COMING CLEAN…AND CLEANING UP?
EXAMINING THE EFFECTS OF SELF-POLICING

MICHAEL W. TOFFEL*
Harvard Business School
Morgan Hall 497
Boston, MA 02163
mtoffel@hbs.edu
Tel: (617) 384-8043
Fax: (206) 339-7123

JODI L. SHORT
Department of Sociology
University of California, Berkeley
415 63rd Street
Oakland, CA 94609
jodishort@earthlink.net
Tel: (510) 594-7467

July 4, 2007

* Corresponding author. Harvard Business School, Morgan Hall 497, Boston MA 02163. (617) 384-8043. Insightful comments by Neil Fligstein, Robert Kagan, Andrew King, David I. Levine, John W. Maxwell, Howard Shelanski, Bill Simpson, Jason Snyder, as well as the participants of the 2007 Harvard-Boalt-UCLA Junior Faculty Environmental Law Workshop are gratefully acknowledged. Ara Abrahamian provided excellent research assistance.

COMING CLEAN…AND CLEANING UP?
EXAMINING THE EFFECTS OF SELF-POLICING

Abstract

As regulators increasingly embrace cooperative approaches to governance, voluntary public-private partnerships and self-regulation programs have proliferated. However, because few have been subjected to robust evaluation, little is known about whether these innovative approaches are achieving their objectives. In the context of a nationwide self-policing program that encourages companies to voluntarily self-disclose regulatory violations, we examine the behaviors of facilities and regulators to gain empirical insights on the theoretical promise of self-policing. We find that regulators reduce their scrutiny over self-policing facilities, and especially over facilities with strong past compliance records. We also find that self-policing is associated with subsequent improvements in compliance records.

COMING CLEAN…AND CLEANING UP?
EXAMINING THE EFFECTS OF SELF-POLICING

1. INTRODUCTION

As part of a trend toward collaboration between the public and private sectors, regulatory agencies have developed a variety of "self-policing" programs that shift the burden of monitoring regulatory compliance from the government to firms themselves. For example, firms with comprehensive safety management programs and low injury rates can join the US Occupational Safety and Health Administration's (OSHA) *Voluntary Protection Program*, which exempts participants from routine OSHA inspections (Chelius and Stark 1984). The US Department of Veterans Affairs sponsors an initiative that encourages medical professionals to self-disclose medical errors (Andrus *et al.* 2003). And the US Department of Justice, the US Department of Defense, and the Securities and Exchange Commission offer incentives including amnesty, limited liability, prosecutorial leniency, and confidentiality to encourage companies to disclose fraudulent or other illegal behavior (Duggin 2003; Fleder 1999; Medinger 2003). While these kinds of programs have proved exceedingly popular in an era of shrinking regulatory budgets, little is known about the effects of the programs themselves or the motivations of those who participate in them. The act of self-disclosure presents a behavioral paradox. Tasked with policing the legality of its own operations, it is not clear why a firm would turn itself in to regulators. Nor is it obvious why regulators would voluntarily forfeit enforcement powers to regulated entities. The goal of this paper is to explore what sort of benefits might justify each party's participation in a self-policing arrangement.

There has been surprisingly little research evaluating the outcomes of self-policing programs. The literature on self-policing is largely theoretical and primarily focuses on program design (e.g., Innes 1999a, b; Innes 2001; Kaplow and Shavell 1994; Malik 1993; Pfaff and Sanchirico 2000). Existing evaluations of voluntary programs typically address themselves to the achievements of "beyond compliance" programs rather than self-policing initiatives (Khanna and Damon 1999; Vidovic and

Khanna 2005). As self-policing programs proliferate, it is important to understand what kind of results these programs produce. We address this need by conducting one of the first empirical evaluations to assess the effects of self-policing on regulatory outcomes. Specifically, we examine the US Environmental Protection Agency's (EPA) *Audit Policy*, a self-policing program that encourages firms to self-disclose environmental compliance violations by offering to mitigate their associated penalties. We examine whether regulators reduce their scrutiny over self-policing facilities, and whether self-policing is associated with improved future compliance records.

We explore these questions in the enforcement context of one of the most widely applicable federal environmental statutes, the Clean Air Act (CAA). We find that, in this statutory context, self-disclosures result in significantly reduced regulatory scrutiny, especially for facilities with clean past compliance records. In addition, we find that voluntary disclosers improve their compliance rates. These findings suggest an important role for self-policing in a broader enforcement scheme.

2. LITERATURE REVIEW

Much of the prior literature on self-policing uses economic models to better understand the self-reporting of legal violations (Innes 2001; Kaplow and Shavell 1994; Pfaff and Sanchirico 2000). This literature suggests a number of reasons why self-policing might benefit both regulator and regulated. Firms that voluntarily turn themselves in, for instance, are said to economize on avoidance costs (Innes 2001) and optimize their levels of self-auditing (Pfaff and Sanchirico 2000). Regulators benefit because self-policing has been shown to save enforcement resources that otherwise would have to be spent identifying self-disclosing wrongdoers (Kaplow and Shavell 1994) and to ensure lower-cost remediation of voluntarily disclosed violations (Innes 1999a).

The limited empirical research on self-policing programs has, however, called into question some of these assumptions. Short and Toffel (Forthcoming), for instance, demonstrate that regulators must devote substantial enforcement resources to get firms to participate in self-policing. And Pfaff and Sanchirico (2004) suggest that firms do not report significant violations under the EPA Audit Policy

because it is a "bad deal" for companies. In short, we know very little about the practices that have come to underlie so many new agency programs.

The few empirical studies of self-policing have identified some factors that encourage firms to "turn themselves in" by self-reporting undetected compliance violations. In essence, what these studies find is that companies are most likely to come clean when they fear they will get caught. So, for instance, Short and Toffel (Forthcoming) find that facilities are more likely to self-report if they were subjected to recent regulatory inspections, prosecuted in an enforcement action, or targeted for heightened scrutiny by a compliance incentive program. Stretesky and Gabriel (2005) find that, compared to companies whose Clean Air Act violations were uncovered by regulators, companies located in industries and regions with high inspection levels are more likely to self-disclose such violations under the Audit Policy. Similarly, related studies find that recently inspected firms are more likely to comply with regulations requiring them to self-report pollution levels and violations (Helland 1998; Laplante and Rilstone 1996).

While there is some literature examining the determinants of self-policing, to our knowledge, no studies have examined the consequences of self-policing programs. For example, the US General Accounting Office recently noted that "OSHA currently lacks the data needed to fully assess the effectiveness of its voluntary compliance programs" (US GAO 2004b: 29) including its *Voluntary Protection Program,* which has been offered since 1982. Similarly, despite the Federal Aviation Association's (FAA) having launched its *Aviation Safety Reporting Program*'s in 1975, "FAA and NASA have no formal national evaluation program to measure the overall effectiveness of the program" (US GAO 2004a: 43). The US EPA's *Audit Policy*, the subject of the current study, has only been "evaluated" once. Three years after the program's inception 1995, the US EPA surveyed participants and state regulators who were involved in the program and reported high levels of participant satisfaction. The report included several anecdotes from participants who claimed the program helped them reduce risks to the environment and human health (Federal Register 1999). Thus, to our knowledge, the current study is the first robust empirical examination of the consequences of self-policing.

In this way, our work will contribute to two related bodies of literature evaluating outcomes under different kinds of voluntary programs. A few studies have examined the effects of third-party monitoring of regulatory compliance. For example, Esbenshade (2001) and Weil (2005) examined an innovative initiative by the US Department of Labor that encouraged major apparel companies to monitor their Los Angeles-based garment suppliers. In her qualitative study, Esbenshade (2001) found that while such independent monitoring was erratic and often failed to follow the agency's guidelines, it was nonetheless prolific: apparel companies and the independent monitors they hired conducted more than 10,000 audits of garment manufacturers in 1998 alone, ten times the number of inspections conducted by state and federal regulators. A second study, based on a robust quantitative evaluation, concluded that garment contractors monitored by their buyers exhibited fewer, and less egregious, violations of minimum wage regulations (Weil 2005).

A second related body of work evaluates the outcomes of government-initiated voluntary programs that encourage firms to (1) perform beyond minimal compliance thresholds (Khanna and Damon 1999; Vidovic and Khanna 2005) or (2) promote regulatory objectives in domains where the regulator has no formal sanctioning authority, such as encouraging energy efficiency to reduce carbon dioxide emissions (Welch et al. 2000). Similarly, some evaluations have examined self-regulation programs purporting to achieve regulatory objectives such as reducing pollution and enhancing worker safety that are initiated by industry associations (King and Lenox 2000; Rivera et al. 2005) and international consortia (Toffel 2006). These studies find that voluntary programs have very little effect.

This paper represents an important contribution to the literature on self-policing and self-regulation. First, it expands previous work on the determinants of self-policing. Existing studies explain self-policing behavior solely in terms of the risks of non-disclosure, but this paper addresses the potential benefits of voluntary disclosure, and thus provides additional explanations for self-policing. Second, it provides a rigorous empirical analysis of self-policing outcomes that, to date, does not exist. Moreover, it examines outcomes from the perspective of both the regulator and the regulated entity. Finally, it overcomes some of the limitations of prior evaluative studies, which typically focus on a single industry

(Esbenshade 2001; King and Lenox 2000; Rees 1994; Rivera et al. 2005; Weil 2005). Our study spans a wide variety of industries, which should produce more generalizable insights about the dynamics of industry self-regulation.

3. EMPIRICAL CONTEXT: US EPA AUDIT POLICY

The US EPA's "Incentives for Self-Policing: Discovery, Correction and Prevention of Violations" (Audit Policy), launched in 1995, provides the empirical setting for our research. The main objective of the Audit Policy is to encourage facilities to implement "systematic, objective, and periodic" environmental auditing and to develop a "documented, systematic procedure or practice which reflects the regulated entity's due diligence in preventing, detecting, and correcting violations" (Federal Register 1995: 66708). Under this program, when a facility promptly discloses a violation to US EPA, corrects the violation, and takes steps to prevent future violations, US EPA reduces or waives the penalties that would have accrued and provides a loose assurance that it will not refer the voluntarily reported case to the US Department of Justice for criminal prosecution. The Audit Policy cannot be applied to violations that are similar to others the facility experienced within the past several years, or to violations that "resulted in serious actual harm or which may have presented an imminent and substantial endangerment to public health or the environment" (Federal Register 1995: 66709). Overall, nearly 3500 facilities have self-disclosed violations under the Audit Policy during 1997-2003. These self-reported violations include "paperwork" violations like failures to report toxic chemical emissions or properly label hazardous materials, as well as violations with more direct environmental consequences, like illegal shipments of hazardous waste to unauthorized facilities and failures to install legally required air pollution control equipment (Federal Register 1999).

The US EPA's Audit Policy is an attempt to alter significantly the enforcement dynamic between regulator and regulated. In fact, US EPA has expressed hope that private sector self-policing will "[render] formal EPA investigation and enforcement action unnecessary" (US EPA 2005). The Audit Policy attempts to achieve this by requiring participating firms to maintain a systematic, internal auditing

system to monitor compliance with environmental regulations. While the particular violations disclosed under the program are certainly helpful to the regulator, the real leverage of the program is its insistence on company-wide compliance monitoring. If self-disclosing is a reliable indicator that the company is conducting effective internal compliance audits that lead to adequate regulatory compliance, then US EPA could improve its inspection efficiency by reallocating its enforcement resources to focus on non-participants, who would thus be more likely to have violations.

4. HYPOTHESES

We evaluate the effects of the EPA Audit Policy on regulatory enforcement effort and outcomes. To assess the benefits of the program from the participants' perspective, we examine whether voluntarily self-disclosing earns the regulator's goodwill. We also evaluate the program's benefits from the regulator's perspective, by examining whether firms that engage in the compliance monitoring required by the Audit Policy "clean up their act" more broadly and improve their overall regulatory compliance by exhibiting fewer violations.

4.1 Inspections

It is often suggested that firms self-report violations under the Audit Policy to generate goodwill with the regulator that might result in tangible benefits, such as reduced regulatory scrutiny (Pfaff and Sanchirico 2004; Short and Toffel Forthcoming). However, the Audit Policy provides no guarantee that participating firms will enjoy any such benefit. US EPA has adopted the stance that: "[a]uditing does not…replace regulatory agency inspections" (Johnson and Frey 2000: 4), and the agency's Office of Enforcement Policy has noted that regardless of self-policing efforts, "inspections play a major role in assuring quality and lending credibility to self-monitoring programs" (Wasserman 1990). Despite these claims, US EPA does nonetheless leave open the possibility that facilities that self-disclose violations to

the Audit Policy might be subjected to fewer inspections (Johnson and Frey 2000; US EPA 1997).[1] Although the agency cautiously avoids making explicit promises, US EPA acknowledges that the Audit Policy can only attract self-disclosures if it avoids the impression that self-disclosing will attract increased regulatory scrutiny.[2] An "inspection holiday," or a decrease in regulatory scrutiny following self-disclosure, would provide significant benefits to participating firms. It reduces direct costs associated with the conduct of inspections, including the staff time and resources that would be distracted from business activities (Shover *et al.* 1984) and the cost of tests conducted during inspections that the firm would have to bear (US EPA 1986). In addition, inspection holidays reduce the likelihood that the firm's violations will be discovered and punished (Dimento 1989).

Inspection holidays also provide potential benefits to regulators. First, they can be used as an incentive to encourage self-reporting and participation in compliance monitoring and auditing. For example, when US EPA launched its Environmental Leadership Program, designed to strengthen internal corporate environmental management practices, the agency "promise[d] not to perform routine inspections during the pilot period" (Orts and Murray 1997:20). Second, regulators may use inspection holidays as a part of a broader targeting strategy, to free up enforcement resources that can then be used to pursue less cooperative firms. According to US EPA (1999b: 17), "approximately half of the states indicate that their resources are insufficient to meet their inspection commitments." The non-profit Environmental Working Group reports that declining environmental enforcement budgets have led to hundreds of "significant" and "high priority" facilities not being inspected at all during the two-year period they analyzed (Coequyt and Wiles 2000). These severe limitations on agency resources

---

[1] For example, US EPA noted in 1997 that "EPA's longstanding policy is not to agree to limit its non-penalty enforcement authorities as a provision of settlement or otherwise. While EPA may consider such a facility to be a lower inspection priority than a facility that is not known to be auditing, whether and when to conduct an inspection does, and should, remain a matter of Agency discretion" (US EPA 1997: vi). Also, US EPA's Regional Council notes that "While EPA inspections of self-audited facilities will continue, to the extent that compliance performance is considered in setting inspection priorities, facilities with a good compliance history may be subject to fewer inspections" (Johnson and Frey 2000: 5).

[2] In a conversation with one of the authors, a US EPA program administrator noted, "The Agency has to avoid the perception that it is picking on companies who participate in the Audit Policy." (Personal communication, March 16, 2004).

"underscore a need for a targeted approach to inspections" (US EPA 1999b: 17), and voluntary disclosures can play an important role in developing that approach. Some regulatory agencies are explicitly using their industry partnerships to hone their inspection targeting. For example, the US Occupational Safety and Health Administration (OSHA) publicizes reduced inspection priority as a benefit to participants of its *OSHA Star Program* (Hunt and Wilkins 1992), while the US EPA does the same for participants of its *National Performance Track* program (US EPA 2006). US EPA also uses a "carrot and stick" approach in many of its Compliance Incentive Programs, which notify targets that they are more likely to be inspected if they fail to participate by auditing themselves and disclosing violations.[3] Because inspection holidays provide substantial potential benefits to both regulators and regulated firms, we hypothesize that self-reporters subsequently will face fewer inspections.

However, because the regulator's approach to inspections is highly discretionary, it is important to consider the possibility that self-disclosures may produce different results under different circumstances. Voluntary disclosure does not occur in a vacuum, but rather against a tapestry of existing impressions and ongoing relationships, including the firm's prior reputation with the regulator. Regulators tend to categorize firms as "good apples" or "bad apples" based on their past compliance records for purposes of targeting inspection resources (Harrington 1988; Helland 1998). Self-disclosures provide regulators with new information that may influence (or be influenced by) these existing assessments of firms. However, it is not clear how regulators will interpret the mixed signal that the voluntary disclosure of a legal violation sends. Will it be seen as an admission of wrongdoing or a gesture of cooperation and future compliance?

On the one hand, voluntarily disclosing violations might be a strategic way of changing regulators' impressions. Some have argued, for instance, that historically poor compliers may be motivated to self-disclose in an effort to burnish their reputation with the regulator and shake their "bad

[3] For example, in its letter encouraging iron and steel mini-mills to report violations under the Audit Policy, EPA wrote: "This is a unique opportunity to ensure compliance with environmental requirements before EPA and authorized states begin increased inspections of minimills."

apple" status (Pfaff and Sanchirico 2004; Short and Toffel Forthcoming). If self-disclosing violations changes regulators' impressions, however, this represents a risk to "good apples," as their disclosures might tarnish their good reputation and spur increased regulatory scrutiny.

On the other hand, voluntary disclosures may reinforce regulators' existing impression of firms as "good apples" or "bad apples." A substantial literature on cognitive biases suggests that regulators will "construe information and events in such a way as to confirm prior attitudes, beliefs, and impressions" (Langevoort 1997: 135). Especially when a signal is ambiguous, people will interpret it in light of what they already know to be true, discarding interpretations that conflict with their pre-existing knowledge (Langevoort 1997; Nelson et al. 1997; Tannen and Wallat 1987). If this occurs systematically as regulators interpret voluntary disclosures, then "good apples" will see benefits from self-disclosing, while "bad apples" may further cement their status.

We empirically examine whether and how regulators respond differently to self-disclosures depending on the facilities' past compliance records.

4.2 Compliance Record

Both firms and regulators are motivated to participate in self-policing by the prospect of improved compliance records following self-disclosure. As Short and Toffel (Forthcoming) and Pfaff and Sanchirico (2004) suggest, firms may see self-disclosure as a way to garner the regulator's goodwill. One manifestation of regulatory favor might be more lenient future inspections in which firms are cited for fewer violations. This expectation is bolstered by research documenting that inspectors' citation practices differ depending on their attitude toward the firm (Aoki and Coiffi 2000; Hawkins 1984).

Improved compliance records are central to the regulator's interest as well. Self-policing is part of a targeting strategy to enhance the overall efficiency of the enforcement regime by identifying compliant firms and thus enabling regulators to shift their resources to less cooperative firms. Toward this end, US EPA only allows an organization to self-disclose violations to the Audit Policy if the organization discovered the violation through its own internal auditing program. This emphasis on

internal auditing is meant to encourage managers to identify and correct compliance problems before regulators arrive to conduct inspections. "First and foremost, environmental auditing informs a company of potential risks of violations and accidents. Better knowledge of these risks encourages prevention" (Orts and Murray 1997:9). By actively auditing their own compliance, the agency is hoping that self-reporters "clean up their act" and improve their regulatory compliance more broadly. To the extent that participation in self-policing motivates facilities to initiate or strengthen their internal compliance monitoring programs, regulatory inspections following voluntary disclosures should yield fewer violations. Accordingly, we hypothesize that, whether it is the result of improved compliance or regulatory goodwill, the compliance record of participating companies will improve following a voluntary disclosure.

5. METHODS

5.1 Data and measures

We gathered data on facilities located across the United States that are subject to the US Clean Air Act (CAA), a statute that applies to a wide range of industries and activities that emit air pollutants beyond regulatory thresholds. We compiled data on self-disclosures associated with the US EPA Audit Policy from the US EPA Integrated Compliance Information System (ICIS) database, the US EPA Audit Policy Docket, and lists of participants in various EPA Compliance Incentive Programs. US EPA provided these datasets in response to Freedom of Information Act requests.

We obtained data on CAA onsite inspections to which each facility was subjected during 1991 through 2003 from the US EPA's Aerometric Information Retrieval System (AIRS)/AIRS Facility Subsystem database.[4] From this database, we calculated the *number of annual inspections* as well as the number of *years since the facility was last inspected* for compliance with the CAA. We also calculated the *annual number of CAA violations*. We created a dummy variable coded 1 when the facility had at least

[4] To avoid spurious results, we recoded annual inspection tallies beyond 23, the 99.99th percentile, to 23. This affected only 98 of the 560,128 facility-year observations in our entire database of CAA inspections.

one *enforcement action*, based on data from the US EPA's ICIS database.[5]

We gathered data on several forms of general deterrence. First, we considered the *National Priority Sectors* that US EPA announced every two years that would be targeted as nationwide enforcement priorities. We coded this as a dummy variable based on data from the US EPA's website.[6] Second, we created a dummy variable to indicate facilities *targeted by US EPA Compliance Incentive Programs* based on data obtained from the agency via Freedom of Information Act requests. These programs encourage facilities in particular EPA Regions or industries, or that conduct specific regulated activities, to reexamine their compliance status regarding a particular regulatory issue and self-disclose and correct any violations they discover. Third, we created two annual state level variables based on AIRS data: the log of total penalties assessed by environmental regulators, and the log of the total number of CAA regulated facilities.

5.2 Inspection holiday model

To assess the effect of self-disclosures on regulatory inspections, we estimate the following difference-in-differences equation on the entire sample (Gawande and Bohara 2005; King and Lenox 2000; Lenox 2006) and on a matched sample as described below:

$$y_{it} = f(\beta_1 D_{i,t} + \beta_2 X_{i,t-j} + \beta_3 C_{i,t} + \beta_4 S_{i,t} + \beta_{5t} \lambda_t + \alpha_i, \varepsilon_{i,t}) \quad (1)$$

The dependent variable y_{it} refers to the number of CAA inspections to which facility *i* has been subjected in year *t*. Our key explanatory variable is *D*, a dummy variable coded 1 when the facility has self-disclosed in any prior year.[7]

We control for many potential determinants of inspections in *X*. According to several economic models, regulators can bolster the effectiveness of their limited enforcement budgets by targeting their

[5] Over 98% of facilities with enforcement actions had only a single one in a particular year. To be conservative and avoid spurious results, we created a dummy variable rather than a count variable to measure enforcement actions.
[6] US EPA's National Priority sectors can be found at http://www.epa.gov/compliance/data/planning/shortterm.html
[7] Prior studies have indicated that self-disclosure is associated with more inspections and enforcement actions (Short and Toffel Forthcoming; Stretesky and Gabriel 2005), both of which are included as control variables in the model.

inspections based on facilities' prior compliance records (Friesen 2003; Harrington 1988). In addition, US EPA notes that achieving compliance given its limited resources "is dependent on effective targeting of the most significant public health and environmental risks" (US EPA 1999a: 20). This means not only targeting enforcement resources in the most pressing problem areas, but also at the firms most likely to be creating those problems, "taking into account… compliance/enforcement history" (US EPA 1999a: 20). Indeed, facilities found in violation are often targeted for more frequent inspections in the near future (Harrington 1988; Helland 1998; US EPA 1990). Thus, we include the number of CAA violations for which the facility was cited, and a dummy variable indicating whether the facility was subjected to an enforcement action, each lagged one and two years. Because regulators may attempt to ensure that they return to inspect facilities before a certain time lag occurs, we create a series of dummy variables to denote the number of years since the facility was last subjected to a CAA inspection.

We include two dummy variables (C) to control for whether the facility was targeted for heightened inspector scrutiny via an EPA Compliance Incentive Program or an EPA National Priority sector. We control for variation in enforcement strategies within states over time by including the log of total penalties environmental regulators assessed and the log of total regulated facilities in each state-year (S).

Year fixed effects (λ) control for year-specific factors. We include conditional fixed effects (α_i) at the facility level to control for all time-invariant factors that might influence a facility's inspection rate, such as heterogeneity across state regulatory authorities, the facility's year of construction, industry, proximity to the inspection agency, and the affluence of the facility's community (Helland 1998).

Our difference-in-differences approach requires the identifying assumption that, if they had not participated in the Audit Policy, voluntary disclosers would have realized the same regulatory outcomes and performance that the control group experienced. However, as mentioned above, self-disclosure was more likely among facilities that recently experienced greater regulatory scrutiny, which suggests that self-disclosers may differ from the entire population of non-disclosers in important ways. Thus, comparing participants to just those non-disclosers who look quite "similar" to them in the years prior to

self-disclosure could bolster the plausibility of the identifying assumption. In other words, if a subset of disclosers and matched non-disclosers look "similar" before self-disclosure occurs, it seems particularly reasonable to assume they would have looked similar in the ensuing years had self-disclosure not occurred. In developing a matched sample, we seek to replicate a randomized experiment that compares "treated" to "controls" who do not differ systematically from each other by the time the treatment occurs (Shadish et al. 2002) or, in our case, when self-disclosure occurs. Applying a difference-in-differences specification on a matched sample has been shown to significantly reduce bias in program evaluation (Blundell and Dias 2000; Smith and Todd 2005).

To develop our matched sample, we implement case-control matching based on seven criteria. For each self-discloser, we consider its industry (3-digit SIC Code) and annual inspections, violations, and enforcement actions record during each of the two years before it self-disclosed.[8] We include as its matched controls those non-disclosing facilities that match exactly along these seven dimensions. We refer to the former's self-disclosure year as the "match year" for this matched group of facilities. We repeat this process for all self-disclosers. We omit from the matched sample any self-discloser for which no matches were available, and all non-disclosers that went unmatched. This matching process results in a matched sample of 19,986 facilities, including 688 that self-disclosed violations.[9] We initially evaluate the matched sample using each matched facility's observations starting two years before its match year. We then focus the analysis more narrowly, limiting the post-match period to five years.

To examine whether regulators respond differently to self-disclosing facilities depending on their recent compliance history, we create two sub-samples of the matched sample. The "good apples" sub-sample includes those matched facilities that had no compliance citations (violations or enforcement

---

[8] As a robustness test, we also ran our regressions on an alternative matched control group, where we matched based on industry (3-digit SIC Code) and annual inspections conducted by the state regulator, annual inspections conducted by US EPA, violations, and enforcement actions record, each averaged over the two years before the match year. The regression results were very similar, demonstrating that inspection holidays were bestowed upon the matched group overall and the good apples, but provided no evidence that inspection scrutiny was reduced for the bad apples.

[9] Approximately 10% of these matched facilities were not inspected in any year of the sample period, which caused them to drop out of the conditional fixed effects negative binomial inspection regression.

actions) during either the match year or the previous two years. The "bad apples" sub-sample includes the matched facilities that had at least one compliance citation during these years. Because our categorization of facilities as "good apples" or "bad apples" is based on their compliance history that extends two years before the match year, we analyze these sub-samples during the period ranging two years prior to the match year through five years after the match year.

5.3 Compliance record model

To assess the effect of self-disclosures on regulatory compliance records, we change our unit of analysis from the facility-year to the individual inspection. Here, we are examining whether the likelihood of a regulatory inspection resulting in no violations increases (improves) once facilities begin self-policing. We estimate the following difference-in-differences equation:

$$y_{id} = f(\beta_1 D_{i,d} + \beta_2 X_{i,t-j} + \beta_3 I_{i,t} + \alpha_i , \varepsilon_{i,d}) \quad (2)$$

The dependent variable y_{id} is a "clean inspection" dichotomous variable that refers to a facility's regulatory inspection on date *d*, and is coded 1 when the inspection resulted in no compliance violations (i.e., it was "clean") and coded 0 when the inspector cited the facility for a violation (i.e., it was "dirty"). This distinction between whether or not inspections resulted in violations has been used by other empirical analyses of regulatory compliance (e.g., Gray and Scholz 1993; US GAO 2001). $D_{i,d}$ is a "post self-disclosure" dummy variable coded 1 for inspections at facilities that have previously self-disclosed a violation to the Audit Policy. The coefficient on this variable is our difference-in-differences estimate.

We control for several factors that can affect a facility's compliance rate. We include in *X* the number of inspections and violations the facility experienced during each of the prior two years, because a facility's recent regulatory experience can affect its current compliance (Gray and Deily 1996; Gray and Jones 1991; Gunningham et al. 2005; Helland 1998; Magat and Viscusi 1990; Olson 1999; Shimshack and Ward 2005; Weil 1996).

Because the perceived likelihood of being inspected can affect compliance behavior (Laplante and Rilstone 1996; Shimshack and Ward 2005), we also control for the predicted probability of being

inspected (*I*) (Earnhart 2004; Gray and Deily 1996; Laplante and Rilstone 1996). We measure this using the predicted value from the baseline inspection model specified above, run as a pooled logit model that estimates the probability of being inspected at least once in the current year.

We include facility-level conditional fixed effects (α_i) to control for all time-invariant factors that might affect a facility's violation rate, such as the facility's and its parent company's size, year of construction, state and EPA Region, industry, and headquarters country location (Delmas and Toffel 2005; Gawande and Bohara 2005; Gray and Deily 1996; Helland 1998; Shimshack and Ward 2005). Like the inspection models, we run the compliance model on the entire sample and on the matched sample.

6. RESULTS

Descriptive statistics for the entire sample and then matched sample are provided in Table 1. In both samples, facilities were subjected to an average of one CAA inspection per year (Panel A). From the sub-sample of inspections examined in the compliance analysis (described below), 85 percent of inspections yielded no cited violations (Panel B), a proportion quite similar to other analyses of CAA regulated facilities (US GAO 2001).

Inspection holidays. For the inspection holiday analysis, we estimate the annual number of inspections with a conditional fixed-effects negative binomial specification.[10] We include dummy variables to control for each year prior to or after the match year (e.g., 1 year before the match year, 1 year after the match year). Table 2 presents our results, which indicate that regulators grant inspection

[10] Bertrand, Duflo & Mullainathan (2004) highlight the potential for serial correlation to lead to seriously underestimated standard errors in difference in differences specifications with continuous dependent variables. While there is no universally agreed upon solution to accommodate serial correlation in conditional fixed-effects count models, our estimates of autocorrelation in our data ranged from -0.08 to +0.09 (using a random sample of about 1000 facilities, and using Generalized Estimating Equation, fixed effects with dummy variables, and random effects models). These autocorrelation estimates are quite low, and are much lower than the +0.80 value used in most tests by Bertrand et al. (2004). Given our estimated autocorrelation levels, we estimate the potential for inaccurate standard errors might result in p-values nearly 0.01 above the nominal p-values (e.g., about 0.06 for a nominal p-value of 0.05). This is based on Bertrand et al.'s (2004) reporting a rejection rate of about 0.12 for a nominal p-value of 0.05 when they examined a low autocorrelation of +0.20 in their data that contained 21 time points; our dataset averages 7 time points per facility.

holidays to self-disclosers.[11] The results from our analysis of the entire sample indicate that regulators subjected self-disclosing facilities to 6 percent fewer annual inspections ($p<0.05$) after they self-disclosed (column 1). We find the same result when we excluded industries that had no self-disclosers (column 2).

Our analysis of the matched sample reveals larger inspection holidays. We find that facilities experienced 21 percent fewer annual inspections ($p<0.01$) in the years after they self-disclosed, compared to the matched controls (column 3). We find a nearly identical result (20 percent decline, $p<0.01$) when we limit the post-period to 5 years (column 4).[12]

We then separately analyzed the "bad apple" and "good apple" subsets of the matched sample. We find no evidence that "bad apples" that self disclosed received reduced inspection scrutiny, compared to their matched controls. Among "good apples," however, self-disclosing facilities experienced a 27 percent reduction in inspections ($p<0.01$) (column 6).

Compliance records. The conditional fixed-effects logistic models provide evidence that self-policing is associated with improved compliance records (Table 3).[13] The results from the entire sample indicate that inspections were 70 percent more likely to be "clean" ($p<0.01$) after facilities self-disclosed (column 1). Results from the matched sample reinforced this finding, with even larger estimates. Inspections conducted during the five years subsequent to self-disclosure were more than twice as likely to be "clean" ($p=0.014$) as pre-disclosure inspections, compared to the matched controls over the same time period (column 2). Together, these results strongly suggest that compliance records improved subsequent to self-disclosure.

---

[11] We calculate marginal effects of negative binomial coefficients as $(e^b - 1) * 100\%$. Note that conditional fixed effects negative binomial models are identified only for facilities that exhibit a change in the dependent variable (number of inspections) during the sample period.

[12] We confirmed that this result is not confounded by differences in trends between the matched self-disclosers and non-disclosers during the two-year period prior to the match year. To do so, we estimated the following differences-in-slopes equation: $(Inspections_{i,\tau} - Inspections_{i,\tau-2}) = \alpha + \beta_1 Match\ Group_i + \beta_2 Self\text{-}discloser\ dummy_i$ for the match year (τ). The results indicated an insignificant difference in slopes between the matched self-disclosers and controls during the two years prior to the match.

[13] We present results that include only facilities for which we had data pre- and post-match.

7. DISCUSSION AND FUTURE RESEARCH

Our results confirm that regulators reward self-policing with an easing of regulatory scrutiny. We found that voluntarily disclosing violations led to inspection holidays, regardless of whether we compared self-disclosers to all other facilities or to a matched set of non-disclosers. "Good apple" facilities, those with no violations during the two years prior to self-disclosing, realized even larger reductions in regulatory scrutiny. Thus it appears, as many have argued, that coming clean by self-reporting regulatory violations does "help to favorably dispose the regulator toward the firm" (Pfaff and Sanchirico 2004 :426). However, this axiom does not appear to hold for firms with more checkered pasts. We find no significant reduction of regulatory scrutiny over self-disclosing "bad apples." This finding suggests that regulators do not interpret each voluntary disclosure as an unambiguous signal about the discloser's willingness to cooperate and comply. Instead, it appears that that self-disclosing reinforces regulators' existing impressions of the facility as "good" or "bad." This finding is consistent with the extensive literature on cognitive biases, which suggests that regulators will process new information through the lens of what they already know about regulated firms (e.g., Fiske and Taylor 1991). In any event, our different results for "good apples" and "bad apples" suggest that self-disclosing may be a double-edged sword, and that firms should expect differing regulatory responses depending on their pre-existing compliance status.

The rewards firms received for their participation in self-policing appear to be warranted: our findings demonstrate that facilities' compliance rates improved after self-disclosing compared to the matched control group's trend. There are two ways to interpret this finding. On the one hand, empirical research on regulatory compliance typically assumes that violations cited by regulatory inspectors represent an unbiased estimate of actual compliance (e.g., Gray and Deily 1996; Gray and Shadbegian 2005; Helland 1998). Under this assumption, our results suggest that many of the facilities that voluntarily "come clean" do indeed "clean up their act." This supports anecdotal evidence gathered by US EPA on improved compliance monitoring by Audit Policy participants. In an anonymous survey, Audit Policy participants noted that self-disclosing led them to "do more frequent audits," establish "a

systematic review procedure" and implement "a better system to monitor…requirements," resulting in a "greater awareness on the part of management that compliance activities must become part of business processes" (US EPA 1998). These are precisely the kinds of organizational structures and institutional commitments on which self-regulation depends (Orts 1995).

If this interpretation of our finding is correct, the Audit Policy appears to be a classic "win-win," with participation producing better relative compliance outcomes with fewer regulatory enforcement resources. This interpretation would also provide support for the approach taken by economic models of self-policing, which predict that self-reporting schemes can lower enforcement costs while maintaining a constant level of deterrence (e.g., Kaplow and Shavell 1994). If, as our results suggest, self-policing firms either maintain or improve their levels of compliance after they make their voluntary disclosures, this would allow regulators to economize resources or shift them elsewhere without sacrificing overall compliance levels.

However, it is important to note that a significant body of research suggests that compliance, at least as measured by violations cited by regulatory inspectors, is highly situational and subjective. McAllister (2006) describes how the meaning of compliance with traditional environmental statutes gets negotiated in the context of an ongoing relationship between regulator and regulated. The amount of goodwill accrued by a regulated firm cannot help but influence the nature of this relationship. Hawkins (1984), for instance, documents how a firm's compliance status emerges from the on-the-ground relationships between inspectors and regulated firms. Inspectors perceive a firm "as 'co-operative' or having a 'good attitude,' or, in contrast, as 'unhelpful,'" (Hawkins 1984:113) and this dichotomy significantly shapes the enforcement approach these officials take with different firms – in some cases, whether they cite violations at all. Similarly, Aoki and Coiffi (2000) argue that regulators tend to "throw the book at" facilities they perceive as recalcitrant by interpreting regulations legalistically to maximize the number of violations. In other words, regulatory goodwill may not be limited to decisions about how frequently to inspect facilities, but may also affect the way in which inspectors both cite and even perceive violations.

In addition, it has been demonstrated that some firms play an active role in manipulating the regulator's perceptions. For instance, Gray (2006) describes how facilities create elaborate "Potemkin Villages" to hide health and safety violations when they know inspectors are going to visit the plant. It is possible that participation in self-policing is simply another mask in the charade that some regulated facilities perform for regulators. In sum, the socially situated and contingent nature of compliance inspections makes it very difficult to interpret our results strictly as an improvement in compliance. Our findings may reflect, in part, these facilities' improved status in the eyes of the regulator, which enabled them to gain leniency from inspectors.

Teasing apart the extent to which self-disclosing facilities subsequently *committed* fewer violations or were merely *cited* less often due to inspector goodwill is a question that is important not only to those interested in the public welfare question of whether self-policing enhances actual compliance. In addition, facility managers should be interested because inspector goodwill may erode if compliance does not actually improve over time. Parsing apart these interpretations presents an important opportunity of future research. Developing techniques that can tease apart actual facility compliance from compliance reported by inspectors is crucial for assessing the public welfare implications of voluntary compliance initiatives.

Finally, future evaluations of self-policing could employ different types of outcomes. For example, researchers could focus on outcome metrics more closely aligned to the ultimate objectives of the regulations. For example, in the Audit Policy context, improving compliance with hazardous waste regulations' labeling and storage requirements might reduce the frequency and severity of spills and injuries, and might reduce the amount of hazardous waste being erroneously shipped to unsuitable treatment facilities. Prior research has found that voluntarily disclosing environmental liabilities can bolster the credibility of other information such firms release, which reduces their cost of capital and attenuates negative shocks to stock prices when they release bad news (Blacconiere and Patte 1994; Cormier and Magnan Forthcoming). Researchers could investigate whether such benefits also accrue to firms that voluntarily disclose regulatory compliance violations.

8. CONCLUSIONS

We have demonstrated some of the benefits and the limitations of self-policing relationships. On average, voluntary disclosers benefit by earning relief from regulatory oversight, with "good apples" earning the biggest holidays. These results suggest that self-disclosure is a strategy that firms with strong compliance records have effectively used to reinforce positive relationships with regulators. However, we found no evidence that inspection holidays were granted to "bad apples," indicating that facilities with poor compliance records must take additional measures to reduce the level of attention they receive from regulators .

Our compliance findings provide some evidence that regulators are justified in granting inspection holidays because, on average, participants in self-policing improve their post-disclosure compliance rates relative to similarly situated facilities. This allows both regulators and regulated entities to claim success in improving compliance through voluntary measures. What remains to be seen, however, is whether these arrangements benefit the public and the environment. While cleaner inspections are a promising indicator, they must be accompanied by lower actual pollution rates before success can be claimed for self-regulation.

REFERENCES

Andrus, C.H., E.G. Villasenor, J.B. Kettelle, R. Roth, A.M. Sweeney, N.M. Matolo. 2003. "To err is human": uniformly reporting medical errors and near misses, a naïve, costly, and misdirected goal. *Journal of the American College of Surgeons* **196**(6) 911-918.

Aoki, K., J.W. Coiffi. 2000. Poles apart: Industrial waste management regulation and enforcement in the United States and Japan. R.A. Kagan, L. Axelrod, eds. *Regulatory Encounters*. University of California Press, Berkeley, CA.

Bertrand, M., E. Duflo, S. Mullainathan. 2004. How much should we trust difference-in-difference estimates. *Quarterly Journal of Economics* **119** 249-275.

Blacconiere, W.G., D.M. Patte. 1994. Environmental disclosures, regulatory costs, and changes in firm value. *Journal of Accounting and Economics* **18**(3) 357-377.

Blundell, R., M.C. Dias. 2000. Evaluation methods for non-experimental data. *Fiscal Studies* **21** 427-468.

Chelius, J., H.F. Stark. 1984. OSHA's Voluntary Protection Program. *Labor Law Journal* **35**(3) 167-174.

Coequyt, J., R. Wiles. 2000. Prime Suspects: The Law Breaking Polluters America Fails to Inspect. Environmental Working Group, Washington, DC.

Cormier, D., M. Magnan. Forthcoming. The revisited contribution of environmental reporting to investors' valuation of a firm's earnings: An international perspective *Ecological Economics*.

Delmas, M., M.W. Toffel. 2005. Institutional pressure and environmental management, Working Paper *Institute for Social, Behavioral, and Economic Research*, University of California, Santa Barbara.

Dimento, J.F. 1989. Can social science explain organizational noncompliance with environmental law? *Journal of Social Issues* **45**(1) 109-132.

Duggin, S.H. 2003. Internal Corporate Investigations: Legal Ethics, Professionalism and the Employee Interview. *Columbia Business Law Review* **2003** 859-964.

Earnhart, D. 2004. Panel Data Analysis of Regulatory Factors Shaping Environmental Performance. *The Review of Economics and Statistics* **86**(1) 391-401.

Esbenshade, J. 2001. The Social Accountability Contract: Private Monitoring from Los Angeles to the Global Apparel Industry. *Labor Studies Journal* **26** 98-120.

Federal Register. 1995. Incentives for self-policing: Discovery, disclosure, and prevention of violations. *Federal Register* **60** 66706-66712.

Federal Register. 1999. Evaluation of 'Incentives for Self-Policing: Discovery, Disclosure, and Prevention of Violations' policy statement, Proposed revisions for public comment. *Federal Register* **64** 26745-26756.

Fiske, S.T., S.E. Taylor. 1991. *Social Cognition (2nd Ed.)*. McGraw-Hill, New York.

Fleder, J.R. 1999. A Voluntary Disclosure Program for FDA – The Time Has Come. *Food and Drug Law Journal* **54** 389-399.

Friesen, L. 2003. Targeting enforcement to improve compliance with environmental regulations. *Journal of Environmental Economics and Management* **46**(1) 72-85.

Gawande, K., A.K. Bohara. 2005. Agency Problems in Law Enforcement: Theory and Application to the U.S. Coast Guard. *Management Science* **51**(11) 1593 - 1609.

Gray, G.C. 2006. The Regulation of Corporate Violations: Punishment, Compliance and the Blurring of Responsibility. *British Journal of Criminology* **46**(5) 875-892.

Gray, W., M.E. Deily. 1996. Compliance and enforcement: Air pollution regulation in the US steel industry. *Journal of Environmental Economics and Management* **31** 96-111.

Gray, W., R. Shadbegian. 2005. When and why do plants comply? Paper mills in the 1980s. *Law & Policy* **27**(2) 238-261.

Gray, W.B., C.A. Jones. 1991. Are OSHA Health Inspections Effective? A Longitudinal Study in the Manufacturing Sector. *The Review of Economics and Statistics* **73** 504-508.

Gray, W.B., J.T. Scholz. 1993. Does regulatory enforcement work? A panel analysis of OSHA enforcement. *Law & Society Review* **27**(1) 177-214.

Gunningham, N., D. Thornton, R.A. Kagan. 2005. Motivating management: Corporate compliance in environmental protection. *Law & Policy* **27**(2) 289-316.

Harrington, W. 1988. Enforcement leverage when penalties are restricted. *Journal of Public Economics* **37** 29-53.

Hawkins, K. 1984. *Environment and Enforcement: Regulation and the Social Definition of Pollution*. Oxford University Press, London.

Helland, E. 1998. The enforcement of pollution control laws: Inspections, violations, and self-reporting. *The Review of Economics and Statistics* **80**(1) 141-153.

Hunt, T.E., T.A. Wilkins. 1992. Environmental audits and enforcement policy. *The Harvard Environmental Law Review* **16** 365-427.

Innes, R. 1999a. Remediation and self-reporting in optimal law enforcement. *Journal of Public Economics* **72** 379-393.

Innes, R. 1999b. Self-Policing and Optimal Law Enforcement When Violator Remediation Is Valuable. *Journal of Political Economy* **7** 1305-1325.

Innes, R. 2001. Violator avoidance activities and self-reporting in optimal law enforcement. *Journal of Law, Economics & Organizations* **17** 239-256.

Johnson, K.A., B.C. Frey. 2000. Environmental Auditing Since EPA's 1986 Audit Policy. US Environmental Protection Agency, Office of Regional Counsel, Region 5, Chicago, IL.

Kaplow, L., S. Shavell. 1994. Optimal law enforcement with self-reporting of behavior. *Journal of Political Economy* **102** 583-606.

Khanna, M., L. Damon. 1999. EPA's voluntary 33/50 program: Impact on toxic releases and economic performance of firms. *Journal of Environmental Economics and Management* **37** 1-25.

King, A.A., M.J. Lenox. 2000. Industry self-regulation without sanctions: The chemical industry's responsible care program. *Academy of Management Journal* **43**(4) 698-716.

Langevoort, D.C. 1997. Organized Illusions: A Behavioral Theory of Why Corporations Mislead Stock Market Investors (and Cause Other Social Harms). *University of Pennsylvania Law Review* **146** 101-172.

Laplante, B., P. Rilstone. 1996. Environmental inspections and emissions of the pulp and paper industry in Quebec. *Journal of Environmental Economics and Management* **31**(1) 19-36.

Lenox, M.J. 2006. The Role of Private Decentralized Institutions in Sustaining Industry Self-Regulation. *Organization Science* **17**(6) 677-690.

Magat, W.A., W.K. Viscusi. 1990. Effectiveness of the EPA's regulatory enforcement: The case of industrial effluent standards. *Journal of Law and Economics* **33** 331-360.

Malik, A. 1993. Self-Reporting and the Design of Policies for Regulating Stochastic Pollution. *Journal of Environmental Economics and Management* **24** 241-257.

McAllister, L.K. 2006. Putting Persuasion Back in the Equation: Compliance in Cap and Trade Programs *Annual Meetings of the Law & Society Association*, Baltimore, MD.

Medinger, J.D. 2003. Antitrust Leniency Programs: A Call for Increased Harmonization as Proliferating Programs Undermine Deterrence. *Emory Law Journal* **52** 1439-1481.

Nelson, T.E., Z.M. Oxley, R.A. Clawson. 1997. Toward a Psychology of Framing Effects. *Political Behavior* **19**(3) 221-246.

Olson, M.K. 1999. Agency rulemaking, political influences, regulation, and industry compliance. *Journal of Law, Economics & Organizations* **15**(3) 573-601.

Orts, E.W. 1995. Reflexive Environmental Law. *Northwestern University Law Review* **89**(4) 1227-1340.

Orts, E.W., P.C. Murray. 1997. Environmental disclosure and evidentiary privilege. *University of Illinois Law Review* **1997**(1) 1-69.

Pfaff, A.S.P., C.W. Sanchirico. 2000. Environmental self-auditing: Setting the proper incentives for discovery and correction of environmental harm. *Journal of Law, Economics & Organizations* **16** 189-208.

Pfaff, A.S.P., C.W. Sanchirico. 2004. Big field, small potatoes: An empirical assessment of EPA's self-audit policy. *Journal of Policy Analysis and Management* **23**(3) 415-432.

Rees, J.V. 1994. *Hostages of Each Other: The Transformation of Nuclear Safety Since Three Mile Island*. University of Chicago Press, Chicago.

Rivera, J., P. de Leon, C. Koerber. 2005. Is greener whiter yet? The Sustainable Slopes program after five years, Working Paper, George Washington University.

Shadish, W.R., T.D. Cook, D.T. Campbell. 2002. *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*. Houghton Mifflin Company, Boston.

Shimshack, J.P., M.B. Ward. 2005. Regulator reputation, enforcement, and environmental compliance. *Journal of Environmental Economics and Management* **50**(3) 519-540.

Short, J.L., M.W. Toffel. Forthcoming. Coerced confessions: Self-policing in the shadow of the regulator. *Journal of Law, Economics & Organizations* **24**(1).

Shover, N., J. Lynxwiler, S. Groce, D. Clelland. 1984. Regional variation in regulatory law enforcement: The Surface Mining Control and Reclamation Act of 1977. K. Hawkins, J. Thomas, eds. *Enforcing Regulation*. Kluwer Nijhoff, Boston, MA.

Smith, J.A., P.E. Todd. 2005. Does matching overcome LaLonde's critique of nonexperimental estimators? *Journal of Econometrics* **125**(1-2) 305-353.

Stretesky, P. 2006. Corporate self-policing and the environment. *Criminology* **44**(3) 671-708.

Stretesky, P., J. Gabriel. 2005. Self-policing and the environment: Predicting self-disclosure of Clean Air Act violations under the U.S. Environmental Protection Agency's Audit Policy. *Society and Natural Resources* **18** 871-887.

Tannen, D., C. Wallat. 1987. Interactive Frames and Knowledge Schemas in Interaction: Examples from a Medical Examination/Interview. *Social Psychology Quarterly* **50**(2) 205-216.

Toffel, M.W. 2006. Resolving information asymmetries in markets: The role of certified management programs. Harvard Business School Working Paper.

US EPA. 1986. Study of the Pulp and Paper Industry in Region IV. US Environmental Protection Agency, Washington, DC.

US EPA. 1990. Environmental Enforcement: A Citizen's Guide. Office Of Enforcement, United States Environmental Protection Agency, Washington, DC.

US EPA. 1997. Audit Policy Interpretive Guidance. Office of Regulatory Enforcement, US Environmental Protection Agency, Washington, D.C.

US EPA. 1998. Audit Policy Survey Results, http://www.epa.gov/compliance/incentives/auditing/auditpolicy.html

US EPA. 1999a. Protecting Your Health & the Environment Through Innovative Approaches to Compliance: Highlights From the Past 5 Years. Office of Enforcement and Compliance Assurance, United States Environmental Protection Agency, Washington, DC.

US EPA. 1999b. A Review of the Compliance Monitoring Strategy. US Environmental Protection Agency, Office of Enforcement and Compliance Assurance, Washington DC.

US EPA. 2005. Compliance Incentives and Auditing. US Environmental Protection Agency.

US EPA. 2006. Compliance Incentives and Auditing. US Environmental Protection Agency.

US GAO. 2001. Air Pollution: EPA Should Improve Oversight of Emissions Reporting by Large Facilities. US Government Accountability Office, Washington, DC.

US GAO. 2004a. Aviation Safety: Better Management Controls are Needed to Improve FAA's Safety Enforcement and Compliance Efforts. United States General Accounting Office, Washington, DC.

US GAO. 2004b. Workplace Health and Safety: OSHA's Voluntary Compliance Strategies Show Promising Results, but Should Be Fully Evaluated before They Are Expanded. United States General Accounting Office, Washington, DC.

Vidovic, M., N. Khanna. 2005. Can voluntary pollution prevention programs fulfill their promises? Further evidence from the EPA's 33/50 Program, Department of Economics, Binghamton University, Binghamton, NY.

Wasserman, C.E. 1990. An Overview of Compliance and Enforcement in the United States: Philosophy, Strategies, and Management Tools *First International Enforcement Workshop Proceedings, International Network for Environmental Compliance and Enforcement, Utrecht*, The Netherlands.

Weil, D. 1996. If OSHA is So Bad, Why is Compliance So Good? *RAND Journal of Economics* **27**(3) 618-640.

Weil, D. 2005. Public Enforcement/Private Monitoring: Evaluating a New Approach To Regulating the Minimum Wage. *Industrial & Labor Relations Review* **58**(2) 238-257.

Welch, E.W., A. Mazur, S. Bretschneider. 2000. Voluntary behavior by electric utilities: levels of adoption and contribution of the climate challenge program to the reduction of carbon dioxide. *Journal of Policy Analysis and Management* **19** 407–425.

Table 1. Summary Statistics

Panel A: Annual inspection models

	Entire sample				Matched sample			
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Annual CAA inspections†	0.759	1.054	0	23	0.619	0.806	0	23
Voluntarily disclosed in prior years (dummy)	0.006	0.074	0	1	0.017	0.130	0	1
Years since prior CAA inspection††	1.942	1.180	1	4	2.157	1.267	1	4
Annual CAA violations†††	0.034	0.183	0	3	0.026	0.161	0	3
Any enforcement actions (dummy)	0.011	0.104	0	1	0.014	0.118	0	1
Compliance Incentive Program target (dummy)	0.024	0.152	0	1	0.052	0.222	0	1
National Priority sector (dummy)	0.109	0.311	0	1	0.156	0.363		1
Log total CAA penalties in the state-year	11.881	4.490	0	17.558	12.459	4.108	0	17.558
Log number of CAA regulated facilities in the state-year	7.238	0.749	1.601	8.289	7.260	0.711	1.601	8.289

Panel B: Compliance models

	Entire sample				Matched sample			
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Clean CAA inspection (dummy)	0.85	0	0	1	0.85	0	0	1
Post self-disclosure (dummy)	0.02	0	0	1	0.08	0	0	1
Predicted probability of a CAA inspection	0.62	0.11	0.21	0.89	0.63	0.10	0.23	0.83
Annual CAA inspections†	3.65	2	0	6	3.79	2	0	6
Annual CAA violations	0.25	0	0	3	0.29	0	0	2

For the inspection models (Panel A), N=426,793 facility-years for the entire sample during 1993-2003, and 109,025 for matched sample. For the compliance models (Panel B), N= 69,514 inspections for entire sample during 1995-2003, and 4,775 for matched sample. In both panels, matched sample observations extend from 2 years prior to 5 years after the match year. CAA = Clean Air Act. Variables denoted † are top coded at 99.99th percentile, and †† are top coded at 4 per year, ††† are top coded at 99th percentile.

Table 2. Self-policing is associated with inspection holidays

Conditional Fixed Effects Negative Binomial Models

Dependent variable: Annual number of CAA inspections

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	Entire sample	Common industries	Matched sample	Matched sample	Matched bad apples	Matched good apples
Evaluation period	1993-2003	1993-2003	τ-2 to 2003	τ-2 to τ+5	τ-2 to τ+5	τ-2 to τ+5
Post self-disclosure	-0.067	-0.063	-0.233	-0.228	-0.052	-0.308
	[0.027]**	[0.028]**	[0.043]***	[0.044]***	[0.071]	[0.062]***
2 years since last CAA inspection	0.041	0.025	0.108	0.112	0.147	0.111
	[0.005]***	[0.006]***	[0.012]***	[0.013]***	[0.046]***	[0.013]***
3 years since last CAA inspection	0.052	0.029	0.213	0.225	0.257	0.224
	[0.009]***	[0.010]***	[0.019]***	[0.019]***	[0.081]***	[0.020]***
4 or more years since last CAA inspection	0.246	0.215	0.593	0.645	0.584	0.652
	[0.008]***	[0.009]***	[0.016]***	[0.017]***	[0.075]***	[0.017]***
Number of CAA violations 1 year ago	0.053	0.055	0.008	0.012	0.038	0.021
	[0.009]***	[0.009]***	[0.025]	[0.026]	[0.048]	[0.032]
Number of CAA violations 2 years ago	0.007	0.008	-0.028	-0.030	-0.071	-0.011
	[0.009]	[0.010]	[0.027]	[0.028]	[0.050]	[0.035]
Any enforcement actions 1 year ago	-0.042	-0.031	-0.002	0.000	0.060	-0.045
	[0.018]**	[0.018]*	[0.037]	[0.038]	[0.065]	[0.053]
Any enforcement actions 2 years ago	-0.046	-0.041	-0.039	-0.041	-0.042	-0.102
	[0.019]**	[0.019]**	[0.039]	[0.040]	[0.070]	[0.056]*
Compliance Incentive Program target	0.012	0.015	0.076	0.067	0.005	0.078
	[0.012]	[0.012]	[0.020]***	[0.020]***	[0.066]	[0.021]***
National Priority sector	-0.011	-0.014	0.092	0.101	0.020	0.104
	[0.008]	[0.008]*	[0.017]***	[0.018]***	[0.061]	[0.018]***
Log total CAA penalties in the state-year	-0.005	-0.006	-0.014	-0.014	-0.013	-0.014
	[0.002]***	[0.002]***	[0.004]***	[0.004]***	[0.017]	[0.005]***
Log number of CAA regulated facilities in the state-year	0.553	0.559	0.641	0.609	0.885	0.588
	[0.013]***	[0.014]***	[0.043]***	[0.045]***	[0.154]***	[0.047]***
Facility-level conditional fixed effects	Included	Included	Included	Included	Included	Included
Year fixed effects (1994-2003)	Included	Included	Included	Included	Included	Included
Fixed effects for *t* years before/after match year			Included	Included	Included	Included
Observations	426,793	367,776	109,025	104,073	5,687	98,386
Number of group(frsid)	57,622	48,972	17,975	17,805	978	16,827
Wald chi-squared	5760.5***	4657.5***	5397.7***	5248.9***	249.8***	5067.9***
Marginal effect of post self-disclosure (difference-in-difference estimate)	**6%↓****	**6%↓****	**21%↓*****	**20%↓*****	**5%↓ (n.s.)**	**27%↓*****

Values reported are negative binomial coefficients, with standard errors in brackets; * p<0.10; ** p<0.05; *** p<0.01. Unit of analysis is the facility-year. The same model was run on six samples: all CAA-regulated facilities across the United States (column 1), the subset of self-disclosers and non-disclosers on the common support of industries (3-digit SIC codes), the entire matched sample (columns 3-4), "bad apple" matched facilities defined as those with at least one Clean Air Act (CAA) violation or enforcement action recorded during the match year or either of the two years prior (column 5); "good apples" matched facilities defined as those that had no violations or enforcement actions during that three year period (column 6). Columns 1-2 include all observations from 1993-2003, column 3 includes matched facility observations starting 2 years prior the match year, columns 4-6 include observations from 2 years prior to 5 years after the match year. The conditional fixed effects negative binomial model drops facilities that have identical annual inspection rates throughout the sample period.

Table 3. Self-policing is associated with improved compliance records

Conditional Fixed Effects Logistic Models

Dependent variable: CAA inspection is "clean" (no cited violations)

Sample	(1) Entire sample		(2) Matched sample	
	Coefficients	Odds ratios	Coefficients	Odds ratios
Post self-disclosure	0.568	1.764	0.768	2.156
	[0.202]***	[0.356]***	[0.326]**	[0.702]**
Probability of a CAA inspection	-0.587	0.556	0.823	2.276
	[0.170]***	[0.095]***	[0.721]	[1.641]
Number of CAA inspections 1 year ago	-0.009	0.991	-0.066	0.936
	[0.012]	[0.012]	[0.043]	[0.040]
Number of CAA inspections 2 years ago	-0.001	0.999	0.050	1.051
	[0.011]	[0.011]	[0.049]	[0.052]
Number of CAA violations 1 year ago	0.798	2.221	1.522	4.583
	[0.042]***	[0.094]***	[0.182]***	[0.836]***
Number of CAA violations 2 years ago	0.816	2.261	1.131	3.097
	[0.044]***	[0.099]***	[0.168]***	[0.520]***
Year fixed effects	Included			
Fixed effects for *t* years before/after match year			Included	
Inspections (N)	69514		4775	
Facilities	7157		523	
Adopters	216		53	
Wald chi-squared	946.7***		136.7***	

Brackets contain robust standard errors clustered by facility; * p<0.10; ** p<0.05; *** p<0.01. Unit of analysis is a facility's inspection. CAA = Clean Air Act. Dependent variable is coded 1 if the inspection results in no cited violations, and coded 0 if at least one violation is cited. Conditional fixed effects are at the facility-level. The same model was run on the entire sample during 1995-2003 (column 1), and then on the matched sample including observations from 2 years prior to 5 years after the match year (column 2). The conditional fixed effects logistic model drops facilities that have only "clean" inspections or only "dirty" inspections throughout the evaluation period.