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Regulatory Stringency, Green Production Offsets and Organizations' Financial Performance

Abstract

While some scholars have argued that environmental regulatory pressures constrain organizations' financial opportunities, others maintain that environmental regulations can spur product and technology innovations and encourage greater operational efficiencies. Advocates on both sides have evidence in support of their positions. However, when considering both perspectives in tandem and recognizing that other factors (which are correlated with a company's environmental performance) may be associated with improved financial performance, we may find that neither position is valid or both are. Relying on OECD data for manufacturing facilities operating in Canada, France, Germany, Hungary, Japan, Norway, and the United States, this study shows that more stringent environmental policy regimes are related to diminished firm profits. Yet, organizations that are motivated by a green production focus (i.e., enhancing internal efficiencies and new product and technology development) are more likely to improve their environmental performance. They also demonstrate a greater probability of benefiting financially, thereby offsetting the cost of regulation or accruing a net gain.

Key Words: environmental regulation, environmental performance, financial performance, environmental efficiency, regulatory stringency, innovation

INTRODUCTION

Organizations spend millions of dollars annually complying with environmental regulations (Portney & Stavins, 2000). For this reason, some scholars argue that regulations are detrimental to an organization's economic performance insofar as they constrain financial opportunities (Christiansen & Haveman, 1981; Conrad & Morrison, 1989; Lave, 1973). In spite of these documented positions, other researchers suggest that regulations can spur organizations to develop innovative practices that reduce their environmental impacts and enhance operational efficiencies (Porter & van der Linde, 1995). Companies that improve their environmental performance also may expand their market prospects, thereby creating opportunities for competitive advantage (Hart & Ahuja, 1996; Khanna & Damon, 1999; Russo & Fouts, 1997; Rivera, 2002). Since the mid-1990s, significant evidence has accrued in support of the idea that "green" production can benefit corporate profitability (e.g. Stanwick & Stanwick, 2000; Russo & Fouts, 1997; Hart & Ahuja, 1996). However, there are three limitations to these previous studies. First, estimating the benefits of environmental improvements, in the absence of controlling for the potential cost of regulation, does not give a full accounting of whether an organization's environmental and financial performance are related. Second, we know little about whether companies that improve their environmental performance do so because they utilize different management practices overall. As such, superior financial outcomes may be attributed mistakenly to improved environmental performance when they are associated more with a company's general management approach and culture. Third, prior research has not considered whether the environmental-financial performance link exists across multiple countries. This issue is particularly important since many more companies now operate globally and adhere to

multiple regulatory settings. When all these factors are considered together we may discover that environmental performance has little relationship with a company's bottom line.

Understanding the potential link between regulatory stringency, green production offsets, and organizations' financial performance is important to public policy. The primary reason why the United States (US) and many other countries do not have national climate change policy and do not advance more robust environmental legislation is due to costs imposed on firms. As such, realizing that these costs can be offset – or eliminated entirely – for companies that undertake proactive environmental practices would provide policy makers with critical information to advance more ambitious environmental goals. Knowledge of this relationship may also be used to encourage additional companies to voluntarily reduce their environmental impacts beyond that required by law, which can improve societal welfare with fewer government resources. Moreover, to the extent that more companies begin to reduce their pollution beyond that required by law, regulators can allocate their scarce resources towards monitoring companies that pose the greatest potential environmental harms. This issue is particularly important in the US since Congress has continually under-funded regulatory inspections and audits, such that the environmental inspection rate is less than 2 percent annually (Davies & Mazurek, 1998).

Finally, understanding the relationship between regulatory stringency, green production offsets, and organizations' financial performance can create more support for private sector partnerships with government managers. For instance, environmental ministries worldwide have been promoting company participation in voluntary environmental programs (VEP). Within the US alone, more than 13,000 companies are participating in government-sponsored VEPs (Mazurek, 2002). VEPs provide participating organizations with incentives to improve their environmental performance beyond regulatory requirements (Darnall & Carmin, 2005).

However, recent concerns have been introduced about the efficacy of these programs (Koehler, 2007; US Office of Inspector General, 2007). At issue is that many VEPs suffer from weak monitoring and sanctioning mechanisms that ensure against free-riding behavior. In the presence of free-riding, participants receive program benefits (including public recognition, access to regulators, information sharing, and, in some instances, consolidated and expedited permitting), while failing to improve the environment in a meaningful way. Weak VEP design structures have been attributed to policy makers' desire to balance developing programs having rigorous mechanisms for monitoring and sanctions with the goal of creating a flexible means for a larger number of participants to move beyond the parameters established by the traditional regulatory system (Darnall & Sides, 2008). However, by providing a stronger business justification that encourages firms to participate in these programs, regulators may be able to enhance VEP rigor, encourage more widespread participation, and improve the natural environment to a greater degree.

This study addresses these issues by evaluating the benefits associated with undertaking proactive environmental strategies and assessing the costs associated with the stringency of the traditional regulatory system. It accounts for the potentially endogenous relationship between environmental and financial performance using data for organizations operating in seven countries. By taking this approach, the research offers a more complete view of whether the regulatory system constrains companies' financial opportunities and whether environmental improvements benefit companies financially.

RELATIONSHIP BETWEEN ENVIRONMENTAL & FINANCIAL PERFORMANCE

Neoclassical economic theory suggests that organizations operate with efficiency driven goals. Possessing perfect information, managers allocate their resources internally so that

efficiency in the production process is maximized. This position suggests that compliance with environmental regulations imposes costs on organizations and these costs reduce firms' overall competitiveness (Christiansen & Haveman, 1981; Conrad & Morrison, 1989; Lave, 1973). If we are to believe this traditional view, there is little incentive for firms to adopt proactive environmental strategies. However, corporate innovation has changed significantly in recent years and its pace is increasing. Innovation spans virtually all organizational boundaries, is increasingly global, and involves stakeholders rarely considered in the past. These changes create significant opportunities for companies that improve their environmental performance beyond that required by law. Firms that innovate by reevaluating their internal processes (that otherwise are overlooked) and increasing efficiencies (by reducing unnecessary materials purchases, increasing productivity, and reducing waste in the production cycle) stand to benefit significantly from lower production costs (Porter & van der Linde, 1995). Additionally, corporate innovation can lead to new product and technology development opportunities. Each of these factors can enhance an organization's social legitimacy, which facilitates their long term survival and competitiveness (Hoffman, 1997).

Scholars advancing this "revisionist view" suggest that firms do not always pursue profit maximizing opportunities because of information asymmetries in the marketplace, which affect managers' abilities to make optimal production decisions (Scott, 2001). Related to the natural environment, organizations do not consistently maximize their profits because of at least three factors: a poor understanding of the organization's environmental costs (Ashford, 1993), weak internal coordination to remedy existing inefficiencies, and significant inertia that prevents organizational action that would allow for the exploration of innovative ideas to traditional problems (Cordano & Frieze, 2000).

In general, managers within all ranks of the organization have a poor understanding of environmental costs. This lack of understanding is due to the fact that environmental costs generally are bundled into administrative costs (overhead) rather than being associated with specific internal processes and products (Ashford, 1993). At the same time, many proactive environmental strategies require cross-functional coordination among organizational departments and work in multi-collaborative teams (Hart, 1995) involving engineers, production managers, purchasing officer, and other employees (Cordano & Frieze, 2000). However, many organizations suffer from limited cross-functional cooperation (Dieleman & de Hoo, 1993). As such, information learned by one organizational department often is not shared with others, thereby creating asymmetries that impede optimal production decisions. The result is that organizations fail to explore innovative environmental solutions that might otherwise improve their profitability (Dieleman & de Hoo, 1993).

Additional factors that impede managers from being environmentally proactive relate to the significant organizational inertia that discourages technological and product innovations (Cordano & Frieze, 2000) and which may improve firm profitability. There are enormous disincentives for organizations to develop innovative environmental technologies because they can disrupt current production systems which otherwise are at least marginally profitable (Sharma, 2000). Coupled with the notion that managers seek to minimize losses rather than maximize gains (Kahneman & Tversky, 1979), undertaking potentially disruptive operational changes that have uncertain payoffs discourage many top-level managers from taking action. Moreover, many executive managers lack information regarding the efficiency gains that can accrue from implementing environmentally proactive practices and mistakenly believe preventing waste is expensive (Dieleman & de Hoo, 1993). As such, environmental managers

often lack executive support to implement significant environmental change (Cordano & Frieze, 2000). As a consequence, unless faced with low risk decisions, companies generally forego opportunities to develop viable new products or technological innovations that may improve the environment and create competitive advantages (Dieleman & de Hoo, 1993). Combined, these factors pose a substantial impediment to companies improving their internal efficiencies and developing product and technological innovations related to the natural environment.

These arguments point to the unrealized financial benefits that may exist for organizations that voluntarily reduce their environmental impacts. For instance, by 2005 3M's pollution prevention program had eliminated more than 2.6 billion pounds of pollution by increasing process efficiencies, reducing material costs (from switching to environmentally friendly inputs), decreasing energy use, and reducing waste in the production cycle. In the first year alone, 3M estimates that it saved \$1 billion from its pollution prevention efforts.

Organizations that demonstrate a strong environmental commitment by producing green products also may derive market benefits (Khanna & Damon, 1999) since these products are becoming increasingly more popular in society. In characterizing the US landscape, 15 percent of consumers routinely pay more for green products, and another 15 percent seek green products if they do not cost more (Ginsberg & Bloom, 2004). This change in market demand is affecting product and service markets (D'Souza, 2004), where consumers are willing to pay price premiums of \$30 per night for hotel services that demonstrate their superior environmental performance (Rivera, 2002), spend 20 – 50 percent more for organically produced food products, (Barkley, 2002), and pay \$3,000 - \$8,000 more for hybrid cars over comparable non-hybrid models (Walters, 2005). Changing market demand also has affected intermediary markets where North American companies report that corporate buyers (especially those in Europe) are offering

preferential purchasing if they demonstrate minimal harm to the natural environment. Combined, these examples support the revisionist view that companies which reduce their environmental impacts may reap financial benefits that offset (partially or entirely) the cost of complying with environmental regulation.

Hypothesis 1: Organizations that voluntarily reduce their environmental impacts are more likely to benefit financially.

The traditional view is that environmental regulation is detrimental to an organization's economic performance because it constrains financial opportunities (Conrad & Morrison, 1989; Christiansen & Haveman, 1981; Lave, 1973). In such instances, firms are forced to internalize external costs they otherwise would impose on society. More stringent environmental regulations have a greater influence on organizations because they reduce a company's organizational flexibility in dealing with environmental concerns and generally require significant capital investments (Portney & Stavins, 2000). Consequently, strict pollution control regulations may have an adverse effect on productivity in that they force companies to commit resources and manpower towards nonproductive environmental activities (Jaffe, et al., 1995; Palmer, Oates & Portney, 1995) such as environmental auditing, waste treatment, and litigation (Haveman & Christiansen, 1981). For this reason we hypothesize:

Hypothesis 2: Organizations that are governed by more stringent environmental policies are less likely to accrue financial benefits.

ENVIRONMENTAL IMPACT REDUCTIONS AND MANAGEMENT APPROACH

Before exploring the relationship between a facility's environmental and financial performance, it is necessary to consider whether organizations that improve their environmental performance do so because of factors that are correlated with environmental performance and the

financial strength of the organization. If these correlations exist, they must be addressed empirically.

Regulatory Stringency

While we hypothesize that a direct relationship exists between regulatory stringency and firms' financial performance, an indirect relationship is also anticipated in that a firm's decision to reduce its environmental impacts is likely influenced by the stringency of the regulatory system. The arguments for a positive relation between regulatory stringency and environmental performance are well known. Pressures from the environmental regulatory system are the most frequently cited drivers for environmental conformity (Hoffman, 1997). These pressures include requirements to obtain operating permits, to adopt specific pollution control technology, to monitor and report on its environmental activities, to allow regulators to audit their environmental activities, and to address non-compliances and violations. Failing to yield to these pressures may lead to environmental penalties and fines, loss of operating permits, and criminal penalties levied against corporate managers. These factors may encourage organizations to reduce their environmental impacts.

Resources and Capabilities

When organizations undertake new strategic directions, they generally rely on existing internal resources and capabilities as the foundation for such action. Organizational resources are production process inputs, and consist of physical, human, and organizational capital (Barney, 1991). Resources are the source of an organization's internal capabilities in that they form the basis for companies to develop capacities to perform some task or activity and to coordinate diverse production skills (Barney, 1991). When an organization's existing internal resources and capabilities facilitate the adoption of a proactive environmental strategy, or offer a means to

expand upon an existing proactive environmental strategy, they are said to be complementary to its proactive environmental management (Darnall & Edwards, 2006). In the presence of complementary resources and capabilities, organizations can undertake new management strategies to reduce their environmental impacts, and do so at a lower cost (Darnall & Edwards, 2006). The sections below discuss how budgets for environmental research and development, designated environmental managers and the presence of quality management systems are complementary to undertaking management strategies that reduce an organization's environmental impacts.

Budget for Environmental Research and Development. By allocating budgetary resources toward environmental research and development, organizations demonstrate a managerial commitment for environmental innovation. They also exhibit an organizational culture for proactively managing their environmental impacts and a capacity to follow through in addressing their environmental concerns (Nakamura, Takahashi & Vertinsky, 2001; Porter & van der Linde, 1995). Each of these factors may lead to greater operational commitments to reduce the organization's environmental impacts. Outside of improving the environment, organizations that invest in environmental innovation generate knowledge-based capital and tacit skills that are difficult for competitors to replicate (Ghemawat, 1986) which is why they may be indirectly related to an organization's financial performance.

Designated Environmental Manager. Organizations that have internally committed resources towards having a staff member address their environmental impacts demonstrate their top level managerial support to address environmental concerns (Tilley, 1999) and are more likely to have a proactive environmental strategy. By designating an environmental manager, these organizations also are more likely to establish that the environment is a central

management issue (Netherwood, 1998) and seek knowledge that increases their operational efficiencies related to environmental issues. Since a portion of the environmental manager's compensation generally depends on his or her ability to reduce the organization's environmental impacts (Slveig, Myrtveit & Trapani, 1999), environmental improvements are more likely to occur. For these reasons organizations that invest in a designated environmental manager may be more likely to reduce their environmental harms.

Quality Management Systems. Prior literature suggests that quality management system capabilities may complement an organization's environmental activities. Organizations that have quality management system capabilities endorse organization-wide management commitments to continually improve their process and product quality and prevent defects (Corbett, Montes-Sancho & Kirsch, 2005). These enterprises employ procedures that ensure quality is measured constantly and appropriate corrective action is taken whenever defects occur (Corbett, Montes-Sancho & Kirsch, 2005). Quality management systems also require extensive employee empowerment, team based approaches to goal attainment, systematic problem-solving, open communication and feedback, cross-functional integration, and continuous improvement (Darnall & Edwards, 2006). By implementing quality management systems, organizations develop knowledge and a capacity to monitor their inputs, production constraints and processes. Because of their cross-functional nature, quality management systems also help reduce information asymmetries across organizational units. These capabilities facilitate proactive environmental management, which is why organizations that adopt quality management systems can implement strategies to reduce their environmental impacts with fewer resources (Darnall & Edwards, 2006).

Green Production Focus

Like organizations that have strong resources and capabilities, companies that perceive their environmental practices as opportunities towards improving internal efficiency and developing new environmentally friendly products and technologies may be more likely to improve their environmental performance. This notion is based on the idea that organizations having a green production focus are more likely to recognize the potential cost savings related to minimizing waste in their production cycle and the importance of developing a green reputation. From a profit-maximizing viewpoint, rational firms possessing sufficient information (regarding costs, substitute products, and other factors) examine the gross benefits and costs of an environmental strategy and undertake it if the strategy offers the best net positive benefits compared to other alternatives (Henriques & Sadosky, 1996). This strategic approach is based on the idea that firms are driven to increase their operational efficiencies and seek competitive advantage by way of product distinction. This drive is the cause for its organizational action and subsequent profits (Alchian & Demsetz, 1972). As a consequence, organizations that believe improving their environmental performance may increase their internal efficiencies are more likely to take action to reduce their environmental impacts. They also are more likely to view the potential risk associated with developing environmentally friendly products and technologies as a strategic opportunity rather than a disruption to current operations.

Parent Company Pressures

Facility-level strategic actions often are the result of decisions made at the firm level (Oliver, 1991). While environmental improvements may occur at the facility-level, the parent company may play a fundamental role in the reasons why these improvements occur. For instance, parent companies may mandate that their operational units improve their environmental performance (Darnall, 2006). However, even in the absence of a corporate mandate, parent companies

generally influence facility-level environmental activities simply by promoting a corporate culture that encourages facility-level innovation related to the natural environment (Darnall, 2006). For these reasons, organizations that endure stronger pressures from their corporate headquarters regarding their environmental practices may be more likely to improve their environmental performance. Additionally, undertaking changes in environmental management may require fewer investments since resources often are shared among facilities, creating greater economies of scale (Bowen, 2002). Resource sharing is especially important within the environmental setting since complex environmental initiatives often are implemented in multi-plant organizations and their success depends on the incentives and the resources provided by their parent enterprise (Bowen, 2002). Parent company influences therefore are likely to be directly related to environmental performance and indirectly related to financial performance.

All of these factors—regulatory stringency, resources and capabilities (budget for environmental research and development, designated environmental manager, quality management systems), green production focus, parent company pressures—therefore may be associated with organizational actions to improve the environment.

RESEARCH METHODS

Data

To evaluate our hypotheses, we relied on data collected from a twelve-page survey developed by the Organisation for Economic Co-Operation and Development (OECD) Environment Directorate and academic researchers from Canada, France, Germany, Hungary, Japan, Norway and the US. The OECD survey was pre-tested in France, Canada and Japan before it was translated into each country's official language and back-translated to validate the accuracy of the original translation. In 2003, surveys were sent to individuals who worked in manufacturing

facilities having at least 50 employees and who were responsible for the facility's environmental activities. The OECD sent two follow-up mailings to prompt additional responses and 4,188 facility managers completed the survey. The response rate was 24.7 percent, which is similar to previous studies of organizations' environmental practices (e.g., Christmann, 2000; Delmas & Keller, 2005; Melnyk, Sroufe & Calantone, 2003), where response rates were 20.1 percent, 11.2 and 10.35 percent, respectively. Almost half of the sample consisted of either small- or medium-sized enterprises (<250 employees), and included publicly traded and privately owned facilities. Because the survey data were cross-sectional in nature, this study evaluates whether associations exist among the variables of interest rather than the existence of causal relationships.

Previous empirical research evaluating environmental performance generally has relied on the US Environmental Protection Agency's (EPA) Toxic Release Inventory (TRI), because these data are widely available. However, international comparisons of facility-level environmental performance using these data are not possible because TRI data are not collected in all countries. Rather, environmental ministries use different metrics and indicators to assess environmental performance, which makes a cross-country evaluation problematic. Similarly, prior studies that evaluate the relationship between environmental and business performance have relied on stock performance, pricing, sales, intangible assets, return on sales, equity, investment, and assets. However, these data are available only for publicly traded firms and therefore a study of both publicly traded and privately owned enterprises would not be possible. By focusing on a broader population of organizations, this study sacrifices greater specificity in its analysis. Such a sacrifice, however, also strengthens the work because the results have broader applicability.

To check for common method variance, we relied on the post-hoc Harman's single-factor test (Podsakoff & Organ, 1986). The basic assumption of this test is that if a substantial amount of common method variance is present, a factor analysis of all the data will result in a single factor accounting for the majority of the covariance in the independent and dependent variables. The results of Harman's single-factor test revealed that no single factor accounted for the majority of the variance in the variables, offering evidence that this type of bias was not a concern. Social desirability bias was addressed by ensuring anonymity for all respondents. Additionally, survey questions related to regulatory and management influences were separated from questions pertaining to environmental performance and these questions were separated from questions pertaining to financial performance. In instances where a social desirability bias exists, researchers are less likely to find statistically significant relationships because there is less variability in respondents' survey answers. However, by finding statistically significant relationships, additional evidence would be offered about the strength of the relationship between the variables of interest (Hardin & Hilbe, 2001). The OECD examined non-response bias by evaluating the general distribution of its survey respondents. It assessed the industry representation and facility size of the survey sample relative to the distribution of facilities in the broader population, and found no statistically significant differences (Johnstone, et al., 2007). Issues related to generalizability were less of a concern because the OECD survey had broad applicability in that it targeted large and small operations across multiple industry sectors and countries.

Assessing the Factors Associated with Financial Performance

Dependent Variable

A facility's financial performance was measured by using OECD survey data that asked managers whether their profits had changed over the past three years. Respondents replied using a five-point scale indicating whether during the last three years revenue was "so low as to produce large losses," "insufficient to cover our costs," "at break even," "sufficient to make a small profit," or "well in excess of costs." To concentrate the analysis on whether or not profits were *positive*, we combined the first three categories and the last two such that positive profits=1, otherwise positive profits=0.¹ We also estimated our models using the five-point scale, and found the results were statistically equivalent. However, because the focus of our analysis was on whether organizations' *positive* profits were associated with reductions in environmental impacts, each model relies on the dichotomous scale.

Explanatory Variables

Environmental Performance. To measure whether or not facilities had reduced their environmental impacts, we relied on OECD survey data that asked managers if their facility had experienced a change in their environmental impacts per unit of output in the last three years. Facility managers reported environmental changes for five impacts: use of natural resources (energy, water, etc.), solid waste generation, wastewater effluent, local or regional (neighboring countries) air pollution, and global pollutants (greenhouse gases). Managers indicated whether their impacts had "decreased significantly," "decreased," incurred "no change," "increased," or "increased significantly" per unit of output. To concentrate our analysis on whether or not pollution had decreased per unit of output, we combined the first two categories and the last

¹ To further assess the stability of the dependent variable, we also estimated our models by including the "break even" value in the "positive profits" score. Across all six models there was no difference in the significance of our primary variables of interest (described in Hypothesis 1 and 2—regulatory stringency and environmental performance and their relationship with firm profitability). Among the variables in the first portion of model estimation (Table 3), the reconfiguration of our dependent variable gained nominal significance in the relationship between facilities' presence of an environmental R&D budget and their air pollution reductions and global pollution reductions. All other relationships among our variables of interest were equivalent. These findings offer evidence of the stability of our dependent variable in estimating the relationships of interest.

three where 1=significant decrease or decrease and 0=no change, increase or significant increase. In addition to estimating the relationship between our dependent variable and reductions in the individual pollutants, we also estimated our models by creating an index of all five environmental performance measures. After meeting Nunnally's (1978) reliability criteria (Cronbach's alpha=.73), the five environmental performance measures were combined using factor analysis with orthogonal varimax rotation. The factor analysis yielded one factor representing facilities' overall environmental performance. The environmental performance index and the five individual environmental performance measures were estimated separately in six empirical models.

Regulatory Stringency. Because companies are subject to regulatory frameworks of varying stringency, we used OECD survey data that asked facilities to describe the environmental policy regime to which they were subject. Respondents indicated whether the environmental policy regime was “not particularly stringent in that obligations can be met with relative ease,” “moderately stringent in that it requires some managerial and technological responses,” or “very stringent in that it has a great deal of influence on decision-making within the facility.” Responses were coded 1, 2 and 3, respectively. To address the potential concern that this variable might be based on managerial perception rather than actual regulatory stringency, we compared the responses of facilities in more polluting industrial sectors to those operating in cleaner industrial sectors. Polluting industries are more heavily regulated and therefore subject to a more stringent environmental policy regime, whereas less polluting industries are not regulated to the same extent and subject to a less stringent environmental policy regime. Relying on existing taxonomies of US manufacturing sectors (Mani & Wheeler, 1997; Gallagher & Ackerman, 2000), “polluting” industries were classified as pulp and paper,

chemical, petroleum refining, primary metal and basic metal industries. “Clean” sectors consisted of fabricated metal products, industrial machinery, electronics, transportation equipment, instrumentation, and textile sectors. We performed a chi-square test, comparing sector groupings with the reported stringency of their environmental policy regime. The results showed that dirty sectors reported that the stringency of their environmental policy regime was greater than facilities operating in clean sectors ($p < .0001$), therefore adding confidence to the accuracy of our measure.

Control Variables

Since the OECD data were for a diverse set of facilities operating within multiple industrial sectors and countries, it was important to control for potential heterogeneities that may relate to a company’s ability to improve its financial performance. To assess the market concentration in which the facility operated, we accounted for whether the facility had less than five competitors, whether it had between five to ten competitors, or whether it had greater than ten competitors. Responses were coded 1, 2 and 3 respectively. Market scope was measured by incorporating OECD survey data that asked respondents whether the facility’s market was primarily at a local, national, regional, or global level. Responses were coded 1, 2, 3 and 4 respectively.

Because organization size is related to its visibility in the community and its associated external pressures (Bowen, 2002), we included a variable to account for the number of employees within the facility (logged). We measured the facility’s primary customer by relying on OECD data that asked whether the facility’s customer was at the beginning, middle or end of the supply chain. We also included data for whether or not the facility was accountable to shareholders and whether or not the company’s head office was located in a foreign company. Finally, dummy variables were used for facilities’ manufacturing sector and country of

operation. The chemical sector was the omitted sector dummy and the US was the omitted country dummy variable.

Assessing the Factors Associated with Reductions in Environmental Impacts

To address the potential endogenous relationship between environmental and financial performance, we accounted for the factors that might encourage facilities' environmental impact reductions. We used OECD survey data that asked whether the facility had experienced a change in its environmental impacts per unit of output in the last three years. Facility managers reported environmental changes for five impacts (use of natural resources, solid waste generation, wastewater effluent, local or regional air pollution, and global pollutants), and an index was created accounting for all five variables. We utilized the same form of these six environmental performance measures that was described earlier in our discussion related to *Assessing the Factors Associated with Financial Performance*.

Explanatory Variables

Regulatory Stringency. In estimating how regulatory stringency was related to facilities' reductions in their environmental impacts, we relied on the same OECD variable discussed earlier that asked environmental managers to describe the environmental policy regime to which they were subject (see *Assessing the Factors Associated with Financial Performance*). Including this variable in both portions of our estimations permitted a more sophisticated empirical approach that accounted for both the direct and the indirect relationship (Lee, 1978) between regulatory stringency and facilities' financial performance. By summing the two effects, we can arrive at a total effect (Greene, 2003) of the stringency of the environmental regulatory system as it relates to firm profitability.

Resources and Capabilities. Investments in environmental innovations were determined by using OECD data that asked facilities whether or not they had a research and development budget allocated towards environmental matters (Nakamura, Takahashi & Vertinsky, 2001; Porter & van der Linde, 1995). Since companies that employ an environmental manager have a greater likelihood of encouraging their employees to be environmentally proactive (Netherwood, 1998), the OECD survey asked facilities whether they had a dedicated person responsible for the facility's environmental affairs. To measure organizations' experience with quality management systems, we relied on OECD survey data that asked managers whether or not their facility had implemented a quality management system.

Green Production Focus. In determining the extent that facilities had a green production focus, we accounted for whether they were efficiency-driven (Alchian & Demsetz, 1972) with respect to the environment. We also considered whether facilities were focused on new product and technology development as it related to the environment. In so doing we incorporated OECD survey data that were drawn from three questions asking managers how important it was for them to achieve cost savings, new product development, and new technology development with respect to the environmental practices of their facility. Managers reported whether these influences were "not important," "moderately important," "very important," and responses were coded 1, 2 and 3, respectively. Since an organization's green production focus generally draws on efficiency, product and technology concerns simultaneously (Hart, 1995), we combined these three measures using factor analysis with orthogonal varimax rotation. As anticipated, the factor analysis yielded one factor representing facilities' overall green production focus (Cronbach's $\alpha = .79$).

Parent Company Pressures. Parent company influences on facilities' environmental practices, were accounted for by using OECD survey data that asked facility managers how important they considered the influence of corporate headquarters on the environmental practices of their facility (Darnall, 2006). Facility managers reported that these influences were “not applicable or not important”, “moderately important”, or “very important.” These influences were coded 1, 2 and 3, respectively.

Finally, facility heterogeneities were controlled using industry and country dummies. We also controlled for facility size (logged number of employees).

Analytic Methods

Spearman correlations among the explanatory variables were within the range of acceptability ($<.50$). An analysis of the variance inflation factors (VIF) revealed the highest VIF being 3.17, which was within the acceptable threshold of 10.0 (Kennedy, 1997). As such, multicollinearity was not an issue in our empirical models. Table 1 describes the distribution of all our variables.

—INSERT TABLE 1 ABOUT HERE—

The relationship between facilities' financial and environmental performance was evaluated using bivariate probit estimation using heteroskedasticity-robust standard errors. This simultaneous equations approach controls for endogeneity related to the fact that unobservable factors may be the reason why a facility takes action (Greene, 2003) to improve its environmental and financial performance. Bivariate probit estimation assumes that a facility's financial performance and environmental performance are separate, but interrelated. The interrelation takes place through a correlated error structure so that, after controlling for explanatory variables, the two outcomes are related. The treatment model relies on a

simultaneous maximum likelihood estimation approach in which the factors that relate to an organization's environmental performance (first portion of model estimation) are estimated in tandem with the factors that are associated with its financial performance (second portion of model estimation). In estimating the interrelationship, a bivariate probit model produces "rho" from the first portion of model estimation. Since rho represents a non-linear function of the variables in the first portion of model estimation, the second portion is identified even without instrumental variables via the normality assumption for the probit model (Greene, 2003).² When rho is statistically different from zero ($\alpha=.05$), there is at least a 95 percent probability that a relationship exists between the factors associated with organizations' reductions in environmental impacts and the factors associated with organizations' positive profits such that simultaneous estimation procedures are essential to appropriate estimation.

RESULTS

Model significance was determined by evaluating the Wald chi-square values for each of the six treatment models. Across all six models, the Wald chi-square statistic was significant at $p<.01$ (see Table 2). The results also illustrate that environmental performance was endogenous, as denoted by the Wald test of rho. For each treatment model, rho was statistically significant ($p<.01$), indicating that a facility's regulatory stringency, complementary resources and capabilities, green production focus, and parent company pressures were important in understanding the relationship between its environmental and financial performance.

—INSERT TABLE 2 ABOUT HERE—

² When applying this two-stage methodology, it is sometimes argued that valid identifier variables for the first stage model cannot be correlated with the second stage dependent variable (Maddala, 1986). This would imply that the two stages cannot share the same independent variables. However previous research shows that two-stage methodology does not suffer from identification problems when the same set of independent exogenous variables (or a subset of them, as in our case) is used for both estimation stages when a nonlinear model is used in the first stage of estimation (Maddala, 1986; Olsen, 1980).

Our results also showed that a company's environmental performance was associated with whether or not it earned positive profits ($p < .01$). This was true for model 1, which assessed facilities' overall pollutant reductions, in addition to models 2-6, which evaluated facilities' individual pollutant decreases. These findings offer evidence in support of Hypothesis 1, which states that organizations that voluntarily reduce their environment impacts are more likely to benefit financially. At the same time, our estimations show that the stringency of the environmental regulatory regime was associated with diminished profits in all six empirical models ($p < .01$). These results offer evidence in support of Hypothesis 2, which suggests that organizations that are governed by more stringent environmental policies are more likely to accrue fewer financial benefits. Additionally, facilities that reported having a greater market concentration were less likely to decrease their environmental impacts ($p < .01 - .10$) whereas facilities with broader market scopes were more likely to decrease their overall environmental impacts ($p < .05$) as well as their use of natural resources ($p < .10$) and production of solid waste ($p < .05$). In instances where our industry sector dummies were statistically significant, the chemical industry (our omitted industry dummy) was less likely to report positive profits. Related to the country dummies the results were more varied in that US facilities were more likely to report positive profits than Canadian or Hungarian facilities, whereas US facilities were less likely to report positive profits than French, German and Japanese facilities.

In evaluating the factors related to facility reductions in their environmental impacts, the stringency of the regulatory system appears to have had an important role. As shown in Table 3, facilities that reported a decrease in their overall environmental impacts, use of natural resources, wastewater effluent, air pollution and global pollutants were more likely to be governed by a more stringent regulatory stringency ($p < .01$). Additionally, the size of the indirect effect of

regulatory stringency was similar to the size of the direct effect, suggesting that the relationship between regulatory stringency and facilities' environmental improvements is as strong as the relationship between regulatory stringency and facilities' profitability.

Facilities' resources and capabilities also were associated with reductions in their environmental impacts. More specifically, facilities that reduced their use of natural resources ($p < .05$) and decreased their solid waste ($p < .01$) were more likely to have a budget for environmental research and development. Related to our other measures of facilities' resources and capabilities, across all six models, organizations that had a person in charge of their environmental affairs ($p < .01$) and had prior experience with quality management systems ($p < .01$) were more likely to reduce their environmental harms. Combined, these findings point to the importance of facilities' complementary resources and capabilities in that they are associated with greater environmental performance improvements.

Related to facilities' green production focus, for all six models, facilities that reported a greater focus towards achieving cost savings and new product and technology development when considering their environmental activities were more likely to reduce their environmental impacts ($p < .01$). These findings offer support for the notion that organizations which recognize the link between their environmental practices and potential internal efficiencies and market opportunities are more likely to act by reducing their environmental impacts to a greater degree. In so doing, these entities may benefit financially. Facilities that reported their parent companies had a greater degree of influence on their environmental practices were more likely to improve their environmental performance. In particular, these facilities were associated with a greater probability of reducing their overall impacts ($p < .01$), use of natural resources ($p < .10$), solid waste production ($p < .10$), and global pollutants ($p < .05$).

In instances where our industry sector dummies were statistically significant, the chemical industry was more likely to report increases in solid waste and decreases in wastewater effluent. There was greater variation in the significance of our country dummies, which made assessing an overall pattern more difficult. However, one area that merits noting is that for all countries, except Germany, US facilities reported fewer decreases in air pollution emissions.

—INSERT TABLE 3 ABOUT HERE—

In summary, our findings support both our research hypotheses, and demonstrate that controlling for the endogenous relationship between an organization’s environmental and financial performance is important to understanding our hypothesized relationships.

DISCUSSION

This study evaluates the relationship between a company’s environmental and financial performance. It offers three research contributions. First, it considers two competing perspectives associated with the relationship between an organization’s environmental and financial performance. Scholars ascribing to the traditional economic perspective argue that regulatory pressures constrain organizations’ financial opportunities (Conrad & Morrison, 1989; Lave, 1973; Christiansen & Haveman, 1981). This perspective is a primary reason why policy makers in the US and many other countries do not have national climate change policy, do not advance more robust environmental legislation, and fail to adequately fund their regulatory inspection and audit programs. However, other scholars ascribing to the “revisionist perspective” posit that regulations can encourage innovation and greater operational efficiencies (Porter & van der Linde, 1995; Russo & Fouts, 1997; Hart & Ahuja, 1996). This position suggests that companies which improve their environmental performance can expand their market prospects, thereby

creating opportunities for competitive advantage (Hart & Ahuja, 1996; Khanna & Damon, 1999; Russo & Fouts, 1997; Rivera, 2002).

The findings of this study offer evidence in support of both theoretical perspectives in that more stringent policy regimes are associated with diminished facility profits. However, facilities which reduce their environmental impacts also have a greater probability of earning positive profits. Combined, the results suggest that facilities incur costs as a result of environmental regulations, but that these costs can be offset – or eliminated entirely – for companies that decrease their environmental harms to a greater degree. As such, the traditional economic argument against pursuing more stringent policies towards climate change and other environmental harms may lack merit in that it considers only one relevant perspective. By considering both the traditional and revisionist views together, we offer a more comprehensive depiction of the relationship between regulatory stringency, environmental performance improvements and organizations' financial benefits.

Additionally, the results show that the stringency of the regulatory system is associated with reductions in facilities' environmental impacts. These findings have important implications to public policy. Environmental regulation is predicated on market failure theory. Under this view, price signals in prevailing markets do not capture the full cost that stems from the production of a good, but rather some of the production costs are imposed on society at large. Regulation is an attempt to reduce pollution in that it creates incentives by imposing costs on facilities that pollute. However, political pressures (especially in the US) increasingly are pushing to reduce the stringency of environmental regulations. This research offers reason to pause in response to these pressures since regulatory stringency is an important factor associated with facility-level actions to improve environmental performance.

These findings also support conventional arguments that market failures can be remedied through the use of coercive regulation. However, some coercive regulations impose more transaction costs on firms than others, and less costly regulations may be equally (or more) effective at delivering equivalent environmental value. For instance, reflexive regulatory systems create incentives and procedures that induce organizations to assess their actions (hence the reflexivity) and adjust them to achieve socially desirable goals, rather than relying on coercive rules and laws (Fiorino, 2006). In the absence of traditional regulatory pressures, it is uncertain whether the organizations in this study would have pursued a proactive environmental strategy. However, some reflexive policies and programs may achieve equivalent environmental outcomes and allow organizations to benefit financially from their green production activities. Future research should study this issue to a greater degree.

One type of reflexive program that has gained significant traction (and debate) is the VEP. These programs create incentives and procedures that encourage firms to commit resources towards participation, to assess their environmental actions, and to adjust their approach to improve their environmental performance. VEPs generally do not dictate the means by which participants achieve program goals. Worldwide, environmental ministries have been promoting private sector participation in VEPs. Within the US these programs account for 1.6% (Morgenstern & Pizer, 2007) of EPA's \$4.3 billion dollar operating budget, or approximately \$69 million (EPA, 2007a). However, numerous concerns have been raised about the efficacy of these programs, in large part because they suffer from weak monitoring and sanctioning mechanisms for non-conforming participants (Darnall & Sides, 2008; Koehler, 2007). Additionally, EPA-sponsored VEPs have been criticized for their inability to determine success,

failure, and ideal models for future program development (US Office of Inspector General, 2007).

One reason why VEPs are developed with weak design structures is that program managers are balancing the need for rigor with the goal of providing a flexible means for participants to move beyond the parameters established by the traditional regulatory system (Darnall & Sides, 2008). A tension therefore emerges between program managers' desires to encourage more widespread VEP participation and the need to ensure that program goals are met. Yet programs that have strong monitoring and sanctioning mechanisms are more likely to lead to improved environmental performance since free-riding is not tolerated (Delmas & Keller, 2005), as do programs advancing more ambitious environmental goals (Darnall & Sides, 2008). The results of this study illustrate that there may be a business justification for companies to participate in VEPs with more robust program designs. In so doing, participants may benefit financially by reducing their environmental impacts to a greater degree. Incentives such as these may have a greater influence on organization behavior than the promise by VEP sponsors to enhance information sharing and facilitate access to peer networks. They also provide a stronger justification for government managers to design VEPs that ensure participants will improve their environmental performance.

With respect to the private sector, facility managers often report that they feel constrained by the cost of environmental regulation. However, the results of this study suggest that facilities may offset their regulatory costs related to environmental compliance if they improve their overall environmental performance. These findings may help private sector managers understand the potential benefits their organizations can accrue by reducing their environmental impacts. The evidence presented here may further assist these managers to gain executive-level support

for expanding upon their current environmental programs so that they take a more proactive stance.

The second contribution of this research is that it demonstrates that complementary management resources and capabilities may be an important reason why organizations improve both their environmental and financial performance. By not controlling for factors such as these, a company's superior financial outcomes may be attributed mistakenly to its improved environmental performance when financial performance may be related to unobservable factors omitted from the discussion. More specifically, resources (including investments in environmental innovation and the employment of dedicated environmental managers), in addition to capabilities (such as quality management practices), are related to whether facilities reduce their environmental impacts. Further, facilities that have a stronger green production focus demonstrate a greater likelihood of reducing their environmental impacts. Each of these management activities provide important information about why organizations do not to adopt proactive environmental practices, even when doing so makes good business sense.

Facilities that forgo dedicating budgetary resources toward environmental research and development and fail to have a person in charge of their environmental affairs are less likely to have support from executive managers regarding environmental issues. One reason may be that executive managers within these organizations lack information regarding the efficiency gains that can accrue from implementing environmentally proactive practices (Dieleman & de Hoo, 1993). Additionally, managers that decline investing resources toward environmental research and development may fear a disruption of current production and operating systems (Sharma, 2000). In both instances, knowledge and uncertainty may be the cause of missed opportunities for improved organizational profitability. Similarly, facilities that lack a formal quality

management system lose the benefit of internal coordination that can identify existing production inefficiencies and environmental costs. Combined, these relationships have implications for government-sponsored policies and programs that attempt to help facilities develop their environmental capacities and enhance their environmental performance.

Within the US, EPA has promoted its technical assistance programs related to the environment since the passage of the Pollution Prevention Act of 1990. These programs are premised on the idea that reduction at the source is more desirable than waste management and pollution control. In 2007, EPA allocated approximately \$4.5 million (about 1% of EPA's budget) towards supporting technical assistance pollution prevention grants, a significant portion of which funded state-level programs that targeted facility pollution (EPA, 2007b). These grants are intended to reduce the information asymmetries associated with managers' abilities to make optimal production decisions. By assisting companies in acquiring knowledge about the benefits of being environmentally proactive and helping to initiate internal environmental assessments, facilities that lack understanding and complementary environmental resources and capabilities are able to take action. The results of this research point to the relevance of these programs, especially for facilities that lack a budget for environmental innovation, a dedicated environmental manager, and prior experience with quality management systems. In the absence of these resources and capabilities, facilities are less likely to reduce their environmental impacts. To the extent that government-sponsored technical assistance can bolster facilities' internal capabilities and reduce information asymmetries associated with managers' poor understanding of the organization's environmental costs and organizational inertia, these programs may have real merit. However, their modest funding levels ultimately may impede their effect on facilities' widespread environmental behavior.

The third contribution of this research is that it takes a significant step forward in advancing our understanding of environmental management in the global environment. While previous research has examined diverse aspects of the relationship between proactive environmental activities and stock performance (e.g., Konar & Cohen, 1997, Hamilton, 1995) and measures of business performance (e.g., Russo & Fouts, 1997; Khanna & Damon, 1999; Hart & Ahuja, 1996; Laplante & Lanoie, 1994; Stanwick & Stanwick, 2000), most scholarship has focused on organizations in a single country, and more specifically US organizations. By examining these relationships for facilities in seven OECD countries, results of this research can be generalized to a much broader international setting and makes an important contribution to existing literature. Understanding these relationships within the international setting is particularly important since many more companies now operate globally and adhere to multiple regulatory regimes.

Future research would benefit by studying the growing demand by consumers for environmentally friendly products. This study only modestly accounted for increased consumer demand by controlling for industry effects and by considering facilities' interest in environmentally friendly product and technology development. However, by studying a specific industry (such as the food industry and consumers' increasing interest in purchasing organic labels) we could begin to understand the extent to which consumer demand for green products has increased over time and to what extent organizations can derive a green dividend for their environmentally friendly products.

CONCLUSIONS

This research offers evidence of the relationship between a facility's environmental, financial performance, and the stringency of the environmental policy regime. It takes an important step by considering these issues empirically across multiple countries. The findings

show that more stringent environmental policy regimes are related to a facility's diminished profits. However, facilities that take measures to improve their environmental performance are associated with a greater probability of reaping financial benefits, thereby offsetting the cost of regulation or accruing a net gain. The findings are useful to public policy makers, researchers, and private sector managers alike in understanding the potential benefits facilities can accrue by reducing their environment impacts, and in promoting programs that encourage proactive environmental management practices among the regulated community.

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Table 1: Summary Statistics

Variable	Mean	Standard Deviation	Min.	Max.
Improved business performance	0.59	0.49	0	1
Decrease in overall environmental impacts	0.00	1.00	-4.15	3.13
Decrease in use of natural resources	0.53	0.50	0	1
Decrease in solid waste	0.56	0.50	0	1
Decrease in wastewater effluent	0.43	0.50	0	1
Decrease in air pollution	0.43	0.50	0	1
Decrease in global pollutants	0.34	0.47	0	1
Regulatory stringency	1.79	0.71	1	3
Facility has budget for environmental R&D	0.09	0.29	0	1
Person in charge of environmental affairs	0.70	0.46	0	1
Quality management system capabilities	0.75	0.44	0	1
Green production focus	0.00	0.89	-1.57	1.29
Parent company pressures	2.04	0.83	1	3
Market concentration	2.10	0.80	1	3
Market scope	2.80	1.05	1	4
Number of facility employees (log)	5.11	1.05	0.69	10.26
Primary customer	1.60	0.82	1	4
Firm is traded on stock market	0.17	0.37	0	1
Firm's head office is in a foreign country	0.12	0.32	0	1
Food, beverage, textiles ISIC (15-19)	0.15	0.36	0	1
Pulp, paper, publishing, print ISIC (20-22)	0.11	0.31	0	1
Refined petroleum, chemicals, plastics ISIC (23-26)	0.15	0.36	0	1
Nonmetallic minerals, metals ISIC (27-33)	0.24	0.42	0	1
Machinery, transport equip. ISIC (29-35)	0.31	0.46	0	1
Furniture recycling ISIC (36-37)	0.03	0.18	0	1
Canada	0.06	0.24	0	1
France	0.06	0.25	0	1
Germany	0.22	0.41	0	1
Hungary	0.11	0.31	0	1
Japan	0.36	0.48	0	1
Norway	0.07	0.26	0	1
U.S.	0.12	0.32	0	1

Table 2: Relationship between Facilities' Positive Profits and Reductions in Environmental Impacts

Variable	ENVIRONMENTAL PERFORMANCE MODEL											
	Decrease in Overall Impacts		Decrease in use of Natural Resources		Decrease in Solid Waste		Decrease in Wastewater Effluent		Decrease in Air Pollution		Decrease in Global Pollutants	
	Coeffic.	S.E.	Coeffic.	S.E.	Coeffic.	S.E.	Coeffic.	S.E.	Coeffic.	S.E.	Coeffic.	S.E.
Environmental performance (see column)	0.17***	0.06	1.18***	0.19	1.33***	0.15	1.30***	0.11	1.38***	0.07	1.03***	0.20
Stringency of environmental policy	-0.17***	0.06	-0.14***	0.04	-0.11***	0.04	-0.19***	0.04	-0.22***	0.04	-0.15***	0.05
Market concentration	-0.13***	0.04	-0.05*	0.03	-0.06**	0.03	-0.06**	0.03	-0.07***	0.03	-0.10***	0.04
Market scope	0.08**	0.04	0.05*	0.03	0.04**	0.02	0.03	0.02	0.03	0.02	0.05	0.03
Number of facility employees (log)	0.05	0.04	-0.02	0.03	-0.03	0.03	-0.01	0.03	0.00	0.03	0.01	0.04
Primary customer	0.03	0.05	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.04	0.04
Firm is traded on stock market	0.13	0.09	0.05	0.06	0.02	0.06	0.02	0.06	0.03	0.06	0.07	0.08
Firm's head office is in a foreign country	0.05	0.11	0.06	0.07	0.09	0.07	0.11	0.07	0.10	0.07	0.04	0.09
Food, beverage, textiles (ISIC 15-19)	-0.12	0.13	-0.19**	0.09	-0.03	0.09	-0.24***	0.09	-0.07	0.09	-0.12	0.11
Pulp, paper, publishing, print (ISIC 20-22)	-0.14	0.14	-0.23**	0.10	-0.12	0.10	-0.27***	0.10	-0.21**	0.10	-0.21*	0.13
Nonmetallic minerals, metals (ISIC 27-33)	-0.13	0.11	-0.14*	0.08	-0.04	0.08	-0.27***	0.08	-0.17**	0.08	-0.16*	0.10
Machinery, transport equip. (ISIC 29-35)	-0.31***	0.11	-0.30***	0.08	-0.17**	0.08	-0.27***	0.08	-0.19**	0.08	-0.32***	0.09
Furniture recycling (ISIC 36-37)	-0.13	0.22	-0.26*	0.16	-0.17	0.15	-0.21	0.17	-0.48***	0.14	-0.22	0.19
Canada	0.36**	0.17	0.40***	0.13	0.34***	0.13	0.17	0.13	0.49***	0.12	0.41***	0.16
France	-0.25	0.17	-0.23*	0.12	-0.01	0.12	-0.26**	0.12	0.23*	0.13	-0.11	0.16
Germany	-0.05	0.13	-0.26***	0.09	-0.13	0.09	-0.11	0.09	-0.02	0.09	-0.09	0.12
Hungary	0.26*	0.15	0.10	0.11	0.18*	0.10	0.25**	0.10	0.23**	0.10	0.30**	0.13
Japan	-0.62***	0.11	-0.66***	0.09	-0.59***	0.09	-0.46***	0.10	-0.34***	0.09	-0.60***	0.10
Norway	-0.07	0.16	-0.10	0.11	-0.24**	0.11	-0.05	0.11	0.27**	0.12	0.04	0.14
Constant	0.66***	0.27	0.32*	0.19	0.01	0.19	0.39**	0.19	0.23	0.19	0.51**	0.24
Observations†	1517		2609		2642		2386		2123		1723	
Wald Chi2(38)	342.90***		830.24***		1099.07***		1142.69***		1242.34***		505.72***	
Rho	-0.18		-0.88		-0.82		-0.83		-0.92		-0.61	
Wald test of rho=0 Chi2(1)	6.17***		11.55***		12.52***		24.41***		20.09***		12.08***	

* Statistically significant at $p < .10$; ** statistically significant at $p < .05$; *** statistically significant at $p < .01$

† The number of observations vary across models due to item responses for the OECD's environmental performance variables. For instance, 263 more companies reported on their environmental performance related to wastewater effluent than air pollution.

Table 3: Relationship between Regulatory Stringency, Facility Management and Reductions in Environmental Impacts

Variable	<i>ENVIRONMENTAL PERFORMANCE MODEL</i>											
	Decrease in Overall Impacts		Decrease in use of Natural Resources		Decrease in Solid Waste		Decrease in Wastewater Effluent		Decrease in Air Pollution		Decrease in Global Pollutants	
	Coeffic.	S.E.	Coeffic.	S.E.	Coeffic.	S.E.	Coeffic.	S.E.	Coeffic.	S.E.	Coeffic.	S.E.
Regulatory stringency	0.16***	0.06	0.12***	0.04	0.05	0.04	0.20***	0.04	0.29***	0.05	0.09*	0.05
Facility has budget for environmental R&D	0.14	0.11	0.17**	0.08	0.31***	0.08	0.09	0.07	0.10	0.07	0.13	0.10
Person in charge of environmental affairs	0.47***	0.09	0.34***	0.06	0.29***	0.05	0.37***	0.06	0.20***	0.06	0.41***	0.08
Quality management system capabilities	0.21***	0.09	0.17***	0.06	0.14***	0.05	0.17***	0.06	0.15***	0.05	0.26***	0.08
Green production focus	0.13***	0.04	0.09***	0.03	0.07**	0.03	0.09***	0.03	0.09***	0.03	0.19***	0.04
Parent company pressures	0.13***	0.05	0.07*	0.04	0.06*	0.03	0.01	0.03	0.01	0.03	0.10**	0.04
Number of facility employees (log)	0.13***	0.03	0.10***	0.03	0.11***	0.03	0.09***	0.03	0.08***	0.03	0.12***	0.03
Food, beverage, textiles (ISIC 15-19)	0.14	0.12	0.06	0.09	-0.20**	0.09	0.21**	0.09	0.03	0.10	0.10	0.12
Pulp, paper, publishing, print (ISIC 20-22)	0.22*	0.13	0.16	0.10	0.03	0.10	0.23**	0.11	0.13	0.11	0.26**	0.13
Nonmetallic minerals, metals (ISIC 27-33)	0.03	0.10	-0.05	0.08	-0.19**	0.08	0.18**	0.08	0.03	0.08	0.10	0.10
Machinery, transport equip. (ISIC 29-35)	0.00	0.10	0.03	0.08	-0.13*	0.08	0.01	0.08	-0.08	0.08	0.11	0.10
Furniture recycling (ISIC 36-37)	0.41**	0.21	0.17	0.16	0.17	0.16	-0.02	0.17	0.56***	0.16	0.47***	0.18
Canada	-0.11	0.14	-0.11	0.12	0.00	0.12	0.17	0.13	-0.33***	0.13	-0.03	0.15
France	-0.13	0.17	0.12	0.13	-0.23*	0.13	0.13	0.13	-0.46***	0.14	-0.21	0.18
Germany	0.17	0.12	0.36***	0.09	0.12	0.09	0.07	0.09	-0.02	0.10	0.35***	0.12
Hungary	-0.27**	0.14	0.10	0.10	-0.09	0.10	-0.31***	0.11	-0.21**	0.11	-0.26**	0.13
Japan	0.01	0.11	0.19**	0.09	0.14	0.09	-0.16*	0.09	-0.15*	0.09	0.18*	0.11
Norway	-0.33**	0.15	0.15	0.12	0.37***	0.12	0.03	0.12	-0.44***	0.13	-0.24	0.16
Constant	-1.92***	0.24	-1.38***	0.18	-0.91***	0.18	-1.49***	0.19	-1.30***	0.20	-2.16***	0.24
Observations†	1517		2609		2642		2386		2123		1723	
Wald Chi2(38)	342.90***		830.24***		1099.07***		1142.69***		1242.34***		505.72***	
Rho	-0.18		-0.88		-0.82		-0.83		-0.92		-0.61	
Wald test of rho=0 Chi2(1)	6.17***		11.55***		12.52***		24.41***		20.09***		12.08***	

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