

08-098

Coming Clean and Cleaning Up: Is Voluntary Disclosure a Signal of Effective Self-Policing?

**Michael W. Toffel
Jodi L. Short**

Copyright © 2008 by Michael W. Toffel and Jodi L. Short.

Working papers are in draft form. This working paper is distributed for purposes of comment and discussion only. It may not be reproduced without permission of the copyright holder. Copies of working papers are available from the author.

**COMING CLEAN AND CLEANING UP:
IS VOLUNTARY DISCLOSURE A SIGNAL OF EFFECTIVE 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
Georgetown University Law Center
600 New Jersey Avenue, NW
Washington, DC 20001
jodishort@earthlink.net
Tel: (510) 594-7467

May 21, 2008

* Corresponding author. Harvard Business School, Morgan Hall 497, Boston MA 02163. (617) 384-8043. For insightful comments on previous drafts, we thank Neil Fligstein, Rob Huckman, 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. Ara Abrahamian and Katherine Lee provided outstanding research assistance. We gratefully acknowledge support from the Division of Research and Faculty Development at the Harvard Business School.

**COMING CLEAN AND CLEANING UP:
IS VOLUNTARY DISCLOSURE A SIGNAL OF EFFECTIVE 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 and enhancing regulatory effectiveness. In the context of a federal government program that encourages companies to voluntarily self-police and self-disclose regulatory violations, we examine how participation affects the behaviors of regulators and regulated facilities. We find that on average, facilities that committed to self-police experienced a decline in abnormal events resulting in toxic pollution, and that regulators reduced their scrutiny over self-policing facilities. Upon closer examination, we find strong evidence of these effects among facilities with clean past compliance records, but find no such evidence of among facilities with more problematic compliance histories. These findings support the theoretical promise of meaningful self-policing practices and suggest that voluntary disclosure can serve as a reliable signal of future compliance—but only among a subset of facilities.

Keywords: self-policing, self-regulation, voluntary programs, environmental regulation, environmental performance, pollution, audits, signaling

COMING CLEAN AND CLEANING UP: IS VOLUNTARY DISCLOSURE A SIGNAL OF EFFECTIVE SELF-POLICING?

1. Introduction: Regulatory Reform and the New “Self-Regulatory” State

Regulatory agencies in the United States continue to adapt and change in response to the trenchant and sometimes vitriolic critique of regulation that developed in the late twentieth century (Demsetz 1968; Noll 1971; Priest 1993; Stigler 1971; Stigler and Friedland 1962). Administrative agencies once denounced as costly, corrupt and coercive now fashion themselves as cooperative, consumer-friendly, even complaisant. Regulated companies once viewed as renegades, recalcitrant or, at best, reluctant compliers, seek no longer to shake off the yoke of regulation, but rather to take the reins. These shifts have resulted in what many have characterized as a “self-regulatory” regulatory regime, in which regulated corporations increasingly undertake core governmental responsibilities like standard-setting, monitoring and enforcement (Ayres and Braithwaite 1992; Delmas and Terlaak 2002; Parker 2002).

While many self-regulation activities are solely private sector initiatives¹ adopted in the hopes of garnering goodwill with consumers (King et al. 2002) or staving off more stringent government regulation (Maxwell et al. 2000), self-regulatory practices have increasingly attracted the attention of government regulators looking for innovative tools to further regulatory objectives and to stretch shrinking agency budgets. So, for instance, the US Occupational Safety and Health Administration (OSHA), an agency once held up as the paragon of “unreasonableness” (Bardach and Kagan 1982), now sponsors the *Voluntary Protection Program*, which exempts participants from routine OSHA inspections if they maintain comprehensive safety management programs and low injury rates (Chelius and Stark 1984). The US Environmental Protection Agency, once derided as the “manure Gestapo” (Centner 2000,

¹ Examples include the codes of conduct adopted by many apparel firms, as well as industry-wide initiatives like the chemical industry’s *Responsible Care*, the ski industry’s *Sustainable Slopes* and the *Hotel Green Leaf Eco-Rating Program*.

250), recently entered into a voluntary agreement with livestock feedlots that “shielded the industry from enforcement action in exchange for participation in a study of its air emissions” (Saiyid 2007, 2598).

Other agency programs push the model of self-regulation still further by outsourcing governmental *enforcement and policing* functions. These programs invite firms not only to monitor themselves, but to voluntarily report and remediate legal violations they find. For instance, the US Department of Veterans Affairs sponsors an initiative that encourages medical professionals to self-disclose medical errors (Andrus et al. 2003). The US Department of Justice, the US Department of Defense, and the Securities and Exchange Commission each 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). Similarly, the US Department of Health and Human Services has a *Provider Self-Disclosure Protocol* that offers leniency to health care providers who voluntarily report violations of their Medicare and Medicaid obligations.²

While these kinds of programs have proved exceedingly popular in an era of tight regulatory budgets,³ little is known about the effects of the programs themselves or the behavior and motivations of those who participate in them. Still less is known about how they might contribute to the overall effectiveness of a regulatory regime. There are two ways to think about whether and how corporate self-regulatory practices might enhance government enforcement efforts. The baseline question for any evaluation is, of course, whether self-regulation improves the performance of those companies that adopt it. To date, most theoretical and empirical work on self-regulation has addressed the achievements (or failures) of companies participating in specific industry-sponsored initiatives (King and Lenox 2000; Rivera et al. 2006) and government-sponsored programs (Khanna and Damon 1999; Vidovic and Khanna 2007).⁴ However, the insights produced by this literature do not end the inquiry for those interested in

² For a review of voluntary self-reporting systems of incidents, accidents, and procedural violations in different industries, see Barach and Small (2000).

³ For recent reviews of voluntary environmental programs, see Darnall and Carmin (2005), King and Toffel (Forthcoming), Koehler (2007), and Lyon and Maxwell (2007).

⁴ A recent meta analysis of voluntary environmental programs concluded that “participants do not improve their environmental performance over nonparticipants” (Darnall and Sides 2008: 95).

how corporate self-regulation fits into the broader regulatory scheme. To understand the dynamics of a mixed voluntary and mandatory regulatory regime, one must also investigate whether self-regulation by some subset of the regulated community helps regulators allocate their enforcement resources more effectively than they would in its absence. In other words, does a regulated firm's decision to adopt or decline self-regulation provide regulators with new and reliable information about which firms to trust and which firms to target? And do regulators process and respond to this information effectively? In addressing these questions, this paper represents one of the first attempts to develop a dynamic account of how self-regulation influences the behavior of both regulators and regulated entities and shapes enforcement outcomes within existing regulatory frameworks.

We analyze these questions in the empirical context of the US Environmental Protection Agency's (EPA) *Audit Policy*, a self-policing program that offers penalty mitigation to regulated entities that agree to systematically monitor their environmental compliance and self-disclose violations to the agency, and in the enforcement context of one of the most widely applicable federal environmental statutes, the Clean Air Act (CAA). Through this analysis, we seek to determine whether the internal monitoring, or "self-policing," required under the *Audit Policy* affects the behavior of regulators and regulated facilities and the relationship between them. Specifically, we examine whether self-policing is associated with improved environmental performance at participating facilities and whether regulators reduce their scrutiny over self-policing facilities. We find that self-policing can enhance the environmental performance of facilities that are already good compliers, but that historically poor compliers do not see significant gains from self-policing. In addition, we find that regulators reward self-policing facilities that already had clean past compliance records with an "inspection holiday," but they do not significantly decrease scrutiny of poor past compliers. These findings suggest that self-policing can help good facilities do better and that regulators are effectively sorting the good facilities from the bad.

2. Theoretical Framework: Self-Regulation as Signal

Theoretical literature on regulatory design has long posited that self-regulatory practices have the potential to improve the performance of participating firms by remaking the regulated corporation as a more “reflexive” (Orts 1995; Teubner 1983), “responsive” (Ayres and Braithwaite 1992), and even “democratic” (Parker 2002) institution. “The basic idea is to encourage internal self-critical reflection within institutions” (Orts 1995, p. 1254) that will enable corporations to attend more effectively to their social and legal responsibilities.

Reflexive solutions offload some of the weight of social regulation from the legal system to other social actors. ... Rather than detailed pronouncements of acceptable behavior, the law adopts procedures for regulated entities to follow. The procedures are adopted with a design in mind to encourage thinking and behavior in the right direction (Orts 1995, p. 1264).

In fact, some have argued that self-regulation can be more effective than government regulation in circumstances where the threat of government regulation is high and the marginal costs of self-regulation are low (Maxwell et al. 2000).

Empirical research on self-regulation, however, paints a more complicated picture. While some studies find that monitored and certified self-regulation programs can improve facilities’ regulatory compliance and performance (Dasgupta et al. 2000; Potoski and Prakash 2004, 2005; Toffel 2006; Weil 2005), the majority find that participation in self-regulation has little connection to measurable improvements in compliance or performance (Ebenshade 2004; King and Lenox 2000; Pirrong 2000; Pirrong 1995; Rivera et al. 2006; Vidovic and Khanna 2007; Welch et al. 2000). In fact, in some cases, the adoption of self-regulation has been linked to performance declines (e.g., King and Lenox 2000). Moreover, while there is no doubt that self-regulatory practices can support companies’ well-intentioned efforts to comply with law, they are often used for more nefarious purposes: to enhance (often unjustifiably) a firm or industry’s reputation and legitimacy with outside stakeholders (Edelman et al. 1993), to stave off more stringent government regulation (King and Lenox 2000; Maxwell et al. 2000), or as a smokescreen to cover up actual wrongdoing (McKendall et al. 2002). Thus, a key challenge in leveraging self-regulation into better overall regulatory enforcement is sorting out whether a given firm’s

self-policing efforts are sincere and effective or whether they are window-dressing or worse. Because it is difficult for regulators to ascertain the quality of internal monitoring systems that are largely private and unobservable, systems of monitored self-regulation present significant information asymmetry problems.

To date, the literature on self-regulation has focused almost exclusively on incentives, addressing questions ranging from how regulators should calibrate rewards and penalties to induce firms to self-regulate (Coglianese and Nash 2001; Lobel 2005; Maxwell and Decker 2006), to how internal self-monitoring practices can change the internal decision-making and incentive structures of firms that adopt them (Orts and Murray 1997; Parker 2002). In designing regulatory programs, agencies too have focused on incentives, going to great lengths to reduce the costs⁵ and to emphasize the benefits⁶ of self-regulating. For both scholars and regulators, the “fundamental regulatory challenge” is “how to create incentives for continuing, yet increasingly costly, environmental improvement” (Johnston 2006, p. 168), and self-regulation is at the core of that effort.

Theoretical work on voluntary regulation has also focused on incentives. Maxwell and Decker (2006), for instance, model the incentive structure that will optimally induce voluntary environmental investment by regulated firms, improve aggregate compliance levels, and economize regulatory resources. They describe the interactions between a regulator who makes a credible offer to reduce its scrutiny of self-monitoring firms and a firm that responds with a credible commitment to invest in self-monitoring. They predict that this arrangement will yield three outcomes that are self-reinforcing: (1) the firm will invest in internal environmental audits or equipment maintenance programs to bolster its regulatory compliance; (2) this investment will, in fact, enable the firm to improve its regulatory compliance; and (3)

⁵ For example, US EPA promotes its WasteWise program by touting the program as being “free, voluntary, flexible” and makes clear that “The amount of time and money you invest is up to you! You are free to set goals that are the most feasible and cost-effective for your organization,” which includes the possibility of zero investment beyond completing the brief online registration form. US EPA, EPA WasteWise Program Overview, <http://www.epa.gov/wastewise/about/overview.htm> (updated December 18, 2007; accessed December 31, 2007)

⁶ US EPA, for instance, provides participants in its *Performance Track* program with “green marketing support” irrespective of the results they ultimately achieve. This includes, according to a Congressional Committee: “motivational posters; camera-ready advertisement “slicks”; press release templates; draft congratulatory letters to be signed by State Governors and other public officials; “tips” for communicating with employees, the public, and the media about Performance Track; video and powerpoint presentations; vehicle signs; flags; and event/conference planning” (Wynn and Stupak Letter, April 13, 2007).

the regulator will make good on its promise to inspect the firm less often. This model is a useful starting point for thinking about the interactions of regulators and firms in a mixed voluntary and mandatory regulatory scheme. However, because Maxwell and Decker's model is based on the regulator's being able to perfectly observe the firm's investment, they explicitly discount the possibility that a facility might establish self-monitoring procedures and fail to follow through on them, or that the competence required to self-police effectively might be unevenly distributed among firms. To the contrary, we suggest that the task of sorting the self-regulators that are disingenuous or ineffective from those that are serious and competent lies at the very heart of the monitored self-regulation enterprise (Darnall and Sides 2008; Lyon and Maxwell 2007). We turn to signaling theory to provide insight into how regulators can address this information asymmetry problem.

Darnall and Carmin (2005, p. 71) note the increasing importance of voluntary regulation practices as signals in the environmental field:

As regulators increasingly rely on voluntary programs, and as more businesses participate, it becomes essential to understand whether [Voluntary Environmental Programs] are leading to meaningful changes in environmental performance and whether the signals they send are accurate reflections of their participants' environmental behavior.

In this paper, we develop their insight by testing the reliability of and response to the voluntary disclosure signal. We use the term "signal" in Eric Posner's (2000b) sense, as a symbolic gesture designed to distinguish oneself to some intended audience as a "good type." Posner draws on the extensive economic literature on signaling in markets to construct a theory of how signals work in social and legal contexts. In economic transactions, for instance, sellers deploy signals to "tell the buyers something about the quality of the individual seller or his product" (Spence 1976, p. 592) when quality is not readily apparent. Signals operate similarly in social and political settings.

In ordinary life people engage in symbolic behavior all the time. They shake hands, applaud in theaters, salute the flag, wear stylish clothes, exchange wedding rings, bow, present gifts, observe diplomatic protocol, and show deference to superiors. In every case, the symbolic behavior is intended as a signal that the agent has a characteristic that the agent wants the receiver of the signal to believe that the agent has, but that the receiver cannot directly observe (Posner 1998, p. 767).

Self-regulation practices, including codes of conduct, internal compliance offices, and industry- or agency-sponsored voluntary programs, have become an important symbolic vocabulary for this kind of socio-legal signaling, as companies increasingly seek to identify themselves as “good types” to regulators and to the broader public (King et al. 2002).

[I]n the absence of accurate information, environmentally proactive companies are unable to differentiate themselves from other firms. In these situations, the environmental performance of companies is ‘pooled’ together. Because there is no readily available means to determine which firms are cleaner than others, market actors, regulators and other external stakeholders who want to identify proactive firms may find it difficult to do so. To remedy environmental information asymmetries, some companies are relying on [self-regulation initiatives] to inform consumers, investors, corporate buyers and regulators about their environmental activities (Darnall and Carmin 2005, p. 75).

It is far from clear, however, whether self-regulation is a particularly useful signal. Darnall and Carmin (2005) find very little to distinguish one voluntary program from the next, so the mere fact of participation does little to sort the good types from the bad. And, as we discuss above, empirical evidence demonstrates that self-regulation rarely improves the measurable performance of those that participate (Darnall and Sides 2008; Lyon and Maxwell 2007).

These findings are not surprising viewed through the lens of signaling theory. The problem with using self-regulatory behavior as a signal is that, in most cases, it is not sufficiently costly to serve as a reliable indicator of the sender’s type. Signals must have some intrinsic, non-trivial cost in order to reliably separate the good types from the bad. “Signals reveal type if only the good types, and not the bad types, can afford to send them, and everyone knows this” (Posner 2000a, p. 19). In other words, to effectively identify the “good” types, a signal must be “too costly to fake” (Camerer 1988, p. S186). Because signals like adopting codes of conduct and participating in most government voluntary environmental programs are relatively costless, they cannot serve as effective signals of good compliance behavior. Unfortunately, this insight has been lost in the “win-win” rhetoric of government voluntary programs. In their efforts to incentivize participation, regulators often strip self-regulatory behavior of any value it might have as a signal.

The *Audit Policy* provides an interesting case study of the signaling value of self-regulation, because it is a more “costly signal” (Stephenson 2006, p. 756) than most. Unlike many other common self-regulation signals, voluntary self-disclosure of regulatory violations is associated with two kinds of costs. First, there is a cost inherent in implementing and maintaining the systematic, internal controls that are the policy’s prerequisite. Not every firm will be willing to incur the initial and ongoing investments this requires. Second, there is a potentially costly risk in revealing to regulators that you have violated the law. Unlike many self-regulation symbols, which merely provide a platform for self-promotion, revealing the existence of a legal violation carries the potential to damage as well as to benefit the self-reporter. A firm that is truly a “bad apple” may be unwilling to risk attracting the regulator’s attention and raising the regulator’s suspicions in this way if it knows that its actual performance cannot withstand the regulator’s scrutiny.

Viewed through this lens, the key question about self-regulation shifts from whether it “works” to whether it is a reliable signal. Posing the question in this way allows us to generate new insights about the dynamic relationship of regulators and regulated firms in a mixed regulatory environment. First, is the adoption of self-regulation practices merely symbolic, as many have charged, or does it signal something meaningful about a company’s willingness and ability to dispatch its social and legal obligations? And, second, do agencies that employ self-regulation as a tool use it effectively to sort the good types from the bad, allowing them to leverage self-regulation at some firms toward better overall compliance? These are the questions we empirically examine in this paper.

Our paper makes important contributions to the empirical literature on self-regulation, as well as to the law and economics literature on signaling. We focus on a little-studied, but increasingly important, subset of self-regulation practices that we characterize as “self-policing,” which encompasses efforts to encourage regulated entities to monitor their own compliance with law and report and remediate violations they discover. 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 and penalty calibration (e.g., Innes 1999a, 1999b; Innes 2001; Kaplow and Shavell 1994; Malik

1993; Pfaff and Sanchirico 2000). In part, this is because data on self-policing behavior is very difficult to obtain. In fact, many of the government agencies that sponsor such programs have found themselves incapable of evaluating them (US GAO 2004b).⁷ Accordingly, our rigorous empirical analysis of the EPA's self-policing program represents a significant contribution to this literature.

The US EPA's *Audit Policy*, the subject of the current study, has been the subject of limited evaluation. Three years after the program's inception in 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). The only academic study examining EPA *Audit Policy* outcomes looks at its impact on enforcement activity over a two-year time period and finds that EPA decreases its scrutiny of participating facilities (Stafford 2007). Our analysis expands on this work in three respects. First, we examine the effect of self-policing on enforcement activity over the life-span of the program. Second, we measure how self-policing affects environmental performance in addition to inspection rates, to determine whether any reduced regulatory scrutiny was warranted. Finally, our theoretical framework allows us to generalize beyond this specific program to understand how self-regulation functions as a signal between regulated facilities and government regulators.

To our knowledge, this paper represents the first attempt to synthesize the insights of the theoretical literature on signaling with an empirical study of self-regulation outcomes. While some have noted the strategic value of self-regulation as a signal (King et al. 2002), demonstrated how it confers benefits on self-regulating firms by communicating quality standards to potential exchange partners (King et al. 2005; Terlaak and King 2006), and highlighted the importance of voluntary program design in validating self-regulation as a signal (Darnall and Carmin 2005), no research to date has used the theoretical framework of signaling to understand how self-regulation affects regulatory outcomes and the

⁷ 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, p. 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, p. 43).

relationships between regulators and regulated firms. We do so in this article, in the context of a government voluntary program that seeks to leverage corporate self-regulation as an enforcement tool. This not only fills a gap in the literature, but provides a practical new way of understanding the dynamic relationship between self-regulation and the broader regulatory scheme.

3. Empirical Context: The 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 self-police by implementing "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, p. 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 committed 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, p. 66709).⁸ Overall, nearly 3500 facilities have self-disclosed violations under the *Audit Policy* during 1997-2003. These self-reported violations include "paperwork" violations such as failures to report toxic chemical emissions or to properly label hazardous materials, as well as violations with more direct environmental

⁸ The Audit Policy provides the following additional conditions for full penalty mitigation and an EPA recommendation for no criminal prosecution: "Systematic discovery of the violation through an environmental audit or the implementation of a compliance management system; Voluntary discovery of the violation was not detected as a result of a legally required monitoring, sampling or auditing procedure; Prompt disclosure in writing to EPA within 21 days of discovery...;Independent discovery and disclosure before EPA or another regulator would likely have identified the violation through its own investigation or based on information provided by a third-party; Correction and remediation within 60 calendar days, in most cases, from the date of discovery; Prevent recurrence of the violation; [Violations of] specific terms of an administrative or judicial order or consent agreement [are ineligible]; Cooperation by the disclosing entity is required" US EPA, EPA's Auditing Policy <http://www.epa.gov/compliance/incentives/auditing/auditpolicy.html> (updated October 15, 2007; accessed December 31, 2007).

consequences such as 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 the regulator and the 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 internal auditing to monitor regulatory compliance. 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: The Effect of Self-Policing on Regulatory Cooperation

We evaluate the value of voluntary disclosure as a signal by analyzing the effects of participation in the EPA *Audit Policy*. We examine, first, the reliability of the voluntary disclosure signal, or whether facilities that commit to engage in the ongoing self-policing activities required by the *Audit Policy* actually “clean up their act” more broadly and reduce the occurrences of abnormal events that release toxic chemicals to the environment. We then investigate how regulators respond to the voluntary disclosure signal.

4.1 Abnormal Environmental Releases

The EPA *Audit Policy* is designed to encourage managers to identify and correct compliance problems through internal monitoring and self-audits. As Orts and Murray (1997, p. 9) note: “First and foremost, environmental auditing informs a company of potential risks of violations and accidents. Better knowledge of these risks encourages prevention.” Beyond ensuring regulatory compliance,

environmental auditing can improve environmental performance. Indeed, EPA's stated objectives for the *Audit Policy* include encouraging "corporate compliance programs that are successful in preventing violations [and] improving environmental performance" and helping to "enhance protection of human health and the environment" (Federal Register 1995, pp. 66710-66712).

While environmental auditing has the potential to improve environmental performance in a variety of ways (US EPA 2001), we focus on its potential to mitigate abnormal events. For example, ongoing auditing can help managers ensure that equipment remains properly maintained and that staff members adhere to training schedules, both of which can prevent breakdowns and accidents. Our interviews with regulators and companies suggest that internal environmental audits can improve housekeeping and require updated management plans, both of which can reduce the severity and frequency of environmental releases associated with abnormal events. A regulator at the New Jersey Department of Environmental Protection offered this example: "Above ground storage tanks must have a berm around them that is large enough to contain the substance held in the container should it rupture. Making sure that these are maintained can prevent further discharge into the environment."⁹ Similarly, an environmental manager at one of California's largest manufacturing plants told us:

I definitely believe regular audits are necessary to ensure not just regulatory compliance, but also the integrity of a facility's environmental safeguard. The purpose of the audits should be to identify potential mechanical or operating gaps in a system. Once identified, the facility can develop countermeasures or remedial actions to address any findings.¹⁰

US EPA claims that benefits of auditing include "the development of spill response plans [that] will help prevent spills and minimize risk of associated harm" (Federal Register 1999, p. 26748).

If facilities that self-disclose to the Audit Policy actually fulfill their promise of self-policing by maintaining internal environmental auditing routines, we would expect to see fewer environmental releases associated with abnormal events and accidents such as tank ruptures, leaking tanks, and spills from improper filling or overfilling tanks. We test this by examining whether facilities that commit to

⁹ Personal communication, March 20, 2008.

¹⁰ Personal communication, March 20, 2008.

conducting routine environmental auditing by disclosing to the Audit Policy subsequently experience fewer abnormal events that lead to environmental releases.

4.2 *Regulatory Inspections*

Self-policing is not only a method for companies to prevent violations and discover and disclose those that do occur. Self-policing is also meant to be a part of the regulator's targeting strategy to enhance the overall effectiveness of the enforcement regime by refining its ability to identify and reward compliant firms and to shift its resources to recalcitrant firms. We assess the extent to which this is occurring by investigating how regulators respond to voluntary disclosures on the part of regulated firms, and whether these responses allow regulators to leverage any gains in performance that self-regulation might produce.

Firms may 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 2008). However, the *Audit Policy* provides no promise that participating firms will enjoy any lessening of regulatory scrutiny. Indeed, US EPA has adopted the formal stance that: “[a]uditing does not in any way serve as a substitute for compliance activities, nor does it replace regulatory agency inspections” (Johnson and Frey 2000, p. 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).¹¹ While US EPA acknowledges that the *Audit Policy* can only elicit self-disclosures if it avoids the impression that self-disclosing will attract increased regulatory scrutiny,¹² our informal conversations with US EPA staff suggest that self-

¹¹ 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).

¹² 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).

disclosures tend to raise some regulators' suspicion that a self-discloser is probably concealing other problems.¹³

Despite US EPA's equivocation on the issue, it is not uncommon for agencies to offer an explicit enforcement *quid pro quo* to voluntary program participants. Programs like *Hazard Analysis and Critical Control Point* at the US Department of Agriculture and OSHA's *Voluntary Protection Program*, for instance, expressly provide that the agency will decrease inspection activity at participating firms (Chelius and Stark 1984). Similarly, 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, p. 20). This approach provides significant incentives for participation. An "inspection holiday," or a decrease in regulatory scrutiny, 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, it reduces the likelihood that the regulator would discover and punish the firm's violations (Dimento 1989).

Inspection holidays also provide important benefits to regulators by giving them the flexibility to effectively target their enforcement resources. Reducing inspections at cooperative firms is central to the agency's broader targeting strategy, because it frees up enforcement resources that can then be used to pursue less cooperative firms. According to US EPA (1999b, p. 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 "underscore a need for a targeted approach to inspections" (US EPA 1999b, p. 17), and voluntary

¹³ In a conversation with one of the authors, a former US EPA attorney said that US EPA tended to regard *Audit Policy* disclosures as a "red flag" that warranted increased scrutiny (Personal communication, June 10, 2004). Our conversations with US EPA inspectors yielded mixed impressions: one inspector said she would be *less* suspicious of firms that self-disclosed, while another inspector said he would be *more* suspicious, noting "if a facility makes a mistake in one area, it is probably making mistakes in other areas" (Personal communication, October 12, 2007).

disclosures can play an important role in developing that approach. In addition, reducing scrutiny of cooperative firms is a way for the agency to communicate to the regulated community its own commitment to cooperative behavior, and thus to sustain the benefits of mutual cooperation in the regulatory arena (Ayres and Braithwaite 1992; Scholz 1984). Because inspection holidays are both materially beneficial and represent sound regulatory strategy, we hypothesize that self-reporters subsequently will face fewer inspections.

However, it is important to consider the possibility that self-disclosures may produce different results under different circumstances. The regulator's approach to inspections is highly discretionary, and the effect of voluntary disclosures on targeting decisions will depend on how the regulator interprets the voluntary disclosure signal: as evidence of wrongdoing or as a gesture of cooperation and future compliance. Voluntary disclosures occur against a tapestry of existing impressions and ongoing relationships, including the firm's prior reputation with the regulator. Specifically, "historical enforcement activity is shown to have a crucial impact on regulators" (Decker 2003, p. 124). To target their inspection resources, regulators tend to categorize firms as *good apples* or *bad apples* based on their past compliance records (Harrington 1988; Helland 1998). Self-disclosures provide the regulator with new information that may influence its assessment of firms.

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 apple* status (Pfaff and Sanchirico 2004; Short and Toffel 2008). 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, p. 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. Below, we explore the conditions under which self-disclosures alter or reinforce regulators' perceptions of firms by empirically examining whether and how facilities' prior compliance records influence regulators' responses to self-disclosures.

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 inspections during 1991 through 2003 from the US EPA's Aerometric Information Retrieval System (AIRS)/AIRS Facility Subsystem database.¹⁴ From this database, we calculated each facility's *annual number of CAA 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 one *enforcement action*, based on data from the US EPA's ICIS database.¹⁵

We measured environmental performance associated with abnormal events by gathering data on facilities' "one-time releases" of toxic chemicals from the US EPA's Toxic Release Inventory (TRI)

¹⁴ To avoid our results being driven by outliers, 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.

¹⁵ Less than 2% of facilities with any enforcement actions had more than a single one in a particular year. To avoid our results being driven by these outliers, we created a dummy variable rather than a count variable to measure enforcement actions.

database. One-time releases refer to toxic chemical emissions that result from circumstances outside of routine operations such as tank ruptures (US EPA 2007, p. 58)¹⁶ Our interviews with state and federal regulators as well as company environmental managers suggested that internal auditing could result in fewer one-time releases.¹⁷ We calculated annual *number of one-time releases* from the subset of facilities in our sample that were required to report TRI data.¹⁸

We obtained data on facilities' annual *production ratio* values—the ratio of a facility's production level in the focal year to the prior year—from the TRI database. Because TRI-reporting facilities report production ratios for each chemical, we calculated the mean value for each facility-year, and top code values at the 99.9% percentile of the entire sample distribution of mean production ratios.

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.¹⁹ 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 dollar value of Clean Air Act penalties assessed by environmental regulators, and the log of the total number of CAA regulated facilities.

¹⁶ Specifically, one-time releases includes all TRI chemicals “disposed or released directly into the environment or sent off-site for recycling, energy recovery, treatment, or disposal during the reporting year due to any of the following events: (1) remedial actions; (2) catastrophic events such as earthquakes, fires, or floods; or (3) one-time events not associated with normal or routine production processes” (US EPA 2007, p. 58). Our calls to New Jersey regulators and US EPA confirmed that this definition was routinely provided to companies. Our calls to several companies that had reported one-time releases also confirmed that they used this definition in deciding what to report as one-time releases.

¹⁷ For example, an EPA Regional TRI coordinator told us that “Internal audits would likely set up systems that could prevent or mitigate one-time releases. They could establish procedures that would prevent or mitigate one-time releases.” A regulator from the New Jersey Department of Environmental Protection told us that internal environmental audits could reduce the frequency of one-time releases.

¹⁸ Facilities are required to report TRI data if they have at least 10 employees, operate in a targeted industry (e.g., manufacturers, utilities, mining), and produces or uses any of the listed chemicals in quantities greater than particular thresholds (which range from 10 to 25,000 pounds) (US EPA 2007: pp. 1 and 6).

¹⁹ US EPA's National Priority sectors can be found at <http://www.epa.gov/compliance/data/planning/shortterm.html>

5.2 *Abnormal Environmental Releases Model*

To assess the effect of self-policing on environmental performance, we estimate the following model:

$$y_{i,t} = f(\beta_1 D_{i,t} + \beta_2 X_{i,t} + \beta_3 \tau_{i,t} + \beta_4 \lambda_t + \alpha_i, \varepsilon_{i,t}) \quad (1)$$

The dependent variable $y_{i,t}$ refers to the number of one-time releases by facility i in year t . Our key explanatory variable is $D_{i,t}$, a dummy variable. For those facilities that self-disclosed sometime during the sample period, this variable is coded 0 in the years prior to and the year the facility self-disclosed, and coded 1 in the years thereafter. For non-disclosers, this variable is always coded 0.

Because changes in facility size and production quantities may affect the number of one-time releases, X includes log employment and log production ratio.²⁰ We also include a full set of dummies ($\tau_{i,t}$) to control for the number of years before or after the match year. We include a full set of year dummies (λ_t) to control for year-specific factors that might affect the number of one-time releases, such as the emergence of new technologies. We include facility-level conditional fixed effects (α_i) to control for all unobserved time-invariant factors that might influence a facility's one-time releases such as the facility's industry, geographic location, its EPA Region and state regulatory authorities, its proximity to inspection agencies, and the political power of its community.

5.3 *Regulatory Inspection Model*

We estimate the following model to assess the effect of self-disclosures on regulatory inspections:

$$y_{i,t} = f(\beta_1 D_{i,t} + \beta_2 X_{i,t} + \beta_3 S_{i,t} + \beta_4 \tau_{i,t} + \beta_5 \lambda_t + \alpha_i, \varepsilon_{i,t}) \quad (2)$$

The dependent variable $y_{i,t}$ refers to the number of CAA inspections to which facility i has been subjected in year t . Our key explanatory variable is $D_{i,t}$, which is coded as described earlier.²¹

²⁰ We also estimated models that omitted these two control variables; our results were unchanged.

²¹ Prior studies have indicated that self-disclosure is associated with more inspections and enforcement actions (Short and Toffel 2008; Stretesky and Gabriel 2005), both of which are included as control variables.

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 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, p. 20). This means not only targeting enforcement resources to the most pressing problem areas, but also to the firms most likely to be creating those problems, "taking into account... compliance/enforcement history" (US EPA 1999a, p. 20). Indeed, EPA's policy suggests that facilities found in violation are often targeted for more frequent inspections in the near future (US EPA 1990), a relationship supported by empirical evidence (Harrington 1988; Helland 1998). 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 control for regulatory programs that may affect a facility's inspection rates by including dummy variables that indicate whether the facility was targeted in a given year 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).

We also include a full set of dummies ($\tau_{i,t}$) to control for the number of years before or after the match year. We include a full set of year dummies (λ_t) to control for year-specific factors that may affect inspection rates, such as changes in presidential administrations, Congress, and EPA leadership. 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 its EPA Region and 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).²²

5.4 *Matched sample*

Our difference-in-differences approach relies on an identifying assumption that, if they had not participated in the *Audit Policy*, the trends in outcomes (specifically, the difference in outcomes between the pre- and post-periods) among voluntary disclosers and non-disclosers would have been indistinguishable. However, prior empirical research has demonstrated that self-disclosure is 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.

To bolster the plausibility of the identifying assumption, we compare disclosing facilities to a matched set of non-disclosers who look “similar” to them in the years prior to self-disclosure. We do this based on the logic that a matched group of disclosers and non-disclosers that look “similar” before self-disclosure occurs would have continued to look 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 at the time the treatment occurs (Shadish et al. 2002) or, in our case, when self-disclosure occurs. Relying on matched samples 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. We include as its matched controls those non-disclosing facilities that match exactly along these seven dimensions. We

²² A facility's size may also affect the attention it receives from regulatory inspectors. Annual data on facility size are not readily available to us or to regulators. Thus, we believe that to the extent regulators consider facility size in their targeting algorithm, they at most consider broad size categories such large, medium, or small. Our use of facility-level (conditional) fixed effects controls this among facilities that remain within a particular size category during the sample period. Furthermore, our results are unbiased even if facilities do change size categories to the extent that the probability of this occurring is uncorrelated with self-disclosing.

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 an overall matched sample of 19,986 facilities, including 688 that self-disclosed violations. Our analysis includes each matched facility’s observations starting two years before its match year through five years after the match year. Because our analyses identify changes in outcomes *within* facilities over time, we restricted our sample in each analysis to only those facilities for which we had data during at least one year before *and* one year after the match year.²³

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 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. We extended the two models described above by interacting all independent and control variables with the *good apple* and *bad apple* (facility-level) dummies to explore whether one-time releases and inspection holidays differed between (a) good apples that self-disclosed versus good apples that did not; (b) bad apples that self-disclosed versus bad apples that did not. We also explore whether there are significant differences *between* these within-group effects.

6. Results

Descriptive statistics are provided in Table 1.

* * * * *
 Insert Table 1 about here
 * * * * *

²³ In cases where this restriction eliminated all the disclosers or all the non-disclosers from a matched group, we excluded the match group. This ensured that our samples always consisted of matched groups that had both disclosers and non-disclosers, and that each of had data during the pre and post-match periods.

6.1 *Abnormal Environmental Releases*

We employ a conditional fixed effects negative binomial model to estimate the number of one-time releases, and a conditional fixed-effects logistic model to determine whether the probability of experiencing *any* one-time releases declined after self-disclosing. Our negative binomial results indicate that the expected annual number of one-time releases declined by 20% ($p < 0.01$) after facilities self-disclosed, holding all other variables constant²⁴ (Table 2, Column 1). The marginal effect of the post-self-disclosure coefficient implies that self-disclosers subsequently experienced 0.35 fewer annual one-time releases, compared to the matched sample of non-disclosers over the same period. To put this number in context, note that facilities in this sample averaged 1.7 one-time releases in the pre-match period. A t-test confirmed that our results were not confounded by pre-existing differences in trends between the facilities that were about to self-disclose and the matched non-disclosing facilities.²⁵ The conditional fixed-effects logistic results indicate that a facility's odds of experiencing *any* one-time releases decline by half (odds ratio of 0.57, $p < 0.01$) after it self-disclosed, holding all other variables constant²⁶ (Column 2).

Our fully interacted model examined changes *within* the group of good apples and *within* the group of bad apples. Our negative binomial results (Column 3) indicate that self-disclosing good apples experienced a statistically significant decline in one-time releases compared to good apples that did not disclose (23% decline, $p < 0.01$). In contrast, bad apples that self-disclosed did not experience a statistically significant decline compared to the non-disclosing bad apples (7% decline, $p = 0.35$). A Wald test indicates that the difference in these effects is statistically significant ($\chi^2 = 3.53$; $p = 0.06$). Our fully interacted logistic model yielded similar results: good apples that self-disclosed subsequently realized a much lower probability of experiencing any one-time releases compared to non-disclosing good apples (odds ratio of 0.55, $p < 0.01$), whereas we found no evidence of any change in this probability between the

²⁴ Calculated as $[\exp(-0.223)-1]*100\%$.

²⁵ We compared the self-disclosers' and non-disclosers' trends of one-time releases during the two years prior to the match year. We calculated the difference between the number of one-time releases each facility experienced in the match (disclosure) year and the number it experienced two years prior. A t-test indicated that the self-disclosers and non-disclosers had indistinguishable pre-trends ($p = 0.37$). We employed this "difference" metric rather than a "percent changes" metric because a large proportion of our sample had no one-time releases in the baseline year, and thus their "percent change" from that period is undefined.

²⁶ Calculated as $[\exp(-0.568)-1]*100\%$.

bad apples that did or did not self-disclose (odds ratio of 0.93, $p=0.83$) (Column 4). A Wald test indicates that the difference in these effects is statistically significant ($\chi^2=2.85$; $p=0.09$).

Insert Table 2 about here

6.2 *Regulatory Inspections*

We also employed a conditional fixed effects negative binomial model to estimate the number of inspections and a conditional fixed-effects logistic model to determine whether the probability of experiencing any inspections declined after self-disclosing. The results of both models indicate that regulators granted inspection holidays to self-disclosers. Our negative binomial results indicate that after facilities self-disclosed, their expected annual number of inspections declined by 17% ($p<0.01$), holding all other variables constant²⁷ (Table 3, Column 1). A t-test confirmed that our results were not confounded by pre-existing differences in trends between the facilities that were about to self-disclose and the matched non-disclosing facilities.²⁸ Our logistic model indicates that facilities that self-disclosed subsequently experienced a decline in the probability of facing any inspections by a factor of 0.74 ($p<0.01$) (Column 2).

Insert Table 3 about here

The results of our fully interacted models reveal that regulators responded differently to self-disclosures depending on whether the self-disclosing facility was a good apple or a bad-apple. Our negative binomial results indicate that good apples that self-disclosed subsequently experienced 23% fewer inspections compared to non-disclosing good apples ($p<0.01$) (Table 4, Column 1). We find no evidence of an inspection holiday being granted to bad apples that self-disclosed; their subsequent inspection rate was no different than non-disclosing bad apples ($p=0.56$). A Wald test indicates the

²⁷ Calculated as $[\exp(-0.185)-1]*100\%$.

²⁸ We compared the self-disclosers' and non-disclosers' inspection trends during the two years prior to the match year. We calculated the difference between the number of inspections each facility experienced in the match (disclosure) year and the number it experienced two years prior. A t-test indicated that two groups had indistinguishable pre-trends ($p=0.96$).

difference between these effects is statistically significant ($\chi^2=5.06$; $p=0.02$), which enables us to conclude that regulators bestowed a larger average inspection holiday on good apples that self-disclosed than they did on bad apples that self-disclosed. Our logistic results present the same pattern (Column 2). Among good apples, regulators subsequently reduced the probability of conducting at least one annual inspection on facilities that self-disclosed by a factor of 0.78 ($p=0.05$). We find no evidence of this effect among bad apples ($p=0.94$).

As an alternative way to distinguish between good apples and bad apples, we used a more myopic time window, classifying as good apples only those facilities that had no cited violations or enforcement actions in the year before match year or the match year (our main analysis considered the firm's compliance record during both one and two years before the match year). The results of both our negative binomial and logistic inspection models were nearly identical to our main results, bolstering the robustness of our finding evidence that inspectors bestowed inspection holidays on good apples that self-disclosed, but no evidence that self-disclosing affected their inspections of bad apples.

Insert Table 4 about here

7. Discussion and Future Research

Our results provide evidence that self-regulatory practices can improve performance under certain circumstances. Specifically, we demonstrate that *Audit Policy* participants with clean past compliance records improved their environmental performance by reducing their accidental releases of toxic chemicals to the environment. We also find that regulators rewarded these effective self-policers with an “inspection holiday.” By contrast, “bad apple” self-disclosers did not improve their performance compared with similar non-disclosing firms. We find no evidence that regulators altered their scrutiny over these ineffective self-policers. These findings suggest both the possibilities and limitations for

integrating self-policing practices into an existing regulatory regime and using voluntary disclosure as a signal of their efficacy.

Three key insights follow from these findings. First, self-regulation has different effects in different contexts. We found that self-disclosing good apples reduced their number of abnormal environmental releases compared to a similar set of non-disclosing good apples. But we found no such improvements among bad apples. This distinction highlights the importance of taking into account firm-level characteristics as an important moderator in future theories and empirical studies of self-regulation. Our results suggest that the would-be self-regulator's existing skill level or capacity place significant limits on what self-regulation can accomplish. We show that self-policing can help good apples do better, but it does not appear to do so for bad apples.

Second, our results suggest that, in some contexts, voluntary disclosure can serve as a reliable signal of future performance, but that the signal must be interpreted against the backdrop of the self-reporter's past compliance. Like other self-regulation signals, both good and bad types can and do send the disclosure signal. These findings are consistent with existing empirical research suggesting that the adoption of self-regulatory practices does not reliably identify participants as good or bad future compliers (King and Lenox 2000; Koehler 2007; Pirrong 2000; Pirrong 1995; Rivera et al. 2006; Vidovic and Khanna 2007; Welch et al. 2000). However, regulators do not appear to be "fooled" by bad apples that send the voluntary disclosure signal. Moreover, voluntary disclosures do appear to provide a means for distinguishing the "great" apples from the merely good apples. These results demonstrate that voluntary disclosures can provide regulators some targeting leverage, but they also suggest the importance of addressing signaling issues more explicitly in designing voluntary programs. To produce meaningful signals—and results—these programs must address the different capabilities and commitment levels participants bring to the process of self-regulation. Programs like US EPA's *Performance Track* and OSHA's *VPP* address this issue by sorting firms in advance, allowing only those with good track records to participate. Regulators should think about other ways to "pre-qualify" companies for participation in voluntary regulation. Another way to strengthen the signaling value of self-regulation is

to raise its costs. As Darnall and Sides (2008, p. 75) show, the vast majority of voluntary environmental programs currently lack even rudimentary monitoring and performance standards, which “creates opportunities for free-riding” by enabling facilities to participate at very little cost—meaning, “without changing their environmental behavior or meeting program goals.” Delmas and Keller (2005, p. 104) suggest that regulators could deter free-riding more effectively with voluntary programs that “combin[e] monitoring and sanctioning mechanisms.” Or, as Kirmani and Rao (2000) put it: “No Pain, No Gain.”

Finally, it turns out that regulators are quite adept at interpreting the voluntary disclosure signal and effectively sorting the good apples from the bad. We found that regulators had accurately parsed these two groups of self-disclosers, rewarding the former but not the latter with inspection holidays. While regulators may have been interpreting voluntary disclosures through the lens of existing reputation, their interpretations were accurate. These results complement previous research finding that regulators grant inspection holidays to facilities that improve their environmental performance by reducing toxic pollution levels (Decker 2005). Our results also extend Maxwell and Decker’s (2006) model by showing that both the performance of and rewards for self-monitoring are contingent. By rewarding the firms that improve while continuing to monitor those that don’t, regulators are engaging in a form of “responsive regulation” (Ayres and Braithwaite 1992) that has the potential to nurture the cooperation of the good apples and encourage future gains by bad apples, motivated by not by self-regulation, but by enforcement scrutiny.

These findings raise a number of interesting questions for future research. Our findings highlight the need for comparative research on self-regulation that attends to distinctions among specific practices and contexts to produce insights about where and why some kinds of self-regulation work better than others (Darnall and Sides 2008). In addition, future evaluations of self-policing could employ different types of outcomes. 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 Patten 1994; Cormier and Magnan 2007). Researchers could investigate whether such benefits also accrue to firms that

voluntarily disclose regulatory compliance violations. While we found no evidence that bad apples claiming to self-police improved their compliance, future research could examine the extent to which this resulted from opportunism (faking) or a capabilities deficit, a distinction critical when considering how to improving the design of self-regulation programs. Finally, we suggest further research about the actual and potential signaling value of different kinds of self-regulation and how regulators might design mixed regulatory schemes that not only encourage companies to self-regulate but that accurately identify those doing so effectively.

8. Conclusions

We have demonstrated some of the benefits and the limitations of self-policing practices and the use of voluntary disclosure as a signal. Compared to similarly situated, non-disclosing facilities, self-disclosing firms on average reduce the number of abnormal events resulting in toxic chemicals being released to the environment. Parsing the sample, we find that these results are driven by improvements by the self-disclosers with clean compliance histories (good apples) when we compare them to non-disclosing good apples. In contrast, we find no evidence of such improvement when we compare self-disclosers to non-disclosers among facilities with poor compliance histories (bad apples). We also find evidence that regulators interpret the voluntary self-disclosure signal accurately, rewarding effective self-disclosers—but not ineffective self-disclosers—with an inspection holiday. These findings suggest that self-regulatory practices can provide some leverage on enforcement, but they can't make a bad apple good.

References

- Andrus, Charles H., Eduardo G. Villasenor, John B. Kettelle, Randolph Roth, Allison M. Sweeney, and Nathaniel 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.
- Ayres, Ian, and John Braithwaite. 1992. *Responsive Regulation: Transcending the Deregulation Debate*. Oxford University Press, New York.
- Barach, Paul, and Stephen D. Small. 2000. Reporting and preventing medical mishaps: lessons from non-medical near miss reporting systems. . *British Medical Journal (BMJ)* **320** 759-763.

- Bardach, Eugene, and Robert A. Kagan. 1982. *Going by the Book: The Problem of Regulatory Unreasonableness*. Temple University Press, Philadelphia.
- Blaconiere, Walter G., and Dennis M. Patten. 1994. Environmental disclosures, regulatory costs, and changes in firm value. *Journal of Accounting and Economics* **18**(3) 357-377.
- Blundell, Richard, and Monica Cosia Dias. 2000. Evaluation methods for non-experimental data. *Fiscal Studies* **21** 427-468.
- Camerer, Colin. 1988. Gifts as economic signals and social symbols. *American Journal of Sociology* **94** S180-S214.
- Centner, Terence J. 2000. Concentrated Feeding Operations: An Examination of Current Regulations and Suggestions for Limiting Negative Externalities. *Columbia Journal of Environmental Law* **25**(1) 219-252.
- Chelius, James, and Harry F. Stark. 1984. OSHA's Voluntary Protection Program. *Labor Law Journal* **35**(3) 167-174.
- Coequyt, John, and Richard Wiles. 2000. Prime Suspects: The Law Breaking Polluters America Fails to Inspect. Environmental Working Group, Washington, DC.
- Coglianesi, Cary, and Jennifer Nash. 2001. Environmental management systems and the new policy agenda. C. Coglianese, J. Nash, eds. *Regulating from the Inside: Can Environmental Management Systems Achieve Policy Goals*. Resources For the Future, Washington, DC, 1-25.
- Cormier, Denis, and Michel Magnan. 2007. The revisited contribution of environmental reporting to investors' valuation of a firm's earnings: An international perspective *Ecological Economics* **62**(3-4) 613-626.
- Darnall, Nicole, and Joann Carmin. 2005. Greener and cleaner? The signaling accuracy of U.S. voluntary environmental programs. *Policy Sciences* **38** 71-90.
- Darnall, Nicole, and Stephen Sides. 2008. Assessing the performance of voluntary environmental programs: Does certification matter? *The Policy Studies Journal* **36**(1) 95-117.
- Dasgupta, Susmita, Hemamala Hettige, and David Wheeler. 2000. What improves environmental compliance? Evidence from Mexican industry. *Journal of Environmental Economics and Management* **39** 39-66.
- Decker, Christopher S. 2003. Corporate Environmentalism and Environmental Statutory Permitting. *Journal of Law and Economics* **46**(1) 103-129.
- Decker, Christopher S. 2005. Do regulators respond to voluntary pollution control efforts? A count data analysis. *Contemporary Economic Policy* **23**(2) 180-194.
- Delmas, M., and A. Keller. 2005. Strategic free riding in voluntary programs: The case of the US EPA Wastewise program. *Policy Sciences* **38** 91-106.
- Delmas, Magali, and Ann Terlaak. 2002. Regulatory commitment to negotiated agreements: Evidence from the United States, Germany, The Netherlands, and France. *Journal of Comparative Policy Analysis: Research and Practice* **4** 5-29.
- Demsetz, Harold. 1968. Why regulate utilities? *Journal of Law and Economics* **11**(1) 55-65
- Dimento, Joseph F. 1989. Can social science explain organizational noncompliance with environmental law? *Journal of Social Issues* **45**(1) 109-132.
- Duggin, Sarah Helene. 2003. Internal Corporate Investigations: Legal Ethics, Professionalism and the Employee Interview. *Columbia Business Law Review* **2003** 859-964.
- Ebenshade, J. 2004. *Monitoring Sweatshops: Workers, Consumer and the Global Apparel Industry*. Temple University Press, Philadelphia.
- Edelman, Lauren B., Howard S. Erlanger, and John Lande. 1993. Internal dispute resolution: The transformation of civil rights in the workplace. *Law & Society Review* **27**(3) 497-534.
- 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.
- Fleder, John R. 1999. A Voluntary Disclosure Program for FDA – The Time Has Come. *Food and Drug Law Journal* **54** 389-399.
- Friesen, Lana. 2003. Targeting enforcement to improve compliance with environmental regulations. *Journal of Environmental Economics and Management* **46**(1) 72-85.
- Harrington, Winston. 1988. Enforcement leverage when penalties are restricted. *Journal of Public Economics* **37** 29-53.
- Helland, Eric. 1998. The enforcement of pollution control laws: Inspections, violations, and self-reporting. *The Review of Economics and Statistics* **80**(1) 141-153.
- 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, Robert. 2001. Violator avoidance activities and self-reporting in optimal law enforcement. *Journal of Law, Economics & Organizations* **17** 239-256.
- Johnson, Karry A., and Bertram C. Frey. 2000. Environmental Auditing Since EPA's 1986 Audit Policy. US Environmental Protection Agency, Office of Regional Counsel, Region 5, Chicago, IL.
- Johnston, Jason Scott. 2006. The Promise and Limits of Voluntary Management-Based Regulatory Reform: An Analysis of EPA's Strategic Goals Program. C. Coglianese, J. Nash, eds. *Leveraging the Private Sector: Management-Based Strategies for Improving Environmental Performance*. Resources for the Future, Washington, DC, 167-200.
- Kaplow, Louis, and Steven Shavell. 1994. Optimal law enforcement with self-reporting of behavior. *Journal of Political Economy* **102** 583-606.
- Khanna, M., and 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, Andrew A., and Michael J. Lenox. 2000. Industry self-regulation without sanctions: The chemical industry's responsible care program. *Academy of Management Journal* **43**(4) 698-716.
- King, Andrew A., Michael J. Lenox, and Ann Terlaak. 2005. Strategic use of decentralized institutions: Exploring certification with the ISO 14001 management standard. *Academy of Management Journal* **48**(6) 1091-1106.
- King, Andrew A., and Michael W. Toffel. Forthcoming. Self-regulatory institutions for solving environmental problems: Perspectives and contributions from the management literature. M. Delmas, O. Young, eds. *New Perspectives in Governance for Sustainable Development*. Cambridge University Press.
- King, Andrew, Michael Lenox, and Michael Barnett. 2002. Strategic Responses to the Reputation Commons Problem" A. Hoffman, M. Ventresca, eds. *Organizations, Policy and the Natural Environment*. Stanford University Press, Stanford, CA, 393-407.
- Kirman, Amna, and Akshay R. Rao. 2000. No Pain, No Gain: A Critical Review of the Literature of Signaling Unobservable Product Quality. *Journal of Marketing* **64**(2) 66-79.
- Koehler, Dinah A. 2007. The effectiveness of voluntary environmental programs—A policy at a crossroads? *Policy Studies Journal* **35**(4) 689-722.
- 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.
- Lobel, Orly. 2005. Interlocking Regulatory and Industrial Relations: The Governance of Workplace Safety. *Administrative Law Review* **57**(4) 1071-1152.
- Lyon, Thomas P., and John W. Maxwell. 2007. Environmental Public Voluntary Programs Reconsidered. *The Policy Studies Journal* **35**(4) 723-750.
- Malik, A. 1993. Self-Reporting and the Design of Policies for Regulating Stochastic Pollution. *Journal of Environmental Economics and Management* **24** 241-257.
- Maxwell, John W., and Christopher S. Decker. 2006. Voluntary environmental investment and responsive regulation. *Environmental & Resource Economics* **33** 425-439.
- Maxwell, John W., Thomas P. Lyon, and Steven C. Hackett. 2000. Self-Regulation and Social Welfare: The Political Economy of Corporate Environmentalism. *Journal of Law and Economics* **43**(2) 583-619.
- McKendall, Marie, Beverly DeMarr, and Catherine Jones-Rikkens. 2002. Ethical Compliance Programs and Corporate Illegality: Testing the Assumptions of the Corporate Sentencing Guidelines. *Journal of Business Ethics* **37**(4) 367-383.
- Medinger, Jason 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, and R.A. Clawson. 1997. Toward a Psychology of Framing Effects. *Political Behavior* **19**(3) 221-246.
- Noll, Roger. 1971. The Economics and Politics of Regulation. *Virginia Law Review* **57**(6) 1016-1032.
- Orts, Eric W. 1995. Reflexive Environmental Law. *Northwestern University Law Review* **89**(4) 1227-1340.
- Orts, Eric W., and Paula C. Murray. 1997. Environmental disclosure and evidentiary privilege. *University of Illinois Law Review* **1997**(1) 1-69.
- Parker, Christine. 2002. *The Open Corporation: Effective Self-Regulation and Democracy*. Cambridge University Press, Cambridge.
- Pfaff, Alexander S.P., and Chris 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, Alexander S.P., and Chris 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.
- Pirrong, Craig. 2000. A theory of financial exchange organization. *Journal of Law and Economics* **43**(2) 437-471.
- Pirrong, Stephen Craig. 1995. The self-regulation of commodity exchanges: The case of market manipulation. *Journal of Law and Economics* **38**(1) 141-206.
- Posner, Eric A. 1998. Symbols, signals, and social norms in politics and the law. *Journal of Legal Studies* **27**(2) 765-798.
- Posner, Eric A. 2000a. *Law and Social Norms*. Harvard University Press, Cambridge.
- Posner, Eric A. 2000b. Law and social norms: The case of tax compliance. *Virginia Law Review* **86**(8) 1781-1819.
- Potoski, Matthew, and Aseem Prakash. 2004. The regulation dilemma: Cooperation and conflict in environmental governance. *Public Administration Review* **64**(2) 152-163.
- Potoski, Matthew, and Aseem Prakash. 2005. Covenants with weak swords: ISO 14001 and facilities' environmental performance. *Journal of Policy Analysis and Management* **24**(4) 745-769.
- Priest, George L. 1993. The origins of utility regulation and the 'Theories of Regulation' debate. *Journal of Law and Economics* **36**(1) 289-323.
- Rivera, Jorge, Peter de Leon, and Charles Koerber. 2006. Is greener whiter yet? The Sustainable Slopes program after five years. *Policy Studies Journal* **34** (2) 195-221.
- Saiyid, Amena H. 2007. Appeals Court Rejects Rehearing Request To Review EPA-Livestock Industry Agreement. *Environment Reporter* **38**(48) 2598.
- Scholz, John T. 1984. Cooperation, Deterrence, and the Ecology of Regulatory Enforcement. *Law & Society Review* **18**(2) 179-224.
- Shadish, William R., Thomas D. Cook, and Donald T. Campbell. 2002. *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*. Houghton Mifflin Company, Boston.
- Short, Jodi L., and Michael W. Toffel. 2008. Coerced confessions: Self-policing in the shadow of the regulator. *Journal of Law, Economics & Organizations* **24**(1) 45-71.
- Shover, Neil, John Lynxwiler, Stephen Groce, and Donald 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, Jeffrey A., and Petra E. Todd. 2005. Does matching overcome LaLonde's critique of nonexperimental estimators? *Journal of Econometrics* **125**(1-2) 305-353.
- Spence, Michael. 1976. Informational aspects of market structure: An introduction. *Quarterly Journal of Economics* **90** 591-597.
- Stafford, Sarah L. 2007. Should you turn yourself in? The consequences of environmental self-policing. *Journal of Policy Analysis and Management* **26**(2) 305-326.
- Stephenson, Matthew C. 2006. A Costly Signaling Theory of 'Hard Look' Judicial Review. *Administrative Law Review* **58**(4) 753-814.
- Stigler, George. 1971. The Theory of Economic Regulation. *Bell Journal of Economic and Management Science* **2**(Spring) 3-21.
- Stigler, George J., and Claire Friedland. 1962. What can regulators regulate? The case of electricity. *Journal of Law and Economics* **5** 1-16.
- Stretesky, Paul , and Jackie 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., and C. Wallat. 1987. Interactive Frames and Knowledge Schemas in Interaction: Examples from a Medical Examination/Interview. *Social Psychology Quarterly* **50**(2) 205-216.
- Terlaak, Ann, and Andrew A. King. 2006. The effect of certification with the ISO 9000 Quality Management Standard: A signaling approach. *Journal of Economic Behavior & Organization* **60**(3) 579-602.
- Teubner, Gunther. 1983. Substantive and Reflexive Elements in Modern Law. *Law & Society Review* **17**(2) 239-285.
- Toffel, Michael 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. 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. 2001. Protocol for Conducting Environmental Compliance Audits of Hazardous Waste Generators under RCRA [EPA 305-B-01-003]. U.S. Environmental Protection Agency, Washington, D.C.
- US EPA. 2005. Compliance Incentives and Auditing. US Environmental Protection Agency.
- US EPA. 2007. Toxic Chemical Release Inventory Reporting Forms and Instructions Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986). Revised 2006 Version (EPA 260-C-06-901). U.S. Environmental Protection Agency, Washington, D.C.
- 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, Martina, and Neha Khanna. 2007. Can voluntary pollution prevention programs fulfill their promises? Further evidence from the EPA's 33/50 Program. *Journal of Environmental Economics and Management* **53** 180–195.
- Wasserman, Cheryl 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, David. 2005. Public enforcement/Private monitoring: Evaluating a new approach to regulating the minimum wage. *Industrial & Labor Relations Review* **58**(2) 238-257.
- Welch, Eric W., Allan Mazur, and Stuart 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

SAMPLE FOR ABNORMAL ENVIRONMENTAL RELEASES ANALYSIS (SEE TABLE 2)

UNIT OF ANALYSIS: FACILITY-YEARS (N=30,919)

	Mean	SD	Min	Max
Number of one-time releases	2.36	4.91	0	240
Post self-disclosure (dummy)	0.04	0.19	0	1
Log production ratio ^a	0.69	0.22	0	1.79
Log employment	3.67	2.34	0	9.90

PANEL B

SAMPLE FOR INSPECTION ANALYSIS (SEE TABLE 3)

UNIT OF ANALYSIS: FACILITY-YEARS (N=94,270)

	Mean	SD	Min	Max
Annual number of CAA inspections ^b	0.64	0.79	0	14
Voluntarily disclosed in prior years (dummy)	0.02	0.14	0	1
Years since prior inspection ^c	2.08	1.24	1	4
Annual number of violations ^a	0.03	0.16	0	3
Any enforcement actions (dummy)	0.01	0.12	0	1
Compliance Incentive Program target (dummy)	0.05	0.22	0	1
National Priority sector (dummy)	0.16	0.37	0	1
Log total penalties in the state-year	12.44	4.11	0	17.56
Log number of regulated facilities in the state-year	7.27	0.71	1.61	8.29

Observations extend from 2 years prior to 5 years after each facility's match year during 1993-2003.

^a top coded at 99th percentile

^b top coded at 99.9th percentile

^c top coded at 4 per year

TABLE 2
SELF-POLICING IS ASSOCIATED WITH FEWER ABNORMAL ENVIRONMENTAL RELEASES

Dependent variable Model	(1)	(2)	(3)	(4)
	Number of one-time releases Conditional Fixed Effects Negative Binomial	Any one-time releases Conditional Fixed Effects Logistic	Number of one-time releases Conditional Fixed Effects Negative Binomial	Any one-time releases Conditional Fixed Effects Logistic
Post voluntary disclosure	-0.223 [0.046]**	-0.568 [0.146]**		
Post voluntary disclosure × good apples			-0.267 [0.071]**	-0.599 [0.204]**
Post voluntary disclosure × bad apples			-0.071 [0.077]	-0.052 [0.251]
Log employment	0.003 [0.010]	0.023 [0.043]		
Log employment × good apples			-0.011 [0.011]	0.002 [0.047]
Log employment × bad apples			0.067 [0.024]**	0.115 [0.108]
Log production ratio	0.011 [0.033]	-0.089 [0.098]		
Log production ratio × good apples			0.045 [0.035]	-0.065 [0.103]
Log production ratio × bad apples			-0.310 [0.112]**	-0.347 [0.340]
Conditional fixed effects at the facility-level	Included	Included	Included	Included
Fixed effects for <i>t</i> years before/after match year	Included	Included		
Fixed effects for <i>t</i> years before/after match year × good apples			Included	Included
Fixed effects for <i>t</i> years before/after match year × bad apples			Included	Included
Year fixed effects (1994-2003)	Included	Included		
Year fixed effects × good apples			Included	Included
Year fixed effects × bad apples			Included	Included
Observations	30,919	24,325	30,919	24,325
Facilities	5,582	4,035	5,582	4,035
Wald X2	9808.4**	7895.2**	9858.8**	7924.1**

Dependent variable: Number of one-time releases of toxic chemicals. Values reported are coefficients, with standard errors in brackets; + $p < 0.10$; * $p < 0.05$; ** $p < 0.01$. All models also include a dummy variable denoting when a missing employment value was recoded to zero. Models 3 and 4 include interactions of all variables with “good apples” and “bad apples” dummy variables. Unit of analysis is the facility-year. The sample includes matched facilities’ observations starting 2 years prior their match year to 5 years after the match year, and include only facilities that reported data to the EPA’s Toxic Release Inventory. The conditional fixed effects negative binomial model drops facilities that have identical annual one-time release rates throughout the sample period. The conditional fixed effects logistic model drops facilities whose annual one-time release rates are either always positive or always zero throughout the sample period.

TABLE 3
SELF-POLICING IS ASSOCIATED WITH FEWER INSPECTIONS
AND LOWER PROBABILITY OF BEING INSPECTED

Dependent variable	(1) Number of annual inspections Conditional Fixed Effects Negative Binomial	(2) Any annual inspections Conditional Fixed Effects Logistic
Post self-disclosure	-0.185 [0.044]**	-0.303 [0.090]**
2 years since last inspection	0.126 [0.013]**	0.372 [0.022]**
3 years since last inspection	0.231 [0.020]**	0.537 [0.030]**
4 or more years since last inspection	0.618 [0.018]**	1.177 [0.027]**
Number of violations 1 year ago	0.026 [0.026]	0.157 [0.061]**
Number of violations 2 years ago	-0.010 [0.028]	0.035 [0.063]
Any enforcement actions 1 year ago	0.002 [0.039]	-0.142 [0.078]+
Any enforcement actions 2 years ago	-0.024 [0.041]	-0.185 [0.081]*
Compliance Incentive Program target	0.049 [0.021]*	0.049 [0.041]
National Priority sector	0.102 [0.018]**	0.282 [0.029]**
Log total CAA penalties in the state-year	-0.012 [0.005]**	0.013 [0.008]†
Log number of CAA-regulated facilities in the state-year	0.623 [0.046]**	1.390 [0.077]**
Facility-level conditional fixed effects	Included	Included
Fixed effects for <i>t</i> years before/after match year	Included	Included
Year fixed effects (1994-2003)	Included	
Observations	94,270	82,287
Facilities	16,078	13,673
Wald chi-squared	4117.4**	4773.0**

Values reported are coefficients with standard errors in brackets; + $p < 0.10$; * $p < 0.05$; ** $p < 0.01$. Unit of analysis is the facility-year. The sample includes matched facilities' observations starting 2 years prior their match year 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. The conditional fixed effects logistic model drops facilities whose annual inspection rates are either always positive or always zero throughout the sample period.

TABLE 4
SELF-POLICING IS ASSOCIATED WITH FEWER INSPECTIONS
AND LOWER PROBABILITY OF BEING INSPECTED –
AMONG FACILITIES WITH CLEAN COMPLIANCE HISTORIES

Dependent variable	(1)		(2)	
	Number of annual inspections		Any annual inspections	
Model	Conditional Fixed Effects Negative Binomial		Conditional Fixed Effects Logistic	
Post self-disclosure × good apples	-0.255	[0.062]**	-0.249	[0.126]*
Post self-disclosure × bad apples	-0.042	[0.072]	-0.012	[0.154]
2 years since last inspection × good apples	0.126	[0.013]**	0.371	[0.023]**
2 years since last inspection × bad apples	0.142	[0.047]**	0.401	[0.091]**
3 years since last inspection × good apples	0.232	[0.021]**	0.535	[0.030]**
3 years since last inspection × bad apples	0.222	[0.085]**	0.607	[0.130]**
4 or more years since last inspection × good apples	0.626	[0.019]**	1.179	[0.028]**
4 or more years since last inspection × bad apples	0.546	[0.078]**	1.183	[0.129]**
Number of violations 1 year ago × good apples	0.023	[0.033]	0.142	[0.074]†
Number of violations 1 year ago × bad apples	0.052	[0.048]	0.231	[0.122]†
Number of violations 2 years ago × good apples	0.004	[0.036]	0.115	[0.076]
Number of violations 2 years ago × bad apples	-0.057	[0.051]	-0.097	[0.124]
Any enforcement actions 1 year ago × good apples	-0.025	[0.054]	-0.306	[0.103]**
Any enforcement actions 1 year ago × bad apples	0.032	[0.066]	0.014	[0.148]
Any enforcement actions 2 years ago × good apples	-0.097	[0.057]+	-0.322	[0.109]**
Any enforcement actions 2 years ago × bad apples	-0.019	[0.070]	-0.044	[0.157]
Compliance Incentive Program target × good apples	0.060	[0.022]**	0.042	[0.043]
Compliance Incentive Program target × bad apples	0.000	[0.067]	0.056	[0.138]
National Priority sector × good apples	0.107	[0.019]**	0.275	[0.030]**
National Priority sector × bad apples	0.010	[0.062]	0.279	[0.116]*
Log total CAA penalties in the state, 1 year ago × good apples	-0.012	[0.005]**	0.010	[0.008]
Log total CAA penalties in the state, 1 year ago × bad apples	-0.016	[0.017]	0.063	[0.036]†
Log number of CAA-regulated facilities in the state, 1 year ago × good apples	0.599	[0.049]**	1.386	[0.080]**
Log number of CAA-regulated facilities in the state, 1 year ago × bad apples	0.906	[0.156]**	1.298	[0.307]**
Facility-level conditional fixed effects	Included		Included	
Fixed effects for <i>t</i> years before/after match year	Included		Included	
Year fixed effects (1994-2003)	Included			
Observations	94,270		82,287	
Facilities	16,078		13,673	
Wald chi-squared	4178.3**		4849.5**	

Values reported are coefficients with standard errors in brackets; + $p < 0.10$; * $p < 0.05$; ** $p < 0.01$. Unit of analysis is the facility-year. Fixed effects for *t* years before/after match year and fixed effects for years are interacted with “good apples” and “bad apples” dummy variables. The results of Model 2 were nearly identical when year fixed effects were included instead of fixed effects for *t* years before/after match year; the model did not converge when both sets of fixed effects were included. The sample includes matched facilities’ observations starting 2 years prior their match year 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. The conditional fixed effects logistic model drops facilities whose annual inspection rates are either always positive or always zero throughout the sample period.