Covenants with Weak Swords: ISO 14001 and Facilities' Environmental Performance

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Abstract

Voluntary environmental programs are codes of progressive environmental conduct that firms pledge to adopt. This paper investigates whether ISO 14001, a voluntary program with a weak sword—a weak monitoring and sanctioning mechanism—can mitigate shirking and improve participants' environmental performance. Sponsored by the International Organization for Standardization (ISO), ISO 14001 is the most widely adopted voluntary environmental program in the world. Our analysis of over 3,000 facilities regulated as major sources under the U.S. Clean Air Act suggests that ISO 14001-certified facilities reduce their pollution emissions more than non-certified facilities. This result persists even after controlling for facilities' emission and regulatory compliance histories as well as addressing potential endogeneity issues between facilities' environmental performance and their decisions to join ISO 14001. © 2005 by the Association for Public Policy Analysis and Management

INTRODUCTION

The natural environment is under considerable stress from pollution, with the ever-expanding industrial economy being a central cause. The command and control approach to environmental regulation, in which governments specify standards and technologies to govern industrial production, has been central to protecting the natural environment since the 1970s. While command and control has significantly reduced industrial pollution, it has been criticized for its high compliance, monitoring, and enforcement costs (Ayres & Braithwaite, 1992; Coglianese & Nash, 2001; Jaffe, Peterson, Portney, & Stavins, 1995) and for fostering an adversarial regulatory culture among governments, businesses, and environmental activists (Kagan, 1991). Several policy approaches such as performance-based regulation have been offered to improve the efficiency and efficacy of command and control and to tackle the next generation of more persistent pollution problems (Fiorino, 1999). Voluntary programs, in which participating firms adopt progressive environmental policies beyond the law's stipulations, are an integral component of the emerging environmental governance paradigm (Kettl, 2002). The promise of voluntary programs is that if participating firms adhere to the program's rules, they reduce their pollution releases relative to non-participating firms and mitigate the impact of their activities on the natural environment.

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Supporters of voluntary programs point to several monetizable and non-monetizable benefits participants in voluntary programs can receive to offset the costs of their participation in the program. After all, "under a voluntary approach, a polluter will not participate unless his payoff (broadly defined) is at least as high as it would be without participation" (Alberini & Segerson, 2002, p. 157). Participation in a voluntary program can signal a firm's commitment to progressive environmental policies, earning it legitimacy and goodwill from stakeholders (Gunningham, Kagan, & Thornton, 2003; Pargal & Wheeler, 1996; Taylor, Sulalaman, & Sheahan, 2001; Videras & Alberini, 2000). Government regulators might reward participants with less frequent inspections and more flexible enforcement of command and control regulations, potentially creating "win-win" cooperative interactions with government regulators (Potoski & Prakash, 2004; Scholz, 1991; Scholz & Gray, 1997). In legal or administrative proceedings, courts might interpret program participation as evidence of firms' due diligence.[1] Banks and insurers may view program participation as lowering risks of environmental mishaps. Stock markets may reward firms for similar reasons (Hibiki, Higashi, & Mastuda, 2004). Participants may uncover waste and reduce costs (Hart, 1995; but see Walley & Whitehead, 1994). Firms may demand that their suppliers participate in a specified voluntary program (Christmann & Taylor, 2001). Finally, consumers who value environmentally friendly products can reward participants through their purchasing decisions (Charter & Polonsky, 2000; Khanna & Damon, 1999; but see Antweiler & Harrison, 2003; Prakash, 2002).

Critics question if participating firms actually adopt the costly environmental policies required by voluntary programs. For them, voluntary programs are "greenwashes" (Steinzor, 1998) because they either fail to impose significant obligations that lead participants to clean their operations, or if programs in fact prescribe clean obligations, the program sponsors fail to enforce those standards in a way that ensures participants do not shirk their program responsibilities.

The efficacy of various voluntary environmental programs has been notably uneven according to scholarly studies.[2] Firms participating in the chemical industry's Responsible Care program (King & Lenox, 2000) and the U.S. Department of Energy's Climate Wise program (Welch, Mazur, & Bretschneider, 2000) appear to have done little to protect the environment beyond what they would have done had they not joined those programs. Conversely, firms that joined the Environmental Protection Agency's (EPA) 35/50 voluntary program reduced their emissions of toxic pollutants more than those that did not (Khanna & Damon, 1999). While Potoski and Prakash (2005) find that ISO 14001 adoption improved U.S. facilities compli-

[1] Voluntary programs could also be viewed as business efforts to preempt and/or shape governments' environmental regulations (Maxwell, Lyon, & Hackett, 2000). Firms joining these programs could reap first-mover advantages in negotiations over regulatory standards (Porter & van der Linde, 1995). In particular, voluntary programs with stringent rules may be attractive to firms advanced in environmental technology. By championing their virtues, these firms could exert upward pressure on environmental regulations and raise rivals' entry costs (Salop & Scheffman, 1983). Although there are obvious collective action dilemmas in such strategies, they can be mitigated in "privileged group" cases (Olson, 1965). That is, a few firms that capture benefits disproportionate to their market share, or incur disproportionate costs, may be willing to defray the cost of collective action. Industry codes such as the chemical industry's Responsible Care and the forestry industry's Sustainable Forestry Initiative are good examples where large firms have championed industry-level codes as a response to collective reputational problems that potentially imposed disproportionate costs to them.

[2] Programs' efficacy can be conceptualized in different ways, including firms' environmental and regulatory performance, financial returns, overall welfare impact on society, dynamic effects on innovation, and so on (Alberini & Segerson, 2002). From a policy perspective, especially from the perspective of citizens and environmental groups that are skeptical of voluntary approaches, environmental performance is perhaps the most important.

ance with the Clean Air Act and Dasgupta, Hettige, and Wheeler (2000) find that ISO 14001 adoption improved Mexican facilities' self-reported compliance with public law, Dahlstrom, Howes, Leinster, and Skea (2003) report that ISO 14001 and EMAS certification did not improve regulatory performance of British facilities. While Russo (2001) finds that joining ISO 14001 reduced firms' pollution emissions, Andrews et al. (2003) provides some evidence that ISO 14001 did not affect firms' environmental performance.[3]

We present an empirical analysis of the effect of ISO 14001 certification on firms' environmental performance using a sample of over 3,000 facilities regulated as "major sources" under the U.S. Clean Air Act. ISO 14001 is sponsored by the International Organization for Standardization (ISO; also called the Organisation Internationale de Normalisation), an international body of national standards institutions based in Geneva. Founded in 1947, ISO has established over 12,000 international technical standards to facilitate international trade and commerce. Building on ISO 9000, the successful voluntary code for quality management launched in the 1980s, ISO launched the ISO 14000 series in October 1996. ISO 14000 consists of a 'mandatory' guideline for environmental management (ISO 14001), and several non-mandatory guidelines governing environmental labeling (14020 and 14021), environmental performance evaluations (14031), and life cycle assessment (14040–43, 14048–49). ISO 14001 has had a phenomenal growth rate (International Organization for Standardization, 2002). By October 2004, 74,004 facilities across 130 countries had joined ISO 14001 (International Organization for Standardization World, 2005).

Our analysis improves on existing studies of ISO 14001 efficacy by expanding the sample size and by controlling for potential endogeneity problems between facilities' decision to join ISO 14001 and their environmental performance. Our analysis suggests that ISO 14001-certified facilities have better environmental performance—they reduced their pollution emissions faster—compared to non-participants.

Our findings confirm King and Lenox's (2000) theoretical conjecture that voluntary programs need effective monitoring and sanctioning programs to prevent shirking, thereby improving program participants' environmental performance. Our analysis suggests that even a relatively "weak sword" program such as ISO 14001, whose enforcement mechanism is based on third-party audits *without* public disclosure of audit information, can mitigate shirking in voluntary programs. Governments, industry associations, or non-governmental organizations that sponsor voluntary programs can use these insights to strengthen program design and to improve program efficacy.

THEORETICAL APPROACH

Like any other policy instrument, voluntary programs are susceptible to institutional failures if not properly designed and implemented. Whatever its other

[3] Anton, Deltas, and Khanna (2004) study how the comprehensiveness of environmental management systems (EMS) influences firms' environmental performance. They find that firms with more comprehensive EMS have lower toxic emissions, particularly for firms with higher pollution intensity. Where Anton et al. study firms unilaterally adopting EMS, we study environmental management systems within the context of a voluntary environmental program. Thus, for Anton et al. the variable of interest is the comprehensiveness of EMSs, while our paper looks at the role of monitoring (holding comprehensiveness constant) in influencing environmental performance in the context of joining a voluntary program. Unlike our paper, Anton et al. do not study program monitoring and enforcement through third-party monitors and how voluntary programs influence firms' environmental performance. This makes our test of ISO 14001's efficacy more stringent because some firms may adopt an ISO 14001-caliber EMS, and perhaps improve their environmental performance accordingly, without joining the program.

virtues, a voluntary program should be considered a failure if it does not attract any members and/or does not improve members' environmental performance. We limit our scope here to voluntary programs with sufficiently large membership rosters and with membership standards that require members to take substantial progressive environmental action, beyond what government regulations mandate. In this context, member shirking is perhaps the most important program failure. Shirkers formally join a program and receive the membership rewards from their stakeholders, but fail to implement the program obligation. Although such shirking may stem from firms' ignorance about program obligations, we do not believe this is likely given that firms have consciously chosen to join a program, and program obligations (unlike the traditional command and control law) are seldom complex. We believe that in the context of voluntary programs, shirking reflects firms' willful evasion of program responsibilities.

Willful shirking can occur because of information asymmetries between the firm and its stakeholders: If the voluntary program does not require firms to publicly disclose whether they are adhering to the program standards, external stakeholders will not be able to differentiate program shirkers and non-shirkers. Arguably, shirking can be curbed by sociological pressures (normative, mimetic, and coercive) from other firms or stakeholders that persuade program members to adopt normatively appropriate policies. Such sociological pressures are likely to be strongest for firms in close proximity, perhaps belonging to a common industry or operating in a common area (King & Lenox, 2000).

Instead of relying on sociological pressures alone, a voluntary program can mitigate shirking through features of its institutional design. Monitoring and enforcement rules can ensure that members comply with program obligations, particularly if they contain three central components: third-party monitoring, public disclosure of audit information, and sanctioning by program sponsors. Third-party monitoring means that firms are required by the program sponsor to have their policies audited by accredited, external auditors. Thus, a third-party auditor's approval is necessary to retain program membership. In some cases, program sponsors may require public disclosure of audit information. Finally, the sponsoring organization may itself act upon the audit information and sanction the members that have been found to be shirking on their obligations. Table 1 summarizes the different monitoring and enforcement programs.

"Strong sword" programs have all three components and are most likely to curb shirking because they mitigate information asymmetries between participants and program sponsors, and external stakeholders, thereby enabling stakeholders and sponsors to sanction shirkers. In addition, program sponsors sanction non-compliance with program rules. In the extreme case, sponsors may expel participants from the program, an undesirable outcome for firms if they value program membership. The EPA's Performance Track is an example of a strong sword program. In addition to third-party audits of its EMS, the EPA requires "each [Performance Track] member facility completes an Annual Performance Report in which it demonstrates to EPA and the public its environmental accomplishments over the year, its continued high level of environmental performance, and its maintenance of the Performance Track membership criteria" (Environmental Protection Agency, 2004). Program membership has to be renewed every three years and members not adhering to program obligations are under a credible threat of not getting readmitted to the program.

"Medium sword" programs require third-party audits and public disclosures. Although they do not provide for sanctioning by the sponsoring organization, they are likely to curb shirking because, with public disclosure of audit information,

Table 1. Voluntary programs and firms' environmental performance.

	Program Features			
Program Type	Monitoring	Public Disclosure	Sanctioning	Effect on Participants' Environmental Performance
No swords Responsible care	No	No	No	No improvement (King & Lenox, 2000)
Weak swords ISO 14001	Yes	No	No	Improved performance as reported in this paper
Medium swords 33/50, EMAS	Yes	Yes	No	Improved performance for 33/50 (Khanna & Damon, 1999). Likely improved performance for other programs
Strong swords Performance track	Yes	Yes	Yes	No empirical study yet, improved performance is very likely

external audiences and the firm's stakeholders can punish the shirkers for failing to live up to their commitments as program members. The EPA's 33/50 program and the European Union's Environmental Management and Audit System (EMAS) are examples of "medium sword" programs. In both these programs, firms are subjected to third-party audits and the information on their environmental performance is available to the public. Because it is not clear how the sponsoring organization sanctions shirkers, we place them in the medium sword category.

"Weak sword" programs require only third-party audits. ISO 14001 is an example of a "weak sword" program. The International Organization for Standardization, the sponsoring organization, is not known to aggressively sanction the shirkers. Importantly, the absence of public disclosure of audit information weakens stakeholders' ability to sanction shirking. The key question is: Can a "weak sword" program that provides only for third-party audits create incentives for participating firms to improve their environmental performance?

Third-party Audits and Shirking

As instruments of quality control, third-party audits are widely used in industries such as accounting, food processing, apparel, and forestry (Bartley, 2003; Juran, 1962). Third-party audits are institutional devices to monitor production processes (or management systems that control them) and to serve as watchdogs to provide information and credibility to outside stakeholders. In addition, firms' environmental programs and performance can be viewed as "post-experience goods"[4] with "Potemkin attributes" (Schaltegger, Burritt, & Petersen, 2003) because stakeholders

[4] There is a boarder literature on information asymmetries (Akerlof, 1970; Nelson, 1970) that provides a theoretical rationale for the use of third-party audits as institutional devices to mitigate shirking. On market failures associated with search, experience, and post-experience goods, see Weimer and Vining (1992, pp. 69–75).

experience the effects of firms' policies after a considerable lag (post-experience good) and also want assurance about the production processes that firms have adopted, not merely the products that they have produced (Potemkin attributes). And, buyers or outside stakeholders are not in a position to observe such production processes in order to judge their environmental progressiveness for themselves.

Audit and certification processes can be of four types: first-party (self-certification), second-party (certified from a manager from a different unit of the same company, a different firm within the same industry, or certified by customers), third-party (certification by an external auditor but paid for by the company), and fourth-party (certification by an external auditor who is not paid for by the company) (Gereffi, Garcia-Johnson, & Sasser, 2001).[5] First-party is the least credible, while fourth-party is the most credible. In reality, very few voluntary programs have fourth-party oversight; third-party is considered to be the "best practice."

There is an established literature in organizational behavior that suggests that the introduction of an outside observer changes team dynamics and improves performance of individual actors (Mayo, 1945). External audits may influence intra-firm dynamics even when their results are not publicly disclosed because firm managers do not want to "look bad" to other colleagues, especially when outsiders are performing the evaluation (Prakash, 2000). With external audits, managers tend to take program requirements more seriously, perhaps similar to a "Hawthorne effect," than they would without audits.[6] While we do not provide direct quantifiable evidence about the role of third-party audits in curbing shirking, we speculate this causal chain leads ISO 14001 participants to adhere to the program rules, thereby improving their environmental performance. Thus, whether third-party audit may be less effective in mitigating shirking in "weak swords" (information disclosure not required) versus the "strong swords" (information disclosure required), they may still be more effective than the "no sword" case (Responsible Care).

External audits are subject to abuse, particularly when their results are not publicly disclosed; auditors may serve as agents of the firms that hire them rather than the firms' stakeholders. There are market and non-market corrections to this problem, such as an organization that accredits the auditors and monitors the quality of their audits. In the case of ISO 14001, a firm's ISO 14001 certification is granted by an accredited auditor, which itself has to be certified (and re-certified as necessary) by a national level accreditation body, as we discuss below.

King and Lenox (2000) propose that Responsible Care failed to improve participants' environmental performance because it lacked sufficient mechanisms to monitor and sanction participants' adherence to the program's obligations. Consequently, Responsible Care participants were able to free-ride on the benefits of program membership without incurring the costs of adhering to programs rules, including establishing effective environmental management systems (EMS). Responsible Care participants shirked their program responsibilities *despite* normative, mimetic, and coercive pressures from within the Responsible Care and the chemical manufacturing communities. Like Responsible Care, ISO 14001 looks to improve firms' environmental performance by requiring participants to establish

[5] Typically, facilities first undergo audits by internal auditors before subjecting themselves to external audits. The objectives of both types of audits are the same: to ensure that the facility is complying with program obligations. While the quality of internal audits may vary—some facilities may establish internal audits purely for public relations reasons (Taylor, Sulalaman, & Sheahan, 2001)—facilities are likely to have less control over accredited external auditors. Hence, external audits are likely to be more successful to mitigate shirking.

[6] We owe this point to Abhishek Srivastava.

and document an EMS. But, where Responsible Care had no effective monitoring and enforcement, ISO requires firms to undergo annual third-party audits to confirm their adherence to ISO 14001's EMS standards. If Responsible Care is a covenant with no sword, ISO 14001 can be viewed as a covenant with a weak one. While the "no sword" program did not improve participants' environmental performance (King & Lenox, 2000), we investigate whether a "weak sword" voluntary program can mitigate shirking and improve participants' performance.

Our test for the efficacy of ISO 14001's enforcement mechanisms is stringent because participants' incentives to shirk are likely to be stronger for ISO 14001 than they were for Responsible Care. As King and Lenox (2000) point out, Responsible Care benefited from important normative, coercive, and mimetic pressures that might potentially counter firms' incentives to shirk (Druckrey, 1998; Rees, 1997). Normatively, firms may join and follow ISO 14001 because it resonates with company philosophy. Actors often have non-instrumental reasons for obeying law and they are more likely to comply if they view laws as being fair (Winter & May, 2001). Because ISO 14001 is not sponsored by an industry association, its participants are more heterogeneous and less susceptible to pressures to conform to program standards through normative diffusion.[7] Unlike the Chemical Manufacturers Association (CMA; now known as the American Chemistry Council, or ACC), the International Organization for Standardization does not possess the information to identify and shame shirkers because it does not require participants to submit compliance or audit reports.[8] Finally, ISO 14001's standards are less specific while Responsible Care's codes are well-specified and detailed. As a result, ISO 14001 has a limited ability to serve as a vehicle to diffuse information about best environmental practices. Thus, compared to Responsible Care, ISO 14001 offers bleaker prospects for sociological pressures (normative, coercive, mimetic) to mitigate shirking. If ISO 14001 succeeds in mitigating shirking and therefore improving participants' environmental performance, monitoring via third-party audits should receive much of the credit.

ISO 14001: AN OVERVIEW

The explicit goal of ISO 14001 is to improve businesses' environmental and regulatory performance by having participating firms adopt stringent EMSs (International Organization for Standardization, 2002). The logic is that if appropriate management systems are in place, superior environmental performance will follow. To receive ISO 14001 certification, a facility must undertake an initial comprehensive review of its environmental practices, formulate and implement an action plan for environmental management with ongoing performance targets, clearly identify internal governance responsibilities for environmental issues, and make necessary corrections to address identified environmental problems. Although firms can self-audit and declare themselves to be in compliance, to get the actual certification,

[7] Would institutional pressures lead companies within the same industry to adopt similar strategies? The literature provides varying answers. Few will contest that, on average, the effects of institutional pressures are less likely to work for a voluntary program that involves several industries (ISO 14001) compared to one involving firms in the same industry (Responsible Care).

[8] But the ACC/CMA does not share this with external stakeholders. Thus, Responsible Care has features to reduce information asymmetries between the association and participating firms, but neither between external stakeholders and program participants nor between external stakeholders and the association. Because the ACC/CMA does not sanction non-compliance, its access to information on firms' compliance with program rules is not likely to mitigate shirking.

firms are required to annually undergo third-party audits (International Organization for Standardization, 2002).

Participants incur non-trivial costs to receive and maintain ISO 14001 certification. Establishing an EMS and having it audited by a third-party can cost from $25,000 to over $100,000 per facility (Kolk, 2000). For a moderately sized firm with ten facilities, monetary costs could range from $250,000 to $1,000,000. In practice, an ISO-certified EMS requires substantial investment beyond the cost of external auditors. These include the costs of maintaining paper trails and increasing headcounts (Prakash, 2000). William Glasser (2004) of the EPA estimates that "large facilities spend on average about $1 million in sunk transaction costs to pursue certification."

Our theoretical grounds for expecting ISO 14001 membership to improve facilities' environmental performance rests on two pillars. First, adopting an EMS can focus a facility's attention and energy toward improving its environmental impact. It may help firms in identifying slack and opportunities to improve performance (Hart, 1995). Second, annual recertification audits, although not the strongest monitoring and enforcement regime, may ensure firms uphold their commitments to maintain their EMS and produce the environmental benefits that follow. This second pillar is important because as in the case of Responsible Care, firms may join ISO 14001, enjoy its several benefits, but not fully adopt or maintain its rules.[9] After all, why incur non-trivial costs if one can get benefits for free? Third-party audits are monitoring tools to curb free-riding.

For external auditors to be effective in mitigating shirking, they must have technical competencies to perform their tasks, have access to relevant information on the facility they are auditing, and enforce standards uniformly across facilities. In the process of ISO 14001 external audit, the team can interview anybody at the facility, from managers to line workers, to assess whether facility personnel understand ISO 14001's procedural and paper documentation requirements. The length of external audits can range from a few weeks to several months, depending on the size of the facility and the advance work it has done (Registrar Accreditation Board, 2004). The auditors are expected to perform surveillance audits of the facilities they have certified at least once a year, and a complete reassessment of certified facilities' EMS every three years. Again, the objective is that managers should have incentives to think of ISO 14001 obligations as long-term commitments rather than a one-shot affair.

Because external audits are key to ISO 14001's efficacy, the ISO requires that third-party auditors themselves receive accreditation. The ISO recognizes an accreditation authority in each country—such as the United Kingdom Accreditation Service, Comité français d'accréditation, Trägergemeinschaft für Akkreditierung GmbH, China National Accreditation Council for Registrars, and the American National Standards Institute–Registrar Accreditation Board (ANSI-RAB)—that certifies which organizations (generally, consulting firms) can perform ISO 14001 certification audits (International Organization for Standardization, 2004). The accreditation authority reviews the paper evidence about the auditors' competencies and performs an on-site audit of the auditors by witnessing how an auditor goes about certifying a facility. To prevent a conflict of interest, the accreditation

[9] Recently, the American Chemistry Council announced that Responsible Care participants will be required to get third-party certification. The Council is also offering joint certification to both ISO 14001 and Responsible Care through a single audit (American Chemistry Council, 2004). This underlines similarities in the programmatic approaches.

authorities typically prohibit auditors from performing other consulting work for facilities seeking certification (International Organization for Standardization, 2004). While the accreditation authority grants the external auditor's accreditation that is valid for four years, the accreditation authority is expected to conduct additional surveillance audits six months after accreditation has been granted, and then annually for each of the next three years. Because accreditation expires after four years, a complete reassessment of the auditor is required every four years. All these features of the ISO 14001 auditing ensure that auditors are competent, know how to do their job, and are taken seriously by managers in the facility that is seeking ISO 14001 certification.

Whether third-party audits succeed in mitigating shirking and improving members' environmental performance is examined empirically below. Our central concern is to examine whether joining ISO 14001 improves facilities' environmental performance (reduces pollution emissions). Thus:

> H_o *(Null Hypothesis): Facilities with and without ISO 14001 certificates will demonstrate comparable levels of improvements in environmental performance.*

> H_a *(Alternative Hypothesis): Facilities with ISO 14001 certificates will demonstrate superior environmental performance to non-participants.*

DATA AND MEASURES

To test our central hypothesis, we compare the environmental performance of ISO 14001-certified and non-certified facilities, controlling for non-random assignment between certification and non-certification along with other intervening factors. Our focus is on facilities regulated under U.S. state and federal air pollution regulations. Facilities in our sample meet air pollution emissions thresholds in order to be tracked by the EPA's Toxics Release Inventory (TRI) program and are classified as "major sources" under federal clean air laws. Information on facilities' regulatory compliance comes from the Aerometric Information Retrieval System (AIRS) subsystem of the EPA's Integrated Data for Enforcement Analysis (IDEA) system. Emissions data are from the TRI database. Other measures are drawn from Dun and Bradstreet's Million Dollar Directory and other sources as discussed below. Our sample contains 3,709 facilities, 151 (4%) of which were ISO 14001-certified as of December 2001. Almost 90% of the facilities list a manufacturing code as their primary Standard Industrial Classification (SIC) code, with about 18% in chemical manufacturing (SIC 28).[10]

Environmental Performance

Our analyses use four dependent variable measures of environmental performance, based on changes in the weighted values of facilities' pollution emissions. Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) requires industrial facilities operating in the United States (employing more than ten employees, operating in certain industrial categories or using

[10] King and Lenox (2000) begin with facility-level data that they then aggregate up to the firm level, an appropriate strategy given that Responsible Care is a firm-level program. We confine our analysis to facilities because ISO 14001 is a facility-level program; that is, some facilities in a firm may be ISO 14001–certified while others are not.

more than 10,00 pounds of specified chemicals, processing more than 25,000 pounds of specified chemicals) to annually report their releases and transfers (that are beyond a certain threshold) of about 600 toxic chemicals to the Environmental Protection Agency, state governments, and tribal governments. The EPA makes this information publicly available via the Toxics Release Inventory (TRI) database. Environmental performance is measured by first calculating each facility's total emissions as reported in the Toxics Release Inventory, weighted by two measures of the emissions' toxicity. First, we follow King and Lenox (2000, p. 175) and measure toxicity as reflected in the "reportable quantity," the threshold amount for reporting an accidental release, according to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).[11] Second, we follow Antweiler and Harrison (2003) and employ toxicity scores as reported in the Chronic Human Health Indicators (CHHI) from the EPA (also known as RSEI: Risk-Screening Environmental Indicators).[12] Unlike the "reportable quantity" (CERLCA) toxicity scoring approach, CHHI/RSEI defines different values for air and water emission streams. Releases for a given facility are thus:[13]

$$E_{it} = \sum w_c * e_{cit}$$

where E_{it} is the weighted total emissions for facility i in year t, w_c is the toxicity weight factor for chemical c in year t, and e_{cit} is the pounds of emissions of chemical.[14] Each dependent variable is the difference in pollution emissions between 1995–1996 and 2000–2001, where time t is 1995 through 1996 and time t+1 is 2000 through 2001. We use two-year time periods to smooth over any year-to-year fluctuations. We use the 1995–1996 through 2000–2001 interval because it straddles the ISO 14001's introduction and the publication of a recent roster of ISO 14001-certified facilities. First, we calculate *environmental improvement* (EI_{it}), as

$$EI_i = E_{it} - E_{i(t+1)}$$

Second, we calculate *logged environmental improvement* as

$$\log(EI_i) = \log(E_i) - \log(E_{it+1})$$

Our analyses contain four measures of environmental improvement: logged and absolute improvement using both the CERCLA and CHHI/RSEI weighting approaches. We divided the absolute measures by 10,000,000 to put the results in a more intuitive scale.

We determined whether a facility joined ISO 14001 by 2001 by examining the list of ISO 14001 certified facilities published by the Center for Energy and Environ-

[11] We include only chemicals listed continuously from 1995 through 2001. There may be a substitution effect such that companies replace unlisted chemicals for listed ones in their production processes. For such substitution effects to confound our analyses, ISO-certified facilities must be more likely to substitute chemicals than non-certified facilities, controlling for the other variables in the analyses.

[12] For an overview of various toxicity scoring schemes, see Environmental Defense's Web site: http://www.scorecard.org/chemical-profiles/index.tcl, retrieved December 15, 2004.

[13] Ideally, this variable would be the ratio of emissions to quantities produced. Unfortunately, production quantities are not available in our data.

[14] The CERCLA pollution measures are weighted by 1/x, where x is the reportable quantity. The CHHI/RSEI weights are the air stream measures.

mental Management (CEEM) (2000, 2001). *ISO 14001 membership* is scored 1 if the facility is certified in the program while non-membership received a score of 0. Along with measures of ISO 14001 membership and environmental performance, our analyses include several control variables in both the analyses of which facilities join ISO 14001 and whether facilities that join ISO 14001 improve their environmental performance. Facilities' environmental performance and ISO 14001 decisions may be influenced by a variety of factors, including facility and industry characteristics, compliance history, and the regulatory and social contexts in which they operate.

Facility size is the number of employees at the facility, as reported in the Dun and Bradstreet database. We also include two dummy variables measuring whether the facility is a branch facility (*branch*), single site company (*single*), or company headquarters (scored 0). $Emissions_t$ is the facility's air pollution in time t as recorded in the TRI data, weighted by each pollutant's toxicity. Facilities with higher initial emissions should have larger emissions reductions. The analysis for joining ISO 14001 also includes the variable $emissions_{95–96}^2$ because the effect of emissions on joining ISO 14001 may vary across emission levels. Our model includes dummy variables reflecting each facility's two-digit SIC code.

Facilities that receive more inspections and enforcement actions may be more likely to join ISO 14001 and reduce their pollution emissions because of ISO 14001's perceived positive standing among government regulators. More inspections and enforcement actions may also spur facilities to greater pollution reductions. $Inspections_t$ is the number of state and EPA inspections and *Enforcement* $actions_t$ is the number of enforcement actions, including notices of violation levied by state and EPA officials, that each facility received over time t. We measure facilities' previous regulatory compliance ($Compliance_t$) with the proportion of months that a facility is out of compliance over time t. We also include the measure $Compliance_t^2$ since the effect of compliance on joining ISO 14001 may vary across levels of compliance. The measures for inspections, enforcement actions, and compliance are drawn from the EPA's IDEA database.[15]

The policy context in which facilities operate is expected to influence facilities' decisions to join ISO 14001 and to reduce pollution emissions (Potoski, 2001). We measure states' legal environment with the variable *state audit protection,* scored one if the state provides privilege or immunity protection for information uncovered in facilities' self-audits.[16] We measure *state litigiousness* using the ratio of environmental court cases to TRI facilities in each state. Data on such cases are from Lexis Nexus State Case database searches with the key words "air pollution," "water pollution," and "hazardous waste" for the entire 1990s. We measure the stringency of state hazardous air standards with the dummy variable *hazardous air regulations* each scored 1 if the state's regulations are more stringent than the

[15] Ideally, our analysis would control for facilities' EMS prior to their joining ISO 14001 because facilities with high-quality extant EMS would be more likely to join ISO 14001 (on variations in EMS, see Khanna & Anton, 2002). We control for the "prior EMS" by treating 1995–1996 emissions as the baseline against which facilities' environmental improvements are assessed. We also control for 1995–1996 compliance that prior EMS should have influenced. We do not claim that audits are the only reason for ISO 14001 facilities to show improved environmental performance. As alternative explanations institutional mimicry effects are weaker for ISO 14001 than for Responsible Care, and because both ISO 14001 and Responsible Care are EMS-based, the discriminating factor explaining variations in participants' environmental performance in the two programs is third-party audits.

[16] ISO 14001 requires annual recertification audits. Firms may be more reluctant to conduct audits without attorney-client privilege protections (which only some states have granted) because regulators may punish self-disclosed violations (Kollman & Prakash, 2001; Pfaff & Sanchirico, 2000).

corresponding EPA minimum criteria. Finally, we control for states' political contexts with *environmental groups*, the number of members in the Sierra Club and the National Wildlife Federation per 1,000 residents in 1998. Facilities in states with stronger environmental groups may be more likely to join ISO 14001 and to reduce pollution emissions. Facilities in states with more litigious climates may be less willing to join ISO 14001 and reduce their emissions, while those in states with more stringent environmental regulations and stronger environmental groups may be more willing to join the program and may have greater reductions in pollution emissions.

We include several controls for the facility's neighborhood context. *Residents' education* measures the percentage of residents living within a three-mile radius of a facility who have a high school education or greater, as reported in the EPA's IDEA database. From the same database, we also include control variables for the percentage of the area population who are *minorities* and the percentage of population making more than $75,000 per year (*income*). The analysis includes the natural log of these three neighborhood context variables.[17] Wealth, education, and ethnicity may provide citizens with leverage for compelling facilities to join ISO 14001 and to have greater reductions in pollution emissions (Kahn, 2002; Pargal & Wheeler, 1996).

ANALYTIC METHOD

Our analysis would ideally compare the environmental performance of a sample of ISO 14001-certified facilities against a sample of non-certified facilities that are otherwise identical to the certified facilities, perhaps because of a random assignment procedure. Such data are unlikely to exist because facilities' decisions about whether to participate in ISO 14001 are likely to be endogenous to their environmental performance. That is, some of the observed and unobserved factors that influence joining ISO 14001 are also likely to influence the amount of pollution facilities emit (Khanna & Damon, 1999; King & Lenox, 2000).

We use a treatment effects model to account for the effect of non-random assignment among ISO 14001 certified and non-certified facilities (Greene, 1999; Heckman & Robb, 1985; for applications see Kane, 1994; Lubell, Schneider, Scholz, & Mete, 2002). This model simultaneously estimates a probit model for why facilities join ISO 14001 and a linear model of facilities' performance with independent variables, including a measure of whether a facility joined ISO 14001, adjusted for potential endogeneity between facilities' decisions to join ISO 14001 and their environmental performance.[18] Treatment effects analyses were conducted with Stata

[17] In a few cases, these measures recorded zero residents making over $75,000 (64 cases) or zero minority residents (26 cases), making natural logs problematic. One approach is to set the value for such cases at zero and add a dummy variable to account for any intercept shift (Cameron & Trivedi, 1998, pp. 239–240). We experimented with this approach but were unable to get maximum likelihood (ML) convergence; some standard errors were in question, although the reported coefficients were essentially identical to those presented here. In the analyses presented here we set the value at 0.05 for the 0 cases of these measures.

[18] This is a statistically more efficient procedure than similar non-nested models (Khanna & Damon, 1999; King & Lenox, 2000) that separately estimate the first stage model using probit and then use predicted values (of joining the program) as an independent variable in the separate second-stage analysis, usually estimated via OLS. The nested and non-nested approaches are asymptotically equivalent; that is, they produce identical results as N approaches infinity. In smaller samples, nested approaches will produce somewhat smaller standard errors. We did experiment with a two-stage procedure, estimating first a log model for joining ISO 14001 and then submitting the predicted values into an OLS analysis of compliance. The results were essentially the same as those presented here.

version 8 using the "treatreg" command. By controlling for the selection of facilities into ISO 14001, we seek to isolate the impact of facilities' ISO 14001 membership on their performance from other factors that induce facilities to join ISO 14001 and emit pollution in the first place. Thus we begin with the outcome equation of the model:

$$Y_i = \boldsymbol{\beta_1 X_{1i}} + \gamma Z_i + \varepsilon_{1i} \tag{1}$$

where Y is the *i*th facility's environmental performance improvement, $\mathbf{X_1}$ is a vector of exogenous variables pertaining to facilities' contexts and characteristics, including their previous environmental performance, Z_i are the facility's participation in ISO 14001, $\boldsymbol{\beta_1}$ and γ are (vectors of) parameters, and ε_{1i} is a random error term. Z_i is scored 1 if the facility is ISO 14001 certified, otherwise, 0. The facility's ISO 14001 decision, Z_i, is likely to be influenced by some of the same observed and unobserved factors that influence Y_i. To correct for selection bias, the treatment effects analysis models a selection equation of facilities' decisions to join ISO 14001 (Z_i) along with the outcome equation of their environmental performance (Y_i). For the selection equation, we assume that the *i*th facility's net benefit of joining ISO 14001 is $Z^\wedge_i = \mathbf{X_{2i}}\ \boldsymbol{\beta_2} + \varepsilon_{2i}$, where, $\mathbf{X_{2i}}$ is an exogenous vector of independent variables, some of which are included in $\mathbf{X_1}$, $\boldsymbol{\beta_2}$ is a vector of coefficients, and ε_{2it} is an independent, normally distributed error term. $Z^\wedge_i$ is unobserved, but we observe $Z_i = 1$ if $Z^*_i = 0$, else $Z^*_i = 0$. The probability of a firm joining ISO 14001, Z^*_i, is thus

$$Z^*_i = F(\mathbf{X_{2i}}\ \boldsymbol{\beta_2}) + \varepsilon_{2i} \tag{2}$$

where F is the cumulative normal distribution. The treatment effects analysis of Y_i, includes the estimates of Z^*_i from (2) for Z_i in (1).

Below we first discuss firms' motivations for joining ISO 14001, corresponding to the selection equation of our treatment effect model (Equation 2) along with factors influencing facilities' environmental performance (outcome equation, Equation 1). The two sets of variables— $\mathbf{X_{1i}}$ and $\mathbf{X_{2i}}$—contain considerable overlap. For example, facilities may be more likely to join ISO 14001 if they receive frequent government inspections and frequent government inspections may improve facilities' environmental performance. Since ISO 14001 was launched in late 1996, we control for such problems by using information from 1995 and 1996 where possible and by using the treatment effects model (Greene, 1999).

To identify the treatment effects model, we include variables that are correlated with the endogenous variable (ISO 14001), excluded in the outcome equation, and are not correlated with the error term of the outcome equation.[19] We use $compliance_{95-96}$ as an instrumental variable on the assumption that a facility's compliance does not affect its emissions status except through compliance's

[19] A single variable is sufficient to identify the model so long as it is sufficiently correlated with the treatment variable and uncorrelated with the errors of the outcome equation. Instrumental variable(s) that are weakly correlated with the treatment variable can be problematic (Bound, Jaeger, & Baker, 1995). A "weak" correlation is problematic when the joint F test of the instrumental variable(s) on the treatment (endogenous) variable is close to one (Bound et al., 1995, p. 446). F-tests on the instrumental variable(s) in our analyses exceed 1 by healthy margins. For an example, see Acemoglu, Johnson, and Robinson (2001).

influence on joining ISO 14001. On theoretical grounds, our rationale for using lagged *compliance* values is that, for the most part, clean air regulations do not directly specify the pollution emission levels facilities are allowed to emit (Fiorino, 1995). Rather, government regulations instead govern the emission control technologies (for example, Best Available Control Technology) and reporting and tracking procedures facilities must adopt. Higher or lower compliance levels do not therefore translate into more or less pollution emissions. We also experimented with four "short-term trend" measures as instrumental variables for the selection equation: $inspections_{95\Delta 96}$, $enforcement\ action_{95\Delta 96}$, $emissions_{95\Delta 96}$, and $compliance_{95\Delta 96}$ (where "Δ" signifies the change between the two-year time periods). For the trend variables, we assume that these trends have some influence on whether facilities join ISO 14001 within a few years but have no influence on their environmental performance four to five years later, controlling for other variables.[20]

The independent variables in the second stage analysis for environmental performance improvement ($\mathbf{X_1}$) include facility characteristics (*size, branch, single, emissions*), regulatory conditions ($inspections_{95-96}$, $enforcement\ actions_{95-96}$), neighborhood context (*education, minorities, income*), policy context (*hazardous air regulations, state litigiousness, state audit protection,* and *environmental groups*), and the measure for *ISO 14001* membership, adjusted from the selection equation. Variables in the selection equation for why facilities join ISO 14001 ($\mathbf{X_2}$) include the same variables as $\mathbf{X_1}$, along with $compliance_{95-96}$, $inspections_{95\Delta 96}$, $enforcement\ action_{95\Delta 96}$, $emissions_{95\Delta 96}$, and $compliance_{95\Delta 96}$ (excluded in $\mathbf{X_1}$ for identification purposes). $\mathbf{X_1}$ also includes the variable *ISO 14001,* adjusted from the selection equation, and $\mathbf{X_2}$ includes $compliance_{95-96}{}^2$ and $emissions_{95-96}{}^2$ since the effect of compliance and emissions on joining *ISO 14001* may vary across levels of compliance and emissions.

While our selection equation (2) adjusts the estimates of the effect of ISO 14001 in the outcome equation (1) for the observable factors in $\mathbf{X_2}$, unobserved factors that influence both facilities' decisions to join ISO 14001 and their environmental performance may still potentially confound our analyses. Heckman and Hotz (1989) suggest a simple way to test for these unobserved effects is to estimate a model of the dependent variable prior to treatment (in this case $emissions_{95-96}$), controlling for the factors that influence the treatment selection, the post-treatment outcome, and the variable identifying whether the facility received the treatment (ISO 14001 certification). An insignificant coefficient for the treatment variable (certification) in this analysis suggests there are not significant unobservable factors that influence both facilities' certification decisions and the environmental outcome dependent variable. We performed this analysis and the coefficient for *ISO 14001* certification did not approach statistical significance, suggesting that our treatment effects model is justified in this case.[21]

[20] The treatment model includes the predictor *rho* from the first-stage equation, in a manner similar to the Inverse Mills Ratio in a Heckman selection model. Since this variable is a non-linear function of the variables in the selection equation, the second-stage model is identified even without instrumental variables by assuming the errors of the selection are normally distributed (Greene, 1999; Heckman & Robb, 1985). With an instrumental variable, we do not need to rely on this assumption for our analyses. However, when we dropped our restriction on $compliance_{95-96}$ and included it in the outcome equation (thus relying on the distribution assumption for identification), the results did not differ from what we present here. Likewise, our results did not change using only the short-term trend or only the compliance measure as instruments.

Results

Tables 2 and 3 report the results of our treatment effects analysis of facilities that join ISO 14001 and how joining ISO 14001 affects changes in facilities' pollution emissions. We first discuss the selection equation of which facilities adopted ISO 14001, as reported in the bottom half of the tables. For simplicity, we focus on the Table 2 CERCLA-dependent variables. We then turn to the central focus of the article, the outcome equation of how joining ISO 14001 affects changes in facilities' pollution emissions.

Which Facilities Join ISO 14001?

Interpreting the selection equation coefficients is complicated by probit's non-linear functional form and by the fact that an occurrence of our dependent variable (an ISO 14001 certified facility) is quite rare. Following Long (1997), we calculate the discrete change in probability of our dependent variable occurring (a facility joins ISO 14001) given changes in the independent variables, holding all other variables at their mean. Note that these changes may seem quite small, but they should be interpreted relative to a "baseline" probability, which in our case is the rather small proportion of facilities joining ISO 14001. Only about 4% of the facilities in our sample joined ISO 14001; holding all independent variables at their mean, the predicted probability of joining ISO 14001 is only 0.025. Overall, the selection equation model discriminates well among firms subscribing to ISO 14001: The chi-square statistic for the selection equation only is 179.0, significant at $p < 0.001$.

Facilities' compliance histories have an important impact on their ISO 14001 decisions. The relationship between the amount of time a facility was out of compliance in 1995 and 1996 and ISO 14001 registration follows an inverted U-shaped curve. The *compliance* coefficients are jointly significant, with the $compliance_{95–96}$ coefficient being positive and the $compliance_{1995–96}{}^2$ being negative. Facilities that are always in compliance or always out of compliance are the least likely to join ISO

[21] An alternative approach by Heckman and Robb (1985) for analyzing the impact of treatments on outcomes suggested is the first difference or fixed effects estimator. Taking advantage of panel data including at least one pre-treatment panel and one post-treatment panel, and assuming $E(U_{it} - U_{it+1} \mid d_i, \mathbf{X}_{it} - \mathbf{X}_{it+1},) = 0$ for all t, t+1, t > k > t+1, where U is the error term. Heckman and Robb (1985, p. 217) suggest the regression model $(Y_{it} - Y_{it+1} \mid \mathbf{X}_{it} - \mathbf{X}_{it+1}, d_i) = (\mathbf{X}_{it} - \mathbf{X}_{it+1})\boldsymbol{\beta} + d_i\alpha$, where $\boldsymbol{\beta}$ and α are (vectors or) coefficients, E denotes expectations. This approach may not be optimal for our data, which contain some panel features (in the variables for *inspections, enforcement actions, compliance,* and the *emissions* measures), but most others are time-invariant measures. Cross-sectional methods, such as the treatment effect analysis, seem more appropriate for our data. We experimented with a fixed effects analysis using the full slate of variables in $\mathbf{X}_1$ and using just the **X1** panel measures. For the two CERCLA and non-logged CHHI/RSEI outcome measures, the results for the ISO 14001 intervention were consistent with those presented in this paper from our treatment effects analysis.

Propensity score matching is an alternative to the treatment effects approach we use in this paper (Imbens, 2004). An advantage of propensity score matching in a selection bias context is that it does not require exogenous instrumental variable(s) to identify the selection equation. However, propensity score matching instead requires strong assumptions about the effect of treatment across levels of the treatment and that correlation between the unobserved factors (between ε_{1i} and ε_{2i}) is 0 (Heckman, Ichimura, & Todd, 1998). Treatment effects analysis instead models directly selection bias and the correlation between ε_{1i} and ε_{2i}. Moreover, while there are rules for selecting exogenous instrumental variables in treatment effects analysis (as we follow here), there are no clear rules for selecting conditioning variables in propensity score matching analysis, and the choice of conditioning variables can bias propensity matching score results (Heckman & Navarro-Lozano, 2004). Nevertheless, we experimented with both propensity score matching techniques using the Becker and Ichino (2002) pscore commands in Stata v8. The results were consistent with the treatment effects analyses presented in this paper.

Table 2. Treatment effects analysis of ISO 14001 certification on reductions in facilities' pollution emissions, emissions weighted by CERCLA toxicity measures.

	Logged Emissions Reduction		Emissions Reduction	
	Coefficient	Standard Error	Coefficient	Standard Error
Facility characteristics				
ISO 14001	1.342*	0.768	25.229**	11.289
Employees	0.0002**	0.0001	–0.001	0.002
Branch	–0.299	0.226	2.941	3.691
Single	–0.693	0.276	3.1819	4.5105
Facility regulatory context				
$\text{Inspections}_{95–96}$	0.146**	0.033	–0.265	0.547
$\text{Enforcement actions}_{95–96}$	0.070*	0.041	–0.034	0.676
$\text{Emissions}_{95–96}$	1.03E–09**	6.23E–11	4.645**	0.428
State policy context				
Litigiousness	–0.022	0.287	–5.3534	4.6835
Hazardous air regulations	0.066	0.174	1.4830	2.8425
Audit and immunity privileges	0.353**	0.166	–2.524	2.719
Environmental groups	–0.091**	0.032	0.675	0.522
Neighborhood context				
Education	3.905**	1.106	6.612	18.033
Minorities	–0.001	0.052	1.051	0.848
Wealth	–0.130**	0.059	–0.6880	0.9714
SIC code dummies (not shown)				
Constant	–0.72361	4.875767	–87.456	79.800
Selection equation for joining ISO 14001				
Facility characteristics				
Employees	0.00008**	3.99E–05	7.94E–05**	4.04E–05
Branch	0.1243	0.1353	0.1237	0.1355
Single	0.0586	0.1670	0.0451	0.1678
Facility regulatory context				
$\text{Inspections}_{95–96}$	0.0286**	0.0154	0.0318**	0.0152
$\text{Inspections}_{95\Delta96}$	0.0046	0.0286	–0.0004	0.0284
$\text{Enforcement actions}_{95–96}$	0.0009	0.0318	0.0030	0.0317
$\text{Enforcement actions}_{95\Delta96}$	–0.1303**	0.0565	–0.1223**	0.0554
$\text{Compliance}_{95\Delta96}$	0.2436	0.2407	0.2470	0.2421
$\text{Compliance}_{95–96}$	1.2212†	0.8110	1.1617†	0.8155
$\text{Compliance}_{95–96}^2$	–1.2828†	0.8610	–1.2673†	0.8689
$\text{Emissions}_{95\Delta96}$	6.30E–11	8.67E–11	9.79E–11	8.48E–11
$\text{Emissions}_{95–96}$	2.42E–10†	8.25E–11	2.06E–10†	7.31E–11
$\text{Emissions}_{95–96}^2$	–1.79E–20†	8.67E–21	–1.24E–20†	7.06E–21
State policy context				
Litigiousness	0.0713	0.1519	0.0941	0.1499
Hazardous air regulations	0.1913*	0.1048	0.1999**	0.1046
Audit and immunity privileges	–0.0444	0.0976	–0.0044	0.0118
Environmental groups	–0.0196	0.0185	–0.0228	0.0186
Neighborhood context				
Education	1.3074**	0.6254	1.3334**	0.6281
Minorities	0.0223	0.0322	0.0232	0.0315
Wealth	–0.0125	0.0310	–0.0134	0.0310
SIC code dummies (not shown)				
Constant	–8.7719**	2.7691	–8.8876	2.7810
N	3,052		3,052	
Rho	–.145*		–0.1202**	
Wald (independent equations)	2.78*		2.65*	
Wald (overall)	265.00**		224.04**	

** $p < .05$, * $p < .10$, † jointly significant $p < .05$.

Table 3. Treatment effects analysis of ISO 14001 certification on facilities' pollution emissions, emissions weighted by CHHI/RSEI toxicity measures.

	Logged Emissions Reduction		Emissions Reduction	
	Coefficient	Standard Error	Coefficient	Standard Error
Facility characteristics				
ISO 14001	0.1209	0.5470	58.319**	16.728
Employees	–2.2E–05	5.26E–05	0.0006	0.0022
Branch	–0.1953	0.1163	–3.3074	4.7803
Single	–0.1454	0.1422	–3.6704	5.8393
Facility regulatory context				
$\text{Inspections}_{95\text{–}96}$	–0.0187	0.0171	–2.086**	0.702
$\text{Enforcement actions}_{95\text{–}96}$	–0.0434**	0.0208	–2.769**	0.856
$\text{Emissions}_{95\text{–}96}$	3.91E–11*	2.09E–11	2.705**	0.508
State policy context				
Litigiousness	–0.0238	0.0897	2.794	6.211
Hazardous air regulations	–0.0291	0.0856	–3.677	3.679
Audit and immunity privileges	0.0210	0.0108	1.366	3.514
Environmental groups	0.0230	0.0164	0.225	0.674
Neighborhood context				
Education	0.2943	0.5712	–3.337	23.369
Minorities	0.0247	0.0265	–0.0003	1.089
Wealth	0.0066	0.0306	–1.507	1.258
SIC code dummies (not shown)				
Constant	–1.14	2.52	–13.761	103.465
Selection equation for joining ISO 14001				
Facility characteristics				
Employees	8.53E–05**	4.06E–05	7.680E–05**	4.040E–05
Branch	0.11	0.14	0.104	0.137
Single	0.07	0.17	0.073	0.169
Facility regulatory context				
$\text{Inspections}_{95\text{–}96}$	0.0330**	0.0154	0.016	1.230
$\text{Inspections}_{95\Delta 96}$	0.0034	0.0282	–0.016	0.028
$\text{Enforcement actions}_{95\text{–}96}$	0.0057	0.0302	0.016	0.028
$\text{Enforcement actions}_{95\Delta 96}$	–0.1265**	0.0558	–0.140**	0.055
$\text{Compliance}_{95\Delta 96}$	0.1510	0.2537	0.123	0.251
$\text{Compliance}_{95\text{–}96}$	1.1573†	0.8386	0.909†	0.834
$\text{Compliance}_{95\text{–}96}^2$	–1.2086†	0.8881	–0.906†	0.884
$\text{Emissions}_{95\Delta 96}$	–3.97E–11	2.71E–10	–1.57E–10	2.41E–10
$\text{Emissions}_{95\text{–}96}$	2.12E–10†	1.35E–10	1.94E–10†	1.23E–10
$\text{Emissions}_{95\text{–}96}^2$	–2.09E–20†	1.77E–20	–9.0E–21†	1.45E–20
State policy context				
Litigiousness	0.1099	0.1533	0.057	0.155
Hazardous air regulations	0.2016*	0.1092	0.185	0.108
Audit and immunity privileges	–0.0261	0.1016	–0.002	0.012
Environmental groups	–0.0236	0.0194	–0.019	0.019
Neighborhood context				
Education	1.5230**	0.658895	1.586	0.651
Minorities	0.03251	0.034454	0.028	0.033
Wealth	–0.01256	0.032753	–0.010	0.032
SIC code dummies (not shown)				
Constant	–9.84857	2.921174	–10.022	2.888
N	2910		2910	
Rho	–0.0714		–0.357	
Wald (independent equations)	0.33		7.02**	
Wald (overall)	274.0**		212.9**	

** $p < .05$, * $p < .10$, † jointly significant $p < .05$.

14001. The predicted probability of joining ISO 14001 for facilities in compliance for the entire two-year period, 0.020, is essentially the same as those who are not in compliance for the same time period (0.024). For those who are out of compliance for about half the time, the predicted probability of joining ISO 14001 is about 0.043. The statistically significant coefficients for $emissions_{95–96}$ and $emissions_{95–96}^2$ results suggest that low-pollution facilities are least likely to join ISO 14001, while moderate- and high-polluting facilities are roughly equally more likely to join ISO 14001. Facilities that receive more *regulatory inspections* are significantly more likely to join ISO 14001. A two standard deviation increase in the number of inspections from one standard deviation below the mean to one above increases the probability of becoming ISO 14001 certified from 0.017 to 0.035. Yet facilities seeing a sharp short-term increase in enforcement actions are less likely to join ISO 14001. Facilities experiencing sharp increases (two standard deviations above the mean) in regulatory enforcement actions are about half as likely to join ISO 14001 compared to facilities experiencing sharp decreases in enforcement actions (0.039 versus 0.013).

For the most part, government policies do not have strong effects on which facilities join ISO 14001. None of the coefficients for *enforcement actions, state audit protection,* and *litigiousness* achieved statistical significance in the analysis of why facilities join ISO 14001. Facility and neighborhood characteristics are significant. Larger facilities, those with more employees, are significantly more likely to join ISO 14001. Facilities in states with more stringent *hazardous air regulations* are more likely to join ISO 14001 (0.038) compared to facilities that are not in such states (0.016). Facilities in neighborhoods with more educated residents are more likely to join ISO 14001. A two standard deviation increase in the logged percentage of educated residents (from one standard deviation below the mean to one standard deviation above) increases the probability that a facility joins ISO 14001 from 0.015 to 0.040, holding the effects of other variables constant at their mean. This may be because ISO 14001's reputation is more valuable to facilities when local residents are better able to detect, interpret, and use the information, or perhaps because more educated residents have a higher demand for environmental performance.

We can draw tentative conclusions about why facilities join ISO 14001. First, government inspections and stringent hazardous air regulations spur facilities to join ISO 14001 though other state-level policies appear to have little influence on facilities' ISO 14001 decisions. With the EPA setting its own policies in areas such as audit privilege and immunity protection while also holding preemption authority over states that do not meet its minimum requirements for air pollution regulation, the variation in state policy contexts facing facilities may be too limited to influence their ISO 14001 certification decisions. Second, facilities with moderate pollution emissions and compliance records are most likely to join ISO 14001. Third, facilities in neighborhoods with more educated residents are more likely to join ISO 14001.

ISO 14001 and Facilities' Environmental Performance

The central question we examine is whether participation in ISO 14001 improves firms' environmental performance. The top halves of Tables 2 and 3 report the results of our outcome equation analysis of the influence of ISO 14001 on the four measures of environmental performance. Interpreting the outcome equation is more straightforward because the statistical method is akin to ordinary least squares regression (OLS). Outcome equation coefficients can be interpreted as the change in the size of the pollution emissions reduction between 1995–1996 and 2000–2001 associated with a one-unit increase in the independent variable.

In the analyses using the EPA's CERCLA weighting method, the coefficient for *ISO 14001* is statistically significant and positive for the both the absolute and the logged pollution reduction dependent variables (Tables 2). In the analyses using the CHHI/RSEI weighting approach (Table 3), the coefficient *ISO 14001* is statistically significant and positive for the absolute pollution reduction dependent variable but is statistically insignificant in the logged pollution reduction dependent variable analysis. These analyses provide some evidence that, compared to non-certified facilities, ISO 14001-certified facilities experienced significantly *larger* reductions in pollution emissions, controlling for other factors and the endogeneity between facilities' decisions to join ISO 14001 and their environmental performance.

To get a sense of the scale for these effects, we calculate the effect of the ISO 14001 using the predicted difference in pollution reduction for treated (certified) and non-treated (non-certified) facilities, holding all other variables at their mean. We then normalized this amount as a percentage of the dependent variable's standard deviation. In the analyses using the EPA's CERCLA weights, the absolute reduction and logged reduction coefficients for ISO 14001 translate, respectively, into a 3.4% and a 6.8% standard deviation larger reduction for facilities certified in ISO 14001. In the analyses using the CHHI/RSEI weights, the absolute reduction coefficient ISO 14001 translates into a 6.6 percent standard deviation larger reduction in pollution emissions.

The key finding that joining ISO 14001 appears to improve facilities' environmental performance has important implications. As we indicated, this can be attributed to a significant extent to third-party auditing, the key program feature to mitigate shirking. The credibility of voluntary environmental programs is not strong among environmental activists (Steinzor, 1998) and the academic literature on their performance is uneven (compare, for example, Khanna & Damon, 1999 with King & Lenox, 2000). Our analysis should support the credibility of ISO 14001 by showing that joining ISO 14001 does improve environmental performance beyond what likely would have occurred had the facilities not joined. We elaborate on the implications of our analysis in the conclusion section.

CONCLUSION

As non-mandatory codes of conduct that firms pledge to follow, voluntary programs can be found in several sectors and policy areas. While the environmental policy area has witnessed a proliferation of such programs, their efficacy remains disputed. Are voluntary environmental programs greenwashes or do they improve members' environmental performance? If improvements in environmental performance are contingent on members honoring program obligations, what program features mitigate shirking? This paper examined this key issue of program design by focusing on monitoring and enforcement as key features to mitigate shirking. Specifically, we examined whether programs that require third-party audits *without* requiring public disclosure of audit information can succeed in improving members' environmental performance. To understand the role of third-party audits in mitigating shirking, we compared ISO 14001 with Responsible Care. While Responsible Care—a covenant without swords—did not improve participants' environmental performance (King & Lenox, 2000), our study finds that ISO 14001, a covenant with a weak sword, improved participants' environmental performance. The discriminating variable in the design of the two programs is third-party audits. Our paper validates King and Lenox's (2000) conjecture that monitoring and sanctioning to curb shirking is necessary for a voluntary program to improve participants' environmental performance.

Our paper raises interesting questions for future research. We have attributed improved performance of ISO 14001 participants to third-party audits. Arguably, the influence of third-party audits is likely to depend on firms' internal organizational structure. Audits may have more salience in firms where audit findings are reviewed by the top-management and are linked to environmental managers' performance evaluation. In other words, to get a more complete sense of how third-party audits influence intra-firm dynamics and managerial incentives, firms will have to be unpacked and audit politics understood within the context of firms' organizational dynamics. Future research should also examine whether, along with internal organizational structure, levels of education of the workforce and whether or not a firm is a subsidiary of a multinational corporation mitigate shirking. Arguably, a more educated workforce would have a better appreciation for business's responsibility toward the natural environment. Because multinationals have been in the forefront to establish ISO 14001, arguably, they will also ensure that their subsidiaries follow it in letter and spirit.

Our paper suggests a framework for reconciling the apparently conflicting research on voluntary programs' efficacy. Stronger voluntary programs have monitoring and enforcement systems with three components: third-party monitoring,[22] public disclosure of audit information, and sanctioning by program sponsors. Weaker programs have fewer of these. Our framework therefore has significant policy implications for program design. If requiring public disclosure of audit information is perceived as "costly" by firms (and therefore lead to lower participation levels), it is worthwhile exploring the benefits of the public disclosure requirement. Future research should compare participants' environmental performance across programs with varying monitoring mechanisms. Our paper has contrasted the "no sword" case, Responsible Care, with the "weak sword" case, ISO 14001. Given that Responsible Care has recently made third-party auditing mandatory, an obvious extension of our work is to examine whether introducing swords has mitigated shirking and induced Responsible Care participants to reduce pollution more than non-participants. Future research should compare the environmental performance of strong sword programs with medium and weak sword programs. This will help to better estimate the incremental gains from public disclosure of audit information and from active sanctioning of shirkers by program sponsors.

Mandatory information disclosure policies have received a lot of attention in recent years. In the early part of the 20th century, Justice Brandeis correctly noted that law alone does not solve social problems: "Publicity is justly commended as a remedy for social and industrial diseases. Sunlight is said to be the best of disinfectants" (Brandeis, 1914). Our interviews with regulators also suggest the importance of disclosures in creating incentives for firms to adopt progressive environmental policies. Dan Fiorino of the EPA emphasized the importance of transparency in fostering trust among stakeholders about the program and inducing accountability. David Ronald, Executive Director of the Multi-State Working Groups echoed this point as well.[23] For these regulators, transparency is a tool to foster accountability. However, along with public disclosure, the disclosure format should minimize transaction costs for externals stakeholders to access and interpret such information. Pro-

[23] Phone interview, 12/11/2003.

[22] Arguably, because auditors are paid by firms they audit, and there are several auditors to choose from, auditors are reluctant to take the hard line. The recent accounting scandals do not inspire confidence about the rigor of third-party auditing.

gram sponsors could require members to report audit information (a) on specific policy-relevant variables, (b) in an accessible format, and (c) made available to any stakeholder.[24] Firms may have a tendency to unload high volumes of information, in inaccessible formats, and to the select few. Such partial, controlled disclosures may well be interpreted as greenwashes of firms' true environmental performance, and may not serve the desired function of mitigating shirking.

Another program design feature that is likely to influence program efficacy is the comprehensiveness and stringency of obligations the program imposes on its members. Anton, Deltas, and Khanna (2004) find that more comprehensive EMS lead to lower toxic emissions, particularly for firms that have higher pollution intensity. While for Anton, Deltas, and Khanna (2004) the variable of interest is the comprehensiveness of firms' EMSs, our paper looks at the role of monitoring (holding comprehensiveness constant) in influencing environmental performance. Future research that compares across voluntary programs could look into the link between comprehensiveness and monitoring—that is, whether firms that opt for more comprehensive EMS are also likely to opt for externally monitored ones and, if so, then with what consequences. Further, future research could also examine whether voluntary programs such as ISO 14001 that focus on management systems are more successful in curbing shirking than the ones that focus on concrete outcomes (such as the EPA's 33/50 program). All these would provide helpful insights to policymakers in terms of what types of voluntary programs regulatory agencies should either sponsor or reward.

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