Industry Risk Moderates the Relation between Environmental and Financial Performance

by

Natalia Semenova[1] and Lars G. Hassel[1,2]

Åbo Akademi University[1] and Umeå School of Business[2]

We acknowledge the financial support from Mistra, Foundation of Strategic Environmental Research in Sweden, and both the Research Institute at the Foundation for Åbo Akademi and the Foundation for Economic Education – Liikesivistysrahasto – in Finland

Sustainable Investment Research Platform Working Papers

www.sirp.se

SIRP WP 08-02

September 2008

FUNDED BY MISTRA

Industry Risk Moderates the Relation between Environmental and Financial Performance

Abstract

This study extends previous research on the relation between different measures of environmental and financial performance by introducing moderating effects of inherent environmental industry risk. We provide empirical evidence from the MSCI World Index U.S. companies by using the GES Investment Services® risk rating for the period 2003-2006. The inherent environmental industry risk has a significant moderating effect on the *form* of the relation between environmental preparedness/performance and operating performance of the companies. In high risk or polluting industries, environmental management is costly and reduces the operating performance of companies. In low risk sectors, such as banking and insurance, leading companies on environmental management are also more profitable. The paper makes a distinction between the reputational benefits of environmental preparedness and the operational gains of environmental performance when studying the effects on market value. A significant *direct* effect of environmental preparedness on the market value of the companies is present, while the relation between environmental performance and market value is *stronger* in low risk industries than in high risk industries. In low risk industries, the market value of the companies is also on average higher and more attuned to benefits to environmental performance than in high risk industries.

1. Introduction

There is a long-standing debate in the academic literature on the relation between environmental and financial performance of companies and the outcomes of studies are mixed and contradictory. The sceptical view is that companies that respond actively to environmental challenges incur extra costs and thus reduce their profits and shareholder value (Walley and Whitehead, 1994). A primary argument for the opposite view is that a company can improve its economic value by being the first-mover to exploit environmental opportunities by anticipating environmental regulation and standards. Leading companies could encounter higher costs, but according to Williams and Siegel (2001) and Lundgren (2007) their customers may be willing to pay higher prices. An environmentally pro-active leading company could therefore be more profitable, and additionally because of benefits to its reputation have a higher market value than environmentally lagging companies.

Empirical studies have predominantly explored the direct effects of environmental/social performance on financial outcomes. Comprehensive literature reviews have been conducted by Griffin and Mahon (1997), Orlitzky and Benjamin (2001), and Orlitzky *et al.* (2003) on the link between social/environmental performance and financial performance/risk of companies. These studies provide a rigorous basis to conclude that empirical findings mostly support a positive, but weak, environmental and financial performance relation. Several individual studies have demonstrated a positive link between environmental performance and the market value of companies. Dowell *et al.* (2000) found that companies in environmentally sensitive industries that adopt more stringent environmental standards have higher market values. Similarly, Konar and Cohen (2001) showed that companies in polluting industries with lower environmental risks related to disposing fewer chemicals, and having fewer lawsuits, had higher market values. King and Lennox (2002) found a positive relation between waste prevention and company value. More recently, Guenster *et al*. (2006) demonstrated across industries in a U.S. company universe that eco-efficient[1] companies had higher market values and that especially companies with low eco-efficiency were penalized by financial markets. Empirical studies also relate environmental performance to the internal operating performance of companies. The results on this relation are mixed and it is not always obvious that environmental management improves

[1] Guenster *et al.* (2006) interpret eco-efficiency as the ability to create more value while using fewer environmental resources, and Dowell *et al.* (2000) as the ability of companies to minimize pollution by improving the production and manufacturing process.

profitability. The resource-based view of management (Hart, 1995) has provided most consistent evidence that pro-active environmental management systems are needed in order to provide future cost savings by increasing efficiency for future operating performance benefits (Porter and Van der Linde, 1995; Waddock and Graves, 1997). In productive environmental management, only the first-movers can exploit market opportunities in a profitable way (Guenster *et al.*, 2006).

This paper is motivated by the fact that environmental regulations, restrictions, and concerns differ among industries, but the environmentally related industry moderator effect has not explicitly been considered in earlier studies. Some research has investigated how industry differences affect the relations between environmental and financial performance. These studies argue that the findings of the direct effects are driven by the fact that a positive effect in one industry is balanced by a negative effect in another (Elsayed and Paton, 2005). An examination of the association between environmental performance and financial performance of companies belonging to different industries has been performed by including industry dummies (Konar and Cohen, 2001; Elsayed and Paton, 2005; Hassel et. al, 2005 and Semenova and Hassel, 2008). The purpose of this paper is to empirically examine if the environmental risk of the industry moderates the relation between environmental performance of the company and two financial performance measures, the operating performance of the company measured by Return on Assets and the market value of the company measured by Tobin's Q.

The next section of the paper develops hypotheses for the moderating effects, presents the research method use, results and a final discussion of the results of study.

2. Hypotheses Development

This paper is based on the notion that the industry context determines the environmental profiles of the companies with resulting financial consequences for operating performance and market values (Semenova and Hassel, 2008). Polluting industries typically have higher environmental regulations and constraints than clean industries. Environmental regulation in polluting industries has been found to negatively affect productivity, increase the operating uncertainty and required rate of return for companies (Jaffe *et al*., 1995; Semenova and Hassel, 2008). By studying the industry effect, we separate the inherent environmental risk of the industry from the company-specific environmental risks and their relations to financial performance of companies. Company-specific environmental risks can be managed through environmental preparedness and performance. By introducing two

dimensions of environmental performance, this study allows a separate examination of the reputational benefits of preparedness on market value and the operational benefits of environmental performance on operating performance. Following Guenster *et al*. (2006) we use Return on Assets (ROA) as a measure for operating performance, and Tobin's Q (Q) as a proxy for the market value of the company's shares. The two measures are complementary in that ROA measures the financial returns from the current assets employed by the company, while Q reflects the intangible value in the stock market beyond the book value of the company.

The theoretical underpinnings for the moderating effects of inherent environmental industry risk on the relations between environmental and financial performance are scarce. At the same time, industries vary considerably in their environmental impacts, governmental regulatory standards, and technological opportunities (Griffin and Mahon, 1997). Further, there are differences among industries on both social/environmental performance and financial performance (Waddock and Graves, 1997, Semenova and Hassel, 2008). The study of Elsayed and Paton (2005) provides a foundation for that the impact of environmental performance on financial outcomes is different across industries. They found that environmental performance had a positive relation to return on assets for companies in the chemical and telecommunication industries, but a negative impact in the metals and motor vehicles industries. Konar and Cohen (2001) also show that the magnitude of the environmental effects varies across industries. The traditionally polluting industries, such as chemical, metals, manufacturing and papers accrue larger financial losses, while smaller losses are in food products, transportation equipment, and electric machinery industries. The studies show that there is a direct industry effect indicating that environmental performance is more costly in polluting industries or in industries with high inherent environmental risk. The moderating effects of the industry risk have, however, not been subject to a systematic study before.

Our initial hypothesis is that when the environmental risk of industry is high, companies operating in those industries incur higher costs and reduce their operating performance when they want to comply with stringent environmental standards and improve their environmental performance. We consider two dimensions of company-specific environmental opportunities which are environmental preparedness and environmental performance. Environmental preparedness includes environmental policies and programs, mandatory and voluntary environmental reporting, environmental certification and environmental screening of suppliers for companies to engage in order to improve their environmental profile. Freedman and Jaggi (1988) argued that companies in polluting industries made

more extensive voluntary disclosures of environmental information. The demand to invest in a pollution prevention policy and clean technologies is costly for companies in polluting industries (Konar and Cohen, 2001). Contrary, companies in green industries encounter smaller expenditures when they want to improve their environmental preparedness and performance. New technologies and processes that are on the cutting edge of emission reductions cost more and the viability of new, clean technologies is unknown as well as the economic consequences of their use (Russo and Fouts, 1997). Walley and Whitehead (1994) posited that it is not easy to be 'green' because environmental challenges are costly for companies, especially in industries with high competition and overcapacity such as the petroleum and chemicals sectors. Henkel *et al*. (2001, p. 448) took a theoretical standpoint that polluting industries consist mostly of companies with high reforming costs, while clean industries consist of firms with lower costs of compliance. Russo and Fouts (1997) made a general argument that industry context moderates the influence of environmental/social performance on economic performance. From this follows the proposition that improving the environmental preparedness and performance in industries with high or low inherent-industry risk will have different effects on companies' operating performance. A moderating effect with a difference in the form of the relationship (Sharma et al., 1981; Hartmann, 1999) is proposed:

> H_1: *The relations between environmental preparedness/performance and operating performance are moderated by inherent-industry risk; when the inherent-industry risk is high (low) environmental preparedness/performance will have a negative (positive) effect on operating performance*.

This paper develops two separate hypotheses for how the environmental risk of the industry relates to the market value of the company. Alessandri and Khan (2006) have explored the role of industry risk and suggested that companies would be penalized if they deviate from the industry risk norms. The nature of the industry and the type of the risk norm were found to be important in company valuation. Elsayed and Paton (2005) report industry differences in the impact of environmental performance on operating performance, but not on market value. Konar and Cohen (2001) found that the magnitude of the market value loss is different across industries.

Prior research has more consistently been able to establish a positive relation between policies and programs to meet environmental demands and the share price of the company. Also, the Swedish

Society of Financial Analysts (SFF) has highlighted the importance of information about a company's environmental concerns and performance to the investors. Their recommendation, *Environmental Information for Financial Analysts*, states: *'For an increasing number of companies a positive environmental profile has become an important element in their marketing strategy of the company and a lack of such a profile constitutes a risk factor'* (SFF, 2000, p. 58; authors' translation). Reputational benefits can be related to the environmental profile. Dowell *et al.* (2000) showed that companies that go beyond global environmental standards in the manufacturing and mining industries have higher market values than companies that barely meet the standards. Konar and Cohen (2001) found support for the proposition that companies with few or no law suits have higher market values. Klassen and McLaughlin (1996) found a positive effect on market values of companies that received environmental achievement rewards, while negative news led to decrease in market value. Companies with low environmental preparedness can potentially encounter the same environmental violations that were found by Karpoff *et al*. (2005) to lead to reputational penalties. This study suggests that high environmental preparedness will bring a positive environmental profile to companies. Environmental preparedness may not have a positive impact on future cash flows, but improved reputation, followed by lower company-specific risk, leads to a lower discount rate and potentially higher present market value. Spicer (1978) saw the risk in that the capital market impute a higher risk factor resulting in a lower present value if the company fail to respond to environmental expectations. The following hypothesis proposes a positive relation between a company's environmental preparedness and the market value:

> $H2_a$: *There is a direct positive relationship between environmental preparedness and market value of the company.*

The most consistent support in prior research has been found for the relation between environmental performance and company value. Prior studies, however, use some composite measure of environmental performance which makes it difficult to judge whether the positive effects on value comes from reputational benefits or changes in net cash flows. Konar and Cohen (2001) have demonstrated that environmental performance correlates with intangible asset values (Tobin's Q) in high risk industries. King and Lennox (2002) found an indication of the 'it pays to be green' effect, but they were unable to separate industry and company effects. Hassel *et al*. (2005) used an abnormal

earnings model with non-financial environmental performance as a driver of future earnings and found an incremental negative effect on market value added. Guenster *et al.* (2006) found a positive relation between best-in-class eco-efficiency and Tobin's Q. The relation strengthened over time indicating that the market value effect of environmental performance was priced with a drift. The difference in market values of low and high eco-efficient companies increased over time indicating especially that the lagging companies were penalized.

Polluting industries are more regulated than clean industries and they have more stringent environmental constraints on company operations. Pollution abatement to comply with stricter environmental standards requires larger capital cost that decrease market value (Konar and Cohen, 2001; King and Lenox, 2001; Semenova and Hassel, 2008). Financial markets can, according to Klassen and McLaughlin (1996) react differently to industries that are environmentally clean and polluting. Improved environmental performance of companies in polluting industries, such as petroleum, may be viewed with scepticism leading to that financial markets initially reward environmental performance only in clean industries. Companies in green industries with low compliance and regulatory costs that improve their environmental performance will have higher market returns than companies in polluting industries. We propose that the strength of the relation (Sharma et al., 1981; Hartmann, 1999) between environmental performance and market value is moderated by industry risk.

> $H2_b$: *The relation between environmental performance and market value is more positive under low than high inherent environmental industry risk*

This study additionally controls for a number of company-specific variables that in previous empirical research were related to operating performance and company value (Konar and Cohen, 2001; Guenster *et al*., 2006). The control variables are introduced in section 3.1.

3. Methodology and Data

3.1 Methodology

In previous research, financial performance of the companies has been defined by profitability-based and market-based dimensions providing a range of measures used to assess corporate financial outcomes of environmental exposures. Griffin and Mahon (1997) found that ROA is one of the most frequently used measures for financial performance in academic literature. A company's ROA evaluates operating performance and gives an estimate of a company's profitability and efficiency (Barber and Lyon, 1996; Guenster *et al.*, 2006). To investigate the relationship between ROA and environmental opportunity, we incorporate control variables, such as size and leverage that affect companies' operating performance. Size is important because smaller companies may have fewer resources for environmentally responsible behaviour than larger companies. Risk tolerance defines a company's attitude toward spending on recycling or waste reduction by incurring high level of current cost but with a potential for money savings in the long run. Based on review of the literature, the following control variables were selected: the company's book value of assets that measure a company's size[2] and the long-term debt to total asset ratio as a proxy for a company's riskiness (Capon *et al.*, 1990; Waddock and Graves, 1997; Guenster *et al.,* 2006).

We use Tobin's Q as a market-derived measure that reflects expected future gains and captures the tangible and intangible values of a company. Tobin's Q is calculated by dividing the market value of a company by the replacement value of assets. The market value of assets equals the book value of assets plus the market value of common equity less the sum of the book value of common equity and the balance sheet deferred taxes (Kaplan and Zingales, 1997; Guenster *et al.*, 2006). Thus, we calculate Tobin's Q as:

$$Q = \frac{Market\ Value}{Total\ Assets} = \frac{\begin{array}{l}\left(Total\ Assets + Market\ Value\ of\ Stock\right) - \\ \left(Book\ Value\ of\ Common\ Stock + Deferred\ Taxes\right)\end{array}}{Total\ Assets} \qquad (1)$$

[2] We also used the total sales as an alternative measure of company size. The results were in all cases not significantly different from those obtained using the total assets.

In addition, we include variables that have been found to influence market value: sales growth, company age, return on assets, and the logarithm of total assets[3] (Konar and Cohen, 2001; King and Lenox, 2001; Guenster *et al.*, 2006). Sales growth has been found to correlate with company value. We measure sales growth as the increase in past two-year sales. ROA is used to control for differences in operating performance of a company. We also account for differences in company size by looking at the logarithm of the total assets. A company's age is computed as the difference between the first registered trading day of shares and the respective date of analysis. Companies with a longer period of market presence have been found to have higher Q values.

We examine three environmental-related measures for each of the companies that affect financial performance: preparedness, performance, and industry risk. Our environmental measures have several notable advantages. Traditional environmental proxies, such as absolute pollution levels and eco-efficiency consider either a single dimension of a company's environmental performance that reflects historical environmental events or embody both current and forward-looking information into one multi-dimensional measure. Our extension is that environmental opportunities, namely environmental preparedness and performance allow us to separately consider reputational and operational benefits from environmental management. In contrast to current studies, which analyse the impact environmental performance on firm performance across different industries by using the dummy variables for each primary two-digit standard industrial classification (Elsayed and Paton, 2005), this study investigates the influence of an industry-specific variable and provides a broader environmental risk and opportunity approach.

The issue of whether the impact of environmental opportunities on financial performance varies across different industries is explored using moderated regression analysis (Lance, 1988; Sharma et al., 1981; McClelland and Judd, 1993; Jaccard, 1990). We assume that environmental inherent-industry risk modifies the relations and specify the following empirical pooled models, which are based on one-way and two-ways interactions between variables:

$$FP_{it} = \beta_o + \beta_1 EO_{it} + \beta_2 C_{it} + \varepsilon_{it} \quad (2)$$

$$FP_{it} = \beta_o + \beta_1 EO_{it} + \beta_2 ER_{it} + \beta_3 C_{it} + \varepsilon_{it} \quad (3)$$

$$FP_{it} = \beta_o + \beta_1 EO_{it} + \beta_2 ER_{it} + \beta_3 EO_{it} ER_{it} + \beta_4 C_{it} + \varepsilon_{it} \quad (4)$$

[3]Due to data restrictions, we had to exclude variables, such as research and development spending, an interaction term between sales growth and research and development spending, and a dummy variable for NASDAQ companies.

where FP_{it} denotes the dependent variables of financial performance. EO_{it} in the models represents the independent variables of environmental opportunities. ER_{it} is the moderator variable, i.e. environmental inherent-industry risk. The multiplicative term $EO_{it}ER_{it}$ encompasses the interaction effect and represents the dependency of EO_{it} on ER_{it}. The slope, β_3, aims to measure the interaction effect. C_{it} is a vector of control variables. i is a randomly drawn cross section observation (i = 1,2,…,534 firms), t denotes time periods for each cross section observation (for financial variables t = quarter1 2004, quarter3 2004, quarter1 2005, quarter3 2005, quarter1 2006, quarter3 2006; for environmental variables t = December 2003, June 2004, December 2004, June 2005, December 2005, June 2006).

The difference between equation (3) and equation (4) is the inclusion of the two-way interaction term in equation (4). If the regression parameter of the interaction term β_3 in equation (4) is significant, inherent-industry risk moderates either the form or strength of the relationship between environmental preparedness/performance and financial outcomes. The difference in R^2 from equation (4) and R^2 from equation (3) indicates the magnitude of the impact of including two-way interaction term in the regression. Given that the regression parameter β_3 in equation (4) is significant, the interaction effect is probed by the plotting techniques and post hoc statistical testing in order to sharpen the understanding of its meaning (Aiken and West, 1991). As it is often the case, the interaction term $EO_{it}ER_{it}$ in the equation (4) is highly correlated with the main effect variable EO_{it} and the moderator variable ER_{it}, leading to uninterpretable regression parameters and inflated standard errors associated with multicollinearity. We avoid these problems and minimise multicollinearity by using a residual-centering approach. The environmental opportunity and inherent-industry risk variables are transformed by subtracting the mean from each value and the interaction terms of the centered variables are built by multiplying both variables that are part of the interaction. The interaction term, created by multiplication of the two centered variables, shows low correlation with the main variables.

In examining the relationship between variables, we use the pooled cross-section time-series data analysis. The advantage of this approach is that the sample is much larger than when only time-series or cross-sectional methods are employed. Consequently, the precision in estimation of the regression parameters will increase. We recognize that pooling six time periods of data for each company requires us to control for a correlation in the error term of the regression models over time for a given company

(Cameron and Trivedi, 2005; Petersen, 2007). Ignoring this panel data problem would lead to underestimated standard errors and inflated t-statistics. In this study, the parameters of the models (2)-(4) are computed by using the pooled OLS estimator with panel-robust standard errors that correct serial correlation and heteroskedasticity. The White heteroskedasticity-consistent estimator is applied to obtain the panel-robust standard errors adjusted for intra-cluster correlation (White, 1980). For the short panels used, this approach does not require specifying the models for individual-specific effects, assuming independence and identical distribution over cross-sectional units and no fixed effects (Cameron and Trivedi, 2005). We control for correlation across time of Tobin's Q and ROA by including time dummies. Including the industry dummies and company-specific controls allow us capture unobserved industry and company-specific effects. Throughout the study, the number of observations varies depending upon which variables have missing data points. To avoid the effect of missing data, we apply the all-available or the replace value imputation methods.

3.2 Data

The data used in this study comes from two main sources. Financial information, i.e., ROA, market value, and a set of control variables, were obtained from Thomson Financial DataStream. The data set consists of quarterly reports for 563 U.S. companies from the last quarter of 2002 through the last quarter of 2006, and covers all key accounting indicators essential for constructing our research measures. For environmental information, multiple data sources have been used in recent quantitative research, e.g. the Fortune survey, the KLD index, the Toxics Release Inventory, the Franklin Research and Development Corporation, and the Innovest Strategic Value Advisors' eco-efficiency ratings (Griffin and Mahon, 1997; Russo and Fouts, 1997; Guenster *et al.*, 2006). The environmental measures were obtained from the Global Ethical Standard (GES) Investment Services® Risk Rating[4]. The strength of the GES Investment Services database is that it provides evaluations of both environmental risk and opportunity of the MSCI World Index companies. The environmental rating includes the inherent industry risk level and the company-specific risk level. The company-specific risk is based on two sub-scores of companies' opportunities, namely performance and preparedness. Preparedness represents reputational benefits from a company's environmental policy, management systems, and regular reporting. Performance covers the pro-active operational ability of the company to handle environmental impacts and risks, such as product performance, energy use, GHG and VOC emissions,

[4] www.ges-invest.com

waste treatment, and other initiatives. Altogether the GES systematic screening evaluates companies' present environmental status and readiness for the future. Environmental measures are intended to embody both *ex post* and *ex ante* dimensions of corporate risk and opportunity.

Table 1 shows the dimensions assessed on a seven-point non-numerical scale from major strength (A) to major weakness (C). Preparedness includes seven and performance fifty-five items. For empirical analysis, we convert the seven GES Investment Services non-numerical ratings into numerical environmental scores in which companies with the lowest industry risk (A) receive a rating equal to zero and the highest industry risk (C) receive a rating of six. Performance and preparedness conversions are based on a reversed scale, i.e., the highest opportunity-ranked (a) companies receive a rating equal to six and the lowest opportunity-ranked (c) companies receive a rating of zero.

INSERT TABLE 1 HERE

Ratings are based on information obtained from companies in their official documents, including annual and interim reports, and through a direct dialogue in the form of surveys or site visits. Evaluation also uses public information by non-governmental organisations (NGO), the media and the international network of analysts in the SiRi Company Ltd. The GES rating includes 2006 about 1,800 of the largest listed companies in the world and the ratings are issued two times a year, in June and December. GES data has not been used in previous research, but the database provides a more differentiated picture on both risk and opportunity dimensions. Based on the MSCI World Index, our environmental data set consists of 574 U.S. companies which were rated from December 2003 to June 2006. After aggregation of samples by company ISIN code, and company name, we were left with 534 listed U.S. companies from diverse industries over the period 2003-2006. Table 2 shows an industry list of the companies in the sample according to the Global Industry Classification Standard (GISC) used by the GES Investment Services.

INSERT TABLE 2 HERE

Table 3 provides the descriptive statistics for the environmental and financial measures. Panel A in Table 3 shows the average values over the research period. For the sample companies, the risk and

opportunity ratings do not change considerably over time. ROA and Tobin's Q show more variability during the period. A high positive kurtosis value for ROA denotes departures from normality because of extreme observations being present on both sides of the distribution. For Tobin's Q, there is also non-normality in the data. Due to outliers in the data, we adopt the approach that detects outliers from a uni-variate perspective and remove observations if they are more than 1.5xIQR away. Panel A also reports the frequency of the environmental risk and opportunities scores divided into seven categories. The sample consists of companies in potentially high and low environmental risk industries. High risk industries include energy, materials, capital goods, automobiles and components, and utilities, while low risk industries consist of commercial services and suppliers, consumer services, media, insurance, retailing, financial, software and services, and health care providers and services. U.S. companies in low and middle risk industries represent the major part of the sample, while the number of companies in high risk industries is lower.

Panel B in Table 3 provides correlation coefficients between the explanatory variables using the pooled sample before removing outliers. The statistics show that ROA is significantly positively related (0.12) to inherent environmental risk of the industry. Tobin's Q is significantly negatively correlated with three of the environmental risk and opportunity variables: industry risk, preparedness and performance. Note that the three environmental variables are significantly correlated with each other. For this reason, the research equation (1) is divided into the single regressions with each environmental variable in statistical analysis. We control for the industry effects in the regressions by including industry dummies in the models, when inherent industry risk as an independent variable is not present. Based on the GISC standard, the different industries are combined into ten industry sectors.

INSERT TABLE 3 HERE

4. Results

Table 4 provides the results of regression models based on equations (2) through (4) for environmental risk and opportunity scores. Columns of the panels report coefficients on dependent variables ROA and Q and their one-tailed tests of significance. Note that the coefficients estimated for

company-specific control variables are consistent with those reported by Guenster et al. (2006), and by Waddock and Graves (1997). Industry and time dummy controls are included but suppressed in the tables.

INSERT TABLE 4 HERE

The first column of Table 4 shows the results of the tests for the main effects of environmental opportunities on financial outcomes. Both environmental preparedness and performance are significantly positively related to company ROA and Q. As shown in the second column of Table 4, the industry risk has a significantly positive relation to operating performance and a significantly negative relation to the market value of the companies. The influence of inherent-industry risk on the relationship between environmental opportunities and financial outcomes is explored by including the two-way interaction term in equation (3). For ROA the interaction terms for both environmental preparedness and environmental performance are significantly negative (β_3 = -0.09, *t*-value = -2.73; β_3 = -0.09, *t*-value = -1.97), suggesting that the relationships are modified by inherent-industry risk. Including the two-way interaction term in the regression equation increases R^2 from 0.1354 to 0.1402 ($p<0.01$). When Q is dependent variable, the interaction term for environmental performance is significant (β_3 = -0.005, *t*-value = -1.43) and increases R^2 from 0.2997 to 0.3004 ($p<0.01$).

Given that significant interactions have been obtained, we further analyze the interactions to sharpen the understanding of their meanings. The techniques for probing of interaction term are plotting the interaction and post hoc probing (Aiken and West, 1991). We construct conditional-effects plots for different combinations of independent variables. Figures 1-2 depict a set of three simple regression lines of the regression of financial performance on environmental opportunities as a function of three values of inherent-industry risk, ER_L, ER_M, ER_H for our data set. Values of industry risk are chosen to be at the minimum value (ER_L = -2.58), at the mean (ER_M = 0), and at the maximum value (ER_H = 3.42). The regression lines are generated by substituting these values in turn into equation (4).

Figures 1-2 reveal a complex pattern of regression of financial outcomes on environmental opportunities depending on the level of environmental industry risk. The regression equations indicate a significantly negative regression of ROA on environmental preparedness for ER_H, a significantly positive regression of ROA on environmental preparedness and performance for ER_L, and essentially

no relationship for ER_M. Our estimates suggest that the underperformance of the companies in polluting industries is almost twice as large as the outperformance of the companies in green industries. Moreover, the operational underperformance associated with environmental inherent-industry risk is significant at the 5% level for both environmental opportunities measured as preparedness and performance. We conclude that the form of the relationship is significantly different under high and low inherent environmental risk of the industry as suggested in Hypothesis 1.

Hypothesis 2b suggested that the strength of the relationship between environmental performance and market value (Q) would be different under high and low environmental risk and the interaction term was found to be significant. The plotting and simple slope analysis indicates a significantly positive relation between environmental performance and Q under ER_L, while there is a weak insignificant positive relation for ER_H. We conclude that the strength of the relation is moderated by industry risk. The results indicate the fact that better environmental performers in green industries get significantly higher market valuation that their counterparts in polluting industries. Additional test shows that in polluting industries only companies with high operating performance can significantly improve their market value through environmental performance[5] .

Thus, all tests indicate that environmental industry risk modifies the form of the relationship between environmental preparedness/performance and operating performance (ROA), and modifies the strength of the relation between environmental performance and market value (Q). Finally, the direct relation between environmental preparedness and market value are significant and companies under high risk trade at a significant discount. Overall, we find empirical support for hypothesis H1, and support for the moderating effects hypotheses H2a and H2b.

5. Conclusions

This study extends previous research on the direct relation between environmental and financial performance by introducing both form and strength as moderating effects of the industry risk. The motivation to study the industry effect is that polluting industries are more regulated than clean industries and they have differing environmental constraints on company operations that directly or

[5] The companies are grouped in the high industry risk sample at the median value of inherent-industry risk (2.33) and then the sample are divided into high and low operating performance sub-sets at the median value of ROA (8.08). The findings indicate that environmental performance has a significantly positive impact on Tobin's Q (β_1 = 0.06, *t*-value = 3.12) for those companies that have high profitability in polluting industries and environmental performance has an insignificant impact on Tobin's Q (β_1 = -0.002, *t*-value = -0.15) for the companies with low profitability in polluting industries,

indirectly affect the economic value of companies. Previous studies have either been restricted to polluting industries (Freedman and Jaggi, 1988; Dowell *et al*., 2000; Konar and Cohen, 2001) because the environmental performance measured used were tuned to polluting industries only, or when industry wide performance measures were used, the environmental profiles of the industries were not explicitly under study (Guenster *et al*., 2006). We use the industry ratings by the GES Investment Services to explicitly capture the inherent environmental risks in a wide range of industries.

The theoretical underpinnings for the direct financial outcomes of inherent industry risk comes from Heinkel's *et al.* (2001) equilibrium model formalizing the effects of exclusionary ethical investments on the behaviour on polluting versus clean companies. Polluting firms are held by fewer investors leading to lower stock prices. As an extension to their model, Heinkel *et al.* (2001, p. 448) concluded that '*some industries are in reality mostly polluting and therefore less acceptable to investors and others are primarily clean and more acceptable to investors'.* This paper suggested that environmental constraints on the polluting industries can get fewer investors to hold their shares and the market value of companies in environmentally constrained and regulated industries can be lower than in clean industries. Konar and Cohen (2001) provided evidence that environmentally conscious investors penalize companies in polluting industries by increasing their cost of capital and decreasing their market values. Similarly, Hong and Kacperczyk (2006) showed that companies operating in socially constrained 'sin' industries had lower market values at the same time as they were more profitable, due to the fact that institutional investors, because of social norms, neglected the sin stocks. This study does not allow a direct verification of investor behaviour for an environmentally driven neglect hypothesis of polluting industries. There is, however, evidence in this study that the actual behaviour of the companies is different in high risk or polluting industries as opposed to low risk or clean industries as was suggested by Heinkel *et al.* (2001). The company ratings on environmental preparedness and performance are significantly higher in high risk than low risk industries indicating that the demands to reform companies in the polluting industries are higher and that the behaviour of companies is driven to comply with stringent environmental norms and standards.

The empirical results of the study are in line with the proposed hypotheses for the financial outcomes of the moderating industry risk effects. The study we decomposes the environmental opportunities of the companies into two dimensions of environmental preparedness and environmental

performance. The two opportunity dimensions allow us to separate the reputational benefits on market value (Q) from the operational benefits on operating performance (ROA). Restrictions in environmental performance constructs have not in earlier studies allowed a multi-dimensional view. The first dimension, environmental preparedness is expected to bring reputational benefits to the company. Leading companies can gain higher market values than lagging companies. The operational costs can, however, outweigh the benefits and the outcomes on operating performance can be either positive or negative. We proposed that environmental preparedness does not bring incremental changes in the internal performance of companies with operational benefits, as also suggested by the pro-active view of Clarksson *et al.* (2006). Preparedness can especially be costly in high environmental risk industries where the companies have to live up to constraining environmental standards. The second dimension, environmental performance can capture the comparative operational benefits that lead to both higher operating performance and market values in leading companies compared to lagging companies. This eco-efficiency paradigm was supported by the Guenster *et al.* (2006) study.

Additionally, the inherent risk of the industry is has a direct positive relation to the operating performance and direct negative relation to the market values of U.S. companies when controlling for company-specific characteristics in a multi-variate setting. The findings are also supported by uni-variate tests that the mean ROA (Q) is significantly higher (lower) in industries rated in the two highest risk classes of industries than in the two lowest rated industries.

The complexity in the relations is demonstrated by both differences in forms and strengths of relations due to industry risk moderators. Operating performance can be improved by both environmental preparedness and performance only in low risk industries. The effect of environmental performance on market value is stronger in low risk industries. Environmental preparedness brings reputational benefits to market value in both low and high risk industries. Thus, this is the first study to provide evidence on the financial outcomes of the moderating industry effect that the GES Investment Services® risk ratings provided a basis for.

References

Aiken L, West S. 1991. *Multiple Regression: Testing and Interpreting Interactions.* SAGE Publications Ltd-London.

Allessandri T, Khan R. 2006. Market performance and deviance from industry norms: (Mis)alignment of organizational risk and industry risk. *Journal of Business Research* **59**: 1105-1115.

Barber B, Lyon J. 1996. Detecting Abnormal Operating Performance: the Empirical Power and Specification of Test Statistics. *Journal of Financial Economics* **41**: 359-399.

Blacconiere W, Northcut W. 1997. Environmental Information and Market Reactions to Legislation. *Journal of*

Accounting, Auditing and Finance **12(2)**: 149-78.
Cameron C, Trivedi P. 2005. *Microeconometrics, Methods and Applications.* Cambridge University Press: New York.
Capon N, Farley J, Hoenig S. 1990. Determinants of Financial Performance: A Meta-Analysis. *Management Science* **36(10)**: 1143-1159.
Chatterjee S, Lubatkin M, Schulze W. 1999. Toward a Strategic Theory of Risk Premium: Moving beyond Capm. *The Academy of Management Review* **24(3)**: 556-567.
Clarksson P, Li Y, Richardsson G, Vasvari F. 2006. Does it really pay to be green? Determinants and Consequences of Pro-active Environmental Strategies. Working Paper. http://kcjd.shufe.edu.cn/News/UploadFiles/news/news-2007-5-23-001.pdf [October 2006].
Dowell G, Hart S, Yeung B. 2000. Do Corporate Global Environmental Standards Create or Destroy Market Value? *Management Science* **46(8)**: 1059-1074.
Elsayed K, Paton D. 2005. The Impact of Environmental Performance on Firm Performance: Static and Dynamic Panel Data Evidence. *Structural Change and Economic Dynamics* **16**: 395-412.
Freedman M, Jaggi B. 1988. An Analysis of the Association between Pollution Disclosure and Economic Performance. *Accounting, Auditing and Accountability* **1(2)**: 43-58.
Griffin J, Mahon J. 1997. The Corporate Social Performance and Corporate Financial Performance Debate. *Business & Society* **36(1)**: 5-31.
Guenster N, Derwall J, Bauer R, Koedijk K. 2006. The Economic Value of Corporate Eco-Efficiency. *ECCE Research Note 2006-02*.
Hamilton J. 1995. Pollution as News: Media and Stock Market Reactions to the Toxics Release Inventory Data. *Journal of Environmental Economics and Management* **28**: 98-113.
Hart S. 1995. A Natural Resource-based View of the Firm. *Academy of Management Review* **20(4)**: 986-1014.
Hart S, 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**: 30-37.
Hartmann F, Moers F. 1999. Testing Contingency Hypotheses in Budgetary Research: an Evaluation of the Use of Moderated Regression Analysis. *Accounting, Organizations and Society* **24**: 291-315.
Hassel L, Nilsson H, Nyquist S. 2005. The Value Relevance of Environmental Performance. *European Accounting Review* **14(1)**: 41-61.
Heinkel R, Kraus A, Zechner J. 2001. The Effect of Green Investment on Corporate Behavior. *The Journal of Financial and Quantitative Analysis* **36(4)**: 431-449.
Herremanns I, Akathaporn P, McInnes M. 1993. An investigation of corporate social responsibility reputation and economic performance. *Accounting, Organizations and Society*, **18(7/8)**: 587-604.
Hong H, Kacperczyk M. 2006. The Price of Sin: The Effects of Social Norms on Markets. Working paper. http://ssrn.com/abstract=766465 [March 2007].
Jaccard J, Turrisi R, Wan C. 1990. *Interaction Effects in Multiple Regression*. SAGE Publications Ltd-London
Jaffe A, Peterson S, Portney P. 1995. Environmental regulation and the competitiveness of U.S. manufacturing: What does the evidence tell us? *Journal of Economic Literature* **33**: 132-163.
Kaplan S, Zingales L. 1997. Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints? *The Quarterly Journal of Economics* **112(1)**: 169-215.
Karpoff J, Lott J, Wehrly E. 2005. Reputational penalties for environmental violations: Empirical evidence. *Journal of Law and Economics* **48(October)**: 653-675.
King A, Lenox M. 2001. Does It Really Pay to Be Green? An Empirical Study of Firm Environmental and Financial Performance. *Journal of Industrial Ecology* **5(1)**: 105-116.
King A, Lenox M. 2002. Exploring the Locus of Profitable Pollution Reduction. *Management Science* **48(2)**: 289-299.
Klassen R, McLaughlin C. 1996. The Impact of Environmental Management on Firm Performance. *Management Science* **42(8)**: 1199-1214.
Konar S, Cohen M. 2001. Does the Market Value Environmental Performance? *The Review of Economics and Statistics* **83(2)**: 281-289.
Lance C. 1988. Residual Centering, Exploratory and Confirmatory Moderator Analysis, and Decomposition of Effects in Path Models Containing Interactions. *Applied Psychological Measurement* **12(2)**: 163-175.
Lundgren T. 2007. On the Economics of Corporate Social Responsibility, Sustainable Investment Research Platform working paper, SIRP WP 03-07.
McClelland G, Judd C. 1993. Statistical Difficulties of Detecting Interactions and Moderator Effects. *Psychological Bulletin* 114(2): 376-390.
Orlitzky M, Benjamin J. 2001. Corporate Social Performance and Firm Risk: A Meta-Analytic Review. *Business & Society* **40(4)**: 369-396.

Orlitzky M, Schmidt F, Rynes S. 2003. Corporate Social and Financial Performance: A Meta-analysis. *Organization Studies* **24(3)**: 403–441.

Penman S. 2001. *Financial Statement Analysis and Security Valuation*. McGraw-Hill: New York.

Petersen M. 2007. Estimating Standard Errors in Financial Panel Data Sets: Comparing Approaches. Working paper.

Porter M, Van der Linde C. 1995. Toward a New Conception of the Environment-Competitiveness Relationship. *The Journal of Economic Perspectives* **9(4)**: 97-118.

Repetto R, Austin D. 1999. A Quantitative Approach to Strategic Environmental Risk Management. *Journal of Business Management and Policy Analysis* **January 1 1999**.

Russo M, Fouts P. 1997. A Resource-Based Perspective on Corporate Environmental Performance and Profitability. *The Academy of Management Journal* **40(3)**: 534-559.

Svenska Finansanalytiker Föreningen (SFF). 2000. Swedish Society of Financial Analysts. ”Finansanalytikernas rekommendationer, miljöinformation för finansanalytiker”*, Sveriges Finansanalytikers Förening*, Stockholm.

Shane P, Spicer B. 1983. Market Response to Environmental Information Produced outside the Firm. *The Accounting Review* **58(3)**: 521-538.

Sharma S, Durand R, Gur-Arie O. 1981. Identification and Analysis of Moderator Variables. *Journal of Marketing Research* **XVIII**: 291-300.

Semenova N, Hassel L. 2008. Financial Outcomes of environmental Risk and Opportunity for US Companies. *Sustainable Development* (in press).

Spicer B. 1978. Investors, Corporate Social Performance and Information Disclosure: An Empirical Study. *The Accounting Review* **53(1)**: 94-111.

Waddock S, Graves S. 1997. The Corporate Social Performance-Financial Performance Link. *Strategic Management Journal* **18(4)**: 303-319.

Walley N, Whitehead B. 1994. It’s Not Easy Being Green. *Harvard Business Review* **May-June**: 46-52.

Williams A, Siegel D. 2001. Corporate Social Responsibility: A Theory of the Firm Perspective. *Academy of Management Review* **28(1)**, 117-127.

White H. 1980. A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica* **48**: 817-838.

Table 1. GES Investment Services Risk and Opportunity Rating Scales

Risk			Opportunity		
General	Specific	Scaled*	Preparedness	Performance	Scaled*
A	a	0	a	a	6
A-	a-	1	a-	a-	5
B+	b+	2	b+	b+	4
B	b	3	b	b	3
B-	b-	4	b-	b-	2
C+	c+	5	c+	c+	1
C	c	6	c	c	0

* converted numerical scale for the study

Table 2. Frequency distribution of companies across industries and stock exchanges.

Panel A. Companies classified by industry based on the Global Industry Classification Standard

Industry	Frequency, %	Industry	Frequency, %
Diversified Financials	6.4	Chemicals	2.1
Media	4.9	Hotels, Restaurants & Leisure	2.1
Banks	4.7	Machinery	1.9
Insurance	4.5	Biotechnology	1.7
Oil & Gas	4.3	Computers & Peripherals	1.7
Health Care Providers & Services	4.3	Electronic Equipment & Instruments	1.7
Electric Utilities	4.1	Food & Drug Retailing	1.7
Specialty Retail	4.1	Aerospace & Defence	1.5
Real Estate	3.7	IT Consulting & Services	1.5
Semiconductor Equipment & Products	3.2	Metals & Mining	1.5
Commercial Services & Supplies	3.0	Multi-line Retail	1.5
Health Care Equipment & Supplies	3.0	Pharmaceuticals	1.3
Software	2.8	Energy Equipment & Services	1.1
Food Products	2.6	Gas Utilities	1.1
Household Durables	2.6	Other (less than 1%)	17
Communications Equipment	2.4	Total	100

Panel B. Companies classified by stock exchanges

Stock Exchange	Frequency, %
NYS	80.9
NAS	18.5
ASE	0.6
Total	100

Table 3. Descriptive statistics and correlation coefficients of key variables.

Panel A reports the descriptive cross-sectional statistics of the sample. The sample consists of 534 US companies listed on the NASDAQ, New York, or American Stock Exchanges in the U.S. The research period of environmental observations is December 2003 to June 2006, and six environmental risk and opportunities ratings are used. The research period of financial observations is the first quarter of 2004 to the third quarter of 2006, including six periods for ROA and Tobin's Q. The statistics present average values over the observation period.

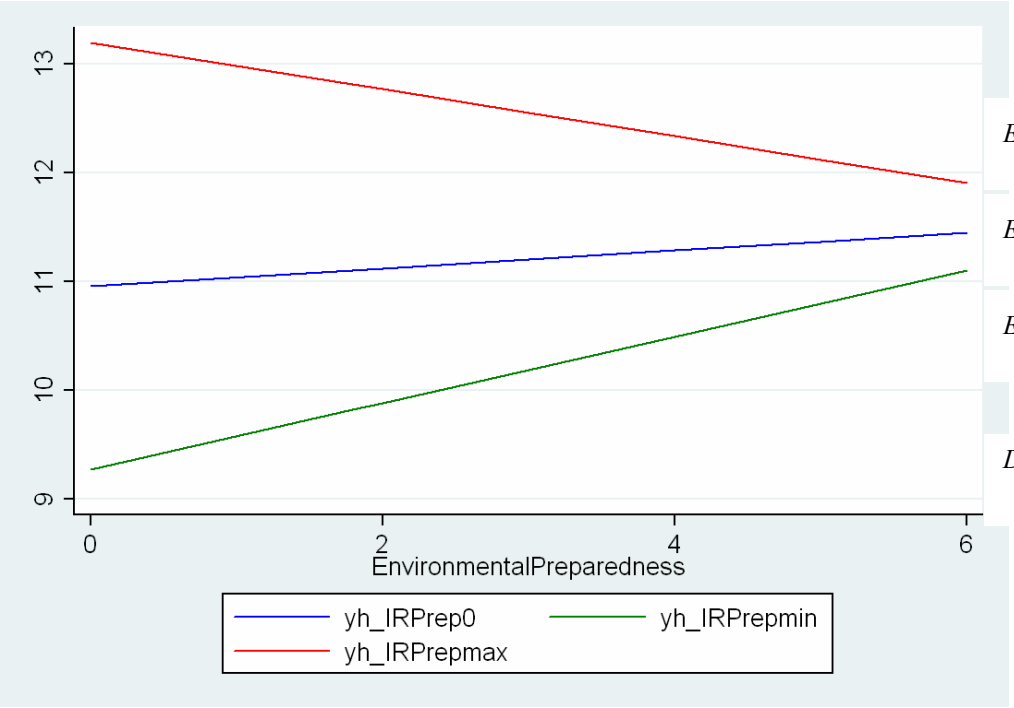
Panel B provides Pearson correlation coefficients among variables in the model using the pooled cross-section time-series sample (P values in parentheses)

Variables	Preparedness	Performance	Industry Risk	ROA	Q
Panel A. All companies before removing outliers					
Mean	1.80	0.91	2.58	8.06	2.10
Median	0.50	0.00	2.33	7.13	1.67
Std. deviation	2.24	1.56	2.18	8.03	1.40
Skewness	0.77	1.67	0.33	-0.01	3.19
Kurtosis	-0.90	2.07	-1.35	14.01	18.75
Minimum	0	0	0	-46.15	0.59
Maximum	6	6	6	54.44	12.84
Number of companies					
ERO = 0	243	301	96		
ERO = 1	0	1	101		
ERO = 2	26	33	20		
ERO = 3	59	72	63		
ERO = 4	17	6	44		
ERO = 5	34	15	35		
ERO = 6	51	16	73		
Total	430	442	430	475	445
Panel B. Pearson Correlation Coefficients (3204 observations)					
Preparedness	1.00				
Performance	0.73 (0.00)	1.00			
Industry Risk	0.47 (0.00)	0.30 (0.00)	1.00		
ROA	0.03 (0.22)	-0.01 (0.76)	0.12 (0.00)	1.00	
Q	-0.08 (0.00)	-0.08 (0.00)	-0.07 (0.00)	0.54 (0.00)	1.00

Table 4. Regression results of sample companies.

The table shows the outcome of estimating linear panel data regressions of financial performance on environmental risk and opportunities with inherent-industry risk as moderator. The unbalanced panel contains 534 companies constituting 3204 company-year observations over the period 2003-2006. The table reports pooled OLS coefficients with the panel-robust t-statistic (in parentheses) based on White (1980) standard errors. The environmental risk, preparedness and performance scores are centered in equations 2-3. Significance at the 1%, 5% and 10% level is indicated by ***, **, and *, respectively (one-tailed tests).

	Equation (2)				Equation (3)				Equation (4)			
Variable	ROA	Q	ROA	Q	ROA	Q	ROA	Q	ROA	Q	ROA	Q
Intercept	11.11***	3.61***	11.23***	3.60***	10.22***	3.66***	10.23***	3.63***	11.11***	3.66***	10.24***	3.61***
	(6.96)	(13.02)	(6.99)	(13.05)	(29.13)	(15.01)	(28.96)	(15.07)	(30.86)	(15.02)	(29.16)	(14.86)
Preparedness	**0.20*** **	**0.017*** **			0.03	0.029***			0.08	0.030***		
	(2.83)	**(2.44)**			(0.35)	(3.81)			(1.03)	(3.93)		
Performance			**0.22** **	**0.013***			0.03	0.018**			0.10	0.023***
			(2.13)	**(1.47)**			(0.28)	(1.95)			(0.91)	(2.37)
Industry Risk					**0.51*** **	**-0.030*** **	**0.51*** **	**-0.020*** **	0.50***	-0.030***	0.51***	-0.020***
					(5.86)	**(-3.64)**	**(6.30)**	**(-2.63)**	(5.81)	(-3.65)	(6.25)	(-2.68)
Preparedness* Industry Risk									**-0.09*** **	**-0.002**		
									(-2.73)	**(-0.59)**		
Performance* Industry Risk											**-0.09** **	**-0.005***
											(-1.97)	**(-1.43)**
Control variables:												
Book Value of Assets	-1.61E-7***		-1.59E-7***		-1.77E-7***		-1.77E-7***		-1.70E-7***		-1.73E-7***	
	(-6.48)		(-6.36)		(-6.99)		(-7.00)		(-6.73)		(-6.81)	
Debt / Assets	-0.05***		-0.05***		-0.06***		-0.06***		-0.06***		-0.06***	
	(-4.07)		(-4.07)		(-5.00)		(-5.00)		(-5.03)		(-5.00)	
Sales Growth		0.000		0.000		0.000		0.000		0.000		0.000
		(0.59)		(0.51)		(0.69)		(0.50)		(0.69)		(0.49)
Firm Age		0.002**		0.003**		0.002*		0.002**		0.002*		0.002**
		(1.76)		(2.02)		(1.37)		(1.65)		(1.39)		(1.64)
Log (Book Value of Assets)		-0.32***		-0.32***		-0.33***		-0.33***		-0.33***		-0.32***
		(-9.39)		(-9.36)		(-10.05)		(-9.90)		(-9.80)		(-9.67)
Return on Assets		0.04***		0.04***		0.04***		0.04***		0.04***		0.04***
		(9.81)		(9.96)		(10.84)		(10.90)		(10.83)		(10.89)
Industry Dummies	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.1546	0.3183	0.1519	0.3160	0.1354	0.3059	0.1353	0.2997	0.1402	0.3061	0.1380	0.3004
F value	12.33	22.22	11.67	21.76	19.23	35.02	19.24	33.60	18.02	32.38	17.97	31.41
	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)
Num. obs.	3204	3204	3204	3204	3204	3204	3204	3204	3204	3204	3204	3204
Num. valid obs.	2716	2343	2716	2343	2716	2343	2716	2343	2716	2343	2716	2343

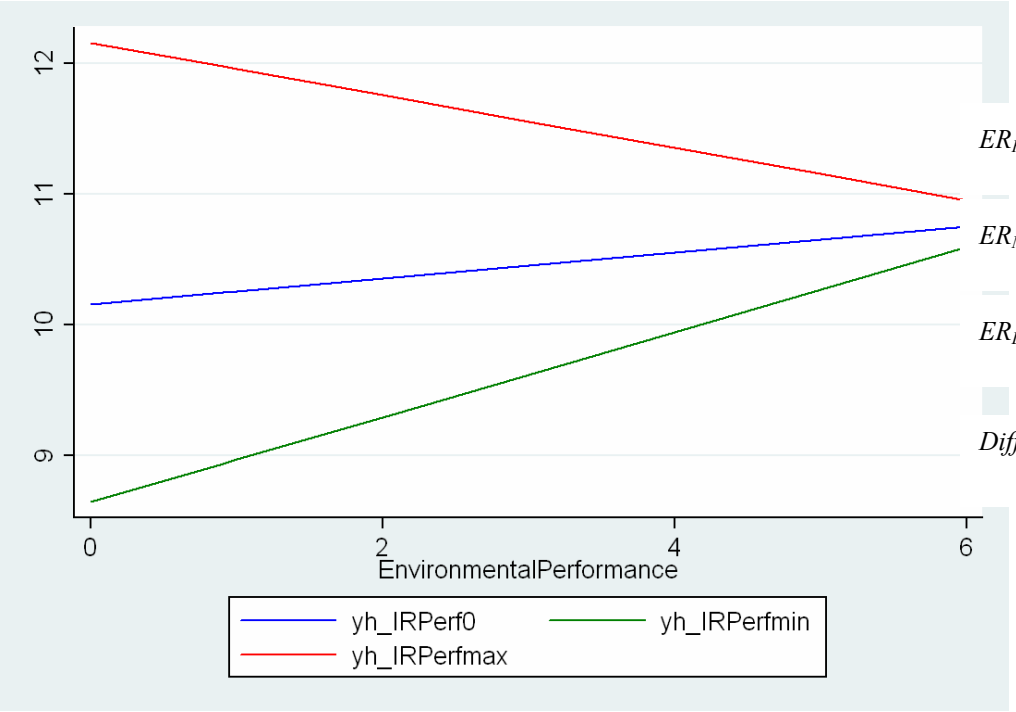


ER_H: $\hat{ROA} = -0.22EPrep + 12.81$
$(-1.82)^{**}$ $(26.34)^{***}$

ER_M: $\hat{ROA} = 0.08EPrep + 11.11$
(1.03) $(30.86)^{***}$

ER_L: $\hat{ROA} = 0.31EPrep + 9.82$
$(2.40)^{***}$ $(24.35)^{***}$

Difference ER_H-ER_L: -0.53^{***}
(-4.22)



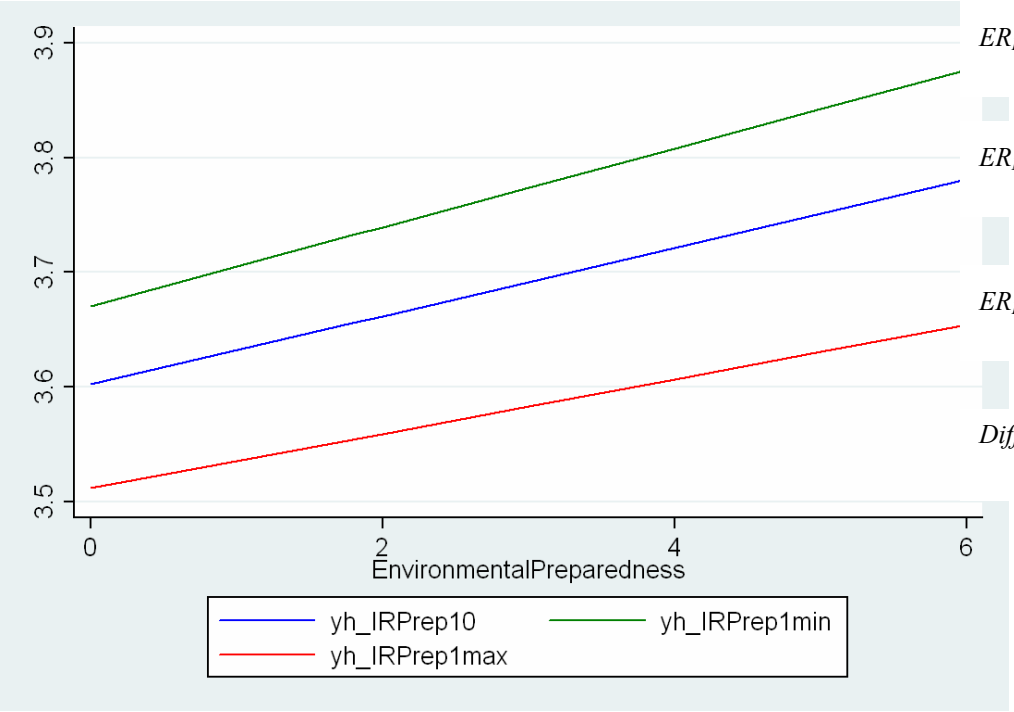
ER_H: $\hat{ROA} = -0.20EPerf + 11.98$
(-1.23) $(26.02)^{***}$

ER_M: $\hat{ROA} = 0.10EPerf + 10.24$
(0.91) $(29.16)^{***}$

ER_L: $\hat{ROA} = 0.33EPerf + 8.94$
$(1.84)^{**}$ $(22.45)^{***}$

Difference ER_H-ER_L: -0.53^{**}
(-3.07)

Figure 1. Conditional-effects plots of profitability on environmental opportunities.



ER_L: $\hat{Q} = 0.03EPrep + 3.73$
$(2.99)^{***}$ $(15.21)^{***}$

ER_M: $\hat{Q} = 0.03EPrep + 3.66$
$(3.93)^{***}$ $(15.02)^{***}$

ER_H: $\hat{Q} = 0.02EPrep + 3.55$
$(1.98)^{**}$ $(14.59)^{***}$

Difference ER_H-ER_L: -0.01
(-1.01)

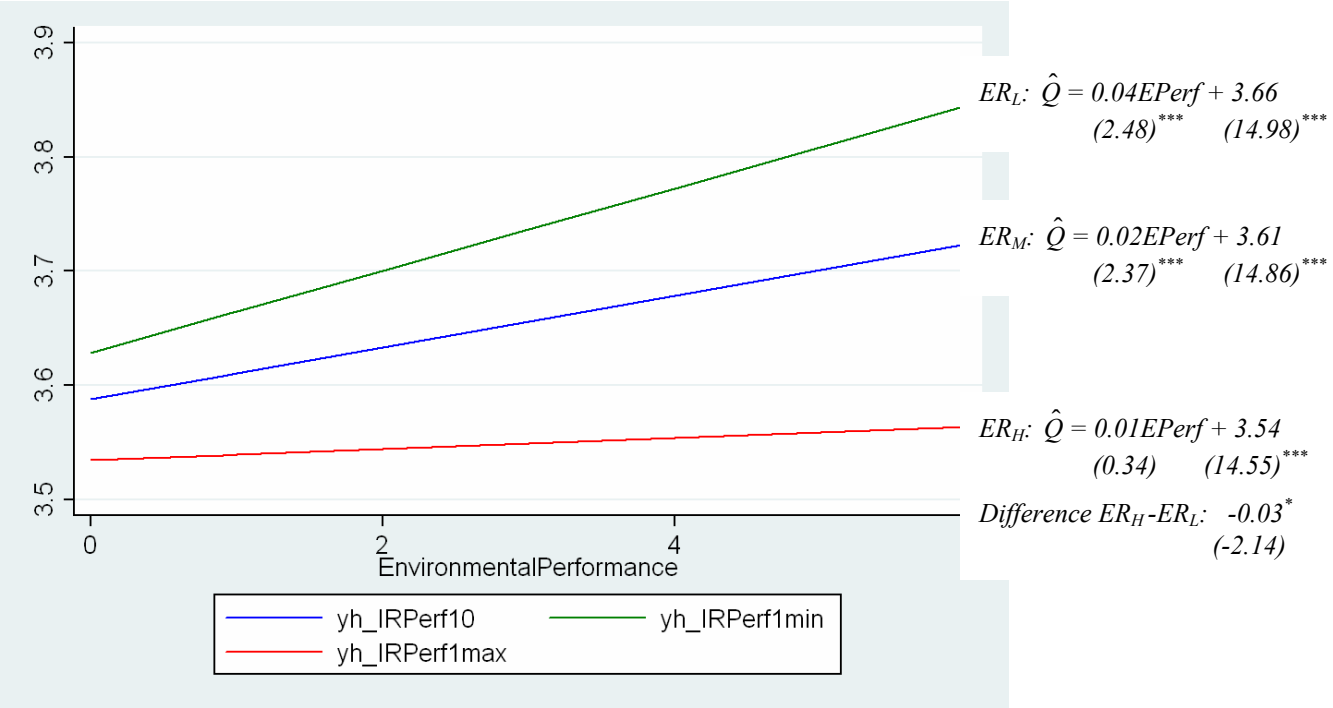


Figure 2. Conditional-effects plots of market value on environmental opportunities.