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Why U.S. Firms Certify to ISO 14001: An Institutional and Resource-based View

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Abstract

While numerous studies have emerged that study the motivations for firms to participate in voluntary environmental programs (VEPs), little attention has been given to why firms go a step further to "certify" their environmental actions. Moreover, previous VEP studies have generally considered the institutional pressures that motivate companies' environmental decisions, while ignoring the internal factors. This study explores both the institutional pressures and internal competencies that comprise firms' decisions certify their environmental management system (EMS) to ISO 14001, the international EMS standard. It compares adopters to non-adopters and uses a hazard model to predict empirically which firms were early adopters of ISO 14001. The results indicate that early adopters endured greater coercive pressures from regulatory and social actors. Early adopters also had greater capabilities with management systems and pollution prevention strategies.

Key Words: Institutional theory, resource-based view, environmental strategy, ISO 14001, hazard model, environmental fines, environmental violations, motivations, coercion

INTRODUCTION

In recent years researchers have given increasing attention to the benefits that organizations receive from proactively managing their relationship with the natural environment. Among other things, firms may improve their operational efficiencies, gain competitive advantage [1], [2] and reduce the costs of complying with environmental regulations. Some firms have gone a step further to "certify" their environmental actions by having independent third parties audit their management practices. Doing so "signals" information to the public, the media, regulators and customers about firms' otherwise ambiguous environmental behaviors and policies. Why firms take an extra step to publicize environmental information is particularly interesting because organizations can improve their environmental performance without informing external parties about their environmental actions.

To date, much research has considered why firms participate in a program, agreement, or commitment that encourages them to voluntarily reduce their environmental impacts beyond that required by the environmental regulatory system e.g., [3], [4], [5], [6]. These studies have largely focused on the institutional pressures that motivate an organization to participate in voluntary environmental programs (VEP).[2] However, firms' prior internal competencies are also expected to be important factors in explaining a companies' environmental actions [2], [8], [9], [10], [11], [12], [13]. Therefore an appreciation of an organization's internal capabilities may also be critical to understanding why different organizations certify their environmental strategies.

Few VEP studies have evaluated organizational decisions to certify their environmental practices. The distinction is important because firms that certify their environmental strategies or actions invest significant resources in environmental audits and other

[2] By 1998, participation in EPA's more than 40 voluntary environmental programs (VEPs) had attracted a projected 13,000 organizations [7] and participation in industry-sponsored VEPs had attracted thousands more.

administrative requirements that their non-certified competitors do not. Studies that have considered certification decisions evaluate them for the facility rather than the firm, e.g., [14]. However, parent companies have a significant influence on facility-level decisions to certify their environmental management systems, in that in almost every case firms either mandate or casually endorse ISO 14001 implementation within their facilities [15]. For this reason, a firm-level analysis seems more appropriate.

This research addresses these issues by considering how firms' institutional pressures and internal competencies affect their decisions to certify their environmental management system (EMS) to ISO 14001, the international EMS standard. The following sections offer a conceptual model and hypotheses that guide the research. Then a hazard model is used to empirically test the factors that influenced firms to certify to ISO 14001. Finally, the paper concludes by discussing the implications of this work and future research.

CONCEPTUAL MODEL

Institutional theory suggests that firms' pressures shape organizational action. Three types of institutional pressures influence organizational change: coercive, mimetic and normative [16]. Coercive pressures are exerted by the institutions that the organization depends on. Normative pressures arise from professional relationships and are a result of networks including industry associations. Finally, mimicry is the attempt by organizations to model other enterprises.

Empirical examinations of institutional theory and its relevance to firms' decisions to proactively manage their environmental affairs have often focused on the effects of coercion on organizations' environmental activity, e.g., [4], [6], [9], [17]. For example, Henriques and Sadorsky [17] show that coercive institutional pressures exerted by legislators, lobbyists, the courts, activists and consumers all define the institutional boundaries of the firm though regulators, protests, lawsuits, political lobbying and direct negotiation also play a part. Similarly,

Welch, Mazur and Bretschneider [6] show that regulatory pressures shape firms' behaviors to participate in an industry-specific VEP.

These studies suggest that institutional influences lead to *homogeneity* among firms. However, this premise is criticized for both its lack of attention to the role of organizational self-interests, as well as casting the organization as a passive participant that responds to institutional pressures and expectations [18], [19].

In considering these criticisms, Hoffman [20] recasts the institutional framework by examining the motivators for organizations' environmental change. He suggests that regulatory, market and social factors[3] influence firms' environmental action. Hoffman explains that although these pressures constrain organizations' economic activities, they also create opportunities for competitive advantage. Such opportunities may expand as the regulatory system becomes more diverse and flexible [20], [21].[4] All of these pressures may also affect an organization's decision to certify its environmental activities.

While institutional theory focuses on the direct impact of institutional rules, pressures and sanctions on organizational structure, the resource-based view of the firm (RBV) emphasizes how firms develop their internal organizational capabilities in the face of institutional constraints. RBV suggests that market imperfections coupled with resources that are rare specialized, or non-replicable create opportunities for *heterogeneity* [23], [24], [25]. An organization's competitive strategies therefore depend on its specific capabilities and abilities to put them to routine productive use [26], [26] and maintain them over time [25], [24], [19].

[3] Social pressures are often related to firms' regulatory pressures. That is, societal expectations cause and shape the democratic process that produces environmental regulations. Similarly, when a firm violates environmental laws or pollutes more than its industry peers, NGOs, investors and other interested parties may publicly question its environmental management practices. As a result, while institutional theorists may suggest that social and regulatory pressures shape organizational change [19], these constructs are not necessarily distinct.

[4] Milstein, Hart & York [22] also discuss how coercive forces may create varied organizational responses in their study of two industrial sectors.

Applying RBV to the natural environment, Hart [2] suggests that an organization's pollution prevention capabilities assist in its ability to successfully reduce its emissions, effluents and wasteful use of resources. Environmental capabilities are people intensive, rather than capital intensive, and rely on employee knowledge and an ability to work in teams and share expertise [2]. A higher level of environmental capability, for example, may broaden a firm's scope of environmental performance beyond its own operations to incorporate the concerns of customers and suppliers. Firms that develop their tacit pollution prevention capabilities may thus implement their more advanced environmental practices more efficiently [12], [28]. For example, to achieve greater levels of internal environmental competency and efficiency (such as EMS) an organization must first be proficient in basic environmental capabilities (such as pollution prevention) [2], [15], [28] else incur additional transaction costs during implementation [28].

Developing basic competencies is necessary for firms to achieve competitive advantage, but not sufficient because over time competitors will attempt to duplicate them [8]. As a result, organizations must constantly improve their internal competencies [2], [8], [11] in order to generate a continual stream of innovations that lead to competitive advantage [8]. Moreover, organizations possessing basic continual improvement competencies may be able to more competently transfer their expertise and generate momentum that encourages greater commitments in environmental management [29].

In making their production decisions, firms are constantly shifting between investments in labor and capital. Competitive environments require that firms have some ability to enter or leave businesses rapidly as conditions change [45]. All else equal, organizations that choose to invest in labor over capital may increase their strategic flexibility, because labor is much less adaptable to new businesses than the knowledge and skills gained through firm-level capabilities [45]. Such an

environment helps foster pollution prevention activities within the organization because they are people intensive, rather than capital intensive [2].

Three factors thus emerge as important variables influencing a firm to certify to ISO 14001: environmental management capabilities, continuous improvement competencies and capital intensity.

APPLICATION & HYPOTHESES

Institutional theory and RBV was applied to a firm's decision to certify its EMS to ISO 14001, the international standard for EMSs. Established in 1996, ISO 14001-certified EMSs are standards for environmental management. Organizations that certify their EMS to ISO 14001 are required to systematically consider their relationship with the natural environment. Firms adopt an environmental policy, evaluate their environmental impacts, set environmental goals, implement a strategy to achieve their goals, establish monitoring and corrective-action procedures and institute management reviews. Once implemented, independent third party auditors then certify whether a firm's EMS meets the international standard's guidelines.

Certification to ISO 14001 can be costly because it requires significant documentation (taking up to two years to produce), multiple environmental assessments and dozens of meetings between managers, executives and employees [30], [31]. An organization should expect to invest between $267 and $1,372 per employee to implement an ISO 14001-based EMS depending on the robustness of its prior capabilities [28]. These costs discourage many organizations from implementing ISO 14001.

Drawing from the framework described above, two institutional pressures (regulatory and social) that are hypothesized to influence firms' decisions to certify to ISO 14001.

Regulatory Pressures

Regulatory pressures come in multiple forms and include mandates to obtain operating

permits, to adopt specific control technology, to monitor and report on media-specific environmental activities, to allow regulators to audit the organization's environmental activities and to address any emissions violations or legal implications of non-compliance. There are two general hypotheses related to a firm's overall regulatory pressures. The first suggests that to the extent that organizations can influence the formation of regulation, managing their environmental impacts may serve as a signal to lawmakers to *increase* restrictions for industry as a whole [32] Under stricter regulation, certified firms may prevail by navigating the more stringent regulatory structure and therefore raise the costs of their competitors, at least in the short-run [32]. However, in order to raise rivals' costs, organizations must certify to ISO 14001, *and* also achieve greater environmental and operational efficiencies than their competitors. This discussion suggests that firms moving their environmental strategies beyond mere compliance with environmental laws have stronger environmental competencies and are cleaner, and therefore more likely certify to ISO 14001.

Other scholars have suggested that regulatory pressures cause enterprises to consider participating in voluntary environmental programs in an effort to *preempt* more stringent environmental regulation [6], [33], [34]. These organizations may influence policy makers to either ease regulations or to preclude further regulation [5], [34], [33], [35], therefore reducing their overall regulatory costs. As an example, enterprises may negotiate agreements with government officials to streamline their environmental permitting process or waive regulatory requirements, thus weakening or preempting forthcoming regulations [6], [33], [34]. As a result, firms may benefit by utilizing informal devices, such as ISO 14001, to signal to regulators and the public their concern for the natural environment. Because these firms are motivated by the fear of a more stringent regulatory system, they are also less likely to have environmental behaviors that are congruent with their certification behavior. Instead, they have difficulties

achieving environmental compliance and have fewer environmental capabilities, and are therefore dirtier firms. Two rival hypotheses thus emerge:

Hypothesis 1: Cleaner firms are early adopters of ISO 14001.
Hypothesis 2: Dirtier firms are early adopters of ISO 14001.

Social Pressures

Social pressures include an organization's external constituents that should be actively managed in order to develop successful environmental strategies [20]. Constituents in the social system, including environmental groups, citizens groups and the media, can mobilize public sentiment, alter accepted norms and change people's perceptions about the environment [20] and pressure firms to consider their relationship with the natural environment.

Social pressures have gained increasing attention since the 1980s due to greater public knowledge of organizations' environmental activities. In the past, a firm's environmental reputation received little attention, because of asymmetric information regarding the harmful effects of industrial activity. However, awareness has increased as media have covered stories of catastrophic environmental disasters such as the Three Mile Island nuclear accident, the Union Carbide toxic gas leak in Bhopal [36] and the Exxon oil spill. Environmental accidents have heightened public awareness and personalized the importance of firms' environmental performance. They also increase social scrutiny by giving rise to demands for redress to improve future performance [37], [38], [39], [40].

Hypothesis 3: Firms that receive negative environmental press are early adopters of ISO 14001.

Turning to firms' internal competencies, three factors—management system capabilities, environmental management capabilities and capital intensity—were considered.

Continual Improvement Capabilities

Continual improvement management systems are predicated on internal evaluation, employee involvement, monitoring, knowledge development and improvement of operational factors. These combined factors assist the organization to achieve greater organizational efficiency [2], [41], [42] and environmental change [8], [41]. They may also help organizations meet their environmental goals by improving operational procedures and by identifying needs for environmental change [43], [44]. Enterprises that have a basic organizational commitment for quality improvement may also more readily apply their system-based knowledge towards environmental management [2], [8], [43] and do so at a lower cost [14], [28]. This ability to shift focus is attributable to the employees who are already trained in implementing a management system and an existing culture for continual improvement [43]. Perhaps most importantly, organizations that have prior continual improvement capabilities also have managers who are already committed to use systems-based strategies to achieve organizational goals [29].

Hypothesis 4: Firms with prior continual improvement experience are early adopters of ISO 14001.

Environmental Management Capabilities

A firm-wide commitment to manage environmental impacts is expected to evolve over time, with multiple levels of employee involvement. Without first having in place smaller environmental programs, firms are less likely to adopt a certified EMS, in part because the costs are greater for firms lacking such preexisting capabilities [28]. Following this argument of path-dependence, pollution prevention activities are a precursor to more integrated and advanced types of environmental management [2], [12] such as EMS adoption.

Hypothesis 5: Firms that have prior experience preventing pollution are early adopters of ISO 14001.

Capital Intensity

Capital resources are a function of a firm's market forces resulting from financial risk [45]. Competition requires the quick ability to enter or leave businesses rapidly as conditions change [45]. Organizations with consistently high capital expenditures may reduce their strategic flexibility, because capital equipment is much less adaptable to new businesses than the knowledge and skills gained through firm-level capabilities [45]. All else equal, capital-intensive firms emphasize automation over labor as the primary factor of production [46]. This emphasis is problematic because pollution prevention activities are people intensive, rather than capital intensive [2]. Therefore, firms that emphasize pollution prevention strategies likely invest fewer resources in capital than their competitors [2].

Hypothesis 6: Firms that have lower capital resources are early adopters of ISO 14001.

VARIABLES & EMPIRICAL MODEL

Dependent Variable

A firm's ISO 14001-certification was measured by the year in which its first facility certified to ISO 14001. Lists of all ISO 14001-certified facilities (1996-1999) were obtained from Global International Quality Group and McGraw-Hill.[5] In addition, the websites of state environmental agencies were searched for additional ISO 14001 certified facilities. All lists were then merged and duplicate records were removed. A total of 972 unique facilities were identified as having certified to ISO 14001 by December 1999. In order to determine the parent companies of these facilities, each facility was cross-referenced in Dun & Bradstreet's *Who Owns Whom 1999/00 (Volume 2),* and in *Hoover's Online* and associated with its corporate owner.[6]

[5] Global International Quality Group's data spanned 1996-1999 and McGraw-Hill's data spanned 1996-1998.
[6] Dun & Bradstreet's *Who Owns Whom 1999/00 (Volume 2)* and *Hoover's Online* contain information for all U.S. facilities, divisions and subsidiaries and belonging to *publicly traded* corporations. Parent companies were identified for 906 of the 972 facilities (558 U.S.-owned and 348 foreign-owned). The unidentified owners of the 66 remaining

ISO 14001 adopters are composed of two types of companies: firms that mandate their facilities to certify to ISO 14001 and firms with facilities that adopted ISO 1400 sans corporate mandate. This latter group is particularly interesting because these enterprises possess a corporate culture that encourages facilities to certify to ISO 14001, in the absence of parent company requirements. Both groups were combined to create the dependent variable that was coded for the time in which each company's first facility certified to ISO 14001.[7]

All U.S.-owned S&P 1500 enterprises within SICs 1000-4999 were evaluated and of them 88 firms had adopted ISO 14001. By focusing on U.S.-owned companies, this study avoided difficulties associated with cross-country comparisons, e.g. [68]. The 88 ISO 14001-certified firms accounted for 85% (459) of *all* U.S. publicly traded organizations certified to ISO 14001 by December 1999. Using the same restrictions, a sample of 612 U.S.-owned non-adopters was also selected.

Independent Variables

A firm's *regulatory pressure* to be "clean" was measured by its ability to comply with six federal environmental law; Atomic Energy Act, Clean Air Act, Resource Conservation and Control Act, Clean Water Act, Toxic Releases and Control Act and the Mining Safety and Health Act. Corporate-level data were obtained from the Investor Responsibility Research Center. Two compliance variables measured firms' annual violations and firms' annual environmental fines. Both measures were estimated in separate models with identical covariates.

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facilities were believed to be *private* companies of either U.S. or foreign ownership. The 558 U.S. facilities were owned by 156 parent organizations, of which 138 were publicly traded corporations.

[7] A separate and equally important empirical question is whether "mandaters" differed from "encouragers." This topic is explored further in [47]. The results showed that firms with stronger corporate commitments to ISO 14001 endured greater external pressures for EMS certification. Mandaters also possessed stronger organizational capabilities that supported their requirements for an organization-wide ISO 14001 policy. These findings suggest that aggregating mandaters and encouragers in a single dependent variable will potentially bias the results by yielding more conservative estimates. Unfortunately, the number of firms that adopted ISO 14001 by 1999 was too small to estimate the two groups of firms. However, if after combining the two groups a statistically significant relationship is found, additional evidence will be provided about whether these two groups together differ from non-adopters.

Prior studies have predicted facility-level certification decisions using measures of annual toxic releases [14] without much success. For this study, I included a measure of firm's production-related waste (logged) was also used to evaluate a firm's "cleanness." Production-related waste is a subset of a firm's annual toxic releases, although it differs along an important dimension. Firms with low production-related waste are engaging in higher levels of pollution prevention than are firms in the same sectors with high production-related waste [48]. As a result, this variable also measured a firm's environmental capability.

Firms' *social pressures* were measured by a binary variable indicating whether they received negative environmental press by being identified by *Mother Jones* as a "Top 100 Corporate Criminals of the 1990s." The *Mother Jones* list focuses public attention to corporations that have either pled guilty or no contest to environmental crimes and have been criminally fined for their wrongdoings. Of the 100 firms identified on *Mother Jones'* list, 38 were recognized as *environmental* criminals and paid fines between $200,000 and $125 million for their environmental wrongdoings.[8]

Continual improvement capabilities were measured by when firms certified to ISO 9001 and 9002, and participated in OSHA's Voluntary Protection Program (VPP).[9] ISO 9001 and ISO 9002 are quality management systems (QMS) that are certified by external registrars. ISO 9001 focuses on quality assurance in design, development, production, installation and servicing, whereas ISO 9002 incorporates the same elements except that it does not have a design

[8] Before including the *Mother Jones* variable in the empirical model, I evaluated its correlation with the other regulatory variables. It was correlated between 11.6 – 19.9 percent with the other regulatory variables, and thus was sufficiently distinct to include in the empirical model.

[9] Coding the management system variables was the most arduous task in this study and its complexity cannot be over-emphasized. The reason for these difficulties was that ISO 9001/2 certification and OSHA VPP participation, like ISO 14001, occurs at the facility-level. In order to code a firm as having at least one facility certified to ISO 9000 or ISO 14001 or having participated in OSHA VPP, each operational unit of every firm had to be identified and researched. For example, a company with 250 facilities and subsidiaries had to have all 250 business units cross-referenced in the ISO 9000 and 14001 databases to properly code this *one* company. Similar searches and assessments were required for all 700 firms in the sample.

requirement. QMS participation was coded as two binary variables equal to 1 when the first facility within the firm certified, and 0 otherwise. These variables thus accounted for both time and participation.

The Occupational Safety and Health Agency's (OSHA) Voluntary Protection Program (VPP) data were also used to measure firms' management system capabilities. This program was designed to recognize firms' exemplary health and safety management systems. VPP participation requires that firms review their plant policies and procedures, injury rates, management commitment, contractor program, hazard analysis, safety health programs and emergency response, and undergo rigorous external audits. A list of all 687 VPP facility participants (1988-1999) was obtained from OSHA. VPP participation occurs at the facility-level and so each facility was associated with its parent company. VPP participation was coded as a binary variable equal to 1 when the first facility within the firm participated in VPP; 0 otherwise.

A firm's *environmental management capability* was measured by whether it participated in EPA's Green Lights Program. Initiated in 1992, Green Lights was designed to encourage firms to prevent pollution by using energy-efficient lighting technologies and reducing greenhouse gas emissions. A list of all 1,900 Green Lights participants (1992-1999) was obtained from EPA and coded two ways based on whether firms were "Allies" or "Partners." Allies were required to provide public education to customers, whereas Partners were required implement more rigorous pollution prevention strategies by reducing their energy usage and upgrading 90 percent of their square footage within five years [49]. Two binary variables accounted for the year in which the firm began participating as an Ally or Partner.

Three measures were used to evaluate a firm's *capital resources*. First, using Computstat© data, firms' annual capital expenditures (logged) were included to measure investments in

property, plant and equipment, excluding amounts arising from acquisitions.[10] Second, each firm's assets and asset age were combined into an index. Following Khanna and Damon's [3] suggestions, the index measured a firm's replacement cost of equipment (or capital turnover). Firms with older assets were expected to face lower costs of replacement than firms with newer assets and may therefore be more willing to take a proactive approach towards the environment. Age of assets was measured by dividing the total assets of a firm by its gross assets [3]. Third, with the revision to the Clean Air Act (CAA) in the 1990s, many firms were required to invest significant resources towards the purchase of costly end-of-pipe pollution control technologies [50]. As a result, firms' CAA violations and fines were interacted with their capital expenditures.

Data from Compustat© were used to control for firms' industrial sector. These variables were created by aggregating sectors at the two-digit level of the standard industrial code (SIC). Then, one dummy was created for mining and construction sectors. Within the manufacturing sectors, nine dummies were created and two dummies were created for the transportation, communication and energy services sector.

Descriptive statistics for each of the variables are described in Table 1.

[Insert Table 1 About Here.]

Empirical Model

A hazard model was used to estimate the timing of firms' ISO 14001-certification. Hazard models are often preferred to discrete choice models (such as logistic regression) because longitudinal data have several features that make these models less reliable; in particular, they do

[10] While some scholars may argue that measuring a firm's total on property, plant, and equipment expenditures is more appropriate than is an annual measure, these two variables are functions of each other and are correlated at 99.23 percent $p \leq 0.0001$.

not account for the length of time until transition [51]. As a result, the precision of the logistic regression is less robust [52].[11]

Beginning in January 1996, all 700 firms were "at risk" of certifying to ISO 14001, and continued to be at risk for the duration of the study. Prior to 1996, no firms were at risk of certification since ISO 14001 did not exist.

A firm's "hazard rate" of certification was suspected a priori to increase over time because as firms learned more about the standard and ISO 14001 gained domestic and international acceptance, certification across all firms would increase with time, at least for early adopters. To test this suspicion, Akaike's [53] information criterion was used to compare the log likelihood values for Gompertz and Weibull specifications with the Cox proportional hazard (PH) specification. The Gompertz and Weibull methods are used in models with monotonically increasing hazard rates, whereas the Cox PH makes no assumption about the hazard rate because researchers often do not have information about the slope of the hazard function. The results of these tests confirmed that the hazard rate was increasing. Therefore, the Gompertz and Weibull specifications were estimated in addition to the Cox PH (with time varying covariates).[12] The generalized form of the hazard model was:

$$h(t,x) = (h_0(t), \beta_0 + x_j\beta_x) \quad (1)$$

where $h_0(t)$ was the baseline hazard function that was assumed to be multiplied by a parametric function for both the Gompertz and Weibull estimations. The constant, β_0, is a function of the baseline hazard function, and the regression coefficients β_x to be estimated from the data.

[11] The most significant disadvantage of the hazard model is also its greatest strength. The model requires precise information about when in time an event occurred. Such information is often always not available, and in its absence logistic regression is the next best alternative [51].

[12] Researchers often consider the Cox PH the preferred default method due to its generalizability and semi-parametric nature [51].

Therefore, the exit from non-ISO 14001-certification (to a state of certification) were modeled as a function of the explanatory covariates:

$$h_{it}(t, X) = \Sigma\beta_1(\text{regulatory pressures})_{it} + \Sigma\beta_2(\text{social pressures})_{it} + \Sigma\beta_3(\text{continual improvement capabilities})_{it} + \Sigma\beta_4(\text{environmental management capabilities})_{it} + \Sigma\beta_4(\text{capital resources})_{it} + \Sigma\beta_6(\text{industry controls})_{it} \quad (2)$$

Prior to estimating the hazard model, missing environmental data for 65 firms were imputed, as were missing data related to capital resources. Then, a frailty test was performed to determine the extent of unobserved heterogeneity. The results showed that unobserved heterogeneity was not present statistically. Table 2 shows the correlations among all the variables.

[Insert Table 2 About Here]

RESULTS

Table 3 shows that a firm's violations of the Atomic Energy Act (AEA) affected its hazard rate of adoption. Firms with greater violations had a hazard rate of adoption that was between 88 and 111 percent more than firms with fewer AEA violations. The AEA regulates nuclear reactors, nuclear fuel facilities and radioactive materials. Firms need not be involved in electric generation to be regulated by the law. In fact, 21 of the 47 firms (45 percent) in the sample incurring at least one AEA violation were manufacturing facilities (SICs 20-39). These firms used radioactive material as component in their manufacturing processes while others produced radioactive waste as a by-product of their manufacturing process.[13]

[Insert Table 3 About Here]

[13] For example, the pharmaceutical company, Bristol-Meyers Squibb (SIC 28), was issued a violation by the U.S. Nuclear Regulatory Commission, for its failure to control occupational dose (two operators received extremity overexposures) and to perform adequate surveys evaluating radiation exposure to employees' extremities [54] USNRC, 2002). Similarly, Mallinckrodt Corporation was issued a violation for 117 exposures to employees' extremities that occurred between 1995 and 2000 [54].

AEA violations often involve harm to workers and others [54]. Such threats to public safety often fuel public concern [55] which is further heightened by increasing reports debating the safety, disposal and storage of radioactive waste [56]. As a result, a firm that violates the AEA is more likely to incite public distress and media scrutiny. Firms that have incurred these pressures may be using ISO 14001 to signal to regulators and the public that they are improving their environmental management.

Firms' violations of the Resource Conservation and Control Act (RCRA) also predicted their certification decisions. Firms with greater RCRA violations certified to ISO 14001 20 percent faster than firms with fewer RCRA violations. RCRA requires firms to track their hazardous waste from production to disposal or from "cradle-to-grave." This systematic approach parallels the procedures required by ISO 14001. Firms that have had difficulty complying with RCRA may be relying on ISO 14001 and its systemic approach in an effort to better address their environmental affairs.

Interestingly, a firm's production-related toxic releases had no statistical effect on the timing of its certification decisions. A firm's production-related waste is a component of its aggregate toxic releases. Firms with low production-related waste engage in higher levels of pollution prevention than firms in the same industries with high production-related waste [48]. These results suggest that early adopters had pollution prevention strategies (related to their overall toxic releases) that were no more robust than non-adopters.[14]

[14] Following King & Lenox's [14] suggestion, to consider whether firms' aggregate TRI releases affected their hazard rate of ISO 14001-certification, TRI emissions were estimated in lieu of production related waste. This variable also did not predict early adopters' certification behavior in either the Gompertz, Weibull or Cox specifications, confirming King and Lenox's results of ISO 14001 at the facility-level [14]. I then tested whether a firm's *number* of TRI reporting facilities predicted their ISO 14001-certification behavior. This model evaluated whether the action of merely reporting toxic releases was a regulatory pressure that firms wish to avoid and ISO 14001 may a means to do so. Consistent with the prior results, the number of TRI reporting facilities was statistically insignificant in all three distributional specifications. Yet, the *announcement* of firms' toxic emissions has been credited with short term reductions in firms' stock price e.g., [57], [58] and the TRI chemical *volumes* have been

The most robust variable in the model was whether or not Mother Jones' identified a firm on its publicized list of "Top Environmental Corporate Criminals." Firms identified on this list adopted ISO 14001 between 568 to 641 percent faster than firms not on *Mother Jones*' list. This list is highly publicized and calls attention to a firm's environmental mismanagement. Also, firms that incur the largest criminal fines are more likely to employ corporate managers that subsequently went to jail for their environmental mismanagement.

Turning to firms' internal capabilities, the results confirmed that an organization's experience with quality management systems played a substantive role in predicting ISO 14001-certification. Firms with facilities certified to ISO 9002 adopted ISO 14001 between 308 and 329 percent faster than firms with no facilities certified to ISO 9002. Similarly, firms with facilities certified to ISO 9001 adopted ISO 14001 at a rate that was between 27 and 104 percent greater than firms having no ISO 9001-certified facilities. The differences in the hazard ratios between ISO 9002 and ISO 9001 are most likely due to the differences in the standards themselves. ISO 9002 is more relevant to firms that do not design their own products and instead have their products designed by their customers [59]. Certification to ISO 9002 is therefore an indicator that the firm operates in the middle of the supply chain whereas ISO 9001 is more often implemented by firms operating towards the end of the supply chain [59]. So while it appears that firms throughout the supply chain with certified QMS are early adopters of ISO 14001, firms in the middle of the supply chain certified at a quicker pace.

Interestingly, whether or not a firm had facilities participating in OSHA's VPP Program had no statistical affect on early adopters. These results confirm prior facility-level studies

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associated with significant changes in firms' environmental strategies, including participation in VEPs , e.g., [4], [5]. Both factors have also contributed to public pledges by corporations and industry associations to better address their environmental affairs. Interestingly, they appear to have no statistical effect on early adopter's ISO 14001 certification decisions.

suggesting that participation in OSHA's VPP does not influence organizations' decisions to adopt an EMS [15].[15]

In evaluating firms' environmental management capabilities, Green Lights Ally participation did not predict a firm's decision to adopt ISO 14001, whereas Partner participation did. Partners certified to ISO 14001 between 66 and 67 percent faster than non-participants. Partners had more rigorous energy reduction requirements than Allies. These greater requirements may have caused Partners to further develop their pollution prevention capabilities, making ISO 14001 more attractive.[16] However, they are also in conflict with the fact that firms' production related waste had no effect on the timing of firms' certification decisions.

Contrary to prior expectations, capital expenditures influenced firms' ISO 14001-certification decisions, while the age of adopters and non-adopters' assets were roughly the same. These results suggest that firms were replacing their capital at the same rate, but that early adopters were investing more resources. All else equal, early adopters were therefore placing greater emphasis on automation over labor as their primary factor of production. Also, in the presence of capital expenditures, CAA violations decreased the hazard rate of ISO 14001 adoption. These findings point to the fact that firms investing in pollution control technology were able to better manage their environmental impacts. However, such technologies generally

[15] In a subsequent hazard model I asked whether ISO 14001 lead to participation in VPP. The results showed that ISO 14001 *does* predict the timing of participation in VPP, and ISO 14001 certification the single most robust predictor of VPP participation. So it appears that firms were first certifying to ISO 9001/2 and then relying on their QMS capabilities to certify to ISO 14001. After broadening their management system capabilities, firms integrated advanced health and safety systems into their operational structure. Because the capability variables were coded for time to reflect which activities occurred first, endogeneity in the estimations was not a problem.

[16] Unfortunately, there is not enough evidence to determine whether Green Lights Partners engage in greater levels of pollution prevention than non-participants. We can only surmise that the increased requirements for participation led to some measurable improvements. While this assumption cannot be assured, studies often use self-initiated pollution prevention policies [17], statements of environmental principles, and other announcements [36] as indicators of a firm's greater concern for the natural environment.

focus on end-of pipe pollution control rather than pollution prevention, which is consistent with early adopters' lack pollution prevention emphasis in production-related waste.

Finally, firms' industrial sector had a strong role in explaining their timing of ISO 14001-certification. Firms within the transportation equipment industry (SIC 37) had a hazard rate of certifying to ISO 14001 that was 48 percent *greater* than any other industrial sector.[17] The industrial sector with the next greatest hazard rate was the industrial machinery and equipment industry (SIC 35), followed by the electronics (SIC 36) and fabricated metal products (SIC 34) industries. The food, tobacco and textile industries (SIC 20-22) and the transportation services and communication industries (SIC 40-48) had the lowest hazard rate of ISO 14001-certification.

Industry differences may exist because some sectors have a greater or lesser impact to the natural environment. The fabricated metal products, industrial machinery, electronics, transportation equipment, instrumentation and textile sectors are known as the cleanest U.S. manufacturing sectors [60]. In contrast, the pulp and paper, chemical, petroleum refining and primary metals industries are cited as the five most polluting industries in the U.S. [61], [62]. With the exception of the textile industry, all of the "cleaner" industrial sectors were also adopting ISO 14001 faster than firms in dirtier sectors. Combined with the fact that early adopters had greater environmental violations, these findings suggest that the dirtiest firms in the cleanest sectors were early adopters of ISO 14001.

Environmental Fines Specification

For the second specification, I tested the same empirical model using firms' annual environmental fines as explanatory variables, rather than environmental violations. Table 4 shows the results of this new specification.

[17] The hazard rates for all the other industrial sectors are in relation to the transportation equipment industry since it was the omitted sector dummy.

[Insert Table 4 About Here]

In general, Table 4 shows that the same variables predicted early adopters' certification decisions. There are, however, a few differences that are worth discussing. First, the effect that a firm's environmental fines had on its hazard rate of ISO 14001-certification was *less* than the effect of its environmental violations. More specifically, firms that *violated* the AEA were 90 to 110 percent more likely to certify to ISO 14001 than firms with fewer AEA violations. In contrast, the *fines* associated with these same violations increased firms' hazard of ISO 14001-certification by only 5.2 to 5.8 percent. In evaluating the effects that other environmental *fines* had on firms' certification behaviors, RCRA fines had no statistical effect. Yet, the number of *violations* of this law did.

These results may be due to the fact that firms often receive significant negative publicity when they are caught violating an environmental law, depending on its severity. Such is often the case for AEA violations where public fears run high. While firms also incur negative publicity when fines are levied against them, it is lessened because several years may pass between the moment a firm is caught and when it actually pays a fine. As a result, the amount of a firm's environmental fine may have an attenuating effect on its decision to certify to ISO 14001. In addition, firms negotiate with EPA to arrive at their final monetary value [63] and the final value of the fine may not be significant enough for firms to invest in changing their strategic environmental behaviors.

Interestingly, the opposite relationship was true for firms that violated the CAA. In this case, the number of environmental *violations* had no statistical effect for early adopters, yet the amount of its environmental *fines* did. Firms with higher environmental fines (and lower capital expenditures) certified to ISO 14001 5.2 to 5.6 percent faster than firms that incurred fewer environmental fines. The average fines associated with CAA violations, while smaller than the

AEA, RCRA and CWA were assessed 1.42 times as frequently as AEA violations, 1.55 times as frequently as RCRA violations and 1.77 times as frequently as CWA violations. CAA fines were therefore more likely to have a greater average financial impact than any other environmental law. This impact is even more significant when considering attorneys' fees, time and resources required to negotiate each fine. Moreover, with the 1990 revisions to the CAA, citizens were granted greater ability to sue non-complying firms, thus increasing firms' overall liability associated with CAA violations [50].

As was true in the environmental violations model, whether or not a firm was identified by *Mother Jones*' as a "Top Environmental Corporate Criminal" maintained its robust ability to predict certification behavior. The same was also true for the internal capability variables and industrial sector.

In summary, the empirical results offer support for most of the hypotheses. For others, the results clarify competing hypotheses in the literature.

DISCUSSION & CONCLUSION

Two primary factors predicted early adopters' ISO 14001-certification decisions. First, institutional pressures played a significant role. Early adopters were more likely to have been identified on Mother Jones' list of "Top Corporate Environmental Criminals" endured more negative environmental publicity. Firms on this list also incurred the greatest *criminal* environmental fines during the 1990s and their corporate managers were more likely to go to jail for their mismanagement. As a result, these firms received a "black eye" for their inability to manage their environmental affairs and were made examples before their industry peers. Similarly, firms that violated the Atomic Energy Act (AEA), the Resource Conservation and Recovery Act (RCRA), and had higher Clean Air Act and RCRA fines, certified to ISO 14001 earlier than other firms. Early adopters were also the dirtiest firms in the cleanest manufacturing

sectors, and less able to hide their environmental wrongdoings among their industry peers and were an easy a target for public scrutiny.

These results build on prior institutional research [3], [4], [5], [6], [14] by supporting the notion that early adopters were relying on ISO 14001 because they endured greater external scrutiny [14]. Scrutiny, however, is not discrete. In fact, it appears to follow a continuum with greater and lesser effects on firms' environmental behaviors. For example, TRI emissions had no effect on early adopters' certification decisions. Yet, more extreme scrutiny from environmental violations played a much greater role. These differences may be due to the fact that the TRI has become far less publicized than it was ten years ago. Moreover, in the vast majority of cases, TRI emissions are legal and do not result in federal penalties. More robust scrutiny occurs when a firm is fined. A fine indicates that a firm violated an environmental law. But because fines are often levied several years after the violation, they are less likely to garner the same degree of public scrutiny that follows on the heels of the violation itself. Firms endure even greater scrutiny when their environmental violations are published nationally by the media, especially if safety and public health are at risk. Chemical spills and accidents also have been shown to have the same effect [64]. The results of this study offer empirical support for notion that coercion has multiple gradations and for Jennings and Zandbergen's [21] proposition that the *more* coercive the pressure, the more likely that organizations will proceed change their environmental management.

[Insert Figure 1 About Here.]

The second primary finding was that early adopters' ISO 14001-certification decisions were influenced by their prior internal capabilities. Early adopters were more likely to have well-developed quality management systems, which supports RBV propositions that firms with demonstrated experience in continual improvement systems have fewer barriers implementing

advanced pollution prevention strategies [2], [8], [9], [11], [14], which also reduces their transaction costs of adoption. Quality management strategies require the voluntary involvement of large numbers of people, especially line employees, in continuous-improvement efforts [65], [66] and thus serve as a basic foundation for ISO 14001 certification [14].

Firms' early pursuit of ISO 14001 also appears to have been marginally dependent upon first demonstrating some competence in prevention pollution, but there is conflicting evidence. Early adopters were more likely to prevent energy pollution, although they were no more likely to prevent production-related pollution from toxic chemical releases. Moreover, while pollution prevention activities are people intensive, rather than capital intensive [2] early adopters incurred greater capital expenditures and were evidenced to have end-of-pipe pollution control strategies. Questions therefore arise about whether the Green Lights program helps build firms' internal pollution prevention competencies or merely acts as platform upon which firms switch their traditional lighting to more energy efficient options and to increase credibility with regulators and other external parties for their actions. If the latter is true, then the results of this study would all indicate that firms certifying to ISO 14001 are doing so primarily because of institutional pressures and because the marginal cost of adoption is less.

These findings beg the question of whether certified firms will actually improve their environmental performance over time and whether they derive market benefits from doing so. Early adopters may be certifying their EMSs merely to deflect attention from their tarnished past. Because early adopters were dirtier, had only moderate pollution prevention capabilities and focused on end-of-pipe pollution control, discovering that they had insincere motives for seeking certification would not be a surprise. If early adopters do not to improve their environmental performance, then certification will provide information that is incongruent with their actual environmental performance.

Indeed, firms may have little to lose by certifying to ISO 14001 and not improving their environmental performance if they expect the costs of doing so will be less than the benefits. For example, certified firms may be able to convince regulators to delay more stringent regulations [5], [6], [33], [35] and reduce their external scrutiny [14]. Certification may also convince regulatory agents to transfer their scrutiny to other types of organizations [34], [33] and at the same time improve relations with regulators [67], at least in the short term.

On the other hand, early adopters of ISO 14001 may have a sincere interest in polishing their environmental records. Firms choosing to certify to ISO 14001 had greater experience with management systems and moderately greater proficiencies in energy reductions. Because these proficiencies assist firms in achieving higher levels of environmental management [41], [2], [29], early adopters may have a greater capacity to improve their environmental performance. For these reasons, we have cause to be optimistic about early adopters' intentions to certify to ISO 14001.

In sum, this study takes an initial step at evaluating institutional theory and RBV together. It provides evidence that considering one view without the other provides only half a picture of why firms certify their EMSs. Indeed, we would have cause for concern that firms were either subverting their environmental obligations or assurance that early adopters possessed the internal capabilities to achieve superior environmental performance. Instead, both factors together may prove a more realistic explanation of whether firms are able to realize greater environmental performance over time.

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Table 1: Correlation Matrix[18]

	ISO 14001	AEA Viol.	CAA Viol.	RCRA Viol.	TSCA Viol.	CWA Viol.	MSHA Viol.	Prod Waste	AEA Fine	CAA Fine	RCRA Fine	TSCA Fine	CWA Fine	MSHA Fine	Mother Jo	ISO9002	ISO9001	OSHA VPP
ISO 14001	1.000																	
AEA Violation	0.016	1.000																
CAA Violation	0.0712*	0.013	1.000															
RCRA Violation	0.0435*	0.0330*	0.1917*	1.000														
TSCA Violation	0.016	0.2229*	0.1072*	0.2148*	1.000													
CWA Violation	0.016	0.011	0.1460*	0.2043*	0.1105*	1.000												
MSHA Violation	0.014	0.006	0.1462*	0.0833*	0.0531*	0.0937*	1.000											
Production Waste	0.1655*	0.0622*	0.1661*	0.1338*	0.0443*	0.1013*	0.0438*	1.000										
AEA Fines	0.015	0.8534*	0.016	0.0368*	0.1079*	0.012	0.003	0.0690*	1.000									
CAA Fines	0.0702*	0.0249*	0.5411*	0.2689*	0.1325*	0.1920*	0.1606*	0.2571*	0.0347*	1.000								
RCRA Fines	0.0413*	0.020	0.1992*	0.7769*	0.1619*	0.1702*	0.0976*	0.1722*	0.0238*	0.2917*	1.000							
TSCA Fines	0.016	0.0953*	0.1507*	0.2339*	0.6853*	0.1634*	0.0910*	0.0628*	0.0906*	0.1826*	0.1969*	1.000						
CWA Fines	0.012	0.018	0.1576*	0.2233*	0.1179*	0.8734*	0.1016*	0.1062*	0.020	0.2082*	0.1916*	0.1639*	1.000					
MSHA Fines	0.018	0.016	0.2500*	0.1768*	0.0925*	0.1712*	0.5692*	0.1047*	0.0273*	0.2445*	0.1806*	0.1434*	0.1762*	1.000				
Mother Jones	0.1056*	0.007	0.1958*	0.1699*	0.1364*	0.1399*	0.1486*	0.1184*	0.007	0.1970*	0.1669*	0.1368*	0.1394*	0.1494*	1.000			
ISO9002 Cert.	0.2427*	0.0456*	0.1536*	0.1132*	0.0525*	0.0676*	0.0937*	0.4677*	0.0461*	0.1548*	0.1138*	0.0540*	0.0679*	0.0962*	0.0672*	1.000		
ISO9001 Cert.	0.2273*	0.0455*	0.1139*	0.0965*	0.0270*	0.0301*	0.0223*	0.4266*	0.0460*	0.1160*	0.0960*	0.0280*	0.0309*	0.0247*	0.020	0.5873*	1.000	
OSHA VPP	0.1496*	0.0273*	0.2074*	0.1712*	0.1172*	0.1252*	0.1184*	0.2347*	0.0268*	0.2051*	0.1664*	0.1186*	0.1264*	0.1230*	0.0771*	0.2136*	0.1676*	1.000
GL Partner	0.1742*	0.016	0.1292*	0.0939*	0.0648*	0.0595*	0.0716*	0.2445*	0.014	0.1288*	0.0914*	0.0664*	0.0594*	0.0745*	0.1132*	0.2762*	0.2345*	0.1952*
GL Ally	0.0445*	0.1555*	0.0787*	0.013	0.0449*	0.020	0.0363*	0.0241*	0.1591*	0.0749*	0.011	0.0455*	0.020	0.0364*	0.0276*	0.006	0.013	0.0338*
Capital Expend.	0.1448*	0.0875*	0.1591*	0.1385*	0.1011*	0.0983*	0.0752*	0.1576*	0.0983*	0.2249*	0.1645*	0.1325*	0.1076*	0.1281*	0.1818*	0.2104*	0.1307*	0.2362*
CAA Viol*Capit.	0.0738*	0.013	0.9600*	0.1826*	0.1083*	0.1512*	0.1386*	0.1516*	0.017	0.4733*	0.1870*	0.1534*	0.1598*	0.2526*	0.1872*	0.1536*	0.1140*	0.2125*
CAA Fine*Capital.	0.0458*	0.0407*	0.3749*	0.1396*	0.0565*	0.1154*	0.0877*	0.0917*	0.0371*	0.6503*	0.1403*	0.0818*	0.1169*	0.1299*	0.0476*	0.0344*	0.013	0.0359*
Asset Age	0.010	0.0501*	0.1248*	0.0804*	0.0498*	0.0936*	0.1115*	0.0954*	0.0620*	0.1685*	0.1076*	0.0878*	0.1009*	0.1870*	0.0867*	0.0628*	0.021	0.1075*
SIC 10-19	0.0232*	0.0441*	0.0276*	0.0525*	0.0334*	0.0318*	0.1349*	0.1727*	0.0443*	0.0295*	0.0526*	0.0336*	0.0318*	0.1356*	0.020	0.1053*	0.0978*	0.007
SIC 20-22	0.0380*	0.0368*	0.008	0.0648*	0.0384*	0.007	0.0638*	0.0546*	0.0370*	0.008	0.0646*	0.0388*	0.007	0.0635*	0.0285*	0.0735*	0.1044*	0.005
SIC 23-27	0.016	0.0393*	0.006	0.0337*	0.0222*	0.0238*	0.0538*	0.004	0.0396*	0.005	0.0338*	0.0226*	0.0247*	0.0546*	0.003	0.0298*	0.0437*	0.010
SIC 28-29	0.019	0.0428*	0.1516*	0.1265*	0.0832*	0.0903*	0.0628*	0.1988*	0.0432*	0.1529*	0.1304*	0.0846*	0.0901*	0.0626*	0.0724*	0.0712*	0.003	0.1012*
SIC 30-33	0.018	0.0376*	0.0588*	0.0468*	0.0380*	0.0329*	0.1391*	0.1459*	0.0378*	0.0574*	0.0481*	0.0382*	0.0328*	0.1378*	0.020	0.0695*	0.0447*	0.0220*
SIC 34	0.011	0.017	0.0331*	0.011	0.0271*	0.0241*	0.0459*	0.0799*	0.018	0.0306*	0.010	0.0269*	0.0242*	0.0461*	0.0325*	0.0521*	0.0714*	0.016
SIC 35	0.0336*	0.0395*	0.0811*	0.0272*	0.0337*	0.0360*	0.0498*	0.012	0.0396*	0.0788*	0.0274*	0.0335*	0.0360*	0.0500*	0.0493*	0.1108*	0.1518*	0.019
SIC 36	0.0440*	0.020	0.0836*	0.0334*	0.0294*	0.0332*	0.0749*	0.0232*	0.020	0.0845*	0.0332*	0.0294*	0.0331*	0.0754*	0.021	0.1024*	0.1537*	0.015
SIC 37	0.1206*	0.019	0.0923*	0.1329*	0.0512*	0.018	0.009	0.1397*	0.019	0.0959*	0.1290*	0.0505*	0.018	0.009	0.005	0.0656*	0.0925*	0.0630*
SIC 28-29	0.004	0.0348*	0.0726*	0.0360*	0.0235*	0.0400*	0.0621*	0.018	0.0349*	0.0721*	0.0359*	0.0235*	0.0401*	0.0620*	0.004	0.0257*	0.0851*	0.0451*
SIC 40-48	0.0299*	0.0386*	0.0489*	0.005	0.0266*	0.014	0.0572*	0.1768*	0.0388*	0.0488*	0.005	0.0266*	0.014	0.0575*	0.005	0.0521*	0.1035*	0.0533*
SIC 49	0.0333*	0.2993*	0.000	0.0558*	0.0370*	0.018	0.0222*	0.2368*	0.3014*	0.002	0.0580*	0.0363*	0.018	0.0243*	0.009	0.1861*	0.1804*	0.0526*

	GL Part	GL Ally	Cap Exp	CAAV*Cap	CAAF*Cap	AssetAge	sic1019	sic2022	sic2327	sic2829	sic3033	sic3400	sic3500	sic3600	sic3700	sic3839	sic4048	sic4900
GL Partner	1.000																	
GL Ally	0.0952*	1.000																
Capital Expend.	0.2478*	0.1391*	1.000															
CAA Viol*Capit.	0.1307*	0.0810*	0.1904*	1.000														
CAA Fine*Capital.	0.0749*	0.0371*	0.5194*	0.3515*	1.000													
Asset Age	0.0255*	0.1130*	0.1547*	0.1236*	0.0287*	1.000												
SIC 10-19	0.0816*	0.0700*	0.0419*	0.0285*	0.016	0.0996*	1.000											
SIC 20-22	0.0520*	0.0598*	0.0597*	0.007	0.0453*	0.021	0.0844*	1.000										
SIC 23-27	0.0338*	0.0497*	0.0660*	0.007	0.0541*	0.0373*	0.1146*	0.0977*	1.000									
SIC 28-29	0.0543*	0.0856*	0.0409*	0.1519*	0.1159*	0.0309*	0.1208*	0.1031*	0.1399*	1.000								
SIC 30-33	0.004	0.0400*	0.0655*	0.0579*	0.0971*	0.0616*	0.0918*	0.0783*	0.1064*	0.1122*	1.000							
SIC 34	0.007	0.0446*	0.0961*	0.0339*	0.0406*	0.004	0.0630*	0.0537*	0.0730*	0.0769*	0.0585*	1.000						
SIC 35	0.0846*	0.0332*	0.0389*	0.0804*	0.0437*	0.1373*	0.0954*	0.0814*	0.1105*	0.1165*	0.0886*	0.0608*	1.000					
SIC 36	0.006	0.0505*	0.1303*	0.0829*	0.0372*	0.0974*	0.1006*	0.0858*	0.1165*	0.1229*	0.0934*	0.0641*	0.0971*	1.000				
SIC 37	0.0760*	0.0321*	0.0455*	0.0943*	0.0512*	0.0330*	0.0711*	0.0606*	0.0823*	0.0868*	0.0660*	0.0453*	0.0685*	0.0723*	1.000			
SIC 28-29	0.016	0.0360*	0.1212*	0.0721*	0.0340*	0.1571*	0.0805*	0.0686*	0.0932*	0.0983*	0.0747*	0.0512*	0.0776*	0.0819*	0.0578*	1.000		
SIC 40-48	0.003	0.0577*	0.2061*	0.0452*	0.2000*	0.0518*	0.0814*	0.0695*	0.0943*	0.0995*	0.0756*	0.0519*	0.0786*	0.0829*	0.0585*	0.0663*	1.000	
SIC 49	0.0435*	0.3660*	0.1742*	0.004	0.1566*	0.1776*	0.1216*	0.1037*	0.1408*	0.1485*	0.1129*	0.0774*	0.1173*	0.1237*	0.0873*	0.0989*	0.1001*	1.000

* $p \leq 0.05$

[18] Environmental violations and fines were estimated separately with the same covariates.

Table 2: Descriptive Statistics

Variable Name	Sample		ISO 14001 Adopters (Obs=1056, 88 Firms)			Non ISO 14001 Adopters (Obs=7344, 612 Firms)		
	Total Obs.	Total Firms	Mean	S.D.	Max*	Mean	S.D.	Max*
INSTITUTIONAL PRESSURE								
Annual Violations								
AEA	306	47	0.0728	0.4398	7	0.0312	0.2603	5
CAA	3836	341	0.6454	1.7962	19	0.4295	2.1239	48
RCRA	1468	291	0.4237	0.994	12	0.1389	0.5971	11
TSCA	556	199	0.1671	0.9066	26	0.0517	0.2886	10
CWA	363	142	0.0823	0.4151	8	0.0376	0.2332	4
MSHA	3226	98	0.2974	1.168	7	0.3965	2.8782	60
Annual Fines								
AEA**	306	47	5608	71364	2155000	2357	24031	780000
CAA**	3836	341	72578	860843	25000000	72578	860843	25000000
RCRA**	3226	98	53423	809742	25600000	17476	234087	9807940
TSCA**	363	142	11766	162503	4916472	5015	131248	10000000
CWA**	1468	291	5577	58905	1129710	6854	173383	13100000
MSHA**	556	199	2437	35813	1098603	3276	59366	4034600
Production-Related Toxic Emissions†,**	3789	519	36500	28700	8650000	12400	139000	1040000
Mother Jones Top Environ. Criminal List	216	18	0.1136	0.3175	1	0.0131	0.1135	1
INTERNAL CAPABILITY								
ISO 9002 Certification††	1955	358	0.482	0.4999	1	.1969	.3977	1
ISO 9001 Certification††	1721	310	0.4366	0.4962	1	.1716	.3770	1
OSHA VPP††	341	54	0.1108	0.314	1	.0105	.1720	1
EPA Green Lights Partner††	927	139	0.2537	0.4353	1	.0897	.2858	1
EPA Green Lights Ally††	397	51	0.0881	0.2835	1	.0414	.1992	1
Capital Expenditures*, **	8295	700	822.14	2693.88	38067	272.41	796.058	15502
Asset Age	8295	700	0.7723	0.1019	0.9731	.78930	.1159	1
INDUSTRY SIC								
10-19–Mining/Construction	756	63	0.0455	0.2083	1	.0964	.2951	1
20-22–Food/Tobacco/Textiles	564	47	0.0114	0.106	1	.0752	.2637	1
23-27–Fabric, Wood, Pulp, Paper	984	82	0.0909	0.2876	1	.1209	.3261	1
28-29–Chemical/Petroleum Refining	1080	90	0.0852	0.2793	1	.1356	.3424	1
30-33–Rubber/Leather/Metals	660	55	0.0455	0.2083	1	.0833	.2764	1
34–Fabricated Metal Products	324	27	0.0568	0.2316	1	.0360	.1862	1
35–Industrial Machinery/Equipment	708	59	0.1591	0.3659	1	.0735	.2610	1
36–Electronics	408	65	0.1818	0.3859	1	.0801	.2714	1
37–Transportation Equipment	780	65	0.1818	0.3859	1	.0294	.1690	1
38-39–Instrumentation, Misc Mfg	516	43	0.0681	0.2521	1	.0605	.2383	1
40-48 Transport, Communic Serv.	528	44	0.0114	0.106	1	.0113	.1060	1
49–Electric/Gas/Sanitary Services	1092	91	0.0682	0.2521	1	.1389	.3459	1

* Minimum values were all zero.

** Indicates variables that were logged during empirical estimations because of their high variances.

† Values are listed in thousands of pounds.

†† Variable coded for time such that it equaled "0" prior to the specified action variable, and "1" afterwards.

Table 3: Factors Predicting ISO 14001 Certification—Violations Model

VARIABLE	MODEL SPECIFICATION—Hazard Ratio (SE)		
	Gompertz	Weibull	Cox PH
INSTITUTIONAL PRESSURE			
Violations			
Atomic Energy Act	2.1440*** (.359)	2.1082*** (.353)	1.8754*** (.360)
Clean Air Act	1.1416 (.133)	1.1404 (.132)	1.1614 (.134)
Resource Conservat. & Recov. Act	1.2107* (.145)	1.2199* (.132)	1.1152 (.172)
Toxic Substances Control Act	1.1882 (.236)	1.1972 (.232)	1.019 (.375)
Clean Water Act	.8273 (.291)	.8244 (.298)	.7284 (.271)
Mining, Safety & Health Act	.9460 (.047)	.9460 (.046)	.9452 (.043)
Production-Related Toxic Emissions	1.0201 (.015)	1.0200 (.015)	1.0229 (.016)
Mother Jones Environ. Criminal List	7.3893*** (2.95)	7.4107*** (2.98)	6.6846*** (2.71)
INTERNAL CAPABILITY			
ISO 9002 Certification	4.0941*** (1.88)	4.0816*** (1.87)	4.2849*** (1.99)
ISO 9001 Certification	1.8727* (.670)	1.8647* (.698)	2.0353** (.747)
OSHA VPP Participant	1.1104 (.394)	1.1137 (.397)	1.1210 (.390)
EPA Green Lights Partner	1.6697** (.398)	1.6669** (.397)	1.6355** (.386)
EPA Green Lights Ally	1.2608 (.638)	1.2625 (.643)	1.3804 (.690)
Capital Expenditures	1.4505*** (.113)	1.4451*** (.112)	1.4322*** (.107)
Capital Expenditures x Clean Air Act Violations	.9563*** (.011)	.9565*** (.011)	.9566*** (.011)
Asset Age	.9076 (1.32)	.9217 (1.34)	1.5580 (2.28)
INDUSTRY SIC†			
10-19–Mining, Construction	.4485 (.317)	.4423 (.312)	.54978 (.370)
20-22–Food, Tobacco, Textile Mill	.0914** (.093)	.0915** (.093)	.10306** (.106)
23-27–Fabric, Wood Prod, Pulp/Paper	.3292*** (.139)	.3286*** (.139)	.36796** (.155)
28-29–Chem., Petroleum Refining	.1690*** (.080)	.1697*** (.080)	.1937*** (.092)
30-33–Rubber, Leather, Prim. Metals	.1642*** (.085)	.1638*** (.085)	.1837*** (.097)
34–Fabricated Metal Products	.4639 (.232)	.4618* (.230)	.5001 (.248)
35–Industrial Machinery & Equip.	.5257* (.192)	.5254* (.191)	.5536* (.197)
36–Electronics	.4846* (.193)	.4850* (.193)	.5193* (.209)
38-39–Instrumentation, Misc. Mfg.	.2373*** (.135)	.2374*** (.135)	.2833** (.154)
40-48–Transport, Communic. Services	.0538*** (.061)	.0542*** (.061)	.0722** (.081)
49–Electric, Gas, Sanitary	.3182 (.253)	.319 (.254)	.4358 (.355)
LR/Wald Chi-Square(27), 8295 obs	242.95***	242.33***	234.09***
LogLikelihood—700 firms, 88 adopters	-54.608	-54.072	-467.687

***p≤0.01; **p≤0.05; *p≤0.10 †SIC 37, transportation equipment, was the omitted dummy variable.

Table 4: Factors Predicting ISO 14001 Certification—Fines Model

VARIABLE	MODEL SPECIFICATION—Hazard Ratio (SE)					
	Gompertz		Weibull		Cox PH	
INSTITUTIONAL PRESSURE						
Violations						
Atomic Energy Act	1.0582**	(.015)	1.0576***	(.015)	1.0521***	(.017)
Clean Air Act	1.0524**	(.025)	1.0526**	(.024)	1.0563**	(.024)
Resource Conservat. & Recov. Act	1.0128	(.010)	1.0131	(.010)	1.0040	(.011)
Toxic Substances Control Act	1.0083	(.021)	1.0093	(.020)	.9993	(.002)
Clean Water Act	.9954	(.016)	.9949	(.016)	.9907	(.017)
Mining, Safety & Health Act	.9818	(.015)	.9816	(.015)	.9980	(.001)
Production-Related Toxic Emissions	1.0184	(.015)	1.0183	(.015)	1.0218	(.015)
Mother Jones Environ. Criminal List	6.2844***	(2.438)	6.3235***	(2.463)	5.9408***	(2.336)
INTERNAL CAPABILITY						
ISO 9002 Certification	4.2484***	(1.944)	4.2510***	(1.948)	4.5236***	(.048)
ISO 9001 Certification	1.7513	(.669)	1.7431	(.665)	1.9154*	(.699)
OSHA VPP Participant	.8234	(.314)	.8289	(.316)	.9818	(.033)
EPA Green Lights Partner	1.6011**	(.395)	1.6005**	(.395)	1.5464*	(.375)
EPA Green Lights Ally	1.4078	(.654)	1.4047	(.658)	1.6552	(.767)
Capital Expenditures	1.2336***	(.093)	1.2294***	(.091)	1.2418***	(.090)
Capital Expenditures x Clean Air Act Violations	.9897***	(.004)	.9897***	(.004)	.9900***	(.003)
Asset Age	1.1528	(1.632)	1.1778	(1.668)	2.3577	(3.404)
INDUSTRY SIC[†]						
10-19–Mining, Construction	.4507	(.325)	.4482	(.322)	.5401	(.383)
20-22–Food, Tobacco, Textile Mill	.0794**	(.082)	.0794**	(.082)	.0889**	(.092)
23-27–Fabric, Wood Prod, Pulp/Paper	.2670***	(.112)	.2675***	(.112)	.3040***	(.126)
28-29–Chem., Petroleum Refining	.1230***	(.063)	.1231***	(.062)	.1512***	(.075)
30-33–Rubber, Leather, Prim. Metals	.1428***	(.076)	.1423***	(.076)	.1656***	(.092)
34–Fabricated Metal Products	.4049*	(.199)	.4028*	(.198)	.4538*	(.223)
35–Industrial Machinery & Equip.	.4392**	(.164)	.4393**	(.163)	.4805**	(.175)
36–Electronics	.4099**	(.164)	.4104**	(.164)	.4566**	(.183)
38-39–Instrumentation, Misc. Mfg.	.2239***	(.120)	.2217***	(.119)	.2563***	(.137)
40-48–Transport, Communic. Services	.0397***	(.045)	.0400***	(.046)	.0554***	(.062)
49–Electric, Gas, Sanitary	.2591*	(.201)	.2586*	(.201)	.3139	(.262)
LR/Wald Chi-Square(27), 8295 obs	-59.325		-58.695		-471.831	
LogLikelihood—700 firms, 88 adopters	221.20***		219.26***		218.37***	

***p≤0.01; **p≤0.05; *p≤0.10 [†]SIC 37, transportation equipment, was the omitted dummy variable.

Figure 1: Continuum of Coercion