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Chapter 6

Understanding the Relationship between a Facility's Environmental and Financial Performance

by

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Abstract

It is often argued that good environmental and commercial performance go hand-in-hand. In this chapter the links between environmental policy stringency, environmental performance and commercial performance (profitability and sales) for a sample of OECD manufacturing facilities are examined. Using a bivariate probit model for six different indicators of environmental performance (natural resource use, solid waste generation, wastewater effluent, local and regional air pollution, global pollutants, and an aggregate index) it is found that environmental performance has a positive and significant effect on both profitability and sales, indicating the potential for "win wins". However, perceived policy stringency has a negative and significant effect, thus indicating that such "win wins" are not policy-induced.

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I. Introduction

An understanding of how a company's environmental performance affects its financial prospects, and how the stringency of the environmental policy regime might constrain a company's financial opportunities are issues of considerable concern to policymakers. Collectively, organizations spend millions of dollars annually when installing mandated pollution control technology, applying for environmental permits, and monitoring and reporting their environmental impacts (Portney and Stavins, 2000). These costs create an incentive for companies to reduce their environmental impacts below minimum reporting thresholds. Doing so also benefits organizations by improving their operational efficiencies. At the same time, regulators can achieve greater environmental improvements without additional monitoring and enforcement. However, questions remain about the extent to which the stringency of the environmental regulatory regime diminishes a company's financial performance.

Other uncertainties relate to whether or not more efficient companies may be the ones that actively reduce their impacts on the natural environment. As such, a company's superior financial outcomes may be mistakenly attributed to its improved environmental performance when financial performance is related more to the fact that a company is more efficient from the outset. These issues have been ignored by many prior studies (*e.g.* Stanwick and Stanwick, 2000; Russo and Fouts, 1997; Levy, 1995; Hart and Ahuja, 1996; Cormier *et al.*, 1993; Arora and Cason, 1995). Moreover, previous research has not explored how the stringency of the environmental policy regime affects a company's environmental and financial performance. Perhaps most importantly, the link between a company's environmental and financial performance has not been studied across multiple countries.

In this chapter the link between facilities' environmental and financial performance is examined, taking into account potential endogeneity associated with improved environmental performance. It draws upon OECD data from manufacturing facilities operating in Canada, France, Germany, Hungary, Japan, Norway, and the United States and utilizes simultaneous equation techniques. The results show that the stringency of the environmental policy regime was associated with fewer financial performance opportunities. However, these opportunities were mitigated if the facility took steps to reduce its impacts to the natural environment. These findings are important because they provide evidence that may encourage additional companies to take a more proactive stance in how they manage their environmental affairs, as well as evidence that the costs of complying with the environmental regulatory system can be lessened or overcome if organizations undertake proactive environmental strategies.

II. Do Companies Benefit Financially by Improving their Environmental Performance?

Orthodox economic theory suggests that organizations should invest in environmental activities only to the extent that their marginal benefit of doing so equals their marginal cost. Interpreted more strictly, investment beyond the current regulatory requirements is detrimental to an organization's economic performance and constrains financial opportunities (Friedman, 1970; Christiansen and Haveman, 1981; Conrad and Morrison, 1989; Denison, 1979; Jaffe and Palmer, 1997; Lave, 1973; Norsworthy, Harper and Kunze, 1979). This rationale suggests that there is little incentive for an organization to be environmentally proactive, and therefore little reason to examine the relationship between environmental and financial performance.

Despite this traditional wisdom, anecdotal evidence suggests that financial benefits exist for "green" firms, which has caused many companies to try to portray themselves as being environmentally friendly. For example, 3M reported saving more than US$ 1 billion between 1975-1990 due to implementing a rigorous pollution prevention program and to reducing its air pollution emissions by 127,000 metric tons (McCloskey, 1993). Similarly, by 1998 participation in

EPA's more than 40 voluntary environmental programs had attracted a projected 13 000 organizations (Mazurek, 1998). Still other firms have voluntarily reduced their emissions significantly over time and reduced their environmental impacts to qualify for eco-labels.

These organizations have not necessarily acted against conventional economic wisdom because companies that invest in proactive environmental strategies may benefit substantially (*e.g.* Hart and Ahuja, 1996; Henderson and Mitchell, 1997; Klassen and McLaughlin, 1996; Porter and van der Linde, 1995). Some benefits relate to regulation itself since achieving regulatory compliance is costly. The regulatory framework therefore creates an incentive for firms to improve their operational efficiencies by reducing their pollution levels. Such actions can reduce product inputs, waste treatment costs, and long-term liabilities (Porter and van der Linde, 1995).

Other financial benefits may also accrue from markets (Konar and Cohen, 1997; Arora and Cason, 1996; Khanna and Damon, 1999). Market pressures for environmental consideration have increased as firms and customers have become increasingly aware of the environment. Information about an organization's environmental performance also affects corporate reputation (Arora and Gangopadhyay, 1995; Konar and Cohen, 1997; Marshall and Mayer, 1991). In the last decade, consumers have increasingly demanded environmentally friendly products, and consumers attest consistently that the environment, broadly defined, is near the top of the list of public concerns (Portney and Stavins, 2000). As consumers become more knowledgeable about companies' impacts to the natural environment, firms are responding by marketing themselves as environmentally friendly organizations (Russo and Fouts, 1997). Increased product sales, consumer satisfaction, and environmental efficiency may also translate into increased shareholder gains. As the ultimate owners of a corporation, shareholders stand to profit from a firm's good environmental deeds.

While a company's proactive environmental practices may have little influence on some customers' purchasing decisions, these same customers still may be persuaded to change their purchasing decisions if a company violates environmental laws or emits high levels of toxins (Prakash, 2002). For example, 33% of US adults claimed to have avoided buying products, at least occasionally, from firms with poor environmental records (Ottman, 1996). Moreover, when environmental crises occur, stakeholders often demand redress to improve future performance (Greening and Gray, 1994; Carrol, 1993; Mitroff and Shrivastava, 1987). Environmental crises, such as chemical spills and accidental releases of toxic emissions, can also affect firms financially, especially for companies with more liability exposure since their "deeper pockets" attract additional scrutiny by regulators and by environmental groups (Arora and Cason, 1996).

Regulatory and market pressures such as these may lead companies to invest in improving their environmental records because they believe that doing so will improve their image (Bansal and Clelland, 2004). For these reasons, firms that obtain greater external acceptability of their perceived environmental performance may derive competitive advantage and subsequently reap greater financial rewards.

Finally, companies that improve their environmental performance faster and earlier than their competitors may also enjoy the advantages of being "first movers," and have a very real opportunity to receive greater purchasing preference than less environmentally conscious competitors, thus fortifying their market positions (Darnall, Gallagher and Andrews, 2002). In instances such as these, customer demand may also play an important role, especially for firms that have operations in Western Europe. For example, US companies that operate in Western Europe are experiencing market pressures from large corporate buyers who request that they provide them with documentation of their environmental procedures (Darnall, Gallagher and Andrews, 2002). These customers recognize that environmental procedures often vary in quality and scope, which is why environmentally conscious corporate buyers

now scrutinize companies' environmental processes for their potential to reduce impacts to the natural environment. Supply chain pressure and other market-driven pressures also point to the potential financial benefits a company may derive from reducing its impacts to the natural environment. All of these examples support the notion that companies that reduce their impacts to the natural environment benefit financially:

> ***Hypothesis 1:*** *Organizations that reduce their impacts to the natural environment benefit financially*.

Drawing on the orthodox economic argument that the current regulatory requirements are detrimental to an organization's economic performance and constrain financial opportunities (Friedman, 1970; Christiansen and Haveman, 1981; Conrad and Morrison, 1989; Denison, 1979; Jaffe and Palmer, 1997; Lave, 1973; Norsworthy, Harper and Kunze, 1979), we further hypothesize that the stringency of environmental policies reduce an organization's financial performance.

> ***Hypothesis 2:*** *Organizations that are governed by more stringent environmental policies accrue fewer financial benefits.*

III. Why Companies Reduce their Environmental Impacts

Before we explore the link between a company's environmental and financial performance further, we first need to ask why a company would choose to reduce its environmental impacts. These motivations are important to address empirically because of problems associated with endogeneity. Endogeneity in this setting relates to the fact that environmental performance is an outcome that it is correlated potentially with unobservable factors that may also affect an organization's financial performance.

There are several reasons why a company might choose to reduce its impacts to the natural environment that are also related to its financial performance. Institutional theory suggests that pressures external to the organization play a role. Within the environmental arena, regulatory pressures are the most frequently cited external drivers for an organization's environmental action (Arora and Cason 1996; Konar and Cohen 1997; Porter and van der Linde 1995). Regulatory pressures exist at the local, county, state, national, and international levels. They also come in multiple forms and include facility mandates to apply for operating permits, to adopt specific control technology, to monitor and report on its media-specific environmental activities, to allow regulator audits of their environmental activities, and to address any emissions violations and their potential legal implications. By reducing their environmental impacts, companies may be able to decrease their emissions below the reporting thresholds thus reducing reporting burdens and eliminating the need to purchase and install costly pollution control technologies.

> ***Hypothesis 3:*** *Organizations that reduce their environmental impacts endure stronger regulatory pressures.*

From a profit-maximising 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 and Sadorsky, 1996). This is because firms are driven to increase their operational efficiencies, and such a drive is the cause for their organizational action (Alchian and Demsetz, 1972). As a result, organizations that believe that reducing their environmental impacts will increase their internal efficiency are more likely to take action to minimize their impact upon the natural environment. Economic arguments therefore suggest that:

Hypothesis 4: *Organizations that reduce their environmental impacts seek to increase their internal efficiencies.*

An organization's corporate headquarters imposes other institutional pressures (Oliver, 1997), which are likely to affect its decision to improve the environment. Unlike single facility organizations, multiple facility organizations with corporate headquarters are also more likely to be held accountable by shareholders. These organizations also must adhere to a reporting system whereby information and resources are transferred between the facility and the head office and vice versa. Consequently, the facility is highly dependent on the head office and unlikely to resist its institutional demands (Oliver, 1997). For these reasons, while implementing actions to improve the environment generally occur within the facility, corporate headquarters often plays a role (Darnall, 2006). As such, the existence of corporate leadership is anticipated to influence an organization's financial performance opportunities.

Hypothesis 5: *Organizations that reduce their environmental impacts have stronger corporate influences.*

However, external pressures may not be the sole reason for companies to reduce their impacts on the natural environment. For instance, facilities that have dedicated a portion of their budgets to environmental research and development demonstrate a culture for proactively managing their impacts on the natural environment. Further, these facilities have a greater capacity to address environmental concerns (Porter and van der Linde, 1995; Nakamura *et al.* 2001) and have invested in innovations that can generate knowledge capital that is critical to competitive advantage (Ghemawat, 1986). Similarly, organizations that have dedicated environmental manager are more likely to encourage employees to be environmentally proactive, and are representative of an organization that shows a stronger commitment to the environment (Henriques and Sadorsky, 2005). In each instance, companies that reduce their impacts to the natural environment are expected to have stronger internal competencies than companies that improve their environmental performance.

Hypothesis 6: *Organizations that reduce their environmental impacts have stronger internal competencies.*

IV. Prior Literature Examining the Environmental-Financial Performance Link

Empirical research on the relationship between firms' financial performance and their environmental performance has been mixed and incomplete. In considering how these studies have measured financial performance, the availability of different types of financial data has allowed for multiple measures including stock performance, pricing, sales, intangible assets, and return on sales, equity, investment and assets. However, the lack of reliable environmental performance measures has made measuring a company's environmental actions more difficult. Because it is widely accessible, the US Toxic Release Inventory (TRI) is the data source used most commonly in prior research. While TRI data are self-reported, and therefore subject to manipulation[1], the dataset is the most comprehensive collection of information available for manufacturing facilities' toxic chemical emissions to the land, air and water.

One of the earliest studies exploring the relationship between facilities' environmental and financial performance relied on TRI data and measured firms' return on sales, assets, and equity (Hart and Ahuja, 1996). The authors showed that there is a positive relationship between emissions reductions and financial performance. However, there is a two-year lag until financial performance benefits are reaped. Building on this study, Russo and Fouts (1997) evaluated the return on assets for 243 US firms and found evidence and that a company's strong "environmental ratings" (based on compliance records, abatement expenditures, support for environmental NGOs, and other factors)

improved its financial performance. By contrast, Levy (1995) studied European, North American and Japanese transnational corporations operating in the US and found no evidence of a relationship between reductions in TRI emissions and changes in returns on assets or sales, or in the growth rate of sales. Given Hart and Ahuja's (1996) findings, the lack of a relationship in Levy's study may be due to a lagged relationship between a company's TRI emissions and its financial gains, which was not considered.

Konar and Cohen (1997) also relied on TRI emissions to assess whether a firm's toxic chemical releases predicted its intangible asset values. The authors argued that intangible assets were an indicator of a firm's future earning power arising from specialized assets such as reputation, trust, and patents. They found evidence that companies' emissions reductions in fact improved their intangible assets. Similarly, Cormier *et al.* (1993) evaluated intangible assets by considering the impact of corporate pollution on market valuation by evaluating whether water pollution discharges reduced these assets. They found weak support for the hypothesis that consumers consider the environmental track records of firms when making investment decisions.

Using event-study methods, and a similar empirical approach as Konar and Cohen (1997), Hamilton (1995) evaluated how firms' stock prices were affected in the days following negative environmental press. The results showed that stock prices fell for companies with higher published TRI releases. However, the level of emissions did not affect changes in stock returns. These findings suggest that stockholders do not differentiate among the companies having to report TRI emissions and only react to the fact that companies' TRI pollutants were large enough to be reported to the EPA.

Also relying on event-study methodologies, Klassen and McLaughlin (1996) demonstrated that public announcements about whether firms had won environmental awards or experienced environmental crises were indicators of their environmental performance. The authors also showed that companies with stronger environmental management (as indicated by their environmental awards) had a higher stock price. Significant negative returns were further documented after firms had an environmental crisis, adding further empirical support for a link between environmental and financial performance.

Using the same event study methodology, Lanoie *et al.* (1994) found evidence that "environmental news" (publication of lists of non-compliers and heavy emitters) did not affect equity prices. Lanoie *et al.*'s (1998) results did not confirm the general findings put forward by Konar and Cohen (1997), Hamilton (1995), Klassen and McLaughlin (1996), Laplante and Lanoie (1994), and Russo and Fouts (1997). However the sample was small and could have led to their inconclusive results because smaller samples bias statistical estimates such that it is difficult to find a statistical relationship (Hoenig and Heisey, 2001; Gillett, 1989). Laplante and Lanoie (1994) also used event study methodology to evaluate the effects of four types of environmental news (publication of lawsuits, settlements, environmental incidents, and investments in pollution abatement equipment) in Canada between 1982 and 1991. Settlements and investments had negative effects on firms' financial performance, but lawsuits and incidents had no effect.

Cohen, Fenn, and Naimon (1995) took a different approach by examining the environmental performance of Standard and Poor's 500 companies. The companies were classified into high pollution and low pollution firms using an index of nine variables. Their results showed that firms with lower pollution portfolios achieved higher returns in some instances. Similarly, Stanwick and Stanwick (2000) examined a sample of 469 *Forbes* 500 companies to determine if environmental disclosures were related to their net income. Firms were classified as low, medium, or high environmental performers based on their disclosures, and the authors showed that firms classified as high financial performers had higher incidences of environmental commitment than low financial

performers. Firms classified as medium financial performers had the highest environmental commitment; possibly indicating they were trying to seek a competitive advantage in the market place.

Using a subset of the TRI (*i.e.* 33/50 chemicals[2]), Khanna and Damon (1999) evaluated whether firms' emissions of toxic 33/50 chemicals had a negative effect on their financial performance. They measured financial performance by a firm's return on investment and the ratio of the valuation of intangible assets relative to sales. Using a Heckman selection model, the authors showed that 33/50 chemical emissions had a negative effect on return on investment, but a positive effect on intangible assets relative to sales. Since return on investment is an indicator of short-run performance and intangible assets relative to sales measures long-run performance, the authors confirmed Hart and Ahuja's suggestion that firms benefit financially in the long-run by reducing their environmental impacts, even if they lose in the short-run. Arora and Cason (1996) also evaluated the financial performance of 33/50 participants and showed similar results in that profit increased slightly for companies in the voluntary environmental program.

Finally, Rivera (2002) examined a cross-section of 164 Costa Rican hotels to determine if voluntary participation in a sustainable tourism certification program increased participants' hotel price and sales. Hotels participating in the program that demonstrated significant environmental improvements derived price premiums and increased sales.

In summary, the results from prior research suggest that there appears to be a positive relationship between a firm's environmental actions and its financial performance (see Table 1). These findings are not significant when evaluating short-run financial effects on stock market valuations, but are when taking a longer view (up to three years after the fact). While these results are encouraging, it is important to recognize that many estimation models used in previous studies did not consider that a firm's environmental performance is endogenous. That is, it is difficult to determine whether a firm's environmental performance improved *because it was more efficient at the onset*, which in turn fueled their greater financial gains in the long run.

We therefore can be tempted to conclude that reducing a company's environmental impact leads to improved financial performance. However, this conclusion may be false. In fact, we do not know whether improved financial performance is due to environmental improvements, or due to the fact that the company already has good management practices prior to the reduction of its environmental impacts. Studies undertaken which do not correct for endogeneity can cause misleading results. Therefore, the results of most prior studies must be interpreted with care and additional studies are needed to evaluate these relationships further.

An additional limitation of each of the aforementioned studies is that they evaluated firms either in the US or in Canada, and in one case Costa Rican firms were considered. As yet, no study has considered the environmental-financial performance relationship among companies across different countries. This issue is particularly important since many more companies now operate globally.

We address these issues by considering the relationship between facilities' environmental performance and financial performance. Our empirical estimations control for endogeneity, thereby offering more robust evidence about whether organizations accrue financial benefits from their proactive environmental actions. This study also takes an important step by considering these relationships in the international context to provide a more complete view of the association between financial and environmental performance.

Table 1: Summary of Prior Studies Evaluating the Link between Environmental and Financial Performance

Study	Financial Performance Measures	Environmental Performance Measures	Relationship	Endogeneity and/or Selection Bias Addressed?
• Arora and Cason, 1995	ROA	33/50 TRI emissions	Positive relationship	No
• Cohen, Fenn, and Naimon, 1995	ROA, ROE, Total return to shareholder	High pollution vs. low pollution firms based on nine variables	Generally positive, with lower pollution portfolios achieving higher returns in some instances	No
• Cormier *et al.*, 1993	Intangible asset values	Water pollution discharges	Weak negative relationship	No
• Hamilton, 1995	Stock price	TRI publication, TRI emissions	Negative relationship for TRI publication; no relationship for amount of emissions	Yes
• Hart and Ahuja, 1996	ROS, ROA, ROE	TRI	Positive relationship in year 2	No
• Khanna and Damon, 1999	ROI, Ratio of the valuation of intangible assets/sales	33/50 TRI emissions	Negative relationship with ROI; Positive relationship with intangible assets/sales	Yes
• Klassen and McLaughlin, 1996	Stock market performance	Environmental performance awards	Positive returns for first-time environmental performance award winners; negative returns for environmental crises	--
• Konar and Cohen, 1997	Intangible asset values	TRI, Environmental lawsuits	Positive relationship for both measures	--
• Laplante and Lanoie, 1994	Firms' equity value	Lawsuits, settlements, environ-mental incidents, investments in pollution abatement equipment	Negative relationship with settlements and investments	--
• Levy, 1995	ROS, ROA, Growth	TRI	No relationship	No
• Lanoie *et al.*, 1998	Equity prices	Publication of non-compliers and heavy pollution emitters	No relationship, but sample was small	--
• Rivera, 2002	Hotel room price and sales	Participation in voluntary environmental program	Positive relationship	Yes
• Russo and Fouts, 1997	ROS	Compliance, abatement ex-penditures, support for NGOs	Positive relationship	No
• Stanwick and Stanwick, 2000	Net income controlled by firm size	Formal environmental policy or description of environmental commitment	Positive relationship	No

-- = Relied on an event-history model and so endogeneity related to temporal ordering was not an issue.

V. Research Methods

To evaluate our hypotheses, we relied on data from a twelve-page postal survey implemented by the OECD Environment Directorate and researchers from Canada, France, Germany, Hungary, Japan, Norway and the US. (See Chapter 1 for a discussion.)

Assessing the Determinants of Financial Performance

To measure a company's financial performance, the OECD survey asked facility managers whether the company's profits had changed over the past three years. Respondents replied using a five-point scale indicating whether their revenue was "so low as to produce large losses," "insufficient to cover our costs," "at break even," "sufficient to make a small profit," "well in excess of costs." The survey also asked facility managers whether the value of their shipments had changed over the last three years. Respondents replied using a similar scale to indicate whether their value of shipments had "significantly decreased," "decreased," "stayed about the same," "increased," "significantly increased." We then combined the first three and the last two categories of each variable to account for whether or not the facility had earned positive profits and increased shipment values during the last three years.

To measure whether or not companies had reduced their impact on the natural environment, the OECD survey 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 their environmental changes for five different impacts: use of natural resources (energy, water, etc.), solid waste generation, wastewater effluent, local or regional (neighbouring countries) air pollution, and global pollutants (greenhouse gases). Managers indicated whether their impacts had "decreased significantly," "decreased," incurred "no change," "increased," or "increased significantly."

We combined the five environmental performance measures into an "environmental performance index" using factor analysis with orthogonal varimax rotation (Cronbach's alpha = .73).[3] Doing so allowed us to assess how a company's overall environmental performance affected its financial prospects. The results of our factor analysis yielded one factor with similar loadings, thus indicating that each of our five indicators measured the same underlying construct. In addition to the environmental impact index, we estimated the five environmental performance measures separately.

Because companies are subject to a variety of regulatory frameworks that may affect their financial performance opportunities, the survey asked facilities to describe the environmental policy regime to which they were subject. In order to obtain an assessment of the perceived stringency of the regulatory regime, respondents were requested to indicate whether it was "not particularly stringent, obligations can be met with relative ease," "moderately stringent, requires some managerial and technological responses," or "very stringent, has a great deal of influence on decision-making within the facility."

In order to address firm heterogeneity and heterogeneity across countries, the OECD survey included numerous control variables that are thought to predict a company's ability to improve its financial performance. To measure the concentration of the market in which the facility operated, the survey accounted for whether the facility had less than five competitors, whether it had between 5 – 10 competitors, or whether they had greater than ten competitors. Facilities having more than 10 competitors were our omitted reference category. To control for economies of scale associated with organizational size, and the fact that larger organizations are more likely to possess the knowledge-based skills that may be critical factors in their capacity to commit to environmental initiatives (Hart and Ahuja, 1996), the survey included a variable for the number of employees within the firm. The survey also accounted for the facility's primary customer, and whether the customer was at the end of the supply chain, or in the middle of the supply chain. Companies that had consumers at the end of the supply chain were our omitted reference category.

To measure export orientation, the OECD survey asked respondents to indicate whether the facility's market was primarily at a local, national, regional, or global level (Nakamura *et al*. 2001).

Global market operations were our omitted reference category. We also controlled for whether companies were accountable to shareholders. For companies that operated internationally, the survey asked whether or not their head office was located in a foreign company.

Finally because this study compared facilities in multiple countries, it was important to control for heterogeneities across these countries. We included a series of dummy variables to account for the country in which the facility operated (Canada, France, Germany, Hungary, Japan, Norway, and the US). Our reference dummy variable was the US. We also created ten aggregated industrial sector dummies to control for variations across industrial sectors. In this case, our reference dummy sector was non-metallic mineral products.

Assessing the Determinants of Improved Environmental Performance

Regulatory pressures were assessed by asking environmental managers how important the influence of public authorities was on their environmental practices, whether preventing or controlling environmental accidents was a significant motivation on their production practices, and whether achieving regulatory compliance was a significant influence on the environmental practices of their facility. Managers indicated whether each was "not applicable," "not important," "moderately important," or "very important." "Not applicable" and "not important" responses were combined. As noted above, respondents were also asked to describe how they perceived the environmental policy regime in which they were subject by indicating whether it was "not particularly stringent, obligations can be met with relative ease," "moderately stringent, requires some managerial and technological responses," or "very stringent, has a great deal of influence on decision-making within the facility." We combined the four regulatory pressures into an index using factor analysis with orthogonal varimax rotation. Doing so allowed us to assess how a facility's overall regulatory pressures affected its decision to reduce its environmental impacts. The results of our factor analysis yielded one factor with similar loadings, thus indicating that each of our four indicators measured aspects of the same construct (alpha = .70).

To account for the extent to which organizations were efficiency-driven (Alchian and Demsetz, 1972) with respect to the environment, the survey asked facility managers they how important it was for them to achieve cost savings due to environmental practices. Facility managers reported whether these influences were "not important," "moderately important," "very important," or "not applicable." "Not applicable" and "not important" responses were then combined. Using the same scale, institutional pressures imposed by the facility's head office (Oliver, 1997) were measured by asking facilities how important they considered the influence of corporate headquarters on the environmental practices of their facility.

Innovation investments generate knowledge capital that is critical to competitive advantage (Ghemawat, 1986). The OECD survey measured these competencies by whether or not the facility had a research and development budget allocated towards environmental matters (Porter and van der Linde, 1995; Nakamura *et al.* 2001). Because organizations that have an environmental manager are more likely to encourage employees to be environmentally proactive (Welford, 1998) the survey asked facilities whether they had a dedicated person responsible for the facility's environmental affairs.

Finally we controlled for heterogeneities across the ten industrial sector dummies by including a series of dummy variables. In this case, our reference dummy sector was non-metallic mineral products. We also accounted for size and country-level differences by incorporating the number of employees per facility, in addition to seven dummy variables to account for the country in which the facility operated (Canada, France, Germany, Hungary, Japan, Norway, and the US).

Empirical Models

The relationship between facilities' financial and environmental performance was first evaluated using chi-square and analysis of variance statistical techniques. To model our two interrelated binary outcomes (improved financial and environmental performance) we also relied on bivariate probit estimation with robust variances. This simultaneous equations approach controls for endogeneity (Ashford and Snowden, 1970; Greene, 1993) related to the fact that the same unobservable factors may be the reason why a facility improves environmental and financial performance. Such an approach represents an important improvement on the existing probability models that evaluate the environmental-financial performance link based on single-equation estimation.

A bivariate probit model assumes that predicting financial performance and environmental performance are separate, but inter-related. The interrelation takes place through a correlated error structure so that, after controlling for explanatory variables, the two outcomes are related. In so doing, the model relies on a simultaneous estimation approach in which the factors that determine an organization's environmental performance are estimated simultaneously with the factors that determine its financial performance. The two equations are jointly estimated using maximum likelihood.

To determine this inter-relationship, the bivariate probit model produces "rho," which, if statistically different from zero, indicates that a relationship exists between the two outcome variables and that a simultaneous estimation procedure is needed. In all but one application of the bivariate probit estimations, our first-stage model estimation produced a rho that was statistically significant, therefore indicating that endogeneity existed and that relying on a two-stage estimation procedure was critical to our estimations.

Sector Analysis

In a complementary set of analyses, we evaluated whether different sectors with different environmental characteristics improved their financial performance. We made three types of comparisons. First we compared the financial performance of facilities operating within low polluting industries or "clean sectors" to facilities operating within high polluting industries or "dirty sectors." To classify facilities within these sectors, we relied on a taxonomy developed by the World Bank (Mani and Wheeler 1997) and Gallagher and Ackerman's (2000) of manufacturing companies operating in the US.[4] "Clean" sectors were characterized as facilities operating within the fabricated metal products, industrial machinery, electronics, transportation equipment, instrumentation, and textile sectors (ISICs 17, 28, 29, 31, 33 and 35). "Dirty" sectors included pulp and paper, chemical, petroleum refining, primary metal and basic metal industries (ISICs 21, 24, 26 and 27). The environmental and financial performance of companies operating within these two types of manufacturing industries was then compared.

In the second stage of our sector analysis, we assessed whether facilities operating within two "dirty" sectors differed in their environmental performance and whether these differences were related to their financial performance. More specifically, we compared whether facilities within the chemical industry that accrued positive profits and increased the value of their shipments also implemented different environmental practices and reduced their environmental impacts to a greater extent than companies operating in the pulp and paper sector. The chemical industry was selected because it has been seeking voluntarily to reduce its impacts to the environment since the 1980s in an effort to improve its overall environmental performance and public image (King and Lenox, 2001; Hart and Ahuja, 1996). For this reason, we classified the chemical industry as an "early environmental mover." By contrast, the pulp and paper industry began later to consider voluntarily reduce its environmental

impacts across the entire sector (Hart and Ahuja, 1996), making it a "late environmental mover." The relationship between environmental and financial performance of companies operating within in these two sectors was then compared.

Finally, we considered whether companies operating in "high growth" industries differed from companies operating in "low growth" sectors in whether they derived positive financial benefits from their environmental actions. This last sector-level analysis was motivated by prior research suggesting that industry growth facilitates the financial benefits that an organization derives from its environmental improvements (Russo and Fouts, 1997). According to Russo and Fouts (1997), industry growth moderates the relationship between environmental and economic performance for several reasons. First industry growth accelerates the maturation of technologies within that industry and as a result, firms that invest in pollution prevention have a higher prospective return than firms in low-growth industries. The argument here is that the newness of the capital stock improves a company's financial and environmental performance. Moreover, high-growth industries have a more organic (rather than bureaucratic) management style, and may therefore reap capture additional financial benefits by going beyond compliance because of their innovative culture. Finally, Russo and Fouts (1997) argue that is easier to create a reputation for environmental stewardship in a high-growth industry rather than a low-growth industry.

To determine which companies operated in high and low growth sectors, we determined whether or not they experienced a change in the value of their shipments. The number of managers within each industry who indicated that their value of shipments had "significantly decreased" were summed and multiplied by 1. Similarly, the number of respondents who indicated that their value of shipments had "decreased," "stayed about the same," "increased," "significantly increased" were summed and multiplied by 2, 3, 4 and 5, respectively. These values were summed to create an "industry score" for each industrial sector represented in the data. Industry scores were then divided by the number of respondents within each respective industry to create a weighted score. Companies operating in sectors with the largest weighted (food) were considered "high-growth" industries, whereas sectors with the lowest score (electronics) were considered "low-growth" industries.

To assess the statistical relationship between facilities' financial and environmental performance among the sector comparisons, we relied on chi-square statistical tests.

VI. Results

Hypothesis 1: *Organizations that reduce their impacts to the natural environment benefit financially*. In all instances, the proportion of facilities that improved their business performance and that reduced their impacts to the natural environment was greater than the proportion of companies that improved their business performance, but did not reduce their environmental impacts (see Table 2). With respect to our index of environmental impacts, our results showed that more than 99% of the time there was a statistically significant difference between a facility's mean reduction in environmental impacts and its positive business performance. However, this relationship was less consistent when considering the value of a facility's shipments. More specifically, 35% of facilities that increased their value of shipments also reduced their wastewater effluent, whereas 32% of facilities that reduced wastewater effluent did not improve their value of shipments. Similar relationships were found for local and regional air pollution, in addition to global pollutants, but not for natural resource use.

Table 2: Relationship between Financial Performance and Decreases in Environmental Impacts

Significant Decrease or Decrease in the Following Environmental Impacts [†]	Business Performance		Value of Shipments	
	Improved	p-value	Improved	p-value
Index of environmental impacts	11.32[††]	0.001***	0.35	0.557
(n=1923, 1934)				
Use of natural resources (energy, water, etc.)	61%	0.044**	34%	0.549
(n=3475, 3506)	58%		35%	
Solid waste generation	62%	0.032**	32%	0.034**
(n= 3521, 3551)	58%		35%	
Wastewater effluent	62%	0.047**	35%	0.028**
(n=3154, 3179)	58%		32%	
Local or regional air pollution	64%	0.009***	35%	0.090*
(n= 2738, 2756)	59%		32%	
Global pollutants (*e.g.* greenhouse gases)	62%	0.082*	35%	0.042**
(n=2214, 2227)	58%		31%	

[†] Top values represent facilities decreased their environmental impacts. Bottom values represent facilities that did not decrease their impacts. P-values are from Chi-square tests.
[††] Represents results from analysis of variance F tests, which is why% improvements do not apply.
* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$.

With respect to the bivariate probit analysis results, our estimations show that in fact environmental performance was endogenous, as illustrated by the Wald test of rho (see Annex Tables 1-4). In all but one instance, the rho statistic was statistically significant, indicating that estimating the reasons why companies reduce their environmental impacts was critical to understanding why a company's environmental and financial performance are related. After controlling for endogeneity, the findings indicated that a company's reported environmental performance was related to whether or not it earned positive profits, and whether or not it increased the value of its sales (see Annex Tables 1-2).

Facilities that reduced their wastewater and air pollution reductions had the greatest probability of earning positive profits. Similarly, facilities that reduced their global pollutants had the greatest probability of increased value of sales. These findings offer evidence in support of Hypothesis 1, which states that organizations that reduce their impacts to the natural environment benefit financially.

Hypothesis 2: *Organizations that are governed by more stringent environmental policies accrue fewer financial benefits.* The results indicated that facilities, which improved their business performance, reported more often that they believed the environmental policy regime was moderately or very stringent (see Table 3).

Table 3: Relationship between Financial Performance and Perceived Policy Stringency

Environmental Policy Regime [†]	Business Performance		Value of Shipments	
	Improved	p-value	Improved	p-value
Perceived to be Very Stringent	64%	0.000***	37%	0.000***
(n=3829, 3857)	52%		28%	

[†] Top values represent facilities that believed the environmental policy regime was moderately or very stringent. Bottom values represent facilities that believed the environmental policy regime was not stringent.
* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

For instance, 64% of facilities that improved their business performance reported that the environmental policy regime was very stringent. By contrast 52% of facilities that improved their

business performance reported the environmental policy regime was not stringent. Similar relationships were found for value of shipment improvements. However, in evaluating these relationships, we have not controlled for the fact that many of these facilities that reduced their environmental impacts (due to regulatory pressures) may be the ones that improve their financial performance more.

When evaluating the bivariate probit results, evidence was provided for our hypothesized relationships, most likely because we controlled for other factors that influenced these relationships. While a facility's improved environmental performance yielded greater positive profits and increased value of sales, these benefits were diminished by the perceived stringency of the environmental regulatory regime. More specifically, companies that reported that the environmental regulatory regime was more stringent also reported that they had diminished their profits, and to a lesser extent, decreased the value of their sales. These results provide evidence in support of Hypothesis 2, which suggests that organizations that are governed by more stringent environmental policies accrue fewer financial benefits.

This pattern did not convey to facilities' value of shipments in that facility managers who reported that the environmental policy regime was more stringent also reduced the value of their shipments, but the relationship was weak. Only one model (of six) showed a weak statistical relationship ($p<.10$) with the stringency of the regulatory regime

With respect to our control variables, facilities with more workers were more likely to both earn positive profits and increase the value of their shipments. Also, companies operating at the end of the supply chain, and thus producing goods for final consumption, were more likely to earn positive profits, as were companies operating in markets with fewer competitors. Facilities with a local market focus were less likely to earn positive profits and increase the value of their sales than companies operating at the international level, and companies with a national market focus were less likely to increase their value of sales than companies operating at the international level.

In comparing how facilities performed by country, Canadian, French, Hungarian, and to a lesser extent some German and Norwegian facilities all reported shipment values had increased more than US facilities, whereas Japanese facilities reported having decreased shipment values in comparison to US entities. Similarly, US facilities reported that they failed to accrue positive profits to the same extent as Canadian or Hungarian facilities, although they fared better than Japanese organizations. Finally, industrial sector had no relationship with facilities' financial performance.

Hypothesis 3: *Organizations that reduce their environmental impacts face stronger regulatory pressures.* In evaluating the reasons why the facilities in this study reduced their environmental impacts, regulatory pressures appear to have had a strong role. In all instances, the proportion of facilities that had reported a decrease in their environmental impacts also reported being subject to a higher degree of regulatory pressure (see Table 4). More specifically, for each of our environmental impact measures, our results showed that there is a statistically significant difference between a facility's mean reduction in environmental impacts and its degree of regulatory pressure.

These results were corroborated by our bivariate probit analyses (see Annex Tables 3-4). Regulatory pressures were associated with whether companies reduced their environmental impacts in all instances except for reductions in solid waste impacts. Despite the finding that a more stringent regulatory regime was related to a reduced probability that the facilities earned positive profits, pressure from regulators appear to have been an important motivator that encouraged companies to reduce their environmental impacts.

Table 4: Relationship between Decreases in Environmental Impacts and Regulatory Pressures

Significant Decrease or Decrease in the Following Environmental Impacts	F-statistic	p-value
Index of environmental impacts (n=1868)	3.46[†]	0.001***
Use of natural resources (energy, water, etc.) (n=3258)	1.61	0.002***
Solid waste generation (n=3294)	1.47	0.001***
Wastewater effluent (n=2990)	2.65	0.000***
Local or regional air pollution (n=2652)	3.32	0.000***
Global pollutants (*e.g.* greenhouse gases) (n=2149)	1.80	0.001***

[†] Represents t-test statistic.
* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

Hypothesis 4: *Organizations that reduce their environmental impacts seek to increase their internal efficiencies.* With respect to other motivations for reducing environmental impacts, the desire to increase opportunities for cost savings had an important role (see Table 5). For example, 50% of facilities that decreased their environmental impacts also reported that opportunities for cost savings related to environmental activities were very important to their operations. By contrast, 43% of facilities that did not decrease their environmental impacts related to natural resources and also believed that opportunities for cost savings were very important to their operations. Similar results were found for our other environmental impact measures as well as for our bivariate probit modes, offering support for Hypothesis 4.

Hypothesis 5: *Organizations that reduce their environmental impacts have stronger corporate influences.* Our results also showed that the influence of pressures from corporate headquarters also had a statistically significant relationship with whether or not facilities reduced their environmental impacts, offering evidence that supports Hypothesis 5. More specifically, 53% of facilities that reduced their use of natural resources also reported strong influences from corporate headquarters as compared to 43% of facilities that did not reduce their environmental impacts, but still reported strong corporate influences (see Table 5). These relationships were confirmed in our bivariate probit regressions.

Table 5: Relationship between Decreases in Environmental Impacts and Opportunities for Cost Savings and Influences from Corporate Headquarters

	Opportunities for Cost Savings		Influences from Corporate Headquarters	
Significant Decrease or Decrease in the Following Environmental Impacts [†]	Very Important Influence	p-value	Very Important Influence	p-value
Index of environmental impacts (n=1941, 1630)	11.82[††]	0.000***	34.27[††]	0.000***
Use of natural resources (energy, water, etc.) (n=3481, 2888)	50% 43%	0.000***	53% 43%	0.000***
Solid waste generation (n=3523, 2910)	50% 43%	0.000***	51% 44%	0.000***
Wastewater effluent (n=3166, 2644)	50% 45%	0.001***	54% 44%	0.000***
Local or regional air pollution (n=2754, 2290)	52% 46%	0.022**	58% 44%	0.000***
Global pollutants (*e.g.* greenhouse gases) (n=2231, 1848)	53% 45%	0.002***	59% 53%	0.000***

[†] Top values represent facilities decreased their environmental impacts. Bottom values represent facilities that did not decrease their impacts. P-values are from Chi-square tests.
[††] Represents results from analysis of variance statistical tests.
* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

Hypothesis 6: *Organizations that reduce their environmental impacts have stronger internal competencies.* Facilities that had budgets for environmental research and development more frequently reduced their impact upon the natural environment, as did facilities that had a person in charge of their organization's environmental affairs (see Table 6). For instance, 12% of facilities that had a budget for research and development decreased their environmental impact as compared to 8% of facilities that did not decrease their environmental impacts, but had an R&D budget. Similarly, 81% of facilities that had a person in charge of its environmental affairs reported decreased in their environmental impacts as compared to 67% of facilities that did not decrease their environmental impacts, but had a person in charge of environmental affairs. These relationships were further validated by the results of our bivariate probit regressions, offering additional support for Hypothesis 6, which states that organizations that reduce their environmental impacts have stronger internal competencies.

In summary, the findings of our multivariate analyses offer evidence for Hypotheses 1-6. While these results are encouraging, our data are cross-sectional, which makes it difficult to determine the causal link between our variables of interest. Even determining the direction of prediction is a challenge. For example, we know a statistically significant relationship exists between environmental performance and financial performance, but we cannot determine whether a company's improved environmental performance occurred prior to its improved financial performance. As a result, the strength of our findings is tempered to a certain degree. However, our approach was able to control for endogeneity associated with the relationship between environmental and financial performance, which is an improvement from previous studies. It also represents the first study to consider these issues across a cross-section of countries.

The next section offers a more in-depth sector-level analysis that considers whether different facilities operating within some industrial sectors benefited more financially than facilities operating in other sectors.

Table 6: Relationship between Decreases in Environmental Impacts and Opportunities for Cost Savings and Influences from Corporate Headquarters

Significant Decrease or Decrease in the Following Environmental Impacts [†]	Budget for Environmental R&D		Person in Charge of Environmental Affairs	
	Yes?	p-value	Yes?	p-value
Index of environmental impacts (n= 1952, 1998)	31.44[††]	0.000***	89.58[††]	0.000***
Use of natural resources (energy, water, etc.) (n= 3532, 3609)	12% 8%	0.000***	81% 67%	0.000***
Solid waste generation (n= 3576, 3654)	13% 6%	0.000***	80% 66%	0.000***
Wastewater effluent (n= 3204 , 3276)	12% 9%	0.001***	83% 69%	0.000***
Local or regional air pollution (n= 2772, 2839)	14% 9%	0.000***	83% 73%	0.000***
Global pollutants (*e.g.* greenhouse gases) (n= 2246, 2297)	15% 9%	0.000***	86% 72%	0.000***

[†] Top values represent facilities decreased their environmental impacts. Bottom values represent facilities that did not decrease their impacts. P-values are from Chi-square tests.

[††] Represents results from analysis of variance statistical tests.

* Statistically significant at $p \leq 0.10$; ** Statistically significant at $p \leq 0.05$; *** Statistically significant at $p \leq 0.01$

Darnall N., Jolley G.J. & Ytterhus B. 2007. Understanding the relationship between a facility's environmental and financial performance. Johnstone N. (ed.) *Environmental Policy and Corporate Behaviour*. Northampton, MA: Edward Elgar Publishing, in association with Organisation for Economic Co-Operation and Development (OECD), Paris, pp. 213-259.

VII. Sectoral Analysis

In the previous section we found significant statistical relationships between a company's environmental and financial performance. This section considers these relationships in greater detail using a targeted sectoral analysis. We began this analysis by first considering how the environmental/financial performance relationship differed for companies operating in "clean" industrial sectors and in "dirty" industrial sectors.

Does the Environmental/Financial Performance Relationship Differ among "Dirty" and "Clean" Sectors?

In assessing the relationship between facilities' environmental and financial performance across dirty and clean sectors, we hypothesized that larger financial benefits would accrue to facilities operating in dirtier industries and that also reduced their environmental impacts. Our rationale was that these companies could reduce their impacts to the natural environment at a lower cost because they have more "low hanging fruit" that can be picked more easily. However, achieving the same environmental improvements for companies operating in cleaner industrial sectors would cost significantly more. As a result, the positive profit for environmental actions taken by facilities operating in clean sectors was expected to be less.

Relying on Mani and Wheeler (1997) and Gallagher and Ackerman's (2000) classification of "clean" and "dirty" manufacturing sectors, we assessed whether the relationship between environmental and financial performance differed. In evaluating environmental performance, we evaluated whether or not companies reduced their environmental impacts. Table 7 compares whether clean sectors differed from dirty sectors in their ability to earn positive profits. The results show that a greater proportion of more facilities that accrued positive profits operated in dirty sectors, as compared to the proportion of facilities that did not earn positive profits and operated in the same sectors. Approximately 4.4% more companies that earned positive profits operated in dirty sectors. By contrast, about 5% *fewer companies* earned positive profits and operated in cleaner sectors.

Table 7: Relationship between Financial Performance and Clean versus Dirty Sectors[+]

Facility Characteristic	**Profit**[†] positive/ break even or negative
Clean sector	31.7%***
(n=3939; n=3966)	36.8%
Dirty sector	30.8%***
(n=3939; n=3966)	26.4%

+ Clean sectors are ISICs 17, 28, 29, 31, 33, and 35. Dirty sectors are ISICs 21, 24, 26, and 27.
† Top values represent facilities that earned positive profits the past three years and that operated in a particular sector. Bottom values represent facilities that did not accrue positive profits and operated from the same sector.
* Statistically significant at $p \leq .10$; ** Statistically significant at $p \leq .05$; *** Statistically significant at $p \leq .01$

To consider these relationships further, we compared companies' environmental practices to their financial performance. In comparing differences among the clean sectors and the dirty sectors, companies operating in dirty sectors reduced their environmental impacts proportionately to clean sector companies (see Table 8). For example, 54.3% of companies in dirty sectors that earned positive profits reported that they also had reduced their use of natural resources. Similarly, 54.5% of clean sector facilities that accrued positive profits also reduced their impacts to natural resources.

Table 8: Relationship between Clean/Dirty Sectors[+] with Positive Financial Performance and Reduction in Environmental Impact

	Facility Comparisons[†]	
Reductions in	**Profit in clean sectors** positive/ break even or negative [1]	**Profit in dirty sectors** positive/ break even or negative [2]
Use of natural resources	54.5%	54.3%
(n = 1129, 1032)	50.8%	52.1%
Solid waste generation	56.1%	58.5%*
(n= 1151, 1044)	55.3%	52.4%
Wastewater effluent	39.6%	46.2%
(n= 1003, 949)	38.4%	43.0%
Local or regional air pollution	39.8%	46.4%
(n= 850, 853)	35.3%	44.0%
Global pollutants	35.7%	36.1%
(n= 684, 699)	34.8%	33.2%

+ Clean sectors are ISICs 17, 28, 29, 31, 33, and 35. Dirty sectors are ISICs 21, 24, 26, and 27.

† Top values represent facilities within the sector that earned positive profits during the past three years and that indicated they had reduced their environmental impacts. Bottom values represent facilities within the sector that had did not accrue positive during the past three years and that reported reduced environmental impacts.

* Statistically significant at $p \leq .10$; ** Statistically significant at $p \leq .05$; *** Statistically significant at $p \leq .01$

In comparing differences within the clean sectors and the dirty sectors, in only one instance did facilities that operated in dirty sectors, and that accrued positive profits, also reduced their impact upon the natural environment. More specifically, 58.5% of companies in dirty sectors that earned positive profits reported that they also had reduced their solid waste generation. Clean sector facilities that earned positive profit did not reduce their impacts to natural resources, solid waste, wastewater, air pollution and global pollutants any more than facilities in the same sectors that did not accrue positive profits. In sum, our findings indicate that there was no statistically significant relationship between facilities' positive financial performance and their environmental performance in both the "dirtiest" and "cleanest" sectors over the last three years. It is important to note, however, that within dirty and clean sectors, there is likely to be differences in the extent to which these companies have reduced their environmental impacts. As such, high environmental performers may be pooled with low environmental performers within each sector. These differences may create the appearance that cleaner facilities do not benefit financially. For this reason, in addition to drawing comparisons across dirty and clean sectors, future research should study the extent to which companies differ within these sectors.

Does the Environmental/Financial Performance Relationship Differ among "Early Movers" and "Late Movers"?

In comparing facilities that operated in "early environmental mover" sectors and "late environmental mover" sectors, we compared whether companies within the chemical industry derived greater financial benefits from their environmental actions than companies operating in the pulp and paper sector (Hart and Ahuja, 1996). These sectors were chosen because the chemical industry has been participating in voluntary environmental programs since the 1980s to improve its overall environmental performance (Khanna and Damon, 1999). We therefore defined these companies as "early movers" within the most polluting industries when it came to addressing their environmental impacts. By contrast, the pulp and paper industry began at a later time to consider voluntarily reducing its environmental impacts across the entire sector (Hart and Ahuja, 1996). For this reason, we considered it a "late mover" among the most polluting manufacturing sectors when it came to reducing

its environmental impacts. The environmental and financial performance of companies operating within these two sectors was then compared.

Our hypothesis was that late movers would derive more low-cost environmental improvements (Hart and Ahuja 1996), and therefore reap greater financial benefits than early movers. By contrast, "early movers" would already have collected the benefits of their low-cost environmental improvements. As a result, their "low hanging fruit" would have long since been picked, and they would be less likely to derive a financial benefit from their environmental improvements. This hypothesis is based on the notion that there are diminishing returns on environmental actions.

The results of our chi-square analyses showed that there were no statistical differences among early or late movers and whether their reduced impacts to the natural environment were associated with earning positive profits (see Table 9).

Table 9: Relationship between Early- /Late- Mover Sectors[+] with Positive Financial Performance and Reduction in Environmental Impact

	Facility Comparisons[†]	
Reductions in	**Profit for Early Movers** positive/ break even or negative [1]	**Profit for Late Movers** positive/ break even or negative [2]
Use of natural resources	53.0%	55.0%
(n= 262, 126)	50.6%	67.4%
Solid waste generation	54.9%	59.2%
(n= 266, 129)	47.6%	60.4%
Wastewater effluent	46.8%	52.6%
(n= 250, 121)	43.0%	62.2%
Local or regional air pollution	50.9%	42.7%
(n= 233, 110)	50.0%	50.0%
Global pollutants	39.2%	35.7%
(n= 188, 95)	28.6%	43.6%

+ Early movers are chemical companies in ISIC 24. Late movers are pulp and paper companies in ISIC 21.
[†] Top values represent facilities within the sector that earned positive profits during the past three years and that indicated they had reduced their environmental impacts. Bottom values represent facilities within the sector that had did not accrue positive during the past three years and that reported reduced environmental impact.
* Statistically significant at $p \leq .10$; ** Statistically significant at $p \leq .05$; *** Statistically significant at $p \leq .01$

There also was no consistent pattern suggesting that late movers who accrued positive profits and reduced their environmental impacts did so more frequently than early movers. However, it is important to note, that this study evaluated facilities' activities for one point in time and would benefit from data that were collected at over multiple time periods. Time series panel data would allow us to compare facility responses longitudinally and determine the temporal ordering of specific events. Such information would offer more rigorous evidence for the relationships we have studied.

Relationships between financial performance and environmental actions among "low-growth" and "high-growth" industries

In the final component of our sector analysis, we considered whether companies operating in "high growth" industries differed from companies operating in "low growth" sectors in whether they derived positive financial benefits from their environmental actions. This analysis was motivated by prior research suggesting that industry growth facilitates the financial benefits an organization derives from its environmental improvements (Russo and Fouts, 1997).

According to Russo and Fouts (1997), industry growth moderates the relationship between environmental and economic performance for several reasons. First industry growth accelerates the maturation of technologies within that industry and as a result, firms that invest in pollution prevention have a higher prospective return than firms in low-growth industries. The argument is that the newness of the capital stock improves a company's financial and environmental performance. Moreover, high-growth industries have a more fluid (rather than bureaucratic) management style, and may capture additional gains by going beyond compliance because of their innovative culture. Finally, it is easier to create a reputation for environmental stewardship in a high-growth industry rather than a low-growth industry.

To determine which companies operated in high and low growth sectors, we asked our survey respondents whether or not they experienced a change in the value of their shipments. Companies operating in sectors with the largest weighted score in the change in the value of their shipments (food) were considered "high growth" industries, whereas companies operating in sectors with the lowest change in the value of their shipments (electronics) were considered "low growth" industries.[5]

Our results showed that companies operating in high growth sectors and that earned positive profits reduced their environmental impacts to natural resources and global pollutants more than companies in this same sector that did not earn positive profits (see Table 10). However, there were no statistical differences among low-growth and high-growth sectors and whether or not they reduced their solid waste, wastewater effluent, and local or regional air pollution.

In sum, compared to our prior two sector comparisons, associations between environmental improvements and facilities' financial performance existed, but were modest. However, unlike the comparison among clean and dirty sectors and early and late movers, some differences did exist among companies operating in high growth sectors. That is, high growth sector facilities that accrued positive profits reduced their environmental impacts to natural resources and global pollutants more than facilities in this same sector that did not accrue positive profits. Our findings therefore do support the arguments put forward by Russo and Fouts (1997) suggesting that facilities in high growth sectors are more likely to derive positive financial benefits from their environmental actions.

Table 10: Relationship between Low- /High-growth Sectors[+] with Positive Financial Performance and Reduction in Environmental Impact

	Facility Comparisons[†]	
Reductions in	**Profit for Low-growth industry** positive/ break even or negative [1]	**Profit for High growth industry** positive/ break even or negative [2]
Use of natural resources	55.0%	57.2%***
(n= 358, 126)	67.4%	39.5%
Solid waste generation	59.3%	48.2%
(n= 349, 129)	60.4%	46.1%
Wastewater effluent	52.6%	44.4%
(n= 355, 121)	62.2%	40.0%
Local or regional air pollution	42.7%	32.5%
(n= 267, 110)	50.0%	36.1%
Global pollutants	35.7%	31.6%***
(n= 214, 95)	43.6%	19.2%

+ Low growth facilities are in electronics (ISIC 31). High growth facilities are in food products (ISIC 15).
† Top values represent facilities within the sector that earned positive profits during the past three years and that indicated they had reduced their environmental impacts. Bottom values represent facilities within the sector that had did not accrue positive during the past three years and that reported reduced environmental impacts.
* Statistically significant at $p \leq .10$; ** Statistically significant at $p \leq .05$; *** Statistically significant at $p \leq .01$

The results of all our sector analysis are summarised in Table 11. Overall, they indicate that facilities did not derive financial benefits as a result of facilities' reductions in their environmental impacts. In high-growth sectors there were some modest differences. More specifically, facilities operating in high-growth sectors that accrued positive profits were able to reduce their use of natural resources and global pollutants more than companies operating in the same sector that did not accrue positive profits. However, it is important to note that there are likely to be differences among companies within each of the sectors we compare. For example, facilities operating in clean sectors have a range of environmental performance, as do facilities operating in dirty sectors. By aggregating the facilities, and evaluating environmental performance at one point in time, we cannot account for these distinctions. Such differences may create the appearance that cleaner facilities within cleaner sectors do not benefit financially. For this reason, in addition to drawing comparisons across different sectors, future research should study the extent to which companies differ within the same sectors over time.

Table 11: Increased profits and Environmental Actions among Different Industrial Sectors

Comparison Group	Earned Positive Profits Associated with Reduced Impacts to the Environment
• Facilities Operating in Clean versus Dirty Sectors	No significant differences
• Early versus Late Movers Operating in Dirty Sectors	No significant differences
• Facilities Operating in Low- versus High-growth Industries	Modest differences—High growth sector that accrued positive profits reduced their use of natural resources and global pollutants more than companies in the same sector that did not accrue positive profits.

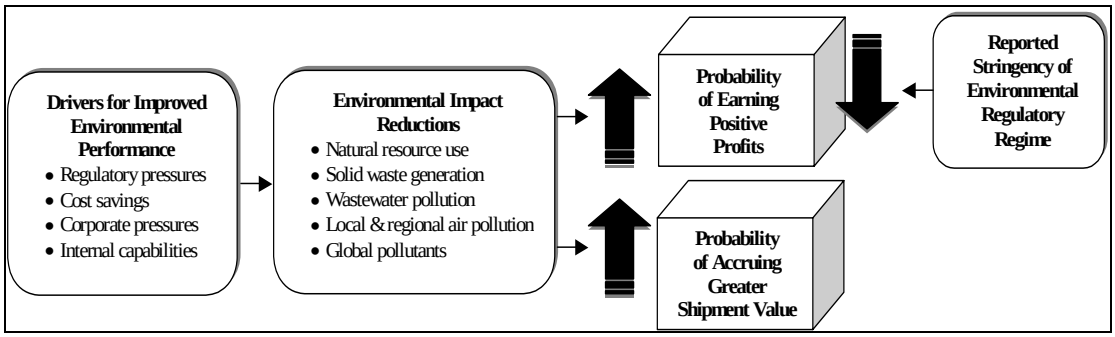
VIII. Discussion and Conclusions

This study takes an important step in evaluating the relationship between a company's environmental and financial performance by studying manufacturing facilities operating in seven different countries, and by controlling for specification problems ignored in most prior studies. The results contribute to a growing body of work indicating that higher levels of environmental performance lead to greater financial returns (Khanna and Damon, 1999; Hart and Ahuja, 1996; Klassen and McLaughlin, 1996; Konar and Cohen, 1997; Russo and Fouts, 1997; Rivera, 2002). More specifically, this study showed that facilities that reduced their environmental impacts also demonstrated a greater probability of earning positive profits. Moreover, in almost every instance, a facility's improved environmental performance was also related to an increased probability of improving the value of its shipments.

By contrast, the stringency of the environmental policy regime was associated with a reduction in companies' financial opportunities. These findings offer evidence for the traditional economic view that that the current regulatory requirements constraints an organization's financial opportunities (Friedman, 1970; Christiansen and Haveman, 1981; Conrad and Morrison, 1989; Denison, 1979; Jaffe and Palmer, 1997; Lave, 1973; Norsworthy, Harper and Kunze, 1979). However, for the facilities in this study, these constraints were mitigated at least partially if the facility took steps to reduce its impacts to the natural environment. Pressure from regulators was strongly related to reductions in environmental impacts. As such, it appears that regulatory pressures are critical to achieving greater environmental improvements, and that while the stringency of the regulatory regime comes at a cost to the organization, these costs may be offset if the facility improves its environmental performance.

With respect to facilities' value of sales, the reported stringency of environmental policies had only a marginal effect. Our findings are illustrated in Figure 1.

Figure 1: Drivers, Environmental Performance and Probabilities for Improved Business Performance



For managers who are considering improving their environmental performance, our findings provide important information that may help them gain organizational support for implementing or expanding its proactive environmental strategy. Such strategies may translate into improved public image and reputation and greater market share because these companies are in a position to market themselves as environmentally friendly organizations (Russo and Fouts, 1997). Moreover, companies that improve their environmental performance faster than their competitors may also enjoy the advantages of being "first movers," and have an opportunity to receive greater purchasing preference than less environmentally conscious companies, thus fortifying their market positions (Darnall, Gallagher and Andrews, 2002).

Our findings further suggest that organizations which seek to improve their environmental performance are not necessarily acting against conventional economic wisdom (Porter and van der Linde, 1995). Instead, facilities in the seven countries we evaluated appear to be reducing their environmental impacts and in the process are benefiting substantially by increasing resource productivity and cost savings. By improving their environmental performance, these companies may be marketing their environmental actions as selling points for their products, and as means to differentiate its products from their competitors (Darnall, Gallagher and Andrews, 2002). Doing so also helps increase their recognition for being an environmental leader, which may explain why these companies benefit from more opportunities to earn positive profits and increase the value of their sales.

With respect to our sector analyses, facilities that operated in dirty and clean sectors, and in early mover and later mover sectors did not differ in whether or not they earned positive profits from their improved environmental performance. High-growth sectors that accrued positive profits had more often reduced their use of natural resources and global pollutants than facilities in the same sector that did not accrue positive profits. However, these differences were modest, and for this reason, our overall conclusion therefore is that, based on the facilities in this sample, there is little empirical support to suggest that there are differences among industry sectors. These results are further corroborated by the lack of statistical significance found in our bivariate probit regression models.

Limitations and Future Research

There are a number limitations to our research design. First, our data were obtained using self-reported information rather than secondary sources. Traditional studies evaluating environmental

performance have generally relied on the US 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 cross-country comparisons a challenge. Similarly, prior studies that evaluate the relationship between environmental strategy and business performance have relied on stock performance, pricing, sales, intangible assets, and return on sales, equity, investment and assets. However, these data are available only for publicly traded firms and therefore a facility-level study of both publicly traded and privately owned enterprises is not possible. By focusing on a broader population of organizations, we have sacrificed greater specificity in our analysis. Such a sacrifice, however, also strengthens our work because our results have broader applicability.

Second, because our data are for a panel of companies at a single point in time, it is difficult to assess the predictive link between our variables of interest. For example, the results showed a statistically significant relationship existed between a company's improved environmental performance and financial performance. However, we cannot determine whether a company's improved environmental performance occurred prior to or after its improved financial performance. Rather, our findings show strong associations among our variables of interest. Future research would benefit from data that were collected longitudinally. Time series panel data would allow us to compare facility responses over multiple periods and determine the temporal ordering of specific events. Such information would offer more rigorous evidence for the relationships identified in this study.

A third limitation of this research is that our self-reported data may be biased in that environmental managers may have misrepresented their facility's environmental impacts and business performance From the onset of this study, we believed that respondents would consist of facilities with more ambitious environmental strategies. We further believed that respondents would want to describe their environmental strategies as being more rigorous than they actually were.[6] While our results suggest that facility managers were not reluctant to identify the shortcomings of their environmental and financial performance, the potential bias would tend to reduce the variance in our sample. As such, we would be less likely to find statistically significant relationships. However, by finding statistically significant relationships, additional evidence is offered about the strength of the relationship between the variables in our models (Hardin and Hilbe, 2001).

One way to increase the rigor of this research would be to compare the cross-country results of this study with the results of *country-specific analyses* that draw on data from other sources. For example, in estimating a facility's financial performance, country-specific publicly available financial data could be gathered to supplement the OECD database. Similarly, combining the data used in this study with publicly available data related to facilities' environmental violations and fines, and toxic environmental releases would provide a more complete view of a company's environmental performance. These additional data would allow for analyses that would assess the specific types of regulatory approaches (notices of violation, fines, and information-based policies) that increase the probability that an organization will reduce its impacts to the natural environment and benefit financially. Since the same type of data are not collected in every country, they cannot be combined in a cross-country study. However, more in-depth country-specific studies could help corroborate the results of this study.

There is still much to learn about the relationship between environmental regulations, facilities' environmental performance, and the impact both factors have on an organization's financial performance. This study offers evidence of the robustness of these relationships even after controlling for the endogenous nature of a facility's environmental performance. It also represents the first study to consider these issues empirically across multiple international settings. The findings of our research

are useful to policy makers, managers, and researchers alike in helping them understand the potential benefits facilities can accrue by undertaking ambitious environmental strategies.

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This chapter contains key findings from the OECD survey, "Environmental Policy Tools and Firm-level Management." The work is the product of eight teams of researchers in seven countries and responses from almost 4,200 environmental managers who were generous in taking the time to participate in this research. The endeavor was challenging at best. We thank everyone involved.

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Everyone who was involved in this study deserves a share of the praise. However, the authors accept responsibility for the ideas and recommendations that are presented. They also accept responsibility for any errors or omissions.

Notes

1 Almost all environmental data suffer from some type of self-reporting bias. Even environmental compliance data and Toxic Release Inventory data are self-reported and can be misrepresented. The only type of environmental data immune from self-reporting bias is that collected by inspectors.

2 33/50 chemicals represent the 17 most toxic chemicals in the US that are released to the environment. Companies participating in the program were required to reduce their emissions of 17 TRI pollutants by 33% by 1992 and achieve 50% reductions by 1995 (Davies et al., 1996).

3 Cronbach's alpha ranges between 0 – 1. When alpha is .8 or over, the set of indicators is often deemed sufficiently reliable for confirmatory research. Alpha scores of between .6 and .8 are sufficient for newly developed measures (Nunnally, 1978).

4 While relying on a classification of manufacturing companies in OECD countries would have been more appropriate, such a classification did not exist.

5 Given that the survey was implemented in 2003 and thus covers the period after the speculative bubble in the ITC sector had burst, results in this area need to be treated with caution.

6 As noted earlier, an often overlooked point is that that TRI data, as well as most compliance data, are self-reported, and are therefore subject to the same manipulation as data obtained from surveys..

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Annex Table 1: Relationship between Facilities' Positive Profits and Reductions in Environmental Impacts

	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	
Variable	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**
Environmental performance (see column heading)	0.219***	0.056	0.867***	0.290	0.907***	0.358	1.238***	0.198	1.200***	0.266	0.926***	0.219
Stringency of environmental policy	-0.141**	0.060	-0.116***	0.043	-0.106***	0.041	-0.130***	0.038	-0.117***	0.043	-0.120**	0.054
Mkt. concentration is < 5 competitors	0.289***	0.094	0.214***	0.069	0.224***	0.069	0.187***	0.065	0.221***	0.070	0.278***	0.084
Mkt. concentration is b/t 5-10 competitors	0.027	0.084	0.096*	0.060	0.093	0.059	0.071	0.054	0.045	0.058	0.073	0.073
Number of employees in the firm	1.7e-05***	7.0e-06	1.3e-05***	5.3e-06	1.3e-05***	5.5e-06	1.5e-05***	5.6e-06	1.3e-05***	5.3e-06	1.3e-05***	5.6e-06
Customer = end of supply chain	0.465***	0.170	0.194*	0.119	0.172	0.120	0.186	0.110	0.264**	0.125	0.314**	0.146
Customer = middle of supply chain	0.322**	0.164	0.125	0.116	0.120	0.116	0.138	0.106	0.180	0.119	0.204	0.140
Market scope = local	-0.413***	0.162	-0.206*	0.114	-0.169	0.113	-0.203	0.108	-0.191*	0.114	-0.383***	0.143
Market scope = national	-0.054	0.092	-0.055	0.066	-0.034	0.065	-0.008	0.058	-0.023	0.062	-0.028	0.079
Market scope = neighbouring counties	-0.100	0.126	-0.102	0.087	-0.099	0.087	-0.141*	0.078	-0.119	0.086	-0.098	0.112
Firm is traded on stock market	0.153*	0.092	0.071	0.073	0.045	0.072	0.014	0.063	0.040	0.070	0.076	0.082
Firm's head office is in a foreign country	0.070	0.111	0.077	0.080	0.081	0.079	0.099	0.071	0.113	0.078	0.055	0.096
Food, beverage and tobacco (15-16)	0.413	0.332	0.179	0.239	0.338	0.240	0.159	0.234	0.088	0.240	0.293	0.275
Textiles, leather and footwear (17-19)	0.155	0.357	-0.267	0.260	-0.028	0.256	-0.152	0.259	-0.157	0.265	0.013	0.304
Pulp, paper, publishing and printing (20-22)	0.254	0.330	-0.029	0.242	0.125	0.236	-0.027	0.235	-0.108	0.243	0.020	0.276
Chemical, rubber, plastics and fuel (23-25)	0.418	0.323	0.185	0.238	0.298	0.230	0.218	0.230	0.070	0.236	0.234	0.267
Basic metal and fabricated products (27-28)	0.535	0.355	0.158	0.260	0.308	0.257	0.117	0.254	-0.026	0.259	0.438	0.299
Machinery and equipment (29-33)	0.331	0.322	0.048	0.234	0.184	0.231	-0.004	0.227	-0.107	0.234	0.109	0.266
Transportation equipment (34-35)	0.173	0.321	-0.134	0.233	0.036	0.231	-0.031	0.225	-0.135	0.237	-0.083	0.264
Furniture (36)	0.298	0.344	0.078	0.248	0.199	0.243	0.107	0.242	-0.006	0.250	0.047	0.285
Recycling (37)	0.440	0.414	0.013	0.294	0.143	0.288	0.231	0.294	-0.288	0.295	0.131	0.346
Canada	0.253	0.178	0.329**	0.139	0.307**	0.142	0.152*	0.144	0.439***	0.145	0.344**	0.167
France	-0.193	0.165	-0.233*	0.127	-0.064	0.127	-0.198	0.119	0.139	0.147	-0.127	0.153
Germany	0.114	0.131	-0.114	0.098	0.011	0.098	0.049	0.095	0.082	0.099	0.036	0.125
Hungary	0.414***	0.167	0.210*	0.124	0.232*	0.121	0.336***	0.116	0.249**	0.119	0.381***	0.150
Japan	-0.599***	0.124	-0.676***	0.102	-0.664***	0.103	-0.408***	0.134	-0.387***	0.144	-0.589***	0.113
Norway	0.026	0.158	-0.069	0.123	-0.114	0.129	0.044	0.117	0.227	0.142	0.082	0.146
Constant	-0.083	0.393	-0.029	0.315	-0.280	0.375	-0.279	0.286	-0.249	0.325	-0.124	0.337
Observations	1390		2362		2188		2389		1939		1570	
Wald Chi2(48)	303.76***		489.01***		848.20***		506.07***		677.12***		400.60***	
Rho	-0.165		-0.487		-0.774		-0.511		-0.743		-0.507	
Wald test of rho=0 Chi2(1)	5.295***		4.589**		8.591***		3.117*		5.242**		8.534***	

* Statistically significant at $p \leq .10$; ** Statistically significant at $p \leq .05$; *** Statistically significant at $p \leq .01$

Annex Table 2: Relationship between Facilities' Positive Shipment Values and Reductions in Environmental Impacts

	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**	
Variable	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**
Environmental performance (see column heading)	0.088	0.058	0.729***	0.279	0.669***	0.234	0.741**	0.309	0.739***	0.290	1.007***	0.276
Stringency of environmental policy	-0.029	0.061	-0.072*	0.043	-0.044	0.042	-0.037	0.046	-0.076	0.051	-0.077	0.056
Mkt. concentration is < 5 competitors	-0.065	0.094	0.008	0.066	0.010	0.066	0.034	0.070	-0.014	0.075	-0.048	0.083
Mkt. concentration is b/t 5-10 competitors	-0.096	0.084	-0.034	0.059	-0.021	0.059	-0.022	0.062	-0.046	0.068	-0.081	0.073
Number of employees in the firm	2.8e-08***	7.7e-06	2.2e-08***	7.0e-09	2.3e-08***	7.2e-09	2.4e-08***	7.3e-09	2.3e-08***	7.1e-09	2.3e-08***	6.9e-09
Customer = end of supply chain	-0.140	0.169	-0.101	0.119	-0.147	0.120	-0.049	0.130	-0.103	0.142	-0.135	0.144
Customer = middle of supply chain	-0.231	0.163	-0.178	0.117	-0.216*	0.117	-0.134	0.127	-0.210	0.138	-0.226	0.141
Market scope = local	-0.419**	0.172	-0.421***	0.123	-0.459***	0.122	-0.370***	0.127	-0.484***	0.143	-0.404***	0.149
Market scope = national	-0.162*	0.092	-0.177***	0.068	-0.182***	0.067	-0.143**	0.070	-0.170**	0.074	-0.183**	0.080
Market scope = neighbouring counties	0.079	0.119	-0.132	0.083	-0.126	0.084	-0.121	0.089	-0.138	0.097	-0.018	0.105
Firm is traded on stock market	-0.035	0.090	-0.101	0.068	-0.090	0.068	-0.094	0.071	-0.092	0.075	-0.124	0.079
Firm's head office is in a foreign country	-0.109	0.104	-0.084	0.075	-0.082	0.075	-0.088	0.078	-0.087	0.083	-0.075	0.090
Food, beverage and tobacco (15-16)	0.097	0.337	0.078	0.237	0.156	0.224	0.092	0.239	-0.040	0.264	0.219	0.314
Textiles, leather and footwear (17-19)	-0.208	0.368	-0.477*	0.265	-0.373	0.250	-0.366	0.266	-0.445	0.294	-0.098	0.338
Pulp, paper, publishing and printing (20-22)	-0.215	0.337	-0.247	0.239	-0.189	0.223	-0.217	0.242	-0.288	0.266	-0.150	0.316
Chemical, rubber, plastics and fuel (23-25)	-0.007	0.329	-0.038	0.233	0.010	0.215	0.048	0.235	-0.054	0.257	0.092	0.305
Basic metal and fabricated products (27-28)	-0.336	0.357	-0.175	0.257	-0.135	0.243	-0.202	0.259	-0.318	0.284	-0.142	0.334
Machinery and equipment (29-33)	-0.173	0.329	-0.163	0.232	-0.128	0.217	-0.171	0.234	-0.208	0.257	-0.115	0.306
Transportation equipment (34-35)	-0.106	0.329	-0.226	0.232	-0.150	0.216	-0.101	0.232	-0.192	0.257	-0.087	0.305
Furniture (36)	0.103	0.347	-0.012	0.245	0.026	0.228	0.124	0.247	0.028	0.270	0.051	0.320
Recycling (37)	-0.462	0.423	-0.472	0.302	-0.332	0.280	-0.248	0.311	-0.433	0.321	-0.568	0.388
Canada	0.426***	0.155	0.536***	0.123	0.540***	0.125	0.473***	0.143	0.671***	0.135	0.426***	0.148
France	0.449***	0.166	0.416***	0.131	0.479***	0.123	0.400***	0.131	0.639***	0.142	0.458***	0.153
Germany	0.109	0.124	0.146	0.098	0.240***	0.093	0.264***	0.096	0.295***	0.101	0.007	0.121
Hungary	0.608***	0.151	0.379***	0.118	0.424***	0.114	0.495***	0.118	0.489***	0.120	0.544***	0.143
Japan	-0.234*	0.125	-0.293***	0.097	-0.256***	0.099	-0.125	0.112	-0.158	0.111	-0.285**	0.115
Norway	0.224	0.159	0.124	0.120	0.097	0.124	0.261**	0.124	0.380***	0.139	0.211	0.149
Constant	0.088	0.058	-0.261	0.302	-0.371	0.305	-0.515*	0.306	-0.266	0.335	-0.246	0.365
Observations	1396		2379		2406		2202		1947		1575	
Wald Chi2(48)	223.24***		382.23***		376.14***		367.95***		335.88***		326.33***	
Rho	-0.112		-0.493		-0.483		-0.449		-0.398		-0.522	
Wald test of rho=0 Chi2(1)	2.444		5.186**		7.376***		3.854**		3.716**		5.576***	

* Statistically significant at $p \leq .10$; ** Statistically significant at $p \leq .05$; *** Statistically significant at $p \leq .01$

Annex Table 3: Determinants of Improved Environmental Performance
First Stage Estimation of Profit Model

	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**	
Variable	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	S.E.	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**
Regulatory influences (factor analysis)	0.102***	0.046	0.059*	0.033	0.008	0.033	0.097***	0.034	0.116***	0.038	0.115***	0.043
Cost savings of environmental practices	0.164***	0.060	0.119**	0.056	0.108*	0.061	0.062	0.049	0.008	0.046	0.067	0.056
Influence of corporate headquarters	0.195***	0.059	0.126***	0.043	0.144***	0.043	0.052	0.040	0.151***	0.054	0.224***	0.056
Facility has budget for environmental R&D	0.203*	0.110	0.206**	0.086	0.336***	0.090	0.150**	0.078	0.212**	0.087	0.246***	0.099
Person in charge of environmental affairs	0.444***	0.098	0.381***	0.066	0.295***	0.067	0.353***	0.068	0.218***	0.072	0.393***	0.094
Number of employees in the facility	1.2e-04**	5.2e-05	1.2e-04***	4.3e-05	1.4e-04***	3.7e-05	1.9e-04***	4.9e-05	1.5e-04***	3.9e-05	1.5e-04***	4.4e-05
Food, beverage and tobacco (15-16)	0.167	0.321	0.119	0.230	-0.497**	0.234	0.278	0.246	-0.001	0.242	-0.215	0.291
Textiles, leather and footwear (17-19)	0.279	0.352	0.296	0.255	-0.218	0.256	0.323	0.272	0.034	0.273	-0.005	0.329
Pulp, paper, publishing and printing (20-22)	0.221	0.319	0.191	0.233	-0.210	0.236	0.309	0.249	0.026	0.244	-0.021	0.292
Chemical, rubber, plastics and fuel (23-25)	0.180	0.313	0.171	0.226	-0.207	0.231	0.152	0.242	-0.001	0.237	-0.134	0.283
Basic metal and fabricated products (27-28)	0.251	0.340	0.005	0.254	-0.397	0.256	0.214	0.268	-0.061	0.265	-0.203	0.315
Machinery and equipment (29-33)	0.163	0.312	0.078	0.226	-0.341	0.229	0.266	0.241	0.005	0.236	-0.073	0.282
Transportation equipment (34-35)	0.236	0.312	0.196	0.224	-0.332	0.228	0.095	0.240	-0.172	0.235	0.010	0.281
Furniture (36)	-0.212	0.331	0.039	0.239	-0.315	0.243	0.015	0.257	-0.200	0.251	-0.032	0.300
Recycling (37)	0.538	0.381	0.312	0.280	0.004	0.285	-0.104	0.303	0.492*	0.298	0.429	0.343
Canada	-0.044	0.150	-0.065	0.125	0.099	0.125	0.155	0.133	-0.216*	0.132	0.104	0.149
France	-0.030	0.163	0.235**	0.127	-0.095	0.124	0.182	0.127	-0.326**	0.140	0.037	0.160
Germany	0.238*	0.127	0.374***	0.096	0.064	0.096	0.029	0.101	0.060	0.106	0.563***	0.121
Hungary	-0.229	0.144	0.099	0.110	-0.010	0.110	-0.331***	0.113	-0.092	0.114	-0.030	0.141
Japan	0.081	0.112	0.240***	0.094	0.220**	0.094	-0.199**	0.097	-0.093	0.101	0.378***	0.109
Norway	-0.168	0.157	0.244**	0.124	0.446***	0.128	0.015	0.125	-0.270**	0.137	0.072	0.156
Constant	-1.529***	0.373	-1.182***	0.297	-0.549*	0.314	-0.880***	0.303	-0.695***	0.311	-1.694***	0.351
Observations	1390		2362		2188		2389		1939		1570	
Wald Chi2(48)	303.76***		489.01***		848.20***		506.07***		677.12***		400.60***	
Rho	-0.165		-0.487		-0.774		-0.511		-0.743		-0.507	
Wald test of rho=0 Chi2(1)	5.295***		4.589**		8.591***		3.117*		5.242**		8.534***	

* Statistically significant at $p \leq .10$; ** Statistically significant at $p \leq .05$; *** Statistically significant at $p \leq .01$

Annex Table 4: Determinants of Improved Environmental Performance
First Stage Estimation of Value of Shipments Model

	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	
Variable	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**	**Coeffic.**	**S.E.**
Regulatory influences (factor analysis)	0.103**	0.046	0.058*	0.033	0.011	0.033	0.115***	0.037	0.126***	0.040	0.117***	0.043
Cost savings of environmental practices	0.169***	0.060	0.142***	0.048	0.142***	0.047	0.094*	0.050	0.041	0.050	0.092*	0.054
Influence of corporate headquarters	0.196***	0.059	0.143***	0.043	0.175***	0.042	0.062	0.047	0.183***	0.049	0.213***	0.055
Facility has budget for environmental R&D	0.224**	0.108	0.236***	0.084	0.384***	0.086	0.171**	0.086	0.243***	0.092	0.296***	0.094
Person in charge of environmental affairs	0.415***	0.098	0.330***	0.068	0.240***	0.066	0.325***	0.073	0.171**	0.080	0.360***	0.096
Number of employees in the facility	1.2e-04**	5.3e-05	1.1e-04**	4.6e-05	1.8e-04***	5.1e-05	1.0e-04**	4.2e-05	1.3e-04***	4.2e-05	1.3e-04***	4.5e-05
Food, beverage and tobacco (15-16)	0.131	0.321	0.089	0.229	-0.478**	0.224	0.287	0.239	0.032	0.250	-0.196	0.312
Textiles, leather and footwear (17-19)	0.267	0.353	0.284	0.254	-0.185	0.245	0.373	0.263	0.069	0.279	0.035	0.347
Pulp, paper, publishing and printing (20-22)	0.208	0.320	0.204	0.231	-0.187	0.225	0.359	0.241	0.060	0.251	0.009	0.311
Chemical, rubber, plastics and fuel (23-25)	0.177	0.314	0.184	0.225	-0.157	0.219	0.180	0.235	0.051	0.243	-0.079	0.304
Basic metal and fabricated products (27-28)	0.267	0.340	0.018	0.251	-0.301	0.243	0.232	0.261	0.006	0.270	-0.130	0.334
Machinery and equipment (29-33)	0.176	0.313	0.097	0.224	-0.288	0.218	0.323	0.233	0.055	0.243	-0.025	0.304
Transportation equipment (34-35)	0.223	0.312	0.192	0.223	-0.286	0.216	0.159	0.233	-0.093	0.241	0.054	0.302
Furniture (36)	-0.185	0.332	0.081	0.237	-0.253	0.231	0.133	0.248	-0.121	0.257	0.027	0.320
Recycling (37)	0.515	0.383	0.287	0.285	-0.006	0.280	-0.068	0.303	0.595**	0.301	0.502	0.366
Canada	-0.064	0.149	-0.089	0.124	0.080	0.124	0.158	0.133	-0.262**	0.131	0.116	0.147
France	-0.054	0.164	0.214*	0.127	-0.103	0.125	0.182	0.129	-0.331***	0.139	0.045	0.161
Germany	0.240*	0.127	0.383***	0.096	0.064	0.095	0.058	0.099	0.074	0.104	0.587***	0.120
Hungary	-0.248*	0.143	0.091	0.109	-0.028	0.110	-0.336***	0.113	-0.122	0.113	-0.026	0.141
Japan	0.064	0.113	0.235***	0.094	0.227**	0.094	-0.174*	0.096	-0.096	0.099	0.347***	0.109
Norway	-0.171	0.157	0.245**	0.123	0.480***	0.126	0.044	0.126	-0.278**	0.137	0.051	0.157
Constant	-1.512***	0.376	-1.243***	0.281	-0.708***	0.272	-1.014***	0.287	-0.852***	0.299	-1.732***	0.365
Observations	1396		2379		2406		2202		1947		1575	
Wald Chi2(48)	223.24***		382.23***		376.14***		367.95***		335.88***		326.33***	
Rho	-0.112		-0.493		-0.483		-0.449		-0.398		-0.522	
Wald test of rho=0 Chi2(1)	2.444		5.186**		7.376***		3.854**		3.716**		5.576***	

* Statistically significant at $p \leq .10$; ** Statistically significant at $p \leq .05$; *** Statistically significant at $p \leq .01$