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Does Self-Policing Help the Environment? EPA's Audit Policy and Hazardous Waste Compliance

Sarah L. Stafford
William & Mary, slstaf@wm.edu

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I. INTRODUCTION

In 1995, the Environmental Protection Agency (EPA) issued a final policy, "Incentives for Self-Policing: Discovery, Disclosure, Correction, and Prevention of Violations."[1] This policy, more commonly referred to as the Audit Policy, is designed to encourage greater compliance with environmental regulations by providing incentives for facilities to voluntarily disclose and correct violations of environmental regulations.[2] More specifically, the Audit Policy eliminates or reduces civil penalties for violations that facilities disclose as the result of a documented self-audit procedure and correct within 60 days.[3] Additionally, regulators may choose not to recommend criminal prosecution for these facilities.[4] Repeated violations, violations that present a "serious or imminent harm" to human health and the environment, or violations that involve criminal activity are not covered by the policy.[5]

Supporters of the Audit Policy argue that it is an "efficient and economical means of ensuring and improving compliance with environmental laws and regulations."[6] Opponents argue that this policy ultimately protects polluters from punishment, and thus will have a detrimental effect on the environment because facilities have less incentive to comply.[7] Many who do not directly oppose the policy are nonetheless skeptical about its ability to measurably affect compliance because of the uncertain legal status of environmental audits, particularly whether the results of the audit can be used against them in court.[8] The goal of this

    1. Incentives for Self-Policing: Discovery, Disclosure, Correction, and Prevention of Violations – Final Policy Statement, 60 Fed. Reg. 66,706 (Dec. 22, 1995) [hereinafter Audit Policy]. Minor revisions to the policy were issued under Incentives for Self-Policing: Discovery, Disclosure, Correction, and Prevention of Violations – Final Policy Statement, 65 Fed. Reg. 19,618 (Apr. 11, 2000).
    2. 60 Fed. Reg. at 66,706.
    3. 60 Fed. Reg. at 66,712.
    4. 60 Fed. Reg. at 66,712.
    5. 60 Fed. Reg. at 66,712.
    6. U.S. Environmental Protection Agency, *Audit Policy Update: Spring 1999, available at* http://www.epa.gov/oeca/apolguid.html.
    7. *See* Richard Dahl, *Audit-Privilege Laws: The Right to Know Nothing,* 107 ENVTL. HEALTH PERSPECTIVES (1999).
    8. *See* Environmental Auditing Policy Statement: Interim Guidance, 50 Fed. Reg. 46,504

paper is to determine whether the Audit Policy has affected compliance with hazardous waste regulations. The results of this analysis will provide important feedback on the effectiveness of the Audit Policy. The remainder of this paper is organized as follows: Section 2 provides an overview of the related literature on self-policing and compliance; Section 3 presents a theoretical framework for this analysis; Section 4 discusses the empirical approach and the results of the analysis; and Section 5 concludes.

II.   OVERVIEW OF SELF-POLICING AND RELATED LITERATURE

The term self-policing, as it is used in this paper, denotes a situation in which a regulated entity notifies authorities that it has violated a regulation or law. In comparison, the term self-reporting denotes a situation in which a regulated entity provides authorities with information about its conduct that does not necessarily include violating a regulation. For example, EPA's regulations implementing the Clean Water Act require entities to measure discharge levels and report them to EPA or the state regardless of whether the emissions exceed specified discharge limitations.[9] In general, self-reporting is a mandatory requirement and entities that are subject to it face two decisions: (1) whether to self-report at all, and (2) whether to self-report correctly.[10] In contrast, self-policing is primarily voluntary and involves only one key decision, whether or not to turn in one's self. However, this distinction between self-policing and self-reporting has not always been observed in the literature; in particular, the term self-reporting is often used to describe self-policing.[11]

(Nov. 8, 1985). A number of public comments on the EPA's guidance document stated that EPA was not doing enough to assuage corporate concerns that audit reports could be used for compliance "witch hunts." However, EPA has consistently refused to grant explicit privilege to audit reports. *See* Environmental Auditing Policy Statement: Final Policy Statement, 51 Fed. Reg. 25,004 (July 9, 1986); Audit Policy, *supra* note 1; Dan J. Jordanger & Christopher R. Graham *Protecting Privilege, Recognizing the Risks of Criminal Liability, and Reaping the Benefits of EPA's Audit Policy*, 12 VA. LAW. 12, 15 (1991) (discussing the limitations of the Audit Policy and risks involved with its use).

   9. *See* EPA Administered Programs: The National Pollutant Discharge Elimination System, 40 C.F.R. § 122.41 (j)-(i) (2002) (describing the self-reporting required under the Clean Water Act).

   10. *See* Jon D. Harford, *Self-Reporting of Pollution and the Firm's Behavior Under Imperfectly Enforceable Regulations*, 14 J. ENVTL. ECON. & MGMT., 293 (1987); Arun S. Malik, *Self-Reporting and the Design of Policies for Regulating Stochastic Pollution*, 24 J. ENVTL. ECON. & MGMT., 241 (1993). Both articles define self-reporting as a situation in which a regulated entity provides authorities with information about its conduct, both positive and negative.

   11. *See* Louis Kaplow & Steven Shavell, *Optimal Law Enforcement with Self-Reporting of Behavior*, 102 J. POL. ECON., 583, 583-84 (1994) (using the term self-reporting to denote what this paper terms self-policing, that is the "reporting by parties of their own harm-producing actions to an enforcement authority"); Robert Innes, *Remediation and Self-Reporting in Optimal Law Enforcement*, 72 J. PUB. ECON. 379 (1999) [hereinafter Innes, *Remediation and Self-Reporting*] (generally following Kaplow & Shavell's definition of self-reporting).

A number of theoretical papers have examined the concept of voluntary self-policing in the context of environmental regulation. Louis Kaplow and Steven Shavell present a model of a probabilistic environmental enforcement regime with self-policing in their 1994 article.[12] In this model, when self-policers pay a fine equal to the certainty equivalent of the sanction they would face if they did not disclose but instead took their chances that the violation would be discovered, self-policing will not affect deterrence and will result in a welfare improvement because enforcement effort and risk are reduced.[13] Robert Innes extends this model in a 1999 article by considering the potential benefits of remediation under a self-policing policy.[14] Because self-policers remediate with certainty while non-disclosers only remediate when caught, self-policing can be welfare enhancing even if enforcement costs are not reduced.[15] In a later article Innes modifies the model to show that self-policing can increase efficiency if violators have different probabilities of apprehension by inducing violators with high probabilities of apprehension to self-police.[16] Additionally, in a subsequent article Innes shows that if violators can engage in avoidance activities, self-policing can increase efficiency by reducing such activities and, in turn, allow the government to achieve the same level of deterrence with a reduced enforcement effort.[17]

Birendra Mishra, Paul Newman, and Christopher Stinson provide an explicit model of EPA's Audit policy.[18] They construct a single-period compliance model and consider the effects of audit privilege and penalty reductions for disclosure on the facility's decision to conduct an audit. In this model, however, compliance is exogenous.[19] Thus while facilities continue to violate, the Audit Policy will induce some to undertake audits and correct their violations more quickly thereby reducing the duration of

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12. Kaplow & Shavell, *supra* note 11, at 583-84.

13. *Id.*

14. *See* Innes, *Remediation and Self-Reporting, supra* note 11.

15. *Id.* at 382.

16. *See* Robert Innes, *Self Reporting in Optimal Law Enforcement When Violators Have Heterogeneous Probabilities of Apprehension,* 29 J. LEGAL STUD. 287 (2000). In this model because only some violators self-police the government can tailor penalties based on violator type. In particular, the government can set a penalty closer to the maximal sanction without overpenalizing violators with high probabilities of apprehension.

17. *See* Robert Innes, *Violator Avoidance Activities and Self Reporting in Optimal Law Enforcement* 17 J. L. ECON. & ORG. 239 (2001). In this model, since avoidance activities are reduced the cost of increasing penalty levels is reduced and thus the government can substitute higher penalties for lower enforcement effort.

18. Birendra K. Mishra, D. Paul Newman & Christopher H. Stinson, *Environmental Regulations and Incentives for Compliance Audits,* 16 J. ACCT. & PUB. POL'Y 187 (1997).

19. *Id.* at 191.

noncompliance.[20]   Alexander Pfaff and Chris Sanchirico also incorporate exogenous compliance into their model of EPA's Audit Policy.[21]   In their model, the social cost of violations is minimized when actual fines are conditioned on the level of self-policing.[22]   Given that investigative effort can not be observed, the authors compare the information requirements and efficiency benefits of self-policing policies based on different observable proxies for self-investigation.

Although EPA's Audit Policy was established in 1996, to date there has not been much empirical analysis of the policy or its effect on compliance. EPA's Office of Regulatory Enforcement publishes an *Audit Policy Update* on an annual basis, but the newsletter does not include any statistical or econometric analyses.[23]   In 1999, EPA completed an Audit Policy Evaluation based on a voluntary survey of companies that disclosed environmental violations under policy, but the analysis is limited primarily to descriptive statistics about the users.[24]   Pfaff and Sanchirico did conduct a statistical analysis of Audit docket cases for 1994 to 1999.[25]   They compare the profile of disclosed violations to all violations in terms of the statutes violated, types of violations, and average fines. They find that the typical disclosed violation is relatively minor such as the failure to submit a required report to EPA.[26]   Given their findings about the types of violations disclosed under the Audit Policy, the authors develop a number of possible explanations about the effect of the Audit Policy on compliance behavior. However, they do not empirically analyze the effect of the policy on compliance behavior.

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20.   *Id.* at 206.

21.   Alexander Pfaff & Chris William Sanchirico, *Environmental Self-Auditing: Setting the Proper Incentives for Discovery and Correction of Environmental Harm*, 16 J. L., ECON. & ORG. 189 (2000) (noting that in this context, self-policing is the investigative efforts made by firms to discover violations).

22.   *Id.* at 207.

23.   *See* Environmental Protection Agency, *Audit Policy Update, available at* http://www.epa.gov/compliance/resources/newsletters/auditupdate/index.html (last visited Jan. 20, 2005).

24.   *See* Incentives for Self-Policing: Discovery, Disclosure, Correction, and Prevention of Violations–Proposed Revisions and Request for Public Comment, 64 Fed. Reg. 26,745 (May 17, 1999).

25.   Alexander Pfaff & Chris William Sanchirico, Big Field, Small Potatoes; An Empirical Assessment of EPA's Self-Audit Policy, 23 J.Pol'y Analysis & Mgmt. 415 (2004).

26.   *See id.* at *418.* Although a reporting violation could be significant if it concerns a large quantity of toxic substances whose safe use requires notification of local officials, Pfaff and Sanchirico use the fines imposed for such violations (prior to any reduction under the Audit Policy) as a proxy for violation severity and find that self-audited, self-reported violations are less significant than violations discovered by the EPA. *Id.*

III. A THEORETICAL FRAMEWORK FOR SELF-POLICING

Under Subtitle C of the Resource Conservation and Recovery Act (RCRA), EPA has developed regulations governing the storage, transport, treatment, and disposal of hazardous waste.[27] Compliance with hazardous waste regulations includes: building, operating, and maintaining storage, treatment, and disposal systems in accordance with requirements;[28] obtaining the necessary permits for such systems; treating, disposing, or sending waste off-site for management within certain time frames;[29] packaging and labeling waste appropriately; instituting good housekeeping practices; keeping records of waste generation and management;[30] reporting quantities and types of wastes generated, managed, and sent off site; and training personnel both in day-to-day operations and for emergencies.[31] Hazardous waste violations may be willful or inadvertent. A facility may knowingly violate the regulations, for example, by sending hazardous waste to a non-hazardous waste landfill for disposal to save money. A facility may unknowingly violate hazardous waste regulations if it does not know that one of the waste products it generates is considered hazardous waste. Ignorance of the law can be seen as a failure to adequately research applicable regulations or train personnel about regulatory requirements. Both types of violations occur because the facility did not adequately invest in compliance. The cost of compliance, including information costs, will vary across facilities depending on the amount and type of waste generated, whether a facility manages its waste on site or sends it off site for management, and the presence of state and federal regulations.[32]

First, consider a facility's compliance decision prior to the implementation of a self-policing policy. To simplify the model, assume that facilities make a discrete choice to comply or not comply with hazardous waste regulations.[33] Let p be the probability that the facility

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27. The Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 6901(c) (1976).

28. 42 U.S.C. § 6924 (a) (1976).

29. 42 U.S.C. § 6925 (1976).

30. 42 U.S.C. § 6924 (s), (r) (1976).

31. 40 C.F.R. § 262-265.

32. For example, in 2001 EPA added two inorganic chemicals to the list of regulated hazardous wastes (Identification and Listing of Hazardous Waste: Inorganic Chemical Manufacturing Wastes; Land Disposal Restrictions for Newly Identified Wastes; and CERCLA Hazardous Substance Designation and Reportable Quantities-Final Rule, 66 Fed. Reg. 58,257 (Nov. 20, 2001)). In the economic analysis that accompanied the final rule, EPA estimated the annual costs of compliance to vary from $736 to $156,842 depending on the type of waste generated and the method used to treat the waste (see Economic Analysis for Listing of Inorganic Chemicals, *Notice of Final Rulemaking* (2001), *available at* http://www.epa.gov/epaoswer/hazwaste/id/inorchem/pdfs/final-ea.pdf).

33. In reality, firms make a continuous choice about how much to invest in compliance with

violates the regulations, given that the facility chooses not to comply. For willful violations, p will be equal to unity, while for inadvertent violations p will be less than one. Let s be the probability that regulators inspect the facility and discover the violation. Finally, let F be the fine associated with the violation. A facility compares the cost of compliance, C, with the expected cost of noncompliance, psF, and will comply when $C<psF$.[34] If $psF<C$, the facility will not comply. As discussed above, the cost of compliance will vary across facilities. The probability of inspection, s, is also facility-specific as EPA targets facilities based on human health and environmental risks and past compliance history.[35] Finally, F could also be facility-specific if the penalty depends on the economic benefit gained through noncompliance or compliance history, as many of EPA's penalty policy guidelines suggest.[36] Because C, s, and F vary across facilities, we should expect to see some facilities in compliance and others not.

Next, consider a self-policing policy whereby facilities that perform environmental audits and disclose any discovered violations receive a reduced fine, R. Under this policy, facilities have three decisions to make: (1) whether to comply: (2) whether to audit: and (3) whether to disclose any discovered violations. Let A be the cost of the audit program.[37] Figure 1 shows the facility's decision tree with the associated cost of each outcome. Working from the last decision, the disclosure decision, a facility will disclose discovered violations if $R<sF$ and will not if $sF<R$. If a facility is not going to disclose, it will not conduct an audit. Thus, facilities will only audit if $R<sF$ and $A+pR<psF$. Those facilities that would audit and disclose will choose to comply instead if $C<A+pR$. Those facilities that would not audit will comply only if $C<psF$.

Table 1 summarizes the effect of this type of self-policing policy on compliance, audit implementation, and disclosure. Note that the policy

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the probability of a violation decreasing in the level of investment.

34. This assumes that detection is complete. Allowing for incomplete detection will not affect the results of the model, just the interpretation of s. Under incomplete detection, s = (probability of an inspection) x (probability of detection given an inspection).

35. *See* Environmental Auditing Policy Statement: Final Policy Statement, 51 Fed. Reg. 25,004 (July 9, 1986) (stating that "EPA will continue to address environmental problems on a priority basis and will consequently inspect facilities with poor environmental records and practices more frequently."). While EPA's targeting policy is no longer made this explicit, it continues to be an integral part of the enforcement strategy. *See* U.S. ENVIRONMENTAL PROTECTION AGENCY, *Fiscal Year 2002 Enforcement and Compliance Assurance Report* (2003), *available at* http://www.epa.gov/compliance/re sources/reports/accomplishments/oeca/fy02accomplishment.pdf ("An integrated approach considers the appropriate tools to use when addressing environmental problems, and uses data analysis and other relevant information to marshal and leverage resources to target significant non compliance.").

36. *See, e.g.*, U.S. ENVIRONMENTAL PROTECTION AGENCY, *RCRA Civil Penalty Policy* (June 2003), *available at* http://www.epa.gov/compliance/resources/policies/civil/rcra/rcpp2003-fnl.pdf.

37. A is the cost of implementing the audit net of any benefits other than the penalty reduction.

will decrease compliance at facilities where $A+pR<C<psF$. However, these facilities will audit and disclose. Additionally, facilities where $A+pR<psF<C$ will begin to audit and disclose, saving enforcement resources and increasing the level of remediation. However, without an accompanying change in the likelihood of an inspection or the size of fines, such a policy cannot increase initial compliance as the only effect it can have is to reduce the expected cost of non-compliance.[38] If the self-policing policy requires that disclosed violations be remediated as a condition for receiving the reduced fine, as the EPA Audit Policy does, such a policy can increase environmental protection even though it does not increase compliance.[39] If there is such a requirement, the reduced fine, R, would reflect both the penalty paid to the regulatory agency as well as the costs of remediating the violation. Similarly, F, the initial fine, would include both monetary penalties and the cost of remediation, as the facility also must remediate detected violations.

FIGURE 1: FACILITY'S DECISION UNDER THE AUDIT POLICY
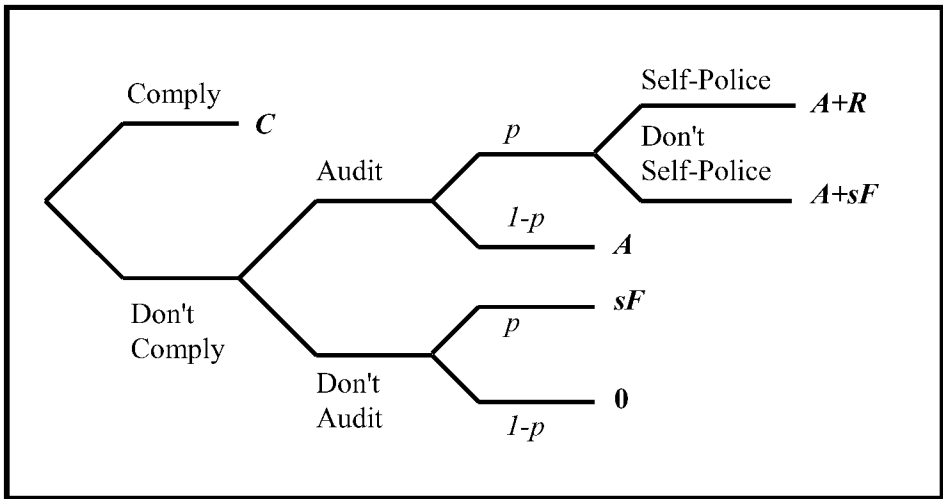
If violations are inadvertent, presumably conducting an environmental

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38. Other models do examine the optimal combination of self-policing policies, fine levels, and enforcement effort. *See* Innes, *supra* note 17.

39. Because facilities where $A+pR < C$ will begin to audit, remediate, and self-disclose, the level of environmental protection will increase. For the remediation requirements of the Audit Policy, *see* 60 Fed. Reg. at 66,711 (stating that the violation must be remediated for a facility to be eligible for a penalty reduction). Moreover, EPA's Audit Policy requires that if a facility benefits economically from the violation, the reduced fine must be at least equal to the amount of economic benefit. 60 Fed. Reg. at 66,712. For example, if a facility reports in 2000 that it did not perform daily sampling for a period of time in 1999, it is not feasible for the facility to go back in time and perform the sampling. Any economic benefit resulting from this violation, i.e., the savings from not sampling, must be paid under the Audit Policy, although any additional fines above that amount could be forgiven. *Id.*

audit is necessary to discover that a violation has occurred. However, if a violation is willful, the facility need not conduct an environmental audit to discover it. In such a situation, the cost of the environmental audit, A, is zero.[40] Additionally, for willful violations $p = 1$. Consider the self-policing policy under these conditions. If $sF<R$, the facility has no incentive to disclose violations and compliance will depend on whether $C<sF$. If $R<sF$, the facility will self-disclose if it chooses not to comply, that is if $R<C$. However, if R includes the cost of remediating the violation, it is unlikely that $R<C$. Thus, without a change in either s or F, the policy will not have any significant effect on willful violations.

If the self-policing policy were combined with a redistribution of enforcement effort, the policy could increase environmental protection as long as remediation of a violation is as environmentally protective as compliance.[41] Without the policy, facilities comply only if $C<psF$ and remediate when a violation is detected during an inspection. Under the policy, facilities will comply or self-police as long as $A+pR<psF$. Consider a facility where $A+pR<C<psF$. Under the policy, this facility will self-police. Therefore, regulators can decrease s to s' where $A+pR<ps'F<C$ without changing the incentives for self-policing. The regulator can then shift enforcement resources to deliberate violators or facilities that otherwise would not self-police, increasing deterrence and/or detection at such facilities. Thus, a self-policing policy complemented by a change in inspection targeting can result in an increase in compliance.

IV. EMPIRICAL APPROACH

Ideally, an empirical analysis of EPA's Audit Policy would examine the effect of the policy on self-policing, auditing, and compliance. Unfortunately, the data required to conduct such a comprehensive analysis is not available. First, because facilities do not need to inform the EPA of their audit program in advance, there is no comprehensive data on facilities that have implemented an audit program.[42] Second, complete data on

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40. However, if an environmental audit is required to receive the penalty reduction, the facility may still have to conduct one. EPA's Audit Policy requires an environmental audit only for complete reduction of the initial fine. *See* 60 Fed. Reg. at 66,711. If an audit is not the source of the discovery, the facility is only eligible for a 75% reduction. *Id.*

41. This assumes that the overall level of enforcement does not change. An increase in overall enforcement should increase environmental protection even without a self-policing policy.

42. EPA does negotiate some audit agreements in advance. These are generally for companies with multiple facilities and allow for disclosure of violations beyond the 21-day disclosure requirement for single-facility disclosures. *See* U.S. ENVIRONMENTAL PROTECTION AGENCY, *Use of Corporate Auditing Agreements for Audit Policy Disclosures, available at* http://www.epa.gov/Compliance/resourc es/policies/civil/rcra/corpaudagree-mem.pdf (last visited Jan. 20, 2005).

facilities that self-police is not available. EPA is only required to make data on settled cases available in the Audit Policy docket.[43] Because cases may not be settled for several years after the violation is disclosed, there can be a significant lag between the act of self-policing and the data being publicly available. Finally, if regulators decide not to pursue a case because it would receive complete penalty mitigation under the Audit Policy, the case may not be placed in the docket. For example, EPA Region 5 (covering Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin) lists thirty-one self-disclosure cases on its website, but only 7 of these are in the Audit Policy docket.[44] Since comprehensive data on auditing and self-policing is not available, this paper uses data on detected hazardous waste violations to assess the effect of EPA's Audit policy on hazardous waste compliance. Additionally, the analysis examines the impact of state audit policies on compliance since many states have recently enacted environmental audit privilege or immunity laws.[45]

The universe for this analysis includes all large quantity hazardous waste generators and management facilities in the continental U.S., excluding newly regulated facilities and federal facilities.[46] Newly regulated facilities are excluded because they are likely to behave differently than established companies as they have less knowledge about the regulations and the best way in which to comply.[47] Federal facilities are excluded because the impact of penalties on federal facilities is not the same as the impact on for-profit companies.[48] Finally, small quantity generators

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43. *See* 60 Fed. Reg. at 66,712.

44. U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 5, *Region 5 Audit Policy Cases*, *available at* http://www.epa.gov/region5/orc/r5cases.htm (last visited Jan. 20, 2005). The Audit Docket (#C-94-001) can be obtained from EPA's Enforcement and Compliance Docket and Information Center, *available at* http://www.epa.gov/compliance/resources/policies/index.html (last visited Jan. 20, 2005). Audit cases are indexed in section VII-B Nine of the 31 cases were resolved by letter and no formal compliant was filed or violations pursued because the facilities satisfied all of the criteria for the Audit Policy.

45. Some state laws prevent state enforcement authorities from obtaining audit data. Some shield companies from liability if they disclose and correct violations discovered through an environmental audit. EPA policy is generally less favorable to industry than much state privilege and immunity legislation. *See generally* John A. Lee & Bertram C. Frey, *Environmental Audit Immunity Laws: A State-by State Comparison*, ENVTL. REP. (BNA), July 9, 2004, at S-3.

46. Some state data are not available for Alaska and Hawaii. Because there are only nineteen facilities in these states that would otherwise be included in the analysis, the author omitted these facilities from the universe.

47. *See* John Brehm & James T. Hamilton, *Noncompliance in Environmental Reporting: Are Violators Ignorant, or Evasive of the Law?* 40 AM. J. POL. SCI. 444 (1996) (finding that facilities that are more likely to be ignorant of regulatory requirements are also more likely to be in noncompliance).

48. *See* S.G. Badrinath & Paul J. Bolster, *The Role of Market Forces in EPA Enforcement* Activity, 10 J. REG. ECON. 165 (1996) (finding that firm value declines in response to EPA enforcement actions).

are not included because the regulations governing them are significantly more lenient than those governing other generators and because they are excluded from some EPA data collection efforts.[49] Approximately 9,500 facilities are included in the panel data set that covers the period from 1992 to 2001.[50] The panel begins in 1992 because the last major changes to hazardous waste regulations, the Toxicity Characteristics Rule and the Land Disposal Restrictions, were in effect by 1992.[51]

a. Inspection Targeting Analysis

The first step in the analysis is to determine whether the probability of inspection for facilities in the analysis has changed since the Audit Policy was enacted. Data on facility inspections is maintained in EPA's RCRA Info database, which includes information on the date of each inspection visit and the types of inspections conducted.[52] Figure 2 shows the total number of RCRA inspections conducted each year during the period of analysis. Although it appears that the total number of inspections held steady and then decreased after the establishment of the Audit Policy in 1996, one cannot necessarily conclude that the probability of an inspection decreased at the facilities in this analysis. For example, inspections might have decreased because the number of regulated facilities decreased. Conducting a probit regression on the probability that a facility would be inspected in a given year allows one to identify the factors that affect whether a facility is inspected and to determine whether inspection targeting changed systematically after the imposition of the Audit Policy.[53] Because the panel data set contains ten observations for each facility, standard errors are clustered by facility.

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49. *See* U.S, Environmental Protection Agency, *RCRA Orientation Manual,* Section III,
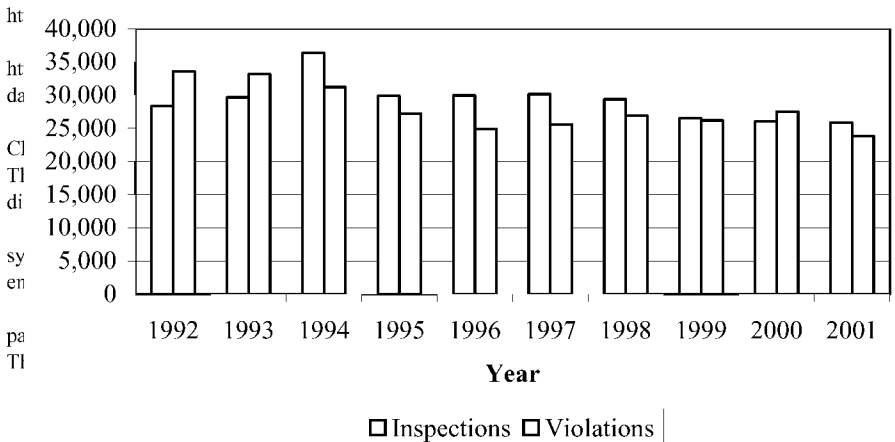

Year

☐ Inspections ☐ Violations

FIGURE 2: RCRA INSPECTIONS AND VIOLATIONS, 1992 - 2001

As shown in Table 2, the regression includes both facility-level and state-level variables. Additionally, the regression includes state dummies which are not shown in the table.[54] Over two-thirds of the state dummies are individually significant and all are jointly significant. This indicates variation across the states in the probability of inspection, as one would expect given that most states run their own hazardous waste program.[55] The first five explanatory variables listed in Table 2 characterize the level and nature of hazardous waste activities at the facility: *Permit* indicates whether the facility has a RCRA operating permit; *Generated* and *Received* measure the quantity of hazardous waste generated at the facility and the quantity received at the facility for management, respectively; and *Combustion* and *Land* indicate whether the facility operates a hazardous waste combustion unit (e.g., an incinerator or industrial furnace) or land disposal unit (e.g., landfill or surface impoundment), respectively.[56] Because there is more potential for environmental damages at facilities that manage large quantities of waste or conduct certain types of management operations, enforcement authorities are likely to target facilities based on hazardous waste activity, as is shown by the positive and significant coefficients on all of these variables.

TABLE 2: PROBIT RESULTS FOR INSPECTION EQUATION

Explanatory Variable	Coefficient	Standard Error
Constant	-1.80**	(0.11)
Permit	0.57**	(0.03)
Generated	0.04**	(0.003)
Received	0.03**	(0.003)
Combustion	0.18**	(0.06)

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54. Complete results are available from the author upon request.

55. EPA will authorize a state to run its own hazardous waste program as long as the state's program is at least as stringent as the federal program. *See* RCRA State Authorization, *available at* http://www.epa.gov/epaoswer/hazwaste/state/index.htm (last visited Jan. 20, 2005). Authorized states implement and enforce their hazardous waste program, while EPA, thorough its regional offices, implements and enforces federal regulations in unauthorized states.

56. *See* U.S. ENVIRONMENTAL PROTECTION AGENCY, Biennial Reporting System (BRS), *available at* http://www.epa.gov/epaoswer/hazwaste/data/ (last visited Jan. 20, 2005). The BRS contains information on the amount and type of waste generated and the waste management systems used at the facility. The data are collected biennially for the odd years, so waste quantities for even years are interpolated. Additionally, due to the time lag between collection and dissemination of the data, 2001 quantity data is not yet available. Thus 1999 data has been used for both 2000 and 2001. The results of analysis with respect to the audit and self-policing variables do not change qualitatively if the quantity data are excluded.

Land	0.21**	(0.06)
5Yr Inspection History	1.38**	(0.03)
Inspected$_{-1}$	-0.09**	(0.02)
Violated$_{-1}$	0.17**	(0.02)
Audit x Permit	-0.02	(0.04)
Audit x Generated	-0.00001	(0.004)
Audit x Received	0.009**	(0.003)
Audit x Combustion	-0.02	(0.07)
Audit x Land	-0.23**	(0.06)
Audit x 5Yr Inspection History	-0.02	(0.04)
Audit x Inspected$_{-1}$	-0.10**	(0.03)
Audit x Violated$_{-1}$	-0.07*	(0.03)
State Inspections	0.34**	(0.24)
State Inspection Intensity	0.26**	(0.04)
State Violations$_{-1}$	-0.09**	(0.03)
State Gross Product	-0.49**	(0.11)
State Compliance Cost	0.35**	(0.09)
State Strict Liability	0.03	(0.02)
State Environmental Membership	0.02**	(0.01)
State Pollution Prevention	-0.03	(0.03)
State Privilege	-0.10**	(0.03)
State Immunity	0.13**	(0.03)
State Self-Police	-0.30**	(0.02)
Audit Policy	0.46**	(0.07)
Audit x Region 1	-0.40**	(0.07)
Audit x Region 2	-0.32**	(0.07)
Audit x Region 3	-0.06	(0.06)
Audit x Region 4	-0.32**	(0.06)
Audit x Region 5	-0.28**	(0.06)
Audit x Region 6	-0.35**	(0.07)
Audit x Region 7	-0.26**	(0.07)
Audit x Region 8	-0.20**	(0.09)
Audit x Region 9	-0.76**	(0.07)

**Statistically significant at 5%, *Statistically significant at 10%.
State dummies are not reported.

The next three variables listed in Table 2 describe the facility's enforcement and compliance history. The *5Yr Inspection History* indicates the percentage of the past 5 years in which the facility has had a least one inspection visit; *Inspected$_{-1}$* indicates whether the facility was inspected in the previous year; and *Violated$_{-1}$* indicates whether the facility had a

detected violation in the previous year. The coefficient on *5Yr Inspection History* is positive and significant while the coefficient on *Inspected₋₁* is negative and significant. Thus, there appears to be an unobserved or omitted characteristic of the facility that the enforcement agency is targeting, such as specific activities or substances, that make the facility more likely to be inspected. Generally, if a facility was inspected in the previous year, a facility is less likely to be inspected in the current year. As one would expect, however, facilities that were found in violation in the previous year are significantly more likely to be inspected in the current year.

The facility-specific variables are also interacted with a binary Audit variable that indicates whether the observation took place before or after the establishment of the Audit Policy. As shown in Table 2, half of these interactions have significant coefficients. This indicates that after the imposition of the Audit Policy, facilities that receive waste from off-site for management are targeted more intensely, while land disposal facilities are targeted less intensely. In addition, facilities that were inspected in the previous year and facilities that were found in violation of hazardous waste regulations in the previous year are targeted less intensely after the imposition of the Audit Policy.

State-specific variables are included in the equation to control for differences in state enforcement. The first three state-level variables measure the level of inspection and enforcement activity in the state.[57] *State Inspections* measures the total number of inspections conducted in the state in a given year, normalized by the gross state product, and has a positive and significant coefficient. *State Inspection Intensity* is equal to the number of inspections in a given year divided by the number of unique facilities inspected. The higher the intensity, the more likely that the state conducts multiple inspections at a single facility. Since the facilities included in this analysis are only a fraction of the facilities regulated by the EPA under RCRA, this positive and significant coefficient on *State Inspection Intensity* suggests that states with higher intensities are more likely to target large quantity generators and management facilities. *State Violations₋₁* measures the total number of violations detected in the state in the previous year, normalized by the *State Gross Product*. The coefficient is negative and significant, which would be consistent with past violations diverting inspection resources for follow up inspections.

State Gross Product is included as a proxy for the enforcement burden

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57. These variables include all inspections and enforcement activity in the state, not just the activity at facilities in this analysis.

that a state's environmental agency faces.[58] The coefficient on *State Gross Product* is negative and significant, as expected, because states with a higher workload possess fewer resources to inspect the facilities in this analysis.   Additionally, states with heavier workloads may be forced to target enforcement efforts which will result in unevenly distributed inspections.   *State Compliance Cost* is an index of average pollution abatement costs across all media.[59]   Compliance costs can be used to measure the stringency of state environmental regulation as more stringent regulation would result in higher pollution abatement costs. The coefficient is positive and significant, suggesting that in more stringently regulated states the probability of inspection is higher.

A *State Strict Liability* dummy variable, indicating whether the state has adopted a law to hold parties strictly liable for accidental hazardous waste spills, is included in this analysis because strict liability will affect the incentives for enforcement agencies to find the responsible parties.[60]   As shown in Table 2, the coefficient on *State Strict Liability* is positive but not significant.   To measure local enforcement pressure, the analysis also includes *State Environmental Membership*, a measure of the proportion of citizens in the state that are members in environmental organizations such as the Sierra Club, because states with high environmental activism may have different inspection strategies than states with less environmentally-concerned citizens.[61] The coefficient on *State Environmental Membership* is positive and significant. *State Pollution Prevention* is a dummy variable indicating whether the state has a voluntary or mandatory pollution prevention program in place.[62]   Because the primary focus of many

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58. To control for the workload faced by state environmental agencies, many studies use the level of manufacturing or number of manufacturers in a state. However, because a significant portion of hazardous waste is produced by facilities in sectors that are not considered manufacturing (i.e., service sectors), this analysis uses the state's gross product. Gross State Product data was obtained from the Bureau of Economic Analysis, Department of Commerce website, available at http://www.bea.gov/bea/r egional/gsp.htm (last visited Jan. 20, 2005).

59. *See* ARIK LEVINSON, AN INDUSTRY-ADJUSTED INDEX OF STATE ENVIRONMENTAL COMPLIANCE COSTS, IN BEHAVIORAL AND DISTRIBUTIONAL EFFECTS OF ENVIRONMENTAL POLICY (G. Metcalf & C. Carrero eds., 2001). Arik Levinson calculated this index by adjusting survey data on pollution abatement costs and expenditures ("PACE") to account for state differences in industrial composition. Because the PACE survey was discontinued from 1995 to 1999, 1994 values are used in this analysis.

60. ENVIRONMENTAL LAW INSTITUTE, RESEARCH REPORT AN ANALYSIS OF STATE SUPERFUND PROGRAMS: 50 STATE STUDY, 1998 UPDATE (1998) (source for the data on strict liability adoption).

61. BOB HALL & MARY LEE KERR, 1991-1992 GREEN INDEX: A STATE-BY-STATE GUIDE TO THE NATION'S ENVIRONMENTAL HEALTH 116 (1991).

62. Data on pollution prevention programs was obtained from the National Pollution Prevention Roundtable, Washington, D.C.

pollution prevention programs is facility education and guidance, this variable is used as a proxy for state outreach efforts.[63] However, as shown in Table 2, the coefficient on this variable is not significant.

By 2001, half of the states had some type of self-policing or audit policy in place.[64] To control for differences in these state policies, the analysis also includes the dummy variables *State Privilege, State Immunity*, and *State Self-Police*.[65] Respectively, for each year these variables measure whether the state considers environmental audit results to be privileged; whether the state grants immunity from penalties for violations disclosed as a result of the audit; and whether the state has a self-disclosure policy (which does not generally require an audit to have taken place to receive relief). The coefficient on *State Privilege* is negative and significant while the coefficient on *State Immunity* is positive and significant. Because only one state has *Immunity* and not *Privilege*, in general the net effect of audit immunity is positive, indicating a higher probability of inspection.[66] However, in states with audit privilege only (and not reduced penalties), the probability of inspection decreases. The coefficient on *State Self-Police* is negative and significant, suggesting that state self-policing statutes may be used as a substitute for inspections.

Finally, the probit equation also includes a dummy variable indicating whether the federal Audit Policy is effective for that year and whether interactions exist between the Audit variable and Regional dummies.[67] The coefficient on the Audit variable is positive and significant, while the coefficients for all the regional interactions are negative (and significant for all but Region 3). For the two western regions, Regions 9 and 10 (the omitted region), the net effect is negative; for all other regions, the net

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63. *See generally* National Pollution Prevention Roundtable, *An Ounce of Pollution Prevention is Worth Over 167 Billion Pounds of Care* (Jan. 2003).

64. Bertram and Frey, *supra* note 45.

65. *See* National Conference of State Legislatures Data *available at* http://www.ncsl.org/programs/esnr/audits.htm (last visited Jan. 20, 2005) (discussing data from all state policies through 1998); *see also* U.S. Environmental Protection Agency's Region Five Office of Regional Counsel Data *available at* http://www.epa.gov/region5/orc/audits/ audit_apil.htm (last visited Jan. 20, 2005) (discussing Region Five's programs through 2001). These data were supplemented with information collected from state statutes and websites.

66. Only Rhode Island grants immunity from penalties disclosed as a result of an audit but does not consider the audit to be privileged. Additionally, three states (Nebraska, South Dakota, and Utah) passed Immunity regulation prior to passing Privilege legislation. Five states (Arkansas, Indiana, Illinois, Mississippi, and Oregon) have only Privilege legislation. *See* State Audit Privilege and Immunity Laws, *available at* http://www.epa.gov/region5/orc/audits/audit_apil.htm (last visited Jan. 20, 2005).

67. The Audit variable was not interacted with state dummies because the federal Audit Policy appears to be implemented either at the regional or federal level, depending on the case, rather than at the state level.

effect is positive. Thus, there appears to be significant variation in Audit Policy implementation across regions.

b.   *Compliance Analysis*

The next step in the analysis is to determine the effect that the Audit Policy has had on hazardous waste compliance, both directly and through changes in inspection targeting. Because of the complexity of hazardous waste regulations, there is no simple measure of compliance. There are approximately forty "areas of violation" which roughly correspond to the subparts of the Code of Federal Regulations for hazardous waste.[68] Within each area, there are numerous specific violations that could occur. Moreover, the severity of each violation can vary. Thus, for the purposes of this analysis, a facility is considered out of compliance if it commits at least one violation. Specifically, the dependent variable in the analysis is a binary variable equal to one if there is any detected RCRA violation at the facility during the calendar year. This does not include any violations that are disclosed under the Audit Policy, only violations detected as the result of a state or federal inspection.[69] Therefore, if a facility is not inspected there is no data on whether the facility is in compliance. Thus, any empirical analysis of compliance must control for this censoring of data by using data on whether or not a facility has been inspected. In addition, a regulator's decision to inspect a particular facility depends in part on the likelihood that the facility will be noncompliant and the facility's decision to comply depends in part on the likelihood of inspection. The censored bivariate probit model developed by William Greene accounts for both of these factors.[70] The censored bivariate probit uses maximum likelihood to estimate a probit model with sample selection where the selection equation and the underlying equation of interest may have correlated errors.

Table 3 presents the results of the censored bivariate probit. As in the inspection analysis, standard errors are clustered by facility. The results for the inspection equation are almost identical to the results of the inspection probit shown in Table 2. The only qualitative difference is that the coefficient on strict liability becomes significant in this model. Note also

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68. 40 C.F.R. § 262-265. For example, a facility may violate the manifest requirements applicable to generators (§262.21-23) or the packaging requirements applicable to generators (§262.30) or the contingency plan requirements applicable to treatment, storage, or disposal facilities (§264.52-56).

69. Although a few disclosed violations may have inadvertently been included in EPA's hazardous waste database, RCRAInfo, an analysis of the Audit docket shows that the majority of disclosed RCRA violations are not recorded.

70. WILLIAM H. GREENE, A STATISTICAL MODEL FOR CREDIT SCORING, (N.Y.U. Dept. Econ. Sch. of Bus., *Working Paper* No. EC-92-29, 1992).

that the correlation coefficient for the two equations, ρ, is positive and significant. Thus, the assumption that the errors in the two equations are correlated is correct.

TABLE 3: CENSORED BIVARIATE PROBIT RESULTS

Explanatory Variable	Inspection Equation		Violation Equation	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	-2.86**	(0.11)	-2.04**	(0.15)
Permit	0.56**	(0.03)	0.37**	(0.03)
Generated	0.04**	(0.003)	0.03**	(0.003)
Received	0.03**	(0.003)	0.02**	(0.003)
Combustion	0.19**	(0.06)	0.26**	(0.05)
Land	0.21**	(0.06)	-0.02	(0.05)
5Yr Inspection History	1.38**	(0.03)	0.64**	(0.06)
Inspected$_{-1}$	-0.09**	(0.02)	-0.38**	(0.03)
Violated$_{-1}$	0.19**	(0.02)	0.27**	(0.03)
Audit x Permit	-0.02	(0.04)	-0.10**	(0.04)
Audit x Generated	-0.0005	(0.004)	-0.001	(0.004)
Audit x Received	0.01**	(0.003)	0.01**	(0.003)
Audit x Combustion	-0.05	(0.07)	-0.04	(0.06)
Audit x Land	-0.22**	(0.06)	-0.08	(0.06)
Audit x 5Yr Inspection History	-0.01	(0.04)	0.01	(0.05)
Audit x Inspected$_{-1}$	-0.11**	(0.03)	-0.11**	(0.04)
Audit x Violated$_{-1}$	-0.06*	(0.03)	-0.02	(0.03)
State Inspections	0.32**	(0.20)	0.03*	(0.02)
State Inspection Intensity	0.26**	(0.04)	0.42**	(0.05)
State Violations$_{-1}$	-0.12**	(0.03)		
State Gross Product	-0.47**	(0.11)	-0.96**	(0.15)
State Compliance Cost	0.40**	(0.09)	0.23**	(0.11)
State Management Options			-0.005**	(0.001)
State Strict Liability	0.04*	(0.02)	0.06*	(0.02)
State Environmental Membership	0.02**	(0.01)	0.03**	(0.01)
State Pollution Prevention	-0.02	(0.03)	-0.01	(0.03)
State Privilege	-0.10**	(0.03)	-0.13**	(0.04)
State Immunity	0.13**	(0.03)	0.06**	(0.04)
State Self-Police	-0.30**	(0.02)	-0.21**	(0.03)
Audit Policy	0.47**	(0.06)	0.02	(0.10)
Audit x Region 1	-0.40**	(0.07)	-0.06	(0.10)

Audit x Region 2	-0.32**	(0.07)	-0.12	(0.10)
Audit x Region 3	-0.06	(0.06)	0.01	(0.09)
Audit x Region 4	-0.33**	(0.06)	-0.01	(0.09)
Audit x Region 5	-0.29**	(0.06)	0.05	(0.09)
Audit x Region 6	-0.35**	(0.07)	-0.02	(0.10)
Audit x Region 7	-0.26**	(0.07)	0.01	(0.10)
Audit x Region 8	-0.20**	(0.09)	0.23**	(0.11)
Audit x Region 9	-0.77**	(0.07)	-0.44**	(0.10)
ρ	0.84**	(0.03)		

**Statistically significant at 5%, *Statistically significant at 10%.
State dummies are not reported.

Now consider the results for the violation equation. Except for the coefficient on *Land*, all of the non-interacted facility-specific coefficients are significant. The positive coefficients on *Permit, Generated, Received*, and *Combustion* suggest that the increased costs of compliance for permitted facilities, facilities that generate or receive large quantities of waste, and facilities with combustion units, outweigh the increased probability that the facility will be inspected. The coefficients on *5Yr Inspection History* are also positive and significant in both equations. Thus, even though facilities with many inspections in the past are more likely to be inspected in the current year, these facilities are also more likely to be found in violation. This suggests that there may be unobserved or omitted characteristics of the facility that the enforcement agency targets that also make the facility more likely to violate. However, the coefficient on *Inspected$_1$* in the violation equation is negative and significant, perhaps because facilities that were inspected in the previous year believed that they were more likely to be inspected in the current year.

Table 3 indicates that facilities that were found in violation in the previous year also are more likely to violate in the current year. This result seems to be inconsistent with the fact that repeat violators experience a higher probability of inspection in the following year and face increased penalties for repeat violations; however, in many cases it will take time to correct a violation, particularly if it requires installing new technology, so past violations may determine current violations. Of the facility-level variables interacted with the Audit dummy variable, only three have significant coefficients. After the imposition of the Audit Policy, permitted facilities are less likely to violate; facilities that receive waste from off-site are more likely to violate. Facilities that were inspected in the previous year are also less likely to violate after the imposition of the Audit Policy.

As in the Inspection probit, state dummies were included in the

censored bivariate probit, although they are not reported in Table 3. In both equations, over two-thirds of the state dummies are individually significant, and all are jointly-significant. The coefficients on *State Inspections* and *State Inspection Intensity* in the Violation Equation are both positive and significant, which appears inconsistent with the positive coefficients in the Inspection equation. However, if the same facilities violate regulations repeatedly, the number of inspections and intensity of inspections may reflect higher levels of past violations. Although the number of violations in the state in a previous year should affect the probability that an inspection will be conducted in the current year, to identify the model *State Violations₋₁* is not included in the Violation Equation because data on the level of violations will not generally be common knowledge to facilities and therefore should not affect the facility's decision to violate.

The coefficient on *State Gross Product* in the Violation Equation is negative and significant, which appears to be inconsistent with the negative coefficient in the Inspection Equation. However, states with high gross products are larger and more industrialized thus are likely to have relatively well established environmental programs, which could result in higher compliance levels. As expected, the coefficient on *State Compliance Cost* is positive and significant, as facilities with higher compliance costs have a higher incentive to violate the regulations. *State Management Options* is a variable that measures the number of commercial hazardous waste management facilities in the state. To identify the model, *State Management Options* is omitted from the Inspection Equation because there is no obvious relationship between the number of commercial waste managers and the probability of inspection for a facility. Moreover, when *State Management Options* was included in the Inspection probit regression, it was not significant. In the Violation Equation, *State Management Options* has a negative and significant coefficient. When there are more hazardous waste managers in a state, a facility has a greater opportunity to send waste off-site for commercial management than manage the waste on site.

The coefficient on *Strict Liability* in the Violation Equation is positive and significant, which is consistent with Anna Alberini and David Austin's finding that states with large numbers of toxic releases (spills) are more likely to adopt strict liability.[71] The coefficient on *Environmental Membership* is also positive and significant though inconsistent with what one might expect, given that James Hamilton finds that penalties are higher

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71. Anna Alberini & David H. Austin, *Accidents Waiting to Happen: Liability Policy and Toxic Pollution Releases,* 84 REV. ECON. & STAT. 729 (2002) *reprinted in* RESOURCES FOR FUTURE, 3 (2001) *available at* http://www.rff.org/Documents/RFF-DP-01-06.pdf

in states where a larger percentage of citizens are members in environmental organizations.[72]   As in the Inspection Equation, the coefficient on *State Pollution Prevention* is not significant.

The coefficients on *State Privilege* are negative and significant in both equations, while the coefficients on *State Immunity* are positive and significant.   However, as only Rhode Island has *Immunity* and not *Privilege*, the net effect of state audit policies on inspections is generally positive (i.e. a higher probability of inspection), while the net effect on compliance is generally negative.[73]   This suggests that state audit policies shift enforcement resources and thus increase compliance. For states with privilege alone, the effect on compliance is positive (fewer violations) even though the probability of an inspection is also low. This suggests that providing privilege may yield incentives for firms to implement audit programs that could decrease violations. The coefficients on *State Self-Policing* are negative and significant in both equations. Thus, it appears that state self-policing statutes may be an effective substitute for direct enforcement (i.e. inspections). Finally, consider the results for the federal Audit Policy. In the Violation Equation, the coefficient on Audit is not significant, neither are most of the coefficients on the interactions between the Audit variable and Regional dummies. As shown in Table 3, the Audit Policy has only significantly affected compliance in Regions 8 and 9. However, in Region 8 the effect is positive, while in Region 9 the effect is negative.

To better understand the effect the federal and state audit policies have on the probability of inspections and violations, Table 4 reports the estimated change in the probability of a representative facility being inspected or violating the regulations under various regimes.   This representative facility has the mean values for continuous explanatory variables and the median values for discrete explanatory variables.[74] Assuming no state or federal audit policies, the probability of an inspection at this facility is estimated to be thirty percent and the probability of a violation is estimated to be twenty-one percent.[75] Imposition of the federal Audit Policy raises the estimated probability of inspection to thirty-one

72. James T. Hamilton, *Going by the (Informal) Book: The EPA's Use of Informal Rules in Enforcing Hazardous Waste Laws*, 7 ADVANCES IN THE STUDY OF ENTREPRENEURSHIP, INNOVATION, AND GROWTH 109, 114 (1996).

73. *See* State Audit Privilege and Immunity Laws, *supra* note 66.

74. Additionally, this representative facility is assumed to be located in New York (EPA Region 1).

75. *Accord* Sarah L. Stafford, *The Effect of Punishment on Firm Compliance with Hazardous Waste Regulations*, 44 J. ENVTL. ECON. & MGMT. 290 (2002).

percent and decreases the probability of violation to eighteen percent.[76] As indicated in Table 4, if the facility were also to be located in a state with audit privilege, the probability of inspection would fall three percentage points to twenty-eight percent and the probability of violation would fall three percentage points to fifteen percent. If the state had both audit privilege and immunity, the probability of inspection would rise to thirty-two percent and the probability of violation would rise to sixteen percent. However, if the state had a self-policing statute, in addition to audit privilege and immunity, the probability of inspection would fall to twenty-two percent and the probability of violation to twelve percent.

TABLE 4: EFFECT OF STATE AND FEDERAL AUDIT POLICIES ON THE ESTIMATED PROBABILITY OF INSPECTION AND VIOLATION AT A REPRESENTATIVE FACILITY

	Inspection Probability	Violation Probability
Representative Facility	30%	21%
Federal Audit Policy in Effect	+ 1%	- 3%
State Privilege in Effect	- 3%	- 3%
State Immunity in Effect	+ 4%	+ 1%
State Self-Policing in Effect	- 10%	- 4%

Changes are in percentage points.

V. CONCLUSIONS

This analysis examines the effect of EPA and state self-policing policies on hazardous waste compliance. Both federal and state policies appear to combine changes in inspection targeting. After the passage of the federal Audit Policy, commercial waste managers (i.e., facilities that receive hazardous waste from off-site) are targeted more heavily, while land disposal facilities are targeted less heavily. Additionally, facilities that were inspected or had detected violations in the previous year, have a lower probability of inspection under the Audit Policy. There also appear to be significant differences in the implementation of the Audit Policy across regions. In some regions the probability of inspection increases under the

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76. This includes the estimated change in probability from both the Audit Policy dummy variable and the Audit Policy interaction terms.

policy, while in other regions it decreases. States that grant privilege to audit documents, but do not provide immunity for violations disclosed as a result of the audit, have a lower probability of inspections. Similarly, in states with self-policing policies, the probability of inspection is lower. Thus, both self-policing and audit privilege without immunity appear to be used as a substitute for inspections. However, states that grant both audit privilege and immunity have a higher probability of inspection. Since immunity reduces the expected fine associated with a disclosed violation, a higher probability of inspection is necessary to ensure that compliance does not decrease.

There is little basis to argue that the federal and state policies have decreased compliance. The only statistically significant increase in the probability of violation occurs at facilities that receive waste for management from off-site and at facilities in Region 8.[77] Conversely, after the imposition of the federal Audit Policy, the probability of violation decreases significantly at permitted facilities and all facilities in Region 9.[78] Moreover, both state audit and self-policing policies appear to decrease the probability of violation. While some increase in compliance may be attributed to changes in inspection targeting, it also appears that compliance increases even when the probability of inspection decreases. This suggests facilities that audit are able to identify and correct problems before they become violations. Ultimately, state policies have had a more significant effect on compliance than the federal policy, perhaps because many state policies provide privilege to audit documents, while the federal policy does not.

While these results suggest that self-policing can help the environment, they also underscore the need for additional theoretical and empirical analysis of the effect of self-policing policies. In particular, analyses that examine the effect of such policies on both the decision to implement an audit program and the decision to self-disclose violations are critical. Further analysis would help to more clearly determine the specific channels through which self-policing policies affect compliance behavior. A more thorough understanding of the effects of self-policing will help regulators design new policies or modify existing policies to improve compliance with environmental laws and regulations in a cost-effective manner.

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77. As shown in Table 3, the only two Audit interactions with positive and significant coefficients are *Audit x Received* and *Audit x Region 8*.

78. As shown in Table 3, the both *Audit x Permit* and *Audit x Region 9* have negative and significant coefficients.