-union inspections where a worker accompanied inspector	23%	9%	15%	35%
Percent of union inspections where a worker accompanied inspector	43%	20%	43%	58%
Percent of accident/complaint inspections which were comprehensive	–	–	–	–

Appendix Table 27:
District Differences in Inspection Attributes

	Complaint Inspections, Safety			
	Mean	Q1	Median	Q3
Average time inspectors are on site of the inspection (hours)	5	3.4	3.9	5
Percent of non-union inspections where a worker accompanied inspector	21%	11%	16%	29%
Percent of union inspections where a worker accompanied inspector	51%	36%	46%	64%
Percent of accident/complaint inspections which were comprehensive	35%	19%	36%	52%

Appendix Table 28:
District Differences in Inspection Attributes

	Complaint Inspections, Health			
	Mean	Q1	Median	Q3
Average time inspectors are on site of the inspection (hours)	6.8	5.2	6.7	7.4
Percent of non-union inspections where a worker accompanied inspector	17%	7%	18%	23%
Percent of union inspections where a worker accompanied inspector	51%	37%	47%	62%
Percent of accident/complaint inspections which were comprehensive	31%	19%	28%	44%

Appendix Table 29:
District Differences in Inspection Attributes

	Accident Inspections, Safety			
	Mean	Q1	Median	Q3
Average time inspectors are on site of the inspection (hours)	9.3	4.6	6.1	7.1
Percent of non-union inspections where a worker accompanied inspector	26%	10%	22%	35%
Percent of union inspections where a worker accompanied inspector	46%	30%	46%	56%
Percent of accident/complaint inspections which were comprehensive	19%	10%	16%	23%

Appendix Table 30:
District Differences in Inspection Attributes

	Other Inspections			
	Mean	Q1	Median	Q3
Average time inspectors are on site of the inspection (hours)	5.5	3.9	4.6	5.6
Percent of non-union inspections where a worker accompanied inspector	21%	9%	17%	33%
Percent of union inspections where a worker accompanied inspector	40%	25%	40%	52%
Percent of accident/complaint inspections which were comprehensive	17%	8%	10%	20%

Appendix Table 31:
District Differences in Violations Cited

	All Inspection Types			
	Mean	Q1	Median	Q3
Percent with no violations cited	38%	29%	37%	45%
Average number of violations cited per inspection	2.81	2.03	2.61	3.06
Average number of serious violations cited per inspection	0.71	0.33	0.49	0.82
Average number of unique standards cited per inspection	3.11	2.58	2.89	3.37
Percent with IIPP cited	41%	32%	45%	49%

Appendix Table 32:
District Differences in Violations Cited

	Programmed Inspections			
	Mean	Q1	Median	Q3
Percent with no violations cited	34%	20%	35%	45%
Average number of violations cited per inspection	4.17	2.7	3.71	4.59
Average number of serious violations cited per inspection	1	0.44	0.68	1.11
Average number of unique standards cited per inspection	4	2.83	3.33	4.17
Percent with IIPP cited	36%	20%	37%	53%

Appendix Table 33:
District Differences in Violations Cited

	Complaint Inspections, Safety			
	Mean	Q1	Median	Q3
Percent with no violations cited	37%	28%	37%	45%
Average number of violations cited per inspection	3.01	2.21	2.81	3.1
Average number of serious violations cited per inspection	0.6	0.25	0.37	0.54
Average number of unique standards cited per inspection	3.34	2.75	3.03	3.56
Percent with IIPP cited	40%	32%	39%	48%

Appendix Table 34:
District Differences in Violations Cited

	Complaint Inspections, Health			
	Mean	Q1	Median	Q3
Percent with no violations cited	37%	27%	34%	48%
Average number of violations cited per inspection	3.34	2.25	3.19	3.95
Average number of serious violations cited per inspection	0.79	0.26	0.45	0.68
Average number of unique standards cited per inspection	3.36	2.74	3.12	3.95
Percent with IIPP cited	40%	34%	43%	49%

Appendix Table 35:
District Differences in Violations Cited

	Accident Inspections, Safety			
	Mean	Q1	Median	Q3
Percent with no violations cited	33%	25%	31%	39%
Average number of violations cited per inspection	2.31	1.61	2.03	2.63
Average number of serious violations cited per inspection	0.89	0.45	0.59	1
Average number of unique standards cited per inspection	2.45	2	2.28	2.68
Percent with IIPP cited	44%	35%	46%	56%

Appendix Table 36:
District Differences in Violations Cited

	Other Inspections			
	Mean	Q1	Median	Q3
Percent with no violations cited	51%	42%	52%	61%
Average number of violations cited per inspection	1.98	1.38	1.71	2.54
Average number of serious violations cited per inspection	0.55	0.31	0.46	0.71
Average number of unique standards cited per inspection	2.75	2.35	2.74	3.11
Percent with IIPP cited	42%	33%	43%	55%

Appendix Table 37:
District Differences in Penalties Levied

	All Inspection Types			
	Mean	Q1	Median	Q3
Average penalty per violation	$ 3,122	$ 280	$ 880	$ 1,682
Average total penalty amount per inspection	$ 14,349	$ 2,339	$ 4,672	$ 9,622
Average penalty per non-serious violation	$ 1,423	$ 342	$ 549	$ 950
Average total penalty amount for non-serious violations per inspection	$ 3,662	$ 709	$ 1,616	$ 2,774

Appendix Table 38:
District Differences in Penalties Levied

	Programmed Inspections			
	Mean	Q1	Median	Q3
Average penalty per violation	$ 516	$ 148	$ 240	$500
Average total penalty amount per inspection	$ 6,510	$ 1,281	$ 2,305	$8,924
Average penalty per non-serious violation	$ 789	$ 121	$ 271	$1,054
Average total penalty amount for non-serious violations per inspection	$ 2,835	$ 494	$ 1,558	$4,061

Appendix Table 39:
District Differences in Penalties Levied

	Complaint Inspections, Safety			
	Mean	Q1	Median	Q3
Average penalty per violation	$683	$114	$244	$352
Average total penalty amount per inspection	$5,238	$1,374	$1,961	$3,053
Average penalty per non-serious violation	$626	$87	$250	$602
Average total penalty amount for non-serious violations per inspection	$2,287	$274	$991	$1,847

Appendix Table 40:
District Differences in Penalties Levied

	Complaint Inspections, Health			
	Mean	Q1	Median	Q3
Average penalty per violation	$1,059	$126	$256	$555
Average total penalty amount per inspection	$6,816	$883	$1,969	$3,951
Average penalty per non-serious violation	$1,049	$128	$264	$435
Average total penalty amount for non-serious violations per inspection	$3,115	$379	$1,161	$1,925

Appendix Table 41:
District Differences in Penalties Levied

	Accident Inspections, Safety			
	Mean	Q1	Median	Q3
Average penalty per violation	$7,236	$1,296	$3,386	$4,995
Average total penalty amount per inspection	$27,364	$7,013	$11,224	$21,477
Average penalty per non-serious violation	$2,903	$441	$898	$2,450
Average total penalty amount for non-serious violations per inspection	$5,684	$846	$2,069	$5,443

Appendix Table 42:
District Differences in Penalties Levied

	Other Inspections			
	Mean	Q1	Median	Q3
Average penalty per violation	$1,463	$273	$557	$1,607
Average total penalty amount per inspection	$9,245	$1,225	$3,158	$8,993
Average penalty per non-serious violation	$1,525	$150	$344	$952
Average total penalty amount for non-serious violations per inspection	$3,396	$365	$997	$2,420

APPENDIX D. MODIFICATIONS TO THE WCIS AND ODI DATA

WCIS LOOKBACK Data:
Dropped SCOPE = C or D
Dropped SIC = missing
Dropped YEAR < 2003

WCIS CHANGE Data:
Dropped SCOPE = C or D
Drop AREA in 35000, 50663, 50664
Time points for calculating change:

Accident data required 12 consecutive months of employment/injury data beginning 2 month before the month of the index event and the same going forward starting the following month after the index event month.

Non-accident data required 12 consecutive months of employment/injury data beginning 1 month before the month of the index event and the same going forward starting the following month after the index event month.

Outcome variable defined 2 ways:
Original (lninjchga1b1): LOG((12 month after rate + 1) / (12 month before rate + 1))
Version 2–trimmed: set lninjchga1b1>1 to 1 and lninjchga1b1<-1 to -1
Drop if sum of monthly employment for preceding or post 12 months is 120 or less
Drop if the preceding or post rate is <0 or >100
Drop if inspector has less than 10 inspections in our data

APPENDIX E: MODEL RESULTS FOR TABLE 5

Appendix Table 43:
Model 1

Variables	Coefficient	St. Error	p-value
Constant	0.006	0.009	0.501
2003	-0.006	0.016	0.721
2004	0.037	0.014	0.011
2005	-0.019	0.014	0.193
2006	-0.035	0.015	0.021
2007	-0.035	0.017	0.035
Inspector Standard Deviation			0.051
Residual Standard Error			0.310
Rho			0.026
F-stat (5,140)	4.44		<0.001

NOTE: Inspectors with at least 20 inspections (n = 121 inspectors). 2002 is the omitted year

Appendix Table 44:
Model 2

Variables	Coefficient	St. Error	p-value
Constant	0.069	0.029	0.020
2003	0.002	0.016	0.924
2004	0.054	0.015	<0.001
2005	0.004	0.014	0.761
2006	-0.005	0.016	0.767
2007	-0.003	0.015	0.828
Manufacturing	-.015	0.009	0.128
Small Employer	-0.026	0.011	0.018
Medium Employer	0.017	0.011	0.119
Union	0.005	0.011	0.636
Walk Around	0.015	0.015	0.316
Health Inspection	0.001	0.016	.939
Complaint Inspection	0.002	0.012	0.892
Programmed Inspection	0.009	0.020	0.670
Other Inspection Type	0.010	0.018	0.564
Comprehensive‡	0.036	0.021	0.087
Penalty	-0.008	0.010	0.423
Years of Experience	-0.015	0.006	0.016
Experience Squared	0.001	0.000	0.098
	-0.003	0.015	0.828
Inspector Standard Deviation			0.060
Residual Standard Error			0.310
Rho			0.036
F-stat (17,140) 4.44			<0.001

‡Comprehensive Accident or Complaint Inspections

NOTE: This model also included inspector fixed effects for inspectors with at least 20 inspections (n = 121 inspectors). The coefficients for each inspector are omitted here. is The omitted year is 2002. "Large Employer" is the omitted size category. "Accident Inspection" is the omitted Inspection type category.

Appendix Table 45:
Model 3

Variables	Coefficient	St. Error	p-value
Constant	0.008	0.023	0.716
2003	-0.001	0.014	0.913
2004	0.045	0.014	0.001
2005	-0.014	0.014	0.323
2006	-0.032	0.014	0.026
2007	-0.035	0.019	0.065
Manufacturing	-0.014	0.009	0.091
Small Employer	-0.024	0.011	0.038
Medium Employer	0.016	0.013	0.207
Union	0.008	0.011	0.452
Walk Around	0.016	0.010	0.115
Health Inspection	0.013	0.011	0.223
Complaint Inspection	0.003	0.011	0.785
Programmed Inspection	0.005	0.020	0.790
Other Inspection Type	0.002	0.017	0.917
Comprehensive*	0.021	0.016	0.196
Penalty	-0.004	0.010	0.696
Years of Experience	-0.002	0.004	0.595
Experience Squared	0.000	0.000	0.774
Region 2, District 1 is the omitted District			
Region 1, District 1	0.031	0.055	0.577
Region 1, District 2	0.039	0.026	0.133
Region 1, District 3	-0.010	0.040	0.809
Region 1, District 4	0.001	0.020	0.948
Region 1, District 5	-0.003	0.029	0.914
Region 2, District 2	0.006	0.027	0.815
Region 2, District 4	-0.011	0.022	0.632
Region 2, District 5	0.025	0.025	0.320
Region 2, District 7	0.055	0.044	0.212
Region 3, District 1	-0.011	0.023	0.624
Region 3, District 2	-0.020	0.030	0.508
Region 3, District 3	0.019	0.019	0.325
Region 3, District 5	0.004	0.024	0.881
Region 3, District 6	0.034	0.042	0.420
Region 3, District 7	0.081	0.040	0.042
Region 4, District 1	-0.030	0.034	0.378
Region 4, District 2	0.021	0.021	0.326
Region 4, District 3	0.044	0.025	0.072
Region 4, District 4	-0.002	0.020	0.908
Region 4, District 5	-0.025	0.062	0.682
Region 6, District 1	0.015	0.029	0.600
Region 6, District 2	0.023	0.023	0.318
F-stat (40,5687)	2.31		<0.001

Appendix Table 46:
Effects of Inspection Practices on Inspection Outcomes

Variables	Coef.	Std. Err.	p-value
y2003	0.002506	0.013768	0.856
y2004	0.048217	0.014343	0.001
y2005	-0.0081	0.014822	0.585
y2006	-0.02305	0.016129	0.153
y2007	-0.02488	0.021326	0.243
manf	-0.01495	0.008527	0.08
empin_sm	-0.02496	0.01137	0.028
empin_md	0.017724	0.012864	0.168
union	0.006891	0.010421	0.508
walk	0.016275	0.009275	0.079
health	0.01116	0.011093	0.314
typecomp	0.000982	0.01091	0.928
typeprog	0.015225	0.015968	0.34
typeothr	0.009887	0.01674	0.555
PENf	-0.00215	0.009739	0.825
comprehens~e	0.025101	0.01572	0.11
yrsexp	-0.00451	0.004588	0.325
yrsexpsq	0.000112	0.000226	0.621
jaSERVIO	0.005825	0.009339	0.533
jpct0viol	0.016201	0.035224	0.646
jpcttop5vio	0.027032	0.053341	0.612
jexperience	0.002387	0.002533	0.346
_cons	-0.02408	0.03999	0.547
Number of obs	5708		
F (22,5685)	3.38		
Prob > F	0.0000		
R-squared	0.012		
Adj R-squared	0.0091		
Dependent	lninjchgtrim		

PENf—was any penalty assessed (current penalty)
comprehens-e–accident or complaint inspection that was comprehensive in scope
yrsexp—inspector's years of experience at Cal-OSHA
yrsexpsq–the square of the years of experience
jaSERVIO—the inspector's average number of serious violations per inspection
jpct0viol–per cent of inspector's inspection which cite zero violations
jpcttop5vio–per cent of violations cited that are among the inspectors' 5 most frequently cited standard
lninjchgtrim—the change in the log of the injury rate from pre-inspection to post-inspection

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