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Does it Really Pay to be Green? Determinants and Consequences of Proactive Environmental Strategies*

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Abstract

This study examines what factors affect firms' decisions to adopt a proactive environmental strategy and whether pursuing proactive environmental strategies leads to improved financial performance. Using longitudinal data from 1990-2003 for the four most polluting industries in the U.S. (Pulp & Paper, Chemical, Oil & Gas, and Metals & Mining), this research empirically models the causal relations between firms' environmental performance and their financial resources and management capability. Our results show that positive (negative) changes in firms' financial resources in the prior periods are followed by significant improvements (declines) in firm's relative environmental performance in the subsequent periods. In addition, we also find that significant improvements (declines) in environmental performance in the prior periods can lead to improvements (declines) in financial performance in the subsequent periods after controlling for the impact of Granger causality. Finally, 3SLS analysis suggests that the positive association between environmental performance and financial performance is robust. Overall, our results are consistent with predictions of the resource based view of the firm and indicate that although becoming "green" is associated with improvement in firm performance, such a strategy cannot be easily mimicked by all firms.

Key Words: environmental performance, financial performance

1. Introduction

The costs of protecting the environment for U.S. firms have increased substantially since the 1970s and are expected to further increase (Barbera and McConnell, 1990; Chan-Fishel, 2002). The magnitude of environmental costs is such that companies must integrate environmental efforts into their business strategy (Christmann, 2000). Responsible environmental management has become an important focus in modern management accounting texts (Hansen and Mowen, 2007). Historically, environmental decisions were often made with little support from the cost management information system and simply were made reactively to comply with environmental regulation. Hansen and Mowen (2007, p. 778) argue that "successful treatment of environmental concerns is becoming a significant competitive issue" and "meeting sound business objectives and resolving environmental concerns are not mutually exclusive." This study provides empirical evidence to support this argument.

In this regard, a growing body of the environmental management literature suggests that firms can gain sustainable competitive advantages by reducing the adverse impacts of their operations on the natural environment. It is argued that pollution is a waste of input that reflects an inefficiency in product design, choice of input, and/or manufacturing process (Nehrt, 1996). Hence, a proactive environmental management strategy can enhance firm performance through process innovation and product differentiation (Porter and van der Linde, 1995; Hart, 1995; Reinhardt, 1998). Although there are empirical studies that link corporate environmental performance with financial success (Orlitzky *et al.*, 2003), such studies have not established consistent evidence that a proactive environmental strategy enhances firm financial performance (Jaffe and Palmer, 1997; Margolis and Walsh, 2003).[1] Further, even studies that do find a positive association between

[1] For instance, out of 109 studies reviewed by Margolis and Walsh (2003) that examine whether corporate social performance enhances financial performance, 28 studies reported non-significance, 20 reported mixed findings, and 7 reported a negative association (p. 274).

environmental performance and financial success can be challenged on a number of methodological grounds (Russo and Fouts, 1997).[2] In particular, it is not clear whether environmentally sound operations lead to financial success or financially healthy firms choose and can afford to operate in an environmentally friendly manner (King and Lenox 2001; Bansal and Roth 2000; Griffin and Mahon 1997).

Although the argument that "it pays to be green" seems forceful, the specific mechanisms under which industries and firms can improve their competitiveness through a proactive environmental strategy remains controversial. Existing studies document a wide variation in corporate environmental performance, even in industries where stringent environmental regulations have existed for decades (King and Lennox, 2001; Hughes, 2000; Clarkson *et al.*, 2004). Further, a survey of CFOs and top environmental officers from the 295 largest public companies in Canada indicates that less than half of the respondents believe environmental performance affects competitiveness and enhances shareholder value (Desjardins *et al.*, 2000). On the other hand, anecdotal evidence indicates that some companies are taking a more proactive approach toward environment management and strive to be the leader in environmental performance in the industry.

One leader in environmental management, the Dow Chemical Company, has publicly announced its specific environmental performance goals to be achieved by 2015, ranging from cutting the number of chemical spills to improving energy efficiency and reducing green house gas emissions. Dow Chemical even invites the public to monitor its progress over time at its web site.[3] Similarly, Nucor Corporation, a successful U.S. steel maker, has disclosed that it has achieved its greenhouse gas emission reduction target six years ahead of the schedule under the Kyoto Protocol,

[2] Examples include small sample size, unreliable (subjective) measures of environmental performance, self-selection bias due to use of survey data, and inappropriate control of other variables that contribute to financial performance.
[3] See http://www.dow.com/commitments/goals/index.htm, accessed June 29, 2010.

even though the U. S. government rejected the Protocol. The company's stated aim is to "continue to set the environmental standard for steel and steel products companies across the world."[4]

This said, conventional economic wisdom suggests that pollution abatement investments divert financial resources from productive investments that will not be recovered (Gray and Shadbegian, 1993; Walley and Whitehead, 1994). Hence, firms should have little incentive to spend more than necessary just to meet minimum compliance. Furthermore, if a proactive environmental strategy leads to enhanced firm performance, such a strategy should be widely mimicked by other firms in the industry. Thus, neither a proactive nor a classic economic perspective can adequately explain why significant variations in environmental performance exist in equilibrium, especially in industries that have been facing stringent environmental regulations for decades. Ullmann (1985) argues that existing empirical studies exploring the relationship between social performance and economic performance have been largely inconclusive and inconsistent mainly because of a lack of theory development.[5]

Recent developments in management theory offer a theoretical framework that helps explain why a proactive environmental strategy may create a sustainable competitive advantage. The "resource-based view of the firm" suggests that not all firms can benefit equally from a proactive environmental strategy (Hart, 1995; Russo and Fouts, 1997; Aragon-Correa and Sharma, 2003). In particular, firms pursuing a proactive environmental strategy are most likely the ones with greater financial resources and superior management capabilities (Christmann, 2000; Sharma and Vredenburg, 1998). This framework predicts that proactive corporate environmental policies and financial success are interrelated.

[4] See http://www.nucor.com/enviropages/articles/nucor_and_global_warming.htm, accessed September 11, 2006

[5] Specifically, Ullmann conjectures that the inconsistent findings in the prior studies may be attributed to incomplete model specification, with one omitted variable being the firm's environmental strategy. This study explicitly models the firm's environmental strategy by focusing on firms experiencing significant changes in their relative environmental performance over time.

Compared to the more traditional "levels" analysis, a "changes" analysis can identify the year when a change in environmental strategy occurs and thus increases the power of tests examining the causes and consequences of adoption or abandonment of proactive environmental strategies. This study employs longitudinal data and a changes focus. Since the decision to pursue a proactive environmental strategy is not directly observable, this research infers a change in the firm's environmental strategy from pronounced changes in its relative environmental performance over time. Within the context of Granger causality tests (Granger, 1969; Griffiths *et al.*, 1993), this study addresses the following two related empirical questions: (1) Is a change in relative environmental performance preceded by a change in relative financial performance, consistent with the resource-based view of the firm (the 'determinants' perspective)? (2) Does a change in relative environmental performance lead to a change in subsequent financial performance, consistent with arguments that "it pays to be green" (the 'consequences' perspective)? We address these two empirical questions in the context of the four most polluting industries in the U.S. (Pulp & Paper, Chemical, Oil & Gas, and Metals & Mining).[6]

Using data from 1990-2003 for these industries, this study finds that firms experiencing a significant improvement in relative environmental performance over time had experienced significant prior increases in return on assets and operating cash flows, consistent with the resource-based view of the firm. Examining the 'consequences' perspective, we find that these firms also enjoy increases in return on assets and operating cash subsequent to a significant improvement in their environmental performance, consistent with arguments that "it pays to be green". To further control for potential endogeneity, we also employ a 3SLS model and observe a positive association between environmental performance and financial performance in our sample firms. Thus, overall,

[6] The utilities sector, another major polluting industry in the U.S., is excluded for two reasons. First, since utilities are rate-regulated, their financial performance is likely difficult to interpret in a cross-sectional study. Second, the 10Ks indicate that R&D spending, a key variable in our analysis, for this industry is minimal, and for most firms non-existent.

our results are consistent with the resource-based view of the firm, and suggest that although becoming "green" is associated with an improvement in firm performance, such a strategy cannot be easily mimicked.

The study contributes to the accounting literature in three ways. First, there is a vast practitioner literature in management accounting focusing on environmental management systems in which environmental responsibility generates a major concern because of the cost magnitude and risk exposure (Burritt, 2004; Jasch, 2003; Figge *et al.*, 2002; Jackson, 2003; Gould and Scaletta, 2009; Cormier and Magnan, 2003; Hansen and Mowen, 2007). For instance, Figge *et al.* (2002) argue that firms must incorporate environmental and social aspects into the four balanced scorecard perspectives in order to practice sustainability management. A maintained assumption of this literature is that pursing proactive environmental strategies is worthwhile.[7] However, as cited earlier, less than one-half of surveyed CFOs' and top environmental officers believe environmental performance enhances shareholder value.[8] Thus, our empirical evidence that "it pays to be green" has important implications for those following the business press.

Second, our research also relates to the environmental accounting literature that examines the relationship between environmental performance and firm valuation (Jaggi and Freedman, 1992; Hughes, 2000; Clarkson *et al.*, 2004; Al-Tuwarijri *et al.*, 2004; Johnston, 2005). This research adds to the literature by providing direct evidence that it does indeed pay to be green if firms are willing to make significant changes in their environmental strategy. More importantly, firms wishing to pursue green investment strategies must carefully plan for such investments since our evidence suggests that not all firms can pursue proactive green strategies.

[7] In addition to process innovation and product differentiation as advocated by Porter and van der Linde (1995) and Hart (1995), other benefits of a proactive environmental strategy include raising rival costs, first mover's advantage in investing in pollution abatement technology, and green goodwill from environmentally conscious customer clientele (Al-Tuwaijri *et al.*, 2004; Clarkson *et al.*, 2004).

[8] We assume that the Canadian survey responses in Desjardins *et al.* (2000) extrapolate to the attitudes of U. S. Company CFO's and top environmental officers towards green investments.

Finally, our research is directly relevant to accounting standards dealing with valuation and impairment (for example, standards addressing business combinations and asset impairment). To the extent that a firm's environmental strategy is linked to its future financial performance, our results suggest that proactive firms enjoy identifiable intangible assets related to environment performance and reactive firms face the prospect of negative future cashflows. Further, good environmental performance reduces regulatory risk, hence, directly affects valuation through a lower discount rate.

The study also contributes to the environmental management literature more broadly. First, a major research issue in the environmental management literature is why some firms embrace ecologically responsive initiatives voluntarily, while others in seemingly similar circumstances merely attempt to comply with the environmental regulations with minimum spending and effort. By modeling factors that affect the adoption of a proactive environmental strategy, our study achieves a better understanding of the observed variation in corporate environmental performance. Second, this study provides a rigorous test of the resource-based view of the firm by explicitly modeling the impact of financial resources and management capability on a firm's decision to improve its relative environmental performance within the industry. One possible reason why previous studies linking corporate environmental performance with financial success have had mixed results is that they do not consider the reciprocal relationship between financial resources and the adoption of a proactive environmental strategy *over time*. Finally, our study develops an intuitively appealing measure of proactive environmental strategy choices based on changes in relative environmental performance over time.

The paper is organized as follows. Section 2 provides a literature review. Section 3 then describes the sample data, followed by hypothesis development and a description of the study's empirical models in Section 4. Results are presented and discussed in section 5, and Section 6 concludes.

2. Review of Relevant Research

The resource-based theory of the firm proposes that valuable, costly to copy firm resources and capabilities provide the key sources of a sustainable competitive advantage (Barney and Arikan, 2005). This theory posits that a competitive advantage can be sustained only if the capabilities creating the competitive advantage are supported by resources that are not easily duplicated by competitors. Resources may include physical and financial assets, as well as firm-specific assets such as employees' skills and organizational processes. A firm's capabilities include its ability to accomplish specific value-added tasks with deployment of supporting resources. The resource-based view focuses on resources that contribute to a firm's capabilities and are difficult to transfer or trade. Such resources can be difficult to replicate because they are intangible assets, accumulated through past experience and learning-by-doing (Hart 1995). In addition, firms may also acquire socially complex resources that can support coordinated activities engaging a large number of employees or teams. Ultimately, firms that are able to accumulate resources to support unique capabilities will be able to enjoy a sustained competitive advantage (Russo and Fouts, 1997; Christmann, 2000).[9]

Hart (1995) extends the resource-based theory by considering the constraint of natural resources. He develops a natural-resource-based conceptual framework in which he characterizes firms' capabilities that facilitate three interrelated environmental strategies: pollution prevention, product stewardship, and sustainable development. Hart argues that firms that adopt environmental strategies that exploit these capabilities can gain a competitive advantage in the form of improved manufacturing efficiency, enhanced reputation, and raising rival's costs by influencing future industry environmental standards. However, not all firms can realize these benefits to the same degree. Pursuing these strategies implies both substantial investment and a long term commitment to

[9] For a comprehensive review of resource-based theory and its origins, see Barney and Arikan (2005).

the environment, thereby requiring sufficient financial resources and superior management capabilities in order to gain these competitive advantages.

Several studies employing survey methodology have tested the implications of the resource-based theory of the firm. Sharma and Vredenburg (1998) explore the link between environmental strategies, firm-specific capabilities, and competitive benefits flowing from these capabilities. Based on a survey of approximately 90 Canadian oil and gas companies, the study finds that the firms' environmental strategies, organizational capabilities, and economic benefits are interrelated as predicted by the resource-based view of the firm. Similarly, Klassen and Whybark (1999) explore how a firm's environmental commitment affects its manufacturing and environmental performance. Using a survey of managers from 66 furniture plants, they find that a firms' environmental commitment (measured by an index score assessed from the survey) is positively associated with a number of manufacturing performance indicators such as cost, product quality, and on-time delivery. In addition, they find that a firm's environmental commitment is positively associated with its environmental performance as measured by toxics release data. Christmann (2000) examines whether environmental strategies create competitive cost advantages, and whether a firm's capability for process innovation and implementation affects its ability to benefit from implementing environmental strategies. Based on survey responses from 88 chemical companies, she concludes that a firm's capability in product and process innovation is a "rare, valuable, non-substitutable, and imperfectly imitable" asset and that the heterogeneity of this capability across firms explains why not all firms can obtain a competitive cost advantage from proactive environmental strategies.

A number of empirical studies using archival data have tested the proposition that "it pays to be green". Klassen and McLaughlin (1996) examine the relationship between environmental performance and financial performance using an event study methodology. They investigate market reactions to the announcements of positive environmental events such as environmental awards and negative environmental events such as oil spills. They find that investors reward firms with positive environmental events and penalize firms with negative environmental events. Overall, their findings are consistent with the notion that positive environmental events lead to a favourable perception of future financial performance. However, it should be noted that the incidental nature of environmental events in their study may not be a reliable proxy for corporate environmental strategies.

Hart and Ahuja (1996) examine whether emission reduction enhances a firms' operating and financial performance in concurrent and subsequent periods. Using a sample of 127 S&P 500 firms, they find that the percentage reduction in emissions between 1988 and 1989 is associated with an improvement in three measures of financial performance (returns on sales, assets, and equity) in 1990, 1991 and 1992.[10] The authors interpret their findings as suggesting that it does "pay to be green", although the economic benefits of becoming green appear to occur one to two years later.

Dowell *et al.* (2000) investigate whether multinational firms adopting a single stringent global environmental standard have higher Tobin's Q than multinational firms subscribing to less stringent or poorly enforced host country environmental standards. Their sample consists of 89 multinational S&P 500 firms with production operations in countries with GDP below $8,000 per capita. Their environmental performance indicator is based on an Investor Responsibility Research Center (IRRC) survey during the period 1994-1997. Respondents were asked whether their firms adopted internal environmental standards that exceed any national standards, or only adhered to local standards in the host countries where environmental regulations are in general less stringent than in the U.S. The authors find that adopting more stringent environmental standards is positively associated with firms' Tobin Q. Finally, King and Lenox (2001) explore the relationship between environmental performance and financial performance using a sample of 652 manufacturing

[10] Hart and Ahuja (1996) acknowledge the limitations caused by having only one year of emission reduction data and call for longitudinal measures of both environmental and firm performance measures. It should be noted that their study does not directly test the resource-based view of the firm as their empirical analyses do not control for resource related variables.

companies from 1987-1996. They examine whether relative environmental performance, measured as the weighed average of toxics release normalized by firm size (number of employees), affects Tobin's Q. Consistent with Dowell *et al.* (2000), they find that relatively high emissions are negatively associated with Tobin's Q.

This study differs from prior research along several important dimensions. First, it employs a large sample from multiple polluting industries to explore the relationship between environmental performance and financial performance over an extended period. Thus, the results from this study may apply to a broad industry context. Second, the longitudinal data allow us to develop a relatively precise proxy for proactive environmental strategies. Specifically, we can identify (ex post) firms that experience either significant improvements or declines in environmental performance relative to industry norms over our sample period from 1990 to 2003. Focusing on these subsets of improving and declining firms increases the power of statistical tests and provides sharper insights into why some firms chose to pursue proactive environmental strategies while others did not during the sample period. Finally, the study's empirical model is explicitly consistent with the resource-based view of the firm because it examines the reciprocal relation between environmental performance and financial performance implied by this construct.

3. Sample Data

The study's sample data consist of all firms in the Pulp & Paper (SIC = 26), Chemical (SIC = 28), Oil & Gas (SIC = 29), and Metals & Mining (SIC = 33) sectors for which environmental performance, stock price, and financial data are available during the period 1990–2003. Our research focuses on these four industries given the prior evidence in the literature that these are the most polluting in the U.S. (Clarkson *et al.*, 2008). Firm specific financial data are provided by COMPUSTAT.

Table 1 presents frequency distributions of the sample firms by industry and year (Panels A and B). As revealed in Panel A, the sample is comprised of observations on 242 distinct firms, with the greatest number of sample firms being in the Chemical and the Metals & Mining industries. Panel B further reveals that while there are slightly fewer observations in the most recent years of the study period (mainly due to consolidations within these industries), the sample size is nevertheless relatively stable over time. Taken together, the sample consists of 2,376 firm-years for 242 distinct firms, with 412 firm-year observations from the Pulp & Paper sector, 995 from the Chemical sector, 261 from the Oil & Gas sector, and 708 from the Metals & Mining sector.

4. Methodology, Variable Selection, and Hypotheses

4.1 Variable Selection and Measurement

In constructing an empirical proxy for a firm's environmental performance, the study measures pollution propensity (*PP*) as toxics releases in pounds scaled by the cost of goods sold ($000).[11] *PP* is computed based on data from the U.S. Environmental Protection Agency's (EPA) Toxics Release Inventory (TRI) and is the sum of all chemicals (in pounds) released to air, water, and land in a particular year. Since the EPA reports data at the plant level, researchers must aggregate the data to the firm level.[12] For ease of interpretation, for much of the subsequent empirical analysis, the study focuses on a firm's environmental performance (*EP*), defined as the inverse of its *PP*.[13] In this regard, firms with *higher* measures of *EP* (and thereby lower relative pollution propensity measures) are viewed as *better* environmental performers.

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[11] Our results remain unchanged if we alternatively use TRI per thousand dollars of sales revenue to control for production scale (Konar and Cohen, 1997).

[12] Environmental data are published by the EPA with a two year lag. Studies using TRI data to measure environmental performance include Konar and Cohen, 1997, Klassen and Whybark, 1999, King and Lenox (2001, 2002), and Clarkson *et al.* (2004, 2008). King and Lenox (2002) weight each chemical using a toxicity index when aggregating total emissions but find that unweighted aggregations deliver similar results.

[13] Since our study focuses on percentile rank values, our results are identical whether we use *PP* or its inverse, *EP*, only the sign of the association differs. *EP* is used to ease our interpretation since our hypotheses are worded in terms of

To examine the determinants of the decision to change environmental strategy, our study requires proxies for both a firm's financial resources and its management capabilities in the prior period. We capture financial resources using profitability, liquidity, and leverage: these are measured as 'return on assets' (*ROA*), 'operating cash flows' (*CF*), and the ratio of total debt to total assets (*LEV*). Further, according to the resource-based view of the firm, firms must also have superior management capabilities in order to pursue proactive environmental strategies.[14] Firms with inferior management capability are more likely to be minimum compliance firms that reactively incur environment costs in response to more stringent environmental regulations. While management capability is not directly observable, we argue that an innovative management team is more likely to pursue proactive investment strategies, even if unrelated to the environment. Our study uses R & D intensity (*RDIN*) as a proxy for innovation, and sales growth (*GRTH*) and enterprise value to assets (*EV*) as manifestations of that proactive investment strategy in intangibles. Thus, we posit that *RDIN*, *GRTH*, and *EV* serve as proxies for unobservable management talent or capability, with management capability varying directly with each proxy.[15] These variables are important drivers of management's compensation package, therefore our proxies have empirical support (Murphy, 1999).

In examining the consequences of adopting a proactive environmental strategy, a sustained improvement in environmental performance should lead to improved future financial performance as reflected in both *ROA* and *CF*. Since enhanced firm performance should manifest itself in a higher firm value, *EV* serves as an additional measure of performance.[16]

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environmental performance. For observations where *PP* is equal to zero, we arbitrarily set *EP* equal to the maximum *EP* for firms in the same year and industry. Since it is possible that *PP* observations with a value of zero for a given year represent missing data rather than zero pollution output, we alternatively treat these observations as missing, and find results based on this alternative treatment (not tabulated) to be qualitatively similar to those presented in the Tables.

[14] As an example of how management capability and commitment may affect corporate environmental strategies, see a recent article on Wal-Mart's CEO Lee Scott in the *Wall Street Journal*: "Can Wal-Mart Sustain a softer Edge?" (February 8, 2006).

[15] Our use of these variables as proxies for management capability is consistent with the literature. However, we acknowledge these variables may be correlated with some financial resource variables.

[16] *EV* captures valuation premiums which reflect, among other things, the existence of goodwill. While use of the traditional 'price-to-book' ratio might be more desirable, it is impractical in our setting since approximately 20 percent of

Finally, this study includes three additional control variables in the analyses, firm size (*TA*), age of equipment (*NEW*), and capital intensity (*CAPIN*). Larger firms are expected to invest more in environmentally friendly technologies, as they are likely to have more resources, and because they bear larger litigation risks. We include age of equipment as a control since newer equipment is expected to employ less polluting technologies. For similar reasons, firms with higher sustaining capital expenditures are expected to have newer equipment, and thus the study also controls for capital intensity.

In summary, the study's variables are defined as follows:

EP	=	environmental performance, measured as the inverse of *PP* where *PP* is calculated as toxics release inventory (TRI) in pounds per thousand dollar cost of goods sold;
TA	=	total assets ($ millions);
ROA	=	return on assets, measured as net operating income divided by beginning period total assets;
CF	=	liquidity, measured as net cash flow from operations divided by beginning of period total assets;
LEV	=	leverage, measured as total debt divided by total assets;
RDIN	=	research and development intensity, measured as R&D expenses divided by beginning of period total assets;
GRTH	=	growth, measured by change in sales divided by beginning of period sales;
EV	=	enterprise value, measured as market capitalization plus debt and preferred shares, divided by beginning of period total assets;
NEW	=	age of equipment, measured as net property, plant, and equipment divided by gross property, plant, and equipment;[17] and
CAPIN	=	capital intensity, measured as capital expenditures divided by beginning of period total assets.

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our sample firms have negative values of shareholders' equity in the year when a pronounced change in environmental performance started to occur. Notwithstanding, when the analyses are repeated based only on the sample of firms with positive shareholders' equity and book value is used as the scalar for all variables instead of total assets, conclusions are similar to those reported in all tables, although in most instances, their statistical significance is reduced given the substantial reduction in sample size.

[17] An alternate measure of equipment age is net property, plant and equipment divided by annual depreciation, which assumes all firms use straight line depreciation. While both approaches capture equipment age, we opted for the ratio of net to gross because it does not require the use of straight line depreciation.

In conducting our analyses, our study pools firms from four different industry sectors. However, directly comparing toxics release per thousand dollar of costs of goods sold (*PP*) across different industries will generally not be meaningful because of statistical differences in industry pollution propensities (i.e., the TRI data). In addition, consistent with prior studies (Clarkson *et al.*, 2004), our *PP* data show a declining trend over time as a result of economy-wide improvements in environmental performance (not tabulated).[18] Thus, in order to pool across sectors and over time, we assess the *relative* environmental performance of the sample firms within industry and year. Similarly, for all other variables in our analyses, we rank the variables within industry and year, and base our analyses on percentile rank values, with higher percentile values implying higher values of the relevant measure. This controls for cross-sectional and contemporaneous variations in our sample.

4.2 Environmental Change Partitions and the Matching Procedure

Our study begins by partitioning the sample firms into five categories based on changes in their relative environmental performance over time. Specifically, we rank the sample firms based on their pollution propensity (*PP*) within each year and industry, and then classify the firms as:

stable good performers (SG)	=	firms ranked in the highest two *PP* quartiles during the entire study period;
stable poor performers (SP)	=	firms ranked in the lowest two *PP* quartiles during the entire study period;
progressive firms (PRO)	=	firms whose *PP* ranking improved by at least two quartiles over at most a three year span at some point during the study period and then stabilized within the two highest quartiles for the remainder of the study period;[19]
regressive firms (RE)	=	firms whose *PP* ranking worsened by at least two quartiles over at most a three year span at some point during the study

[18] The differences in *PP* across industries and over time are revealed in the following descriptive statistics. In 2003, the mean *PP* measures were 1.374, 2.616, 2.347, and 1.612, respectively, for our sample firms in the Pulp & Paper, Chemical, Oil & Gas, and Metals & Mining sectors. In contrast, the analogous figures for 1990 were 2.711, 7.752, 3.405, and 2.475, respectively.

[19] For the ‘progressive’ classification, firms moved from the third or fourth quartile to the first quartile, or from the fourth quartile to the second. For the ‘regressive’ classification, firms moved from the first to the third or fourth quartile, or from the second quartile to the fourth. The typical firm took two years to complete the change.

		period and then stabilized within the two lowest quartiles for the remainder of the study period; and
variable performers (VP)	=	all remaining firms.[20]

Panel C of Table 1 reveals that of the 242 sample firms, 70 are classified as 'stable good environmental performers' (*SG*), 67 as 'stable poor environmental performers' (*SP*), 43 as 'progressive' (*PRO*), 24 as 'regressive' (*RE*), and 38 as 'variable performers' (*VP*). Panel C also reveals that the proportions of firms in the five categories are relatively stable across the four industries. Based upon the reported Chi-square test statistic, independence between environmental performance change partition and industry sector cannot be rejected at conventional levels of significance ($\chi^2 = 5.642$, $p = 0.933$).[21]

Using these classifications, our research considers two separate comparisons. First, we compare the characteristics and attributes of 'progressive' firms with 'stable poor performers'. By construction, both groups were ranked in the lowest fifty percent of the sample firms within their industry sector in terms of environmental performance at the beginning of the study period (1990). However, at some subsequent point, the relative environmental performance of the *PRO* firms improved significantly so that they moved into the highest fifty percent whereas the *SP* firms remained in the lowest fifty percent. The second comparison we make is between 'regressive' firms and 'stable good environmental performers'. These two groups started in the best fifty percent of sample firms within their industry sector but over the study period, the *RE* firms dropped into the lowest fifty percent while the *SG* firms remained within the highest fifty percent. Thus, in both

[20] One concern relating to this classification strategy is that changes in a firm's environmental performance may have arisen "artificially" because of merger and acquisition (M&A) activity. To ensure that our results are not being influenced by these firms, we searched the COMPUSTAT database finding that two sample firms classified as 'progressive' and one firm classified as an 'regressive' had engaged in M&A activity during the study period, with the M&A activity roughly coinciding with the change in their environmental performance in each instance. We then repeated all analyses after dropping these observations, finding our results to be qualitatively unaffected.

[21] In terms of the year in which their industry ranked environmental performance started to change (FY_0), the 'progressive' (*PRO*) and 'regressive' (*RE*) firms are also broadly distributed across the study period. Specifically, the distribution of FY_0 for the *PRO* / *RE* firms by year is: 1992 (6/3); 1993 (4/1); 1994 (6/3); 1995 (6/4); 1996 (3/3); 1997 (5/3); 1998 (4/1); 1999 (4/3); and 2000 (5/3). Thus, it is unlikely that our results are driven by macro-economic factors.

instances, a comparison of the characteristics and attributes of the two "related" subsamples over time provides insights into how they differed both before and after their relative environmental performance changed. The use of the *SP* and *SG* firms as benchmarks against which to judge the *PRO* and *RE* firms, respectively, is reasonable because these benchmark firms could also have selected a strategy which changed their environmental performance but elected not to do so.

Finally, firms are matched and aligned in the following fashion. First, fiscal year 0, FY_0, is defined as the year in which the industry ranked environmental performance of a firm classified as either *PRO* or *RE* started to change. We then identify the *PRO* and *RE* firms (the 'treatment' firms) for which complete data are available over the seven-year period, FY_{-3} to FY_{+3}. Lastly, we match each treatment firm with a 'control' firm drawn from the same industry and from within the appropriate stable classification (i.e., *PRO* with *SP* and *RE* with *SG*) after ensuring that the matched firm has complete data available over the same seven year interval. For each matched pair, the selected control firm is the one which has the closest environmental performance (*EP*) measure to that of the treatment firm at the end of year FY_{-1}. Our aim is to have no difference in *EP* for treatment relative to control firms in the year prior to a sustained improvement or deterioration. This enables us to infer when a change in environmental strategy takes place.[22] This procedure results in 41 matched *PRO* / *SP* firm pairs and 23 matched *RE* / *SG* firm pairs.[23]

4.3 Empirical Models and Hypotheses

4.3.1 Determinants Model

For the 'determinants' of change analysis, the specific form of our econometric model is:

[22] Consistent with the matching procedure, standard statistical tests (not reported) reveal that there is no statistical difference in mean EP_{t-1} rank or mean raw EP_{t-1} values for either the *PRO / SP* or the *RE / SG* pairs.

[23] Clearly, the choice of the appropriate interval involves a tradeoff between sample size and having a sufficiently long time series of observations to draw inferences about how the characteristics and attributes of the various subsamples change over time. The cost associated with selecting a seven-year interval is the loss of two *PRO* / *SP* pairs and one *RE* / *SG* pair. If the interval is shortened to five years (FY_{-2} to FY_{+2}), only one of the *PRO* / *SP* pairs is recovered and results are qualitatively identical to those reported based upon the seven-year interval.

$$\Delta EP_t = \delta_0 + \delta_1 \Delta ROA_{t-1} + \delta_2 \Delta CF_{t-1} + \delta_3 \Delta LEV_{t-1} + \delta_4 \Delta RDIN_{t-1} + \delta_5 \Delta GRTH_{t-1} + \delta_6 \Delta EV_{t-1}$$

$$+ \delta_7 \Delta lnTA_{t-1} + \delta_8 \Delta NEW_{t-1} + \delta_9 \Delta CAPIN_{t-1} + \delta_{10} \Delta EP_{t-1} + \varepsilon \qquad (1)$$

where we consider changes over a two year period, measuring ΔEP_t as the cumulative change in the firm's relative within industry *EP* percentile rank from the beginning of year FY_0 to the end of year FY_{+1} (i.e., the Environmental Performance Change Period in Figure 1) and the lagged independent variables as the cumulative change in the firm's relative within industry percentile rank from the beginning of year FY_{-2} to the end of year FY_{-1} (i.e., the Determinants of Change Period in Figure 1).[24]

For the model which explains sustained improvements in environmental performance, the 41 'progressive' firms and their matched 'stable poor' firms are pooled. Following from the resource-based view of the firm, our first hypothesis (stated in the alternative form) is:

H_1: Improved environmental performance is preceded by improved financial resources and management capabilities in prior periods.

Thus, within the context of H_1, the coefficients on ΔROA_{t-1}, ΔCF_{t-1}, $\Delta RDIN_{t-1}$, ΔGRT_{t-1}, and ΔEV_{t-1} should be positive, and the coefficient on ΔLEV_{t-1} should be negative. Further, illustrating the argument with *ROA*, to the extent that ΔROA_{t-1} explains ΔEP_t after controlling for ΔEP_{t-1}, the researcher can infer that ΔROA_{t-1} 'Granger causes' ΔEP_t (Granger, 1969; Griffiths *et al.*, 1993). For tests of H_1 to H_4, we state our predicted signs only for variables that relate to our hypotheses, and follow this convention in Tables 4 to 6.

[24] By construction, the 'progressive' and 'regressive' firms are those for which their within industry percentile *PP* rank changed by at least two quartiles over at most a three year span within the study period and then stabilized. In contrast, we conduct both our determinants and consequences change analyses using, as depicted in Figure 1, a two-year 'Environmental Performance Change' Period which runs from the beginning of year FY_0 to the end of year FY_{+1}. For our sample, 34 of the 41 *PRO* firms and 18 of the 23 *RE* firms complete their transformation within this two-year window. While the remaining 7 *PRO* and 5 *RE* firms have substantially moved through the *PP* percentile ranks by the end of these two years, their transformation is not fully completed until the end of the third year (FY_{+2}). Given this potential slippage, we undertake further analysis to explore the sensitivity of our decision to use of a two-year instead of a three-year 'Environmental Performance Change' Period. The results of this analysis are presented and discussed in Section 5.4.

For the model which explains sustained declines in environmental performance, the 23 ‘regressive’ firms and their 23 matched ‘stable good’ firms are pooled. Here, following from the resource-based view of the firm, our second hypothesis (stated in the alternative form) is:

H_2: Deterioration in environmental performance is preceded by deterioration in financial resources and management capabilities in prior periods.

Thus, H_2 implies that the coefficients on ΔROA_{t-1}, ΔCF_{t-1}, $\Delta RDIN_{t-1}$, ΔGRT_{t-1}, and ΔEV_{t-1} should be positive, and the coefficient on ΔLEV_{t-1} should be negative. Similar inferences about Granger causality follow. Finally, for completeness, our study repeats the analysis based on the pooled sample of the 41 progressive and 23 regressive firms, with the same sign expected on all independent variable coefficients as those predicted for the two previous analyses.

4.3.2 Consequences Model

Considering the consequences perspective, the specific form of the econometric model is:

$$\Delta ROA_{t+1} = \gamma_0 + \gamma_1 \Delta EP_t + \gamma_2 \Delta ROA_t + \gamma_3 \Delta RDIN_t + \gamma_4 \Delta GRTH_t + \gamma_5 \Delta EV_t + \gamma_6 \Delta TA_t + v \qquad (2)$$

where we again consider changes over a two year period, measuring ΔROA_{t+1} as the cumulative change in the firm’s relative within industry percentile *ROA* rank from the beginning of year FY_{+2} to end of year FY_{+3} (the consequences period in Figure 1) and the lagged independent variables as the cumulative change in the firm’s relative within industry percentile rank from the beginning of year FY_0 to the end of year FY_{+1} (the environmental change period in Figure 1).

For the model which explores the consequences of sustained improvements in environmental performance, the 41 ‘progressive’ firms and their 41 matched ‘stable poor’ firms are pooled. Following from the “pays to be green” literature, we hypothesize (stated in the alternative form):

H_3: Improved environmental performance is followed by improved financial performance in subsequent periods.

Thus, within the context of H_3, the coefficient on ΔEP_t should be positive. Further, to the extent that ΔEP_t explains ΔROA_{t+1}, after controlling for ΔROA_t, the researcher can infer that ΔEP_t Granger causes ΔROA_{t+1}.

For the model which explores the consequences of sustained declines in environmental performance, the 23 'regressive' firms and their 23 matched 'stable good' firms are pooled. Here, following the pays to be green literature, we hypothesize (stated in the alternative form):

H_4: Deterioration in environmental performance is followed by deterioration in financial performance in subsequent periods.

Thus, H_4 also implies that the coefficients on ΔEP_t should be positive. Similar inferences about Granger causality follow. Finally, once again, for completeness, the analysis is repeated based on the pooled sample of 41 progressive and 23 regressive firms, with the coefficients on all variables expected to be positive.

4.3.3 Three-Stage Least Squares (3SLS) Analysis

The Granger causality analysis described above is one way to address the endogeneity of environmental strategy and financial performance. Yet another way to address this joint endogeneity is in the spirit of Al-Tuwarijri *et al.* (2004) who argue that any exploration of environmental strategy, financial performance, and environmental reporting transparency must all be examined simultaneously, and that an analysis of a subset of any two of these measures is incomplete. Thus, to examine the robustness of our results and conclusions, following Al-Tuwarijri *et al.* (2004), our study also presents results for a three-stage least squares (3SLS) simultaneous equations model which examines the relations in the levels among economic performance, environmental performance, and environmental disclosure.[25] This analysis is conducted on only a single year (2003) and for only the 191 of our sample firms for which we have access to disclosure data for that

[25] We thank one of the referees who suggested this alternative approach to dealing with the endogeneity in our analysis.

particular year. The environmental disclosure scores (*ED*) are drawn from Clarkson *et al.* (2008) who develop and implement a content analysis index. The index is based on the Global Reporting Initiative sustainability reporting guidelines to assess the extent of discretionary environmental disclosures presented in the firm's environmental report and that of any web-based environmental disclosures made by the firm.[26] The structural equations are as follows:

Economic performance equation

$$EV_t = \theta_0 + \theta_1 EP_t + \theta_2 ED_t + \theta_3 ROA_t + \theta_4 CF_t + \theta_5 RDIN_t + \theta_6 GRTH_t + \theta_7 CAPIN_t + \tau \quad (3)$$

Environmental performance equation

$$EP_t = \lambda_0 + \lambda_1 EV_t + \lambda_2 ED_t + \lambda_3 ROA_t + \lambda_4 CF_t + \lambda_5 LEV_t + \lambda_6 RDIN_t + \lambda_7 GRTH_t$$
$$+ \lambda_8 lnTA_t + \lambda_9 NEW_t + \lambda 10_2 CAPIN_t + \eta \quad (4)$$

Environmental disclosure equation

$$ED_t = \phi_0 + \phi_1 EV_t + \phi_2 EP_t + \phi_3 ROA_t + \phi_4 LEV_t + \phi_5 lnTA_t + \phi_6 NEW_t + \phi_7 CAPIN_t + \pi \quad (5)$$

where all variables are as previously defined.

Within the context of this 3SLS model, if "it pays to be green", then the estimated coefficient on EP_t in equation (3) should be positive. In addition, according to the resource-based view of the firm, the estimated coefficients on EV_t, ROA_t, CF_t, $RDIN_t$, and $GRTH_t$ in equation (4) should be positive, and the coefficient on LEV_t should be negative. We do not provide predictions for model (5) because its inclusion in this study is mainly to control for endogeneity in our analysis.[27]

4.4 Descriptive Statistics

Table 2 presents descriptive statistics for the entire sample of 242 firms, with statistics for the overall pooled sample of 2,376 firm-years in Panel A and statistics for the sample partitioned by

[26] See Clarkson *et al.* (2008) for details.
[27] Li, Richardson and Thornton (1997) develops a theory that predicts a positive association between environmental performance and voluntary environmental disclosure.

environment performance in Panel B. As revealed in Panel A, there is considerable diversity in the characteristics of the sample. The pollution propensity measure (*PP*) has an interquartile range of 0.226 to 3.582, with a mean (median) value of 4.687 (1.211).[28] Thus, on average, our sample firms have 4.687 pounds of toxics release per $1,000 of cost of goods sold. Firms also vary considerably in terms of size, profitability, and operating cash flow. The total assets of our sample firms (*TA*) has an interquartile range of $389.216 million to $5.432 billion with a mean (median) value of $5.194 billion ($1.336 billion), the return on assets (*ROA*) has an interquartile range of 1.2 percent to 8.4 percent with a mean (median) value of 4.6 percent (4.7 percent), and the ratio of cash flow to total assets (*CF*) has an interquartile range of 4.4 percent to 12.8 percent with a mean (median) value of 8.1 percent (7.4 percent). On average, firms are somewhat levered with a mean (median) debt-to-assets ratio (*LEV*) of 0.306 (0.289). Firms also vary in terms of the ratio of R&D to total assets with *RDIN* having an interquartile range of 0.004 to 0.027 and a mean (median) value of 0.020 (0.012). Realized growth (*GRTH*) has an interquartile range of -0.020 to 0.139 with a mean (median) value of 0.070 (0.056). The firms' *EV* ratio has an interquartile range of 0.973 to 1.532 with a mean (median) of 1.461 (1.185). Finally, the equipment 'newness' (*NEW*) and capital intensity (*CAPIN*) measures have interquartile ranges of 0.496 to 0.672 and 0.028 to 0.083, respectively.

Panel B of Table 2 presents descriptive statistics for the sample partitioned on the basis of pollution propensity (*PP*). Herein, the sample has been ranked on *PP* within year and industry, and the descriptive statistics presented are for the firm-years ranked in the two extreme quartiles (the so-called 'best' and 'worst' *PP* categories). As revealed, there are several dimensions along which these two *PP* categories differ. Consistent with prior studies (Hart and Ahuja, 1996; Dowell *et al.*, 2000; King and Lennox, 2001), the best environmental performers (lowest *PP*) are more profitable (*ROA*) (p = 0.016) and have a higher *EV* ($p < 0.001$). Thus, the results indicate a univariate positive

[28] The variables *PP* and *TA* exhibit positive skewness. This supports the use of ranked variables in our empirical analysis.

association between environmental performance and financial performance. In addition, the best environmental performers are larger (*TA*) ($p < 0.001$), have greater cash flow (*CF*) ($p = 0.069$), and experience higher growth (*GRTH*) ($p = 0.082$), but have a lower capital intensity measure (*CAPIN*) ($p = 0.029$). There is no difference between the two sub-samples in terms of the remaining attributes, leverage, R&D intensity, and age of equipment. However, caution must be exercised when interpreting these results given their univariate nature and because they are simply based on the aggregate of all firm-years within the two extreme quartiles and do not discriminate between firms with stable environmental performance patterns and those for which their relative performance changes over the study period.

5. Empirical Results

5.1 'Determinants' Analysis

Panel A of Table 3 presents the mean *ROA*, *CF*, and *EV* intra-industry percentiles for the *PRO / SP* matched pairs while Panel B presents the corresponding means for the *RE / SG* matched pairs. In both instances, the patterns reveal separation before FY_0 (see Figure 1) in the direction predicted by H_1 and H_2. In detail, Panel A reveals that the mean intra-industry percentile of *ROA* for the *PRO* firms in year FY_{-2} is 62.770, the corresponding figure for the *SP* firms is 47.314, and the difference in the mean percentiles is 15.456 ($p = 0.018$). The corresponding difference for year FY_{-1} is 17.331 ($p = 0.001$). Turning to Panel B, for *ROA*, the difference metrics in years FY_{-2} and FY_{-1} are -14.042 ($p = 0.072$) and -15.629 ($p = 0.052$), respectively. Similar differences are depicted for *CF* and *EV*. Thus, the patterns are consistent with the notion that profitability differences *precede* improvements or declines in environmental performance in the predicted directions.

Panel A of Table 4 presents mean one-year percentile change statistics by matched pair for our primary financial performance measures, *ROA* and *CF*, in the years leading up to year FY_0, changes which can be easily derived from Table 3.[29] These results imply an increasing difference in relative performance within each of the matched pairs. For example, for the *PRO / SP* matched pairs in FY_{-2}, the differences in mean percentile changes for *ROA* and *CF* are 9.365 ($p = 0.002$) and 2.699 ($p = 0.052$). In an analogous fashion, the *RE* consistently experience negative mean percentile changes relative to the *SG* firms. Here, for FY_{-2}, the differences in mean percentile changes for *ROA* and *CF* are -4.050 ($p = 0.011$) and -2.696 ($p = 0.038$). Thus, taken together, the results provide consistent support for both H_1 and H_2, with *PRO* firms demonstrating a significant increase in financial resources relative to their matched *SP* firms and *RE* firms experiencing a significant decline in financial resources relative to the *SG* in the years immediately prior to the beginning year of a marked change in environmental performance (FY_0).

Results for the multivariate determinants change model (equation (1)) are presented in Panel B of Table 4. As discussed, the tabulated results are based on two-year changes, with the dependent variable ΔEP_t measured as the change in the firm's within industry *EP* percentile rank from the beginning of year FY_0 to the end of year FY_{+1} and all independent variables measured as the change from the beginning of year FY_{-2} to the end of year FY_{-1}.

Here, for the financial resource measures, our study consistently finds as predicted, positive and significant coefficients on ΔROA and ΔCF, and negative and significant coefficients on ΔLEV.[30] For example, based on the sample comprised of the *PRO* and *SP* firms, their coefficients (*p*-values) are 0.040 (0.045), 0.020 (0.051), and -0.070 (0.043). For the management capability proxies, the coefficients on $\Delta RDIN$, $\Delta GRTH$, and ΔEV are consistently positive as predicted, with the $\Delta RDIN$ and $\Delta GRTH$ coefficients significant for two of the three samples while the ΔEV coefficient is only significant for the *RE / SG* sample. For the control variables, the coefficient on ΔTA is consistently

[29] For example, the figure of 5.512 for the change in mean intra-industry *ROA* percentile rank for the *PRO* firms in year FY_{-2} is determined as the difference in mean year-end intra-industry percentile ranks between FY_{-2}, 62.770, and FY_{-3}, 57.258 (Panel A, Table 3).

[30] Although the signs for these variables are consistent with our hypotheses, all *t*-tests and reported *p*-values are two-tailed.

negative and significant, the coefficient on ΔNEW is consistently positive and typically significant, and the coefficient on $\Delta CAPIN$ is consistently insignificant.

Thus, taken together, the results support H_1 and H_2. That is, a firm's actions to improve its relative environmental performance are preceded by improvements in its relative financial resources and/or management capabilities; the converse also applies.

5.2 'Consequences' Analysis

Panel A of Table 3 reveals that for the *PRO / SP* matched pairs, the mean differences for *ROA* in years FY_{+2} and FY_{+3} are 25.214 (p = 0.006) and 27.370 (p = 0.001), respectively, differences that are both greater than those in the pre-event period. Thus, it would appear that a marked improvement in environmental performance precedes enhanced profitability differences relative to the no-change group as implied by H_3. Similar patterns are apparent for *CF* and *EV*, with a clear widening in the relative differences between the two groups in both measures subsequent to a pronounced change in environmental performance. Turning to Panel B, for the *RE / SG* matched pairs, the difference metrics for *ROA* are -24.017 (p = 0.019) and -24.865 (p = 0.004) in years FY_{+2} and FY_{+3}, respectively, also consistent with the expectation, as implied by H_4, of a widening gap.

Panel A of Table 5 presents mean percentile change statistics for *ROA* and *CF* by matched pair for years FY_{t+2} and FY_{t+3}, figures which can again be inferred from Table 3. As can be seen, the results are largely consistent with separation in performance across the groups in the manner predicted by H_3 and H_4. For the *PRO* / *SP* matched pairs, the differences in mean intra-industry percentile changes in *ROA* and *CF* are positive and significant in both years. To illustrate, in year FY_{+2} the *PRO* firms show positive mean intra-industry percentile changes in *ROA* and *CF* (2.019 and 1.395, respectively) whereas the *SP* firms show negative percentile changes (-0.066 and -1.107, respectively). The p-values on the differences in mean percentile changes are 0.036 and 0.018, respectively. In an analogous fashion, for the *RE* / *SG* matched pairs, the differences in mean intra-industry percentile changes in *ROA* and *CF* are negative in both years but significant only in year FY_{+2}. This may suggest that the persistence of the environmental performance change for *RE* / *SG* firms is not a great as that for *PRO* / *SP* firms. Thus, while admittedly univariate in nature, these results are suggestive of a causal mapping from changes in environmental performance into congruent changes in relative economic performance.

Results for the multivariate consequence 'changes' model (equation (1)) are presented in Panel B of Table 5. As discussed, the tabulated results are based on two-year changes, with the dependent variable ΔROA_{t+1} measured as the change in the firm's *ROA* from the beginning of year FY_{+2} to the end of year FY_{+3} and all independent variables measured as the change from the beginning of year FY_0 to the end of year FY_{+1}. As predicted by H_3 and H_4, the coefficient on the environmental strategy variable (ΔEP_t), γ_1, is positive and significant for all analyses. For example, for the analyses based on the *PRO* / *SP* and *RE* / *SG* matched pairs samples, the coefficients are 0.065 (p = 0.043) and 0.151 (p = 0.022), respectively, while that based only on the *PRO* and *RE* sample firms, the coefficient on ΔEP_t is 0.096 (p = 0.021). Additionally, the coefficient on the lagged change in *ROA* is positive and significant for all samples. The coefficients on the lagged changes in *RDIN* are positive and significant for the analyses based on the *PRO* / *SP* and *RE* / *SG* matched pairs, while the coefficient on lagged *EV* is significant for the *RE* / *SG* partitioning only. All remaining variables are insignificant at conventional (i.e. 0.10, two-tailed) levels.

Note, while for brevity, the reported results focus on *ROA* as the measure of firm performance, qualitatively identical results (untabulated) derive from an analysis of *CF*. Thus, taken together, these results provide strong support for the predictions from H_3 and H_4 that an observed improvement in environmental performance is followed by subsequent improvements in financial performance; conversely, firms which appear to have abandoned a proactive environmental strategy have subsequently suffered declines in financial performance.[31]

5.3 Three Stage Least Squares (3SLS) Regression Results

To resolve endogeneity concerns, a simultaneous equation model was constructed, similar to that used by Al-Tuwaijri *et al.* (2004). Results for this three stage least squares (3SLS) system described in equations (3), (4), and (5) are presented in Table 6. The results reveal both a significant positive coefficient on the environmental performance variable (*EP*) in the economic performance (*EV*) model (equation (3)) and a significant positive coefficient on *EV* in the *EP* model (equation (4)). Their respective coefficients (*p*-values) are 0.085 (< 0.001) and 0.171 (< 0.001). Further, within the *EP* model, the coefficients on *ROA*, *CF*, *RDIN*, and *GRTH* are positive and significant, while the coefficient on *LEV* is negative and significant (at 0.10 level), as implied by the resource-based view of the firm. Thus, taken together, these results are broadly consistent with our above changes analyses, and suggest patterns of two-way causality which are implied by the resource-based theory of the firm and the "pays to be green" literature. The significance of *EP* in the *EV* model is suggestive of good environmental performance being valued by the market (i.e. it pays to be green); further the significance of the above mentioned variables in the *EP* model implies that strong financial resources and superior management capability underlie good environmental performance,

[31] We caution that our finding of a two-way causality in a cross-sectional sample does not suggest that firms will continue to benefit from improved economic performance forever. As for any capital investment, investments in environmental strategy will be subject to diminished rates of return and firms will choose to deploy capital in more efficient investment projects with higher marginal benefits beyond a certain time. There are also exogenous shocks to firms in terms of financial resources or changes in market conditions that may force a firm to abandon its current strategy. In addition, management's ability to turn firms around is a key variable in the resource-based view of the firm. Our analysis of the resource-based view of the firm framework does not preclude that the management can turn around non-performing firms. We thank one reviewer for this very relevant suggestion.

as implied by the resource-based view of the firm.[32]

The results for these models also reveal both *EP* and *EV* to be positively and significantly related to environmental disclosure (*ED*). Further, the results for the environmental disclosure (*ED*) determinants model (equation (6)) are consistent with those of Clarkson *et al.* (2008), with *ED* positively and significantly related to environmental performance (*EP*) but not economic performance (*EV*).

5.4 Robustness Tests

In this section, we discuss the results of tests designed to explore the sensitivity of our results to two specific issues, the use of cost of goods sold as the scalar for our environmental performance (*EP*) measure and the use of a two-year 'Environmental Performance Change' period window. As will be seen, in each instance our results and conclusions appear robust to our choice.

As discussed in Section 4.1, while the use of TRI scaled alternatively by either cost of goods sold or sales revenue finds considerable precedence in the literature, there is nevertheless the concern that both scalars are in fact measures of economic performance and thereby our classification scheme is possibly being driven by changes in economic performance through the scalar rather than changes in environmental performance. To examine the sensitivity of our results to the choice of scalar, we alternatively use gross property, plant, and equipment (PP&E) as the scalar when developing our measure of environmental performance (*EP*) and then repeat both the 'determinants' and 'consequences' analyses.[33] Based on this alternative measure of *EP*, 41 firms are now classified as

[32] There are differences in the way we implement 3SLS, compared to Al-Tuwaijri *et al.* (2004). For example, they use data from 1994 while we use data from 2003. They employ an empirical model and variable measures that differ somewhat from ours. Nevertheless, our finding that *EP* is positive and significant in the economic performance model is consistent with their results. Thus, both studies point to green benefits.

[33] Results based on net property, plant, and equipment are identical. Note, we base our primary analysis on TRI normalized by cost of goods sold in order to be consistent with the existing literature. Regarding the use of PP&E as the scalar, while arguably it is a good proxy for production capacity, it may not be a good proxy for production volume due to cross-sectional variation in capacity utilization. Thus, using PP&E as a scalar may also introduce potential bias.

‘progressive’ and 25 firms as ‘regressive’. These 41 ‘progressive’ firms are a proper subset of the 43 firms originally classified as *PRO*, with the remaining two firms showing signs of improved environmental performance based on the alternative *EP* measure but not progressing by the required two quartiles. The 25 ‘regressive’ firms include the original 24 *RE* firms plus one additional firm that was seen to improve more rapidly under the alternative *EP* measure. Equations (1) and (2) are then re-estimated based on this new classification scheme. As noted at the outset, the results (not tabulated) indicate that neither the conclusions from the ‘determinants’ nor from the ‘consequences’ analyses are sensitive to the choice of scalar.

In detail, for the ‘determinants’ analysis (equation (1)), based on the *PRO / SP* matched firms, the coefficients on ΔROA_{t-1} and ΔCF_{t-1} are now 0.037 (p = 0.029) and 0.023 (p = 0.048) while based on the *RE / SG* matched firms, they are now 0.086 (p = 0.042) and 0.022 (p = 0.034). For the ‘consequences’ analysis (equation (2)), based on the *PRO / SP* matched firms, the coefficient on ΔEP_t is now 0.063 (p = 0.038) while based on the *RE / SG* matched firms, it is now 0.149 (p = 0.027). The coefficients on all remaining variables in all models also remain qualitatively identical to those reported in Panel B of Tables 4 and 5.

Second, as presented above and depicted in Figure 1, both the determinants and consequences analyses have been conducted based on a sequence of non-overlapping two-year periods. Of specific note, the ‘Environmental Performance Change’ period over which we measure ΔEP_t in both analyses covers the two-year period from the beginning of fiscal year FY_0 to the end of fiscal year FY_{+1}. In contrast, the ‘progressive’ (*PRO*) and ‘regressive’ (*RE*) firms have been defined as those for which their within industry percentile *PP* rank changed by at least two quartiles over at most a three year period and then stabilized. Thus, as pointed out in footnote 24, notwithstanding the fact that within the two-year ‘Environmental Change Period’, we observe that the vast majority of our sample firms (34 of the 41 *PRO* firms and 18 of the 23 *RE* firms) had completed their transformation and that the remaining 7 *PRO* and 5 *RE* firms had substantially completed their change in environmental performance, there is potential for slippage given the differences in the time period definition.

To examine the sensitivity of our 'determinants' analysis to the length of the 'Environmental Performance Change' period, ΔEP_t is measured over the three-year period from the beginning of fiscal year FY_0 to the end of fiscal year FY_{+2} and equation (1) is re-run. The results (not tabulated) indicate that conclusions from the 'determinants' analysis are not sensitive to the use of either a two- or three-year 'Environmental Performance Change' period window. Turning to the consequences analysis with ΔEP_t again re-measured over the three-year period from the beginning of fiscal year FY_0 to the end of fiscal year FY_{+2}, the subsequent (non-overlapping) 'Consequences' period (see Figure 1) is shifted so that it now runs from the beginning of fiscal year FY_{+3} to the end of fiscal year FY_{+4}. As a result of this shift, our sample is reduced to only 36 matched *PRO / SP* firms (from 41) and 17 matched *RE / SG* firms (from 23). Equation (2) is re-run using these new measures based on the reduced samples. These results (not tabulated) also indicate that conclusions from the 'consequences' analysis are not sensitive to the use of either a two- or three-year window to measure ΔEP_t.

6. Summary and Conclusion

The results in this study indicate that firms that choose to improve their environmental performance significantly over time ('progressive' firms) tend to experience improvements in their financial resources and/or management capabilities immediately prior to the material improvement in their relative environmental performance. Further, 'progressive' firms appear to enjoy real economic benefits following the improvement in environmental performance as proxied for by profitability (*ROA*) and cash flow (*CF*) as compared to the peer firms that choose not to change their environmental performance.

Similarly, our research shows that firms experiencing significant declines in environmental performance ('regressive' firms) tend to experience relative declines in their financial resources and/or management capabilities immediately prior to their relative declines in environmental performance. In addition, 'regressive' firms also appear to experience a subsequent decline in profitability (*ROA*) and cash flow (*CF*), relative to the base-line no-change group. These overall results are robust to alternative criteria used to classify firms, different model specifications, and after controlling for endogeneity.

The study's findings suggest that the relation between environmental performance and economic performance is consistent with the resource-based view of the firm. Our results indicate that although a proactive environmental strategy may be associated with improved future economic performance (i.e., "it pays to be green"), not all firms can mimic such a strategy. It would appear that only firms with sufficient financial resources and management capabilities can pursue a proactive environmental strategy. This finding helps to explain the continued variation in environmental performance within polluting industries even after three decades of increasingly stringent U.S. environmental regulations.

The study's findings have some important implications for policy makers, accounting researchers, and management accounting practitioners. Our findings suggest that corporate environmental performance is likely driven by management's strategic choice in the context of firms' resource constraints and may evolve over time. Thus, future research in this area should consider time variations in corporate environmental performance in order to capture a firm's strategic choices and the time lag associated with resource constraints.

Recognizing the resource constraints may also benefit environmental policy makers in designing more effective pollution abatement policies. To realize aggregate pollution abatement, effective environmental policies should provide economic incentives to encourage poor environmental performers to become ‘progressive’ firms, and to discourage good environmental performers from backsliding into becoming ‘regressive’ firms. For instance, voluntary environmental programs may be more effective in industries where resource constraints vary significantly across firms. In addition, public recognition of superior environmental performance may be a strong incentive as such recognition could lead to real economic benefits in the form of consumer “green goodwill” in the marketplace.

Finally, management accounting practitioners may benefit from the study’s findings as they are consistent with the proposition in the existing management accounting literature that firms should manage environmental risks and responsibilities proactively. For firms with sufficient financial resources and management capability, proactive investment in pollution abatement may not only benefit the environment but may also lead to better future financial performance down the road.

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Figure 1
Time Line Depicting the Predicted Relations between Changes in Environmental Performance, its Determinants, and its Consequences

Period 1 ‘Determinants of Change’ Period		Period 2 ‘Environmental Performance Change’ Period		Period 3 ‘Consequences’ Period	
FY_{-2}	FY_{-1}	FY_{0}	FY_{+1}	FY_{+2}	FY_{+3}

Determinants Model:

← ΔROA_{t-1} →	← ΔEP_t →	

ΔEP_t measures the cumulative change the firm’s within industry percentile rank from the beginning of FY_0 to the end of FY_{+1} (i.e., the Environmental Performance Change Period), the dependent variable in our determinants model (equation (1)), and ΔROA_{t-1}, one of the independent variables in the determinants model, measures the cumulative change in the firm’s relative within industry *ROA* percentile rank from beginning of year FY_{-2} to the end of year FY_{-1}.(i.e., the Determinants of Change Period). Other independent variables in the determinants model are measured in the same fashion.

Consequences Model:

	← ΔEP_t →	← ΔROA_{t+1} →

ΔROA_{t+1} measures the cumulative change the firm’s relative within industry percentile *ROA* rank from the beginning of FY_{+2} to the end of FY_{+3} (i.e., the Consequences Period), the dependent variable in our consequences model (equation (2)) and ΔEP_t, one of the independent variables in the consequences model, measures the cumulative change in the firm’s relative within industry percentile *EP* rank from beginning of year FY_0 to the end of year FY_{+1} (i.e., the Environmental Performance Change Period). Other independent variables in the consequences model are measured in the same fashion.

TABLE 1
Frequency Distribution for a Sample of 242 Firms from the Period 1990 – 2003

Panel A: Distribution of Sample Firms by Industry Sector

	Industry				
	Pulp & Paper *(SIC = 26)*	**Chemical** *(SIC = 28)*	**Oil & Gas** *(SIC = 29)*	**Metals & Mining** *(SIC = 33)*	**Total Firms**
Firms	42	97	28	75	**242**

Panel B: Distribution of Sample Observations by Year and Industry

Year	Industry				**Total Firm-Years**
	Pulp & Paper *(SIC = 26)*	**Chemical** *(SIC = 28)*	**Oil & Gas** *(SIC = 29)*	**Metals & Mining** *(SIC = 33)*	
1990	31	74	22	49	176
1991	33	77	23	51	184
1992	32	77	20	52	181
1993	32	74	18	52	176
1994	31	70	17	52	170
1995	30	78	20	60	188
1996	31	77	20	59	187
1997	31	74	19	56	180
1998	30	69	17	51	167
1999	29	67	18	52	166
2000	30	68	19	50	167
2001	27	67	17	44	155
2002	23	63	16	41	143
2003	22	60	15	39	136
Total	**412**	**995**	**261**	**708**	**2,376**

Panel C: Distribution of Sample Observations by Environmental Performance Change Partition

	Industry				
Partition	**Pulp & Paper (SIC = 26)**	**Chemical (SIC = 28)**	**Oil & Gas (SIC = 29)**	**Metals & Mining (SIC = 33)**	**Total Firms**
SG	11	30	8	21	70
SP	13	25	7	22	67
PRO	7	14	8	14	43
RE	3	11	3	7	24
VP	8	17	2	11	38
Total	**42**	**97**	**28**	**75**	**242**
Chi-square[a] (*p*-value)	5.642 (0.933)				

The environmental performance change partitions have been developed by ranking firms on the basis of their *TRI* within year and industry. Firms classified as 'stable good environmental performers' (*SG*) or 'stable poor environmental performers' (*SP*) are those ranked in the best or worst two quartiles, respectively, during the entire study period. Firms classified as 'progressive' (*PRO*) or 'regressive' (*RE*) are those firms whose rankings improved or worsened, respectively, by at least two quartiles over at most a three year span at some point during the study period and then stabilized over the remainder of the study period. *VP* are the firms with variable environmental performance (all remaining firms).

[a] Chi-square test for independence between industry category and environmental performance change partition.

TABLE 2
Descriptive Statistics for a Sample of 242 Firms (2,376 Firm-Years) from the Period 1990 – 2003

Panel A: Descriptive Statistics for the Pooled Sample of 2,376 Firm-Years

	PP	*TA*	*ROA*	*CF*	*LEV*	*RDIN*	*GRTH*	*EV*	*NEW*	*CAPIN*
Mean	4.687	5,194.58	0.046	0.081	0.306	0.020	0.070	1.461	0.579	0.051
Median	1.211	1,336.04	0.047	0.074	0.289	0.012	0.056	1.185	0.574	0.045
Std. Dev	19.381	11,218.35	0.074	0.061	0.175	0.027	0.218	1.026	0.137	0.046
First Quartile	0.226	389.216	0.012	0.044	0.203	0.004	-0.020	0.973	0.496	0.028
Third Quartile	3.582	5,432.075	0.084	0.128	0.393	0.027	0.139	1.532	0.672	0.083

Panel B: Partitioned by Environmental Performance

Environmental Performance Category	*PP*	*TA*	*ROA*	*CF*	*LEV*	*RDIN*	*GRTH*	*EV*	*NEW*	*CAPIN*
Best	0.114	5,580.39	0.049	0.091	0.313	0.021	0.076	1.737	0.595	0.082
n = 594	(0.181)	(9,885.11)	(0.075)	(0.085)	(0.176)	(0.025)	(0.270)	(1.032)	(0.129)	(0.042)
	0.070 – 0.544	914.113 – 5,805.095	0.024 – 0.076	0.051 – 0.135	0.187 – 0.386	0.004 – 0.031	-0.029 – 0.128	0.962 – 1.913	0.493 – 0.669	0.034 – 0.080
Worst	12.501	3,616.31	0.038	0.083	0.314	0.023	0.052	1.256	0.585	0.089
n = 594	(25.136)	(6,184.57)	(0.050)	(0.074)	(0.185)	(0.032)	(0.228)	(0.604)	(0.151)	(0.069)
	1.568 – 5.321	247.592 – 3,288.819	0.019 – 0.060	0.020 – 0.122	0.187 – 0.384	0.005 – 0.034	-0.040 – 0.136	0.978 – 1.606	0.470 – 0.651	0.034 – 0.091
t-statistic[c]	*-12.336*	*4.338*	*2.415*	*1.819*	-0.100	-1.251	*1.739*	*11.116*	1.281	*-2.192*
(*p*-value)	*(< 0.001)*	*(< 0.001)*	*(0.016)*	*(0.069)*	(0.920)	(0.211)	*(0.082)*	*(< 0.001)*	(0.200)	*(0.029)*

Variable definitions: *PP* is a firm's pollution propensity; *TA* is the firm's total assets ($ millions); *ROA* is the firm's return on assets; *CF* is the firm's net operating cash flow deflated by total assets; *LEV* is the firm's leverage (total debt / total assets); *RDIN* is research and development (R&D) intensity (R&D expense / total assets); *GRTH* is the firm's growth (change in sales / beginning of period sales); *EV* is the enterprise value of the firm divided by total assets; *NEW* is the newness of the firm's equipment (net p,p,e / gross p,p,e); and *CAPIN* is capital intensity (capital expenditures / total assets).

For Panel B, the sample firms have been ranked within industry and year by *PP* (= *TRI/COGS*). The worst environmental performer partition consists of the firm-years in the lowest *PP* quartile and the best environmental performer partition consists of the firm-years in the highest *PP* quartile. The figures shown are the mean, standard deviation (in parentheses), and inter-quartile range (Q1 – Q3).

The *t*-test is for difference in mean values between environmental performance categories (*p*-values are two-tailed).

TABLE 3
Mean Percentile Statistics for Matched Pairs Samples Classified by Environmental Performance Change Partition

Measure		FY_{-3}	FY_{-2}	FY_{-1}	FY_{0}	FY_{+1}	FY_{+2}	FY_{+3}
Panel A: Progressive (PRO) versus Stable Poor Environmental Performers (SP) (41 matched pairs)								
ROA	*PRO*	57.258	62.770	66.116	68.705	70.389	72.408	73.856
	SP	51.167	47.314	48.785	49.857	47.260	47.194	46.486
	diff (+)	6.091	15.456	17.331	18.848	23.129	25.214	27.370
	p-value	0.186	*0.018*	*0.001*	*0.012*	*0.008*	*0.006*	*0.001*
CF	*PRO*	58.002	60.316	58.738	62.504	67.390	68.785	70.505
	SP	45.291	45.906	40.689	39.638	34.705	33.598	33.193
	diff (+)	12.711	14.410	18.049	22.866	32.685	35.187	37.312
	p-value	*0.022*	*0.018*	*0.003*	*0.001*	*< 0.001*	*< 0.001*	*< 0.001*
EV	*PRO*	58.601	60.676	64.297	65.785	63.964	65.008	65.593
	SP	47.119	44.490	43.114	44.013	43.363	42.366	41.731
	diff (+)	11.482	16.186	21.183	21.772	20.601	22.642	23.862
	p-value	*0.068*	*0.027*	*0.003*	*0.002*	*0.008*	*< 0.001*	*< 0.001*
Panel B: Regressive (RE) versus Stable Good Environmental Performers (SG)(23 matched pairs)								
ROA	*RE*	41.275	39.824	37.275	36.370	31.783	28.944	28.626
	SG	51.267	53.866	52.904	54.234	52.734	52.961	53.491
	diff (–)	-9.992	-14.042	-15.629	-17.864	-20.951	-24.017	-24.865
	p-value	*0.060*	*0.072*	*0.052*	*0.040*	*0.039*	*0.019*	*0.004*
CF	*RE*	40.992	37.778	36.658	31.070	28.099	26.795	26.531
	SG	53.017	52.499	53.925	56.010	56.429	57.005	57.290
	diff (–)	-12.025	-14.721	-17.267	-24.940	-28.330	-30.210	-30.759
	p-value	0.078	*0.053*	*0.033*	*0.012*	*0.007*	*0.002*	*< 0.001*
EV	*RE*	38.203	36.221	39.027	34.528	31.657	29.665	29.042
	SG	49.086	49.839	51.851	50.964	54.492	52.481	53.583
	diff (–)	-10.883	-13.618	-12.824	-16.436	-22.835	-22.816	-24.541
	p-value	*0.091*	*0.069*	*0.074*	*0.028*	*0.010*	*0.009*	*< 0.001*

The environmental performance change partitions have been developed by ranking firms on the basis of their *TRI* within year and industry. Stable Good (*SG*) or Stable Poor (*SP*) environmental performers are those consistently ranked in the best or worst two quartiles, respectively. 'Progressive' (*PRO*) and 'Regressive' (*RE*) firms are those whose rankings improved or worsened, respectively, by at least two quartiles over a three year span and then stabilized.

Variable definitions: *ROA* is the firm's return on assets measured as net operating income divided by beginning of period assets; *CF* is the firm's operating cash flow divided by beginning of period assets; and *EV* is enterprise value divided by beginning of period assets. All variables have been ranked within industry and year. Measures presented represent mean percentile ranks. Fiscal year FY_0 is the first year of a marked change in relative *EP* percentile for the *R* or *AR* firms, as appropriate.

Reported *p*-values are for the one-tailed test of difference (diff) in mean percentile values between the *PRO / SP* or *RE / SG* categories, as appropriate (predicted sign in parentheses).

TABLE 4 Results for the 'Determinants' Analyses

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Panel A: One-Year Changes in Mean Percentile Ranks For the Years Preceding A Change in Environmental Performance

		Matched Pair			
Measure		***PRO* versus *SP***		***RE* versus *SG***	
		FY$_{-2}$	***FY$_{-1}$***	***FY$_{-2}$***	***FY$_{-1}$***
ROA	*PRO* or *RE*	5.512	3.346	-1.451	-2.549
	SP or *SG*	-3.853	1.471	2.599	-0.962
	difference	9.365	1.875	-4.050	-1.587
	p-value	***0.002***	*0.083*	***0.011***	0.112
CF	*PRO* or *RE*	3.314	-1.578	-3.214	-1.12
	SP or *SG*	0.615	-6.217	-0.518	1.426
	difference	2.699	4.639	-2.696	-2.546
	p-value	*0.052*	***0.040***	***0.038***	***0.049***

Panel B: Regression Results – 'Determinants' Model

Sample Predicted sign	***inter***	***ΔROA* (+)**	***ΔCF* (+)**	***ΔLEV* (–)**	***ΔRDIN* (+)**	***ΔGRTH* (+)**	***ΔEV* (+)**	***ΔTA***	***ΔNEW***	***Δ CAPIN***	***ΔEP***	*Adj R^2*
PRO / SP	-3.684	***0.040***	*0.020*	***-0.070***	***0.110***	***0.043***	0.050	***-0.235***	*0.077*	-0.007	***0.757***	0.505
(n = 41 + 41)	(< 0.001)	***(0.045)***	*(0.051)*	***(0.043)***	***(0.008)***	***(0.016)***	(0.192)	***(< 0.001)***	*(0.086)*	(0.690)	***(< 0.001)***	
RE / SG	-0.893	***0.101***	***0.026***	*-0.033*	0.133	***0.025***	***0.078***	***-0.376***	0.015	0.012	***0.795***	0.495
(n = 23 + 23)	(0.189)	***(0.036)***	***(0.034)***	*(0.079)*	(0.118)	***(0.043)***	***(0.050)***	***(< 0.001)***	(0.657)	(0.553)	***(< 0.001)***	
PRO / RE	-2.442	***0.153***	***0.055***	*-0.109*	*0.145*	0.029	0.039	***-0.344***	***0.319***	-0.037	***0.890***	0.584
(n = 41 + 23)	(0.010)	***(0.024)***	***(0.043)***	*(0.062)*	*(0.052)*	(0.287)	(0.652)	***(< 0.001)***	***(0.002)***	(0.546)	***(< 0.001)***	

Panel A presents one-year changes in mean percentile ranks; fiscal year FY_0 is the first year of a marked change in relative *EP* percentile rank for the *PRO* or *RE* firms, as appropriate.

The environmental performance change partitions have been developed by ranking firms on the basis of their *TRI* within year and industry. Stable Good (*SG*) or Stable Poor (*SP*) environmental performers are those consistently ranked in the highest or lowest two quartiles, respectively. 'Progressive' (*PRO*) and 'Regressive' (*RE*) firms are those whose rankings improved or worsened, respectively, by at least two quartiles over a three year span and then stabilized.

In Panel B, the 'determinants' model (equation (1)) is: $\Delta EP_t = \delta_0 + \delta_1 \Delta ROA_{t-1} + \delta_2 \Delta CF_{t-1} + \delta_3 \Delta LEV_{t-1} + \delta_4 \Delta RDIN_{t-1} + \delta_5 \Delta GRTH_{t-1} + \delta_6 \Delta EV_{t-1} + \delta_7 \Delta lnTA_{t-1} + \delta_8 \Delta NEW_{t-1} + \delta_9 \Delta CAPIN_{t-1} + \delta_{10} \Delta EP_{t-1}$ where ΔEP_t measures the change in mean within industry *EP* percentile rank from the beginning of year FY_0 to the end of year FY_{+1} and for each of the independent variables, the change is measured from the beginning of year FY_{-2} to the end of year FY_{-1} Figures reported are coefficient estimates and *p*-values (in parentheses). Reported *p*-values are two-tailed.

Variable definitions: *EP* is the firm's environmental performance, measured as the inverse of toxics release inventory in pounds per thousand dollar cost of good sold (*PP*); *ROA* is the firm's return on assets measured as net operating income divided by beginning of period total assets; *CF* is the firm's cash flow from operations divided by beginning of period total assets; *LEV* is the firm's leverage measured as total debt divided by total assets; *RDIN* is research and development (R&D) intensity measured as R&D expense divided by total assets; *GRTH* is the firm's growth as measured by change in sales divided by beginning of period sales; *EV* is enterprise value divided by total assets; *TA* is the firm's total assets ($ millions); *NEW* is the newness of the firm's equipment measured as net property, plant, and equipment divided by gross property, plant, and equipment; and *CAPIN* is capital intensity measured as capital expenditures divided by total assets.

TABLE 5 Results for the 'Consequences' Analyses

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Panel A: Mean Percentile Change Statistics for Firm Performance following changes in Environmental Performance

Measure		Matched Pair: *PRO* versus *SP* FY_{+2}	*PRO* versus *SP* FY_{+3}	*RE* versus *SG* FY_{+2}	*RE* versus *SG* FY_{+3}
ROA	*PRO* or *RE*	2.019	1.448	-2.839	-0.318
	SP or *SG*	-0.066	-0.708	0.227	0.530
	Difference	2.085	2.156	-3.066	-0.848
	p-value	***0.036***	***0.035***	***0.021***	0.172
CF	*PRO* or *RE*	1.395	1.720	-1.304	-0.264
	SP or *SG*	-1.107	-0.405	0.576	0.285
	difference	2.502	2.125	-1.880	-0.549
	p-value	***0.018***	***0.032***	***0.047***	0.317

Panel B: Regression Results – 'Changes' Model

Sample Predicted sign	***Inter***	***ΔEP* (+)**	***ΔROA***	***ΔRDIN***	***ΔGRTH***	***ΔEV***	***ΔTA***	*Adj* R^2
PRO / SP (n = 41 + 41)	-1.291 (0.303)	***0.065*** ***(0.043)***	***0.673*** ***(< 0.001)***	*0.170* *(0.066)*	-0.009 (0.746)	0.179 (0.140)	-0.241 (0.143)	0.240
RE / SG (n = 23 + 23)	-1.511 (0.270)	***0.151*** ***(0.022)***	***0.505*** ***(< 0.001)***	***0.232*** ***(0.023)***	-0.033 (0.254)	***0.180*** ***(0.025)***	0.193 (0.355)	0.282
PRO / RE (n = 41 + 23)	-0.633 (0.691)	***0.096*** ***(0.021)***	***0.344*** ***(0.001)***	0.047 (0.766)	0.025 (0.665)	0.103 (0.373)	-0.240 (0.165)	0.212

Panel A presents one-year changes in mean percentile ranks; time FY_0 is the first year of a marked change in relative *EP* percentile.

The environmental performance change partitions have been developed by ranking firms on the basis of their *TRI* within year and industry. Stable Good (*SG*) or Stable Poor (*SP*) environmental performers are those consistently ranked in the highest or lowest two quartiles, respectively. 'Progressive' (*PRO*) and 'Regressive' (*RE*) firms are those whose rankings improved or worsened, respectively, by at least two quartiles over a three year span and then stabilized.

In Panel B, the 'changes' model (equation (1)) is: $\Delta ROA_{t+1} = \gamma_0 + \gamma_1\Delta EP_t + \gamma_2\Delta ROA_t + \gamma_3\Delta RDIN_t + \gamma_4\Delta GRTH_t + \gamma_5\Delta EV_t + \gamma_6\Delta TA_t$ where ΔROA_{t+1} measures the change in *ROA* from the beginning of year FY_{+2} to the end of year FY_{+3} while for each of the independent variables, the change is measured from the beginning of FY_0 to the end of FY_{+1}. Figures reported are coefficient estimates and *p*-values (in parentheses). Reported *p*-values are two-tailed.

Variable definitions: *ROA* is the firm's return on assets; *EP*, the firm's environmental performance measured as the inverse of toxics release inventory in pounds per thousand dollar cost of good sold (*PP*); *RDIN* is research and development (R&D) intensity measured as R&D expense divided by total assets; *GRTH* is the firm's growth as measured by change in sales divided by beginning of period sales; *EV* is enterprise value divided by total assets; and *TA* is total assets.

TABLE 6
Three-stage least squares (3SLS) Results

Variable	Predicted Sign	Economic Performance (*EV*)	Predicted Sign	Environmental Performance (*EP*)	Predicted Sign	Environmental Disclosure (*ED*)
Intercept		10.216 (< 0.001)		53.392 (< 0.001)		-52.881 (< 0.001)
EV		- - -	(+)	***0.171*** ***(< 0.001)***		-0.703 (0.397)
EP	(+)	***0.085*** ***(< 0.001)***		- - -		***0.890*** ***(< 0.001)***
ED		***0.030*** ***(0.047)***		***0.043*** ***(0.035)***		- - -
ROA		***0.624*** ***(< 0.001)***	(+)	***0.055*** ***(0.019)***		0.400 (0.271)
CF		***0.077*** ***(0.001)***	(+)	***0.078*** ***(0.024)***		- - -
LEV		- - -	(–)	*-0.054* *(0.099)*		***15.089*** ***(< 0.001)***
RDIN		***0.177*** ***(< 0.001)***	(+)	*0.060* *(0.053)*		- - -
GRTH		*0.039* *(0.051)*	(+)	***0.040*** ***(0.026)***		- - -
lnTA		- - -		***-0.111*** ***(< 0.001)***		***11.448*** ***(< 0.001)***
NEW		- - -		***-0.063*** ***(0.030)***		*-11.099* *(0.060)*
CAPIN		***-0.051*** ***(0.014)***		0.029 (0.336)		***28.045*** ***(< 0.001)***

Variable definitions: *EV* is enterprise value divided by total assets; *EP* is the firm's environmental performance, measured as the inverse of toxics release inventory in pounds per thousand dollar cost of good sold (*PP*); *ED* is a measure of the firm's voluntary environmental disclosures (see Clarkson et. al, 2008); *ROA* is the firm's return on assets measured as net operating income divided by beginning of period total assets; *CF* is the firm's cash flow from operations divided by beginning of period total assets; *LEV* is the firm's leverage measured as total debt divided by total assets; *RDIN* is research and development (R&D) intensity measured as R&D expense divided by total assets; *GRTH* is the firm's growth as measured by change in sales divided by beginning of period sales; *TA* is the firm's total assets ($ millions); *NEW* is the newness of the firm's equipment measured as net property, plant, and equipment divided by gross property, plant, and equipment; and *CAPIN* is capital intensity measured as capital expenditures divided by total assets.

The figures reported are coefficient estimates and *p*-values (in parentheses). All reported *p*-values are two-tailed.