Empirical Evidence on Environmental Performance and Operating Costs*

Nadja Guenster and Jakob Koegst[1]

University of Muenster, Germany

This version: May 2017

ABSTRACT

We investigate how environmental performance affects operating costs using a sample of 785 U.S. firms for the period 2006 – 2014. Environmental performance is measured as the overall environmental score provided by Asset4. We find that better environmental performance is negatively associated with direct production costs, but increases overhead costs. Because direct production costs have a larger impact than overhead costs, aggregate operating costs decline as environmental performance improves. To deal with endogeneity and to interpret the results causal, we use an instrumental variables approach.

Keyword: Environmental performance, Natural Resource Based View, Operating Cost

* We thank Jeroen Derwall, Stefanie Kleimeier and seminar participants at the Open University Heerlen, the Netherlands for valuable comments and feedback.

[1] Contact author: Jakob Koegst, University of Muenster, Universitaetsstrasse 14-16, 48143 Muenster, jakob.koegst@wiwi.uni-muenster.de, phone: +49-2518321965

INTRODUCTION

The link between environmental performance and financial performance at the firm level is an often discussed topic among economists (Endrikat, Guenther, & Hoppe, 2014; Friede, Busch, & Bassen, 2015; Guenster & Koegst, 2016; Horvathova, 2010). Many empirical papers show a positive relation between environmental performance and profitability (Guenster, Bauer, Derwall, & Koedijk, 2011; Hart & Ahuja, 1996; Horvathova, 2012; Jo, Kim, Lee, & Park, 2013; King & Lenox, 2002; Russo & Fouts, 1997). While aggregate profitability measures are used in the empirical implementation, the underlying theoretical argumentation points towards effects of environmental performance on revenues and costs. Several studies motivate a cost decreasing effect of environmental performance with the resource efficiency argument (Guenster et al., 2011; Hart & Ahuja, 1996; Russo & Fouts, 1997). Following that argument, environmental performance can be increased through more efficient processes, which are accompanied by a reduction in input factors and better waste management (Hart, 1995; Shrivastava, 1995a, 1995b). Empirical evidence on the environmental performance cost link is scarce. A number of case studies examine specific companies and generally point to a negative effect of environmental performance on costs (Hart, 1995; Nidumolu, Prahalad, & Rangaswami, 2009; Shrivastava 1995b). Christmann (2000) provides survey evidence on firms from the chemical industry. The results reveal that the development of proprietary pollution prevention technologies leads to a cost advantage. Yet to our knowledge, there is no large sample empirical evidence based on accounting cost measures. However, this topic is of special importance as many executives do not consider the cost decreasing effect of environmental performance improvements in their investment decisions. The McKinsey Global Survey (2014) results reveal that only 26% of the executives name cost cutting as a factor why companies address sustainability. Our findings, however, show that these investments are actually accompanied with lower direct production costs.

We examine the link between environmental performance and operating costs. We split operating costs into overhead and direct production costs. We expect a positive relation between environmental performance and overhead costs due to the installation of environmental managements systems (Klassen & Whybark, 1999). In contrast, for direct production costs we hypothesize a negative relation. In line with previous studies, we refer to the resource efficiency argument (Hart, 1995; Shrivastava, 1995a, 1995b). To measure environmental performance, we use the overall environmental score provided by Asset4. The overall environmental score comprises the three areas emission reduction, product innovation, and resource reduction. Our dataset consists of 4,112 firm year observations of large U.S. companies in the time period 2006 – 2014.

We find that firms with a higher level of environmental performance have significantly higher overhead costs. For direct production costs, our results show a negative effect of environmental performance. The effect on operating costs is again negative, because direct production costs account for 78% of operating costs. To deal with endogeneity and to interpret the results causal, we use an instrumental variable approach. Di Giuli and Kostovetsky (2014) show that the political environment influences the corporate social responsibility of a firm. We use U.S. election results of the state, where the company's headquarter is located, as an instrument for the environmental performance of the respective company. The results of the instrumental variables approach confirm our previous findings. Our results are robust to different IV estimation techniques.

Our findings support theoretical arguments that environmental performance can decrease costs. However, we also document a differential effect on different types of costs. These insights are not only academically relevant, but also important for managers to reach informed decisions on how to evaluate investments in environmental performance.

In section 2, we discuss the theory and derive hypotheses. Section 3 provides details on the measure of environmental performance, operating costs, and the control variables. The results of the empirical analysis are shown in section 4. Section 5 concludes.

BACKGROUND AND HYPOTHESES

Environmental Performance and Direct Production Costs

Porter and Kramer (2011) argue that innovation, environmental performance, and cost savings go hand in hand. One example they bring forward are the enormous cost savings of Dow Chemical, which arise from the reduced consumption of fresh water. The authors point out that innovative eco-efficient systems can yield to net costs savings through better process efficiency and resource utilization. This is in line with Shrivastava and Hart (1992) who interpret pollution as inefficiency in the manufacturing process. They suggest to use recycled or renewable materials from the production process. Russo and Fouts (1997) argue in the same vein and propose that proactive environmental policies such as the redesign of production and service delivery processes can result in a better resource efficiency. The higher level of resource efficiency leads to lower input and waste management costs, which ultimately decreases direct production costs (Hart, 1995; Shrivastava, 1995a, 1995b).

Case study evidence speaks in favor of a potential cost decreasing effect of environmental performance. Shrivastava (1995b) evaluates the environmental technology of the 3M Company. He points out that the innovative environmental approaches from 3M lead to a decrease in costs. These innovative technologies aim to decrease the use of virgin materials and increase the usage of recycled materials in the production process. Nidumolu et al. (2009) examine different large US companies and how they achieved better environmental performance (e.g. HP, Wal Mart, FedEx, Cisco, P&G, Clorox, Waste Management). Nidumolu et al. (2009) describe that improvements in

environmental performance are a rich source of organizational and technological innovations. They suggest that the reduction in input factors contributes to a decrease in direct production costs. To sum up, it seems that environmental performance can decrease the usage and consequently the costs of input factors in the production process.

Another part of direct production costs is the cost of labor. Henrique and Sadorsky (2007) use a large cross-country survey to examine the influencing factors of firm's environmental performance. Their results reveal that workers have a positive impact on firm's adaption of environmental management systems. Grolleau et al. (2007) argue in the same vein and show that firms aiming for a better human resource management are more likely to implement an environmental management system. Both studies point towards workers preferences for a higher level of environmental performance. Ambec and Lanoie (2008) argue that firms with higher levels of environmental performance can hire more productive and skilled employees. Furthermore, they conjecture that better environmental performance can reduce labor costs by less illness and less personnel turnover. Darnall et al. (2000) make the point that the adoption of environmental management systems positively affects the morale of the employees. Based on these arguments, we expect a higher level of environmental performance to reduce the costs of input factors and increase labor productivity. Thus, we hypothesize:

Hypothesis 1. Firms with higher levels of environmental performance have lower direct production costs.

Environmental Performance and Overhead Costs

Few papers discuss the effect of environmental performance on overhead costs. Hunt and Auster (1990) and Klassen and Whybark (1999) point out that environmental technologies have to be accompanied by an environmental management system. Klassen and Whybark (1999) emphasize the overhead costs of environmental management systems. These systems should be

capable of employee training for environmental performance, including environmental aspects in capital budgeting decisions, and engaging outside stakeholders in managing operations. Furthermore, Klassen and Whybark (1999) recommend the installation of an environmental department. In a nutshell, the aforementioned arguments point to an increase in overhead costs as the firm improves its environmental performance.

Hypothesis 2. Firms with higher levels of environmental performance have higher overhead costs.

DATA

Environmental Performance

We use data from Asset4 provided by Thomson Reuters Datastream to measure the environmental performance of a firm. Asset4 data have been used in several other studies (Gupta, 2015; Ioannou & Serafeim, 2012; Semenova & Hassel, 2015). The Asset4 database covers more than 4,600 companies worldwide and generates more than 250 KPI's for the ESG performance of every company. Asset4 processes publicly available information, e.g. from company reports, company websites, company filings and NGO websites. In addition to that, Asset4 considers information from established and trustworthy media.

In our analysis we concentrate on the overall environmental score.[2] The score is normalized, where 1 is the best and 0 the worst environmental performance. The overall environmental score evaluates the firm's performance in the fields of resource usage, emissions and emissions reductions. Furthermore, environmental activism and product and

[2] In unreported results we conduct all analyses with the resource reduction score provided by Asset4 and get very similar results.

process innovation are taken into account. The overall environmental score is built upon 53 binary and 17 metric indicators (Thomson Reuters, 2013).

Financial Measures

Cost measures. We include three different types of costs: direct production, overhead, and operating costs. We use the item "costs of goods sold" from Compustat to measure direct production costs. Costs of goods sold is defined in Compustat as "all costs directly allocated by the company to production, such as material, labor and overhead" (Compustat data definition). We use the item "selling, general and administrative expenses" from Compustat to measure overhead costs. Selling, general and administrative expenses are the major non-production costs and include among other things, compensation paid to management, accounting expenses, engineering expenses, corporate expenses etc. (Compustat data definition).

We use the item "operating expenses total" from Compustat to measure the overall operating costs. These costs comprise all ongoing costs, which are necessary to run a business. They capture both overhead costs and direct production costs.

We scale all three types of costs by total assets to obtain a cost measure that is independent of firm size similar to previous studies (Guenster et al., 2011; Hart & Ahuja, 1996; Horvathova, 2012; Jo et al., 2013; King & Lenox, 2002; Russo & Fouts, 1997). We refrain from using sales volume as a scaling variable, as it is likely to be influenced by environmental performance.[3] In unreported results, we use employees as a scaling variable. Our results are qualitatively similar and seem not to be dependent on the scaling variable.

[3] Russo and Fouts (1997) point out that eco-aware customers prefer buying from companies with a high level of environmental performance. Furthermore, many studies provide evidence of a link between environmental performance and price premia (Bjørner, Hansen, & Russell, 2004; Casadesus-Masanell, Crooke, Reinhardt, &

Control variables. We include the debt to assets ratio as a control variable in our analysis. The debt to assets ratio is commonly used as a control variable in studies examining firm profitability (Guenster et al., 2011; Horvathova, 2012; King & Lenox, 2002). Jensen (1986) posits that debt exerts discipline on managers, which decreases wasteful spending and increases the investments in profitable opportunities. Ultimately, this effect should decrease the operating costs and we conjecture a negative sign for the debt to assets ratio.

The book to market ratio is used to control for firms' growth opportunities. Russo and Fouts (1997) describe that low-growth firms are more likely to be hierarchical, inflexible, and bureaucratic. Thus, we expect that firms with a high book to market ratio face higher costs compared to firms with a low book to market ratio.

We use the natural logarithm of sales volume as a control for firm size. Sales volume is an often used proxy for firm size (Guenster et al., 2011; Hillman & Keim, 2001; Sarkis & Cordeiro, 2001). In the context of our analysis, sales volume bears the advantage of accounting for changes in costs that are driven by sales volume. Therefore, we can control for the effect that a change in sales volume has on costs.

Descriptives

Table 1 shows descriptive statistics for all variables. After merging both databases our sample consists of 785 U.S. firms and 4,112 firm year observations. The examined time period ranges from 2006 to 2014. The means of direct production costs and overhead costs scaled by total assets are 0.53 and 0.18, respectively. Given the larger magnitude of direct productions costs, they are of greater importance for operating costs.

Vasishth, 2009). Both effects imply a positive correlation between environmental performance and sales, which would bias our findings.

When examining the year 2014 in our dataset, we find the 3M Corporation to be the company with the highest environmental score of 0.9492. The lowest environmental score assigned by Asset4 was 0.0876 in 2014.

Insert Table 1 about here

RESULTS

Table 2 reports the results for the pooled OLS estimations. We control for industry effects with industry dummies at the one-digit SIC level. Furthermore, we include year dummies to control for time effects. We use standard errors, which are clustered at the firm level. We believe that pooled OLS is an appropriate way to explore the data, as most of the variation in environmental performance is between and not within-variation.[4] To confirm the robustness of our findings, we also present the results of several different estimation methods in the appendix. We present results for fixed effect regressions (Table A1), Fama-MacBeth regressions (Table A2) and cross sectional regressions (Table A3-A5).

Insert Table 2 about here

The results in table 2 confirm our first hypothesis that environmental performance is negatively associated with direct production costs. The results show a significant positive relation between overhead costs and environmental performance. This finding confirms our second hypothesis. When considering the effect of environmental performance on operating

[4] A table with a variance decomposition of environmental performance in between and within variation is shown in Table A6.

costs, we find a cost decreasing effect of environmental performance. All coefficients for environmental performance are significant at the 5% level.

The debt to assets ratio has a negative effect on all types of cost. This result is in accordance with our expectation that debt disciplines the firm's management and prevents them from wasteful spending. Sales volume is positively associated with direct production costs and operating costs. This is also in line with our expectations. Surprisingly, sales volume is negatively associated with overhead costs. The book to market ratio is negatively associated with overhead costs and operating expenses. For direct production costs the effect is insignificant.

Up to now, we find with the method of pooled OLS that environmental performance is positively related to overhead costs and negatively related to direct production and operating costs. One issue that we might face in our analysis is the reverse causation problem. One possibility is that environmental performance decreases costs. The other possibility is that firms with low costs have more slack resources which they can then invest in environmental performance (Waddock & Graves, 1997). Therefore, the slack resource hypothesis points towards a reverse causation problem. Another potential issue is the omitted variables problem. One important variable, which is missing in our analysis, is management quality. Management quality is hard to measure. However, a good management can increase environmental performance and decrease operating costs. The test results of the Durbin-Wu-Hausmann test reveal that endogeneity is present in our sample. Deng et al. (2013) face a similar problem in their analysis. They use the instrumental variable approach to deal with this issue and use the political orientation of the state, where the firm is headquartered, as an instrument. We use a similar methodology as Deng et al. (2013). In the following we explain our instrument and argue why it fulfills the relevance and exclusion restriction. Di Giuli and Kostovetsky (2014)

and Rubin (2008) show that the political environment influences the corporate social responsibility of a firm. Firms which are headquarted in democratic leaning states are accompanied with a higher corporate social responsibility than firms in republican leaning states. We construct our proxy for the democratic leaning of a state with principal component analysis. We incorporate election results on the state and country level. We use the elections for the Lower and Upper House for the respective state. On the country level we take the House of Representatives and the presidential elections into account. Furthermore, we incorporate the partisan voter index. We hypothesize that firms headquartered in a democratic leaning state have a higher level of environmental performance. We argue that the exclusion restriction is fulfilled as the political orientation of the state is not likely to directly influence the operating costs. Our check of the relevance condition shows F-statistics higher than 12 for all regressions where environmental performance is instrumented by the political orientation of the state. Stock et al. (2002) suggest a critical F-Value of 8.96 for one instrument. Therefore, our instrumental variable regression is not likely to have a weak instrument problem.

Insert Table 3 about here

We run a Fuller LIML estimation because it is more robust than the standard 2SLS technique (Fuller, 1977; Stock & Yogo, 2005). Our results can be confirmed with other specifications such as 2SLS or Moreiera's CLR, which are omitted for brevity and available on request.

The instrumental variable regressions shown in table 3 show similar results as in the pooled OLS setting. They indicate a decreasing effect of environmental performance on direct production and operating costs and an increasing effect on overhead costs. The coefficients of

environmental performance are significant at the 1% level in each setting. The control variables also point in the expected direction. To sum up, we find a significant influence from environmental performance on all type of costs, which is not likely to be driven by endogeneity or reverse causality.

CONCLUSION

Our findings confirm theoretical arguments that environmental performance decreases direct production costs (Nidumolu et al, 2009; Porter & Kramer, 2011; Shrivastava, 1995b). For operating costs, we find the same relation. Furthermore, our results show that environmental performance increases overhead costs. Our results are qualitatively similar for all methods. We deliver evidence that a higher level of environmental performance provides a means of cutting costs. We encourage managers to consider this evidence in future investment decisions.

REFERENCES

Ambec, S., & Lanoie, P. 2008. Does it pay to be green? A systematic overview. ***The Academy of Management Perspectives,*** 22(4): 45–62.

Bjørner, T. B., Hansen, L. G., & Russell, C. S. 2004. Environmental labeling and consumers' choice – an empirical analysis of the effect of the Nordic Swan. ***Journal of Environmental Economics and Management,*** 47(3): 411–434.

Casadesus-Masanell, R., Crooke, M., Reinhardt, F., & Vasishth, V. 2009. Households' willingness to pay for "green" goods: evidence from Patagonia's introduction of organic cotton sportswear. ***Journal of Economics & Management Strategy***, 18(1): 203–233.

Christmann, P. 2000. Effects of "best practices" of environmental management on cost advantage: The role of complementary assets. ***The Academy of Management Journal,*** 43(4): 663–680.

Compustat data definition. Accessed 01/07/2017
http://web.utk.edu/~prdaves/Computerhelp/COMPUSTAT/Compustat_manuals/user_05r.pdf

Darnall, N., Gallagher, D. R., Andrews, R. N. L. & Amaral, D. 2000. Environmental management systems: Opportunities for improved environmental and business strategy? ***Environmental Quality Management,*** 9: 1–9.

Deng, X., Kang, J. K., & Low, B. S. 2013. Corporate social responsibility and stakeholder value maximization: Evidence from mergers. ***Journal of Financial Economics,*** 110(1): 87–109.

Di Giuli, A., & Kostovetsky, L. 2014. Are red or blue companies more likely to go green? Politics and corporate social responsibility. ***Journal of Financial Economics,*** 111(1): 158–180.

Endrikat, J., Guenther, E., & Hoppe, H. 2014. Making sense of conflicting empirical findings: A meta-analytic review of the relationship between corporate environmental and financial performance**. *European Management Journal,*** 32(5): 735–751.

Friede, G., Busch, T., & Bassen, A. 2015. ESG and financial performance: aggregated evidence from more than 2000 empirical studies. ***Journal of Sustainable Finance & Investment,*** 5(4): 210–233.

Fuller, W. A. 1977. Some properties of a modification of the limited information estimator. ***Econometrica: Journal of the Econometric Society***, 45(4): 939–953.

Grolleau, G., Mzoughi, N., & Thomas, A. 2007. What drives agrifood firms to register for an Environmental Management System? ***European Review of Agricultural Economics,*** 34(2): 233–255.

Guenster, N., Bauer, R., Derwall, J., & Koedijk, K. 2011. The economic value of corporate eco-efficiency. ***European Financial Management,*** 17(4): 679–704.

Guenster, N. & Koegst, J. 2016. Environmental responsibility and firm value. *Working paper*.

Gupta, K. 2015. Environmental sustainability and implied cost of equity: International evidence. ***Journal of Business Ethics,*** vol. online: 1–23.

Hart, S. L. 1995. A natural resource-based view of the firm. ***Academy of Management Review,*** 20: 986–1014.

Hart, S. L., & Ahuja, G. 1996. Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. ***Business Strategy and the Environment,*** 5(1): 30–37.

Henriques, I., & Sadorsky, P. 2007. Environmental management and practices: An international perspective. In N. Johnstone (Ed.), ***Environmental policy and corporate behaviour:*** 34–87. Cheltenham. UK.

Hillman, A. J., & Keim, G. D. 2001. Shareholder value, stakeholder management, and social issues: What's the bottom line? ***Strategic Management Journal,*** 22(2): 125–139.

Horvathova, E., 2010. Does environmental performance affect financial performance? A meta-analysis. ***Ecological Economics,*** 70: 52-59.

Horvathova, E. 2012. The impact of environmental performance on firm performance: Short-term costs and long-term benefits? ***Ecological Economics,*** 84: 91–97.

Hunt, C. B., & Auster, E. R. 1990. Proactive environmental management: Avoiding the toxic trap. ***Sloan Management Review,*** 31(2): 7–18.

Ioannou, I., & Serafeim, G. 2012. What drives corporate social performance? The role of nation-level institutions. ***Journal of International Business Studies,*** 43(9): 834–864.

Jensen, M. C. 1986. Agency costs of free cash flow, corporate finance, and takeovers. ***The American Economic Review,*** 76(2): 323–329.

Jo, H., Kim, H., Lee, B.S. and Park, K. 2013. Corporate environmental responsibility and financial performance around the world. *KAIST College of Business Working Paper Series* (2013-017).

King, A., & Lenox, M. 2002. Exploring the locus of profitable pollution reduction. ***Management Science,*** 48(2): 289–299.

Klassen, R. D., & Whybark, D. C. 1999. The impact of environmental technologies on manufacturing performance. ***The Academy of Management Journal***, 42(6): 599–615.

McKinsey Global Survey (2014): http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/sustainabilitys-strategic-worth-mckinsey-global-survey-results

Nidumolu, R., Prahalad, C. K., & Rangaswami, M. 2009. Why sustainability is now the key driver of innovation. ***Harvard Business Review***, 87(9): 56–64.

Porter, M. E., & Kramer, M. R. 2011. Creating shared value. ***Harvard Business Review,*** 89(1): 62–77.

Rubin, A. 2008. Political views and corporate decision making: The case of corporate social responsibility. ***Financial Review***, 43(3): 337–360.

Russo, M. V., & Fouts, P. A., 1997. A resource-based perspective on corporate environmental performance and profitability. ***The Academy of Management Journal,*** 40(3): 534–559.

Sarkis, J., & Cordeiro, J. J. 2001. An empirical evaluation of environmental efficiencies and firm performance: Pollution prevention versus end-of-pipe practice. ***European Journal of Operational Research,*** 135(1): 102–113.

Semenova, N., & Hassel, L. G. 2015. On the validity of environmental performance metrics. ***Journal of Business Ethics,*** 132(2): 249–258.

Shrivastava, P. 1995a. Ecocentric management for a risk society. ***Academy of Management Review,*** 20(1): 118–137.

Shrivastava, P. 1995b. Environmental technologies and competitive advantage. ***Strategic Management Journal,*** 16(1): 183–200.

Shrivastava, P., & Hart, S. 1992. Greening organizations. ***Academy of Management Proceedings,*** 1992(1): 185–189.

Stock, J. H., Wright, J. H., & Yogo, M. 2002. A survey of weak instruments and weak identification in generalized method of moments. ***Journal of Business & Economic Statistics,*** 20(4): 518–529.

Stock, J. H., & Yogo, M. 2005. Testing for weak instruments in linear IV regression. In D. W. K. Andrews (Ed.), ***Identification and Inference for Econometric Models.*** New York: Cambridge University Press: 80–108.

Thomson Reuters, 2013. Accessed 12/09/2016. http://financial.thomsonreuters.com/content/dam/openweb/documents/pdf/tr-com-financial/methodology/corporate-responsibility-ratings.pdf

Waddock, S. A., & Graves, S. B. 1997. The corporate social performance-financial performance link. ***Strategic Management Journal,*** 18(4): 303–319.

TABLE 1
Means, Standard Deviations, Min, Max[a]

Variable	Mean	S.D.	Min	Max
1. Direct Production costs (COGS)[a]	0.53	0.59	0.00	4.73
2. Overhead costs (SGA)[a]	0.18	0.17	0.00	1.09
3. Operating expenses (OPEX)[a]	0.68	0.67	0.00	4.85
4. Environmental Score	0.44	0.32	0.09	0.97
5. Debt to Assets Ratio	0.24	0.18	0.00	0.94
6. Book to Market Ratio	0.53	0.46	0.00	8.07
7. Sales Volume[b]	8.43	1.35	2.35	13.09

[a] N = 4,112. [b] COGS, overhead costs, and operating expenses are scaled by the firms' total assets. [c] Logarithm of sales

TABLE 2
Pooled OLS Results

Variable	COGS	SGA	OPEX
Environmental Score	-0.31***	0.04**	-0.27***
	(0.07)	(0.02)	(0.07)
Debt to assets ratio	-0.40***	-0.24***	-0.61***
	(0.10)	(0.03)	(0.11)
Book to market ratio	-0.03	-0.07***	-0.09**
	(0.03)	(0.01)	(0.04)
Sales Volume	0.18***	-0.02***	0.16***
	(0.02)	(0.00)	(0.02)
Intercept	-0.86***	0.36***	-0.50**
	(0.24)	(0.05)	(0.22)
Industry Controls	YES	YES	YES
Year Dummies	YES	YES	YES
Observations	4,493	4,112	4,493
R-squared	0.44	0.38	0.48

All specifications include industry dummies at the one-digit SIC level and year dummies. Standard errors in parentheses are clustered at the firm-level. Significance is denoted with * p<0.1, ** p<0.05, *** p<0.01 (Two-tailed tests).

TABLE 3
Instrumental Variable Regression Results

Variable	First Stage DV=ENV	Model 1: COGS	First Stage DV=ENV	Model 2: SGA	First Stage DV=ENV	Model 3: OPEX
Environmental Score		-5.47***		0.75***		-4.78***
		(1.18)		(0.19)		(1.05)
Democratic Leaning	0.01***		0.01***		0.01***	
	(0.00)		(0.00)		(0.00)	
Debt to assets ratio	0.01	-0.41***	-0.01	-0.22***	0.01	-0.63***
	(0.02)	(0.12)	(0.02)	(0.02)	(0.02)	(0.11)
Book to market ratio	-0.05***	-0.29***	-0.04***	-0.04***	-0.05***	-0.32***
	(0.01)	(0.08)	(0.01)	(0.01)	(0.01)	(0.08)
Sales Volume	0.13***	0.84***	0.13***	-0.11***	0.13***	0.74***
	(0.00)	(0.15)	(0.00)	(0.02)	(0.00)	(0.13)
Industry Controls	YES	YES	YES	YES	YES	YES
Year Dummies	YES	YES	YES	YES	YES	YES
Observations	4,461	4,461	4,092	4,092	4,461	4,461
F test (instrument, overall)	12.97***	12.14***	12.91***	19.42***	12.97***	13.54***

All specifications include industry dummies at the one-digit SIC level and year dummies. Standard errors in parentheses are robust to heteroscedasticity.
Significance is denoted with * p<0.1, ** p<0.05, *** p<0.01 (Two-tailed tests). Estimation is made with Fuller's modified LIML.

TABLE A1
Fixed Effect Regression Results

Variable	Model1a: COGS	Model1b: COGS	Model1c: COGS	Model2a: SGA	Model2b: SGA	Model2c: SGA	Model3a: OPEX	Model3b: OPEX	Model3c : OPEX
Environmental Score		-0.08***			-0.02**			-0.09***	
		(0.02)			(0.01)			(0.03)	
Resource Reduction Score			-0.09***			-0.01***			-0.10***
			(0.02)			(0.01)			(0.03)
Debt to assets ratio	-0.38***	-0.37***	-0.37***	-0.06**	-0.05**	-0.05**	-0.43***	-0.42***	-0.42***
	(0.12)	(0.12)	(0.12)	(0.02)	(0.02)	(0.02)	(0.14)	(0.14)	(0.14)
Book to market ratio	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Sales Volume	0.07***	0.08***	0.08***	-0.01**	-0.01*	-0.01*	0.06**	0.07***	0.07***
	(0.02)	(0.02)	(0.02)	(0.00)	(0.00)	(0.00)	(0.02)	(0.03)	(0.03)
Intercept	0.14	0.11	0.10	0.29***	0.28***	0.28***	0.42**	0.38*	0.37*
	(0.20)	(0.20)	(0.20)	(0.04)	(0.04)	(0.04)	(0.21)	(0.21)	(0.21)
Observations	4,493	4,493	4,493	4,112	4,112	4,112	4,493	4,493	4,493
R-squared	0.04	0.05	0.05	0.02	0.02	0.02	0.04	0.04	0.05

Standard errors in parentheses are robust to heteroscedasticity. Significance is denoted with * p<0.1, ** p<0.05, *** p<0.01 (Two-tailed tests).

TABLE A2
Fama-MacBeth Regression Results

Variable	Model1b: COGS	Model2b: SGA	Model3b: OPEX
Environmental Score	-0.32***	0.04***	-0.29***
	(0.03)	(0.01)	(0.02)
Debt to assets ratio	-0.41***	-0.24***	-0.63***
	(0.03)	(0.01)	(0.03)
Book to market ratio	-0.09	-0.10***	-0.18**
	(0.06)	(0.01)	(0.06)
Sales Volume	0.19***	-0.02***	0.17***
	(0.01)	(0.00)	(0.01)
Intercept	-0.68***	0.45***	-0.24***
	(0.04)	(0.02)	(0.05)
Industry Controls	YES	YES	YES
Observations	4,493	4,112	4,493
R-squared	0.44	0.40	0.49

All specifications include industry dummies at the one-digit SIC level. Standard errors in parentheses are heteroscedasticity and autocorrelation consistent Newey-West (1987) estimates.
Significance is denoted with * p<0.1, ** p<0.05, *** p<0.01 (Two-tailed tests).

TABLE A3
Cross-Sectional Regression Results - COGS

Variable	COGS - 2006	COGS - 2007	COGS - 2008	COGS - 2009	COGS - 2010	COGS - 2011	COGS - 2012	COGS - 2013	COGS - 2014
Environmental score	-0.34***	-0.31**	-0.45***	-0.40***	-0.32***	-0.26***	-0.28***	-0.30***	-0.27***
	(0.13)	(0.13)	(0.12)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)
Debt to assets ratio	-0.63***	-0.37*	-0.45***	-0.39***	-0.31***	-0.36***	-0.41***	-0.39***	-0.39***
	(0.19)	(0.19)	(0.15)	(0.13)	(0.10)	(0.12)	(0.12)	(0.10)	(0.10)
Book to market ratio	-0.43***	-0.22**	-0.00	-0.04	-0.08	-0.01	-0.00	-0.04	-0.03
	(0.16)	(0.10)	(0.03)	(0.06)	(0.06)	(0.04)	(0.05)	(0.06)	(0.03)
Sales Volume	0.22***	0.20***	0.22***	0.19***	0.18***	0.19***	0.17***	0.17***	0.17***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Intercept	-1.21***	-0.99***	-0.72***	-0.61***	-0.82***	-0.95***	-0.76***	-0.78***	-0.76***
	(0.21)	(0.22)	(0.20)	(0.15)	(0.25)	(0.27)	(0.26)	(0.26)	(0.25)
Observations	298	315	425	500	578	585	587	595	610
R-squared	0.49	0.43	0.45	0.46	0.45	0.44	0.42	0.40	0.42

All specifications include industry dummies at the one-digit SIC level. Standard errors in parentheses are robust to heteroscedasticity. Significance is denoted with * p<0.1, ** p<0.05, *** p<0.01 (Two-tailed tests).

TABLE A4
Cross-Sectional Regression Results - SGA

Variable	SGA - 2006	SGA - 2007	SGA - 2008	SGA - 2009	SGA - 2010	SGA - 2011	SGA - 2012	SGA - 2013	SGA - 2014
Environmental score	-0.01	0.06	0.07**	0.05*	0.03	0.04*	0.04*	0.03*	0.04*
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Debt to assets ratio	-0.26***	-0.21***	-0.23***	-0.19***	-0.22***	-0.25***	-0.28***	-0.26***	-0.26***
	(0.06)	(0.06)	(0.05)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Book to market ratio	-0.19***	-0.09***	-0.04***	-0.13***	-0.11***	-0.11***	-0.10***	-0.13***	-0.05**
	(0.04)	(0.03)	(0.01)	(0.02)	(0.04)	(0.02)	(0.03)	(0.03)	(0.02)
Sales volume	-0.01	-0.03***	-0.03***	-0.01**	-0.01**	-0.02***	-0.02***	-0.02***	-0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Intercept	0.36***	0.30***	0.37***	0.27***	0.32***	0.36***	0.41***	0.41***	0.45***
	(0.05)	(0.06)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.05)	(0.08)
Observations	262	288	377	464	530	542	542	547	560
R-squared	0.45	0.41	0.38	0.37	0.41	0.41	0.40	0.38	0.37

All specifications include industry dummies at the one-digit SIC level. Standard errors in parentheses are robust to heteroscedasticity. Significance is denoted with * p<0.1, ** p<0.05, *** p<0.01 (Two-tailed tests).

TABLE A5
Cross-Sectional Regression Results - OPEX

Variable	OPEX - 2006	OPEX - 2007	OPEX - 2008	OPEX - 2009	OPEX - 2010	OPEX - 2011	OPEX - 2012	OPEX - 2013	OPEX - 2014
Environmental score	-0.35***	-0.27**	-0.39***	-0.36***	-0.29***	-0.21**	-0.24***	-0.26***	-0.22***
	(0.13)	(0.14)	(0.13)	(0.10)	(0.10)	(0.08)	(0.08)	(0.08)	(0.08)
Debt to assets ratio	-0.83***	-0.57***	-0.65***	-0.57***	-0.50***	-0.59***	-0.67***	-0.62***	-0.62***
	(0.20)	(0.21)	(0.17)	(0.14)	(0.11)	(0.14)	(0.13)	(0.11)	(0.12)
Book to market ratio	-0.59***	-0.30***	-0.04	-0.14**	-0.17**	-0.08*	-0.09	-0.14**	-0.08*
	(0.16)	(0.10)	(0.03)	(0.07)	(0.07)	(0.05)	(0.06)	(0.07)	(0.04)
Sales volume	0.21***	0.18***	0.19***	0.18***	0.16***	0.16***	0.14***	0.15***	0.14***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
Intercept	-0.85***	-0.72***	-0.35*	-0.33**	-0.50**	-0.59**	-0.34	-0.37	-0.32
	(0.21)	(0.23)	(0.20)	(0.15)	(0.23)	(0.26)	(0.25)	(0.24)	(0.22)
Observations	298	315	425	500	578	585	587	595	610
R-squared	0.57	0.49	0.49	0.50	0.50	0.48	0.46	0.44	0.45

All specifications include industry dummies at the one-digit SIC level. Standard errors in parentheses are robust to heteroscedasticity. Significance is denoted with * p<0.1, ** p<0.05, *** p<0.01 (Two-tailed tests).

TABLE A6:
Variance Decomposition Environmental Performance

Variable: Environmental Score		Mean	S.D.	Min	Max	Observations
	overall	0.44	0.32	.09	.97	N = 4493
	between		.29	.09	.95	n = 785
	within		.13	-.22	.96	T-bar = 7.19