Corporate Environmental Responsibility, Media Coverage, and Ownership Structure*

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Abstract

This paper explores the relationship between corporate environmental responsibility (CER) and ownership structure along with the role of media coverage. Our results show that environmental costs measuring CER are lower for firms with higher media coverage. There is also a statistically significant U-shaped curvilinear relationship between managerial ownership and total environmental costs. Environmental costs decrease with managerial ownership before managerial ownership reaches 20.8% level, and then increase afterwards. Our results support the view that good governance by external monitoring and incentivized management improves a firm's CER activities and long-term viability of firms.

JEL classification: G30, G34, M14

Keywords: Corporate Environmental Responsibility (CER), Media coverage, Ownership structure, Environmental costs, External monitoring

1. Introduction

Corporate environmental responsibility (CER), one of the major components of corporate social responsibility (CSR) that has become an indispensable part of business practices, can be defined as corporate activities that address environment-related issues to eliminate a waste of resources and maximize the efficiency of their utilization in the whole business process (Mazurkiewicz, 2004). According to a survey conducted by Accenture and the United Nations Global Compact (UNGC) in 2010, 93 percent of managers believe that sustainability issues are essential to the future success of their business and 91 percent of CEOs claim that they need to invest in new technologies to address environmental issues (Lacy et al., 2010). Many companies also devote a significant part of their annual reports or websites to CSR activities, demonstrating the importance of such activities (Servaes and Tamayo, 2013). As CER becomes recognized as an important factor for a firm's long-term value and sustainability, managers face a growing demand to engage in corporate environmentally responsible activities (Kim et al., 2015).[1]

According to the literature on CER, it not only helps firms be socially and environmentally responsible, but also enhances the capacity to achieve their business goals (Glavopoulos et al., 2014). CER activities have a significant and positive effect on building a firm's reputation (Mohr et al., 2001; Brammer and Pavelin, 2006), contribute to cost saving associated with energy, materials, and waste reductions (Hart, 1995; King and Lenox, 2002), reduce the cost of capital (Sharfman and Fernando, 2008; El Ghoul et al., 2011), and mitigate a firm's

[1] Common law firms tend to perform better for CER than civil law firms, indicating that a firm's legal origin matters for its CER. CER also requires a long-term management perspective and enhances stakeholder value (Kim et al., 2015).

systemic or idiosyncratic risk (Boutin-Dufresne and Savaria, 2004; Lee and Faff, 2009). Moreover, firms that engage in CER activities achieve financial profits and sustainability. Specifically, previous studies find that the environmental management and the reduction process of pollution emission positively affect a firm's financial performance (Konar and Cohen, 2001; Chava, 2014; Jo and Harjoto, 2011; Jo et al., 2015). However, despite the extensive evidence on the positive effects of CER on firm performance, studies that explore the driving forces for companies to engage in CER activities are relatively scarce. Prior studies find that external corporate governance such as institutional ownership (Francoeur et al., 2008; Jo and Harjoto, 2011) and media coverage (Cormier and Magnan, 2003; Dawkins and Fraas, 2011) provides incentives to improve corporate environmental disclosure.

This paper explores the relationship between corporate environmental responsibility (CER) and ownership structure along with the role of media coverage and attempts to add evidence on driving forces that encourage firms to engage in CER. We measure environmental costs as CER because the main driving force of CER involvement is the potential to reduce the environmental cost (King and Lenox, 2002). Our results show that environmental costs are lower for firms with higher media coverage, while there is no significant relationship between institutional ownership and environmental costs. These results suggest that firms with higher media coverage are more likely to concern about customer awareness and take efforts to build up good reputation by engaging more in corporate environmental responsibility activities that reduce environmental costs

Moreover, we find that there is a statistically significant U-shaped curvilinear relationship between managerial ownership and total environmental costs. At a relatively low level of managerial ownership, environmental costs decrease as managerial ownership increases,

suggesting that higher managerial ownership provides higher managerial incentives to invest more in CER activities to enhance a firm's long-term value. In contrast, at a relatively high-level managerial ownership, the increase in ownership held by managers leads to higher environmental costs, suggesting that the effect of managerial entrenchment outweighs that of long-term value creation incentives of managers. Our estimates suggest that corporate environmental costs are the lowest when managerial ownership is at a level of 20.8%, which appears to be the optimal level of managerial ownership to achieve CER. Our findings are consistent with the agency theory and convergence-of-interest hypothesis. Further, we conduct a piecewise linear regression to estimate entrenchment points between managerial ownership and total environmental costs. We also find marginal effects of media coverage on total environmental costs by industry and conduct a set of several robustness tests and find qualitatively the same results. Overall, our results suggest that external monitoring by media coverage plays an important role in reducing environmental costs and an appropriate level of managerial ownership induces firms to pay more attention to CER activities.

Our paper contributes to the literature in several ways. While CER captures more attention both in the academic literature and in business practices, there are not many clear findings that identify main determinants to encourage firms to participate in corporate environmental activities. The prior literature mostly examines the financial incentives of firms through their participation in CER activities or the influence of media on CSR disclosures. We add to this literature by exploring the link between media coverage and environmental costs, for which there is no prior study in this context, to the best of our knowledge. Further, we use unique data, the Trucost database to measure environmental costs and LexisNexis for hand-collected news data, measuring the level of media coverage. Overall,

this study is the first attempt in the literature to analyze the relationship between corporate environmental responsibility (CER) and ownership structure along with the role of media coverage.

The paper proceeds as follows. In Section 2, we develop our hypotheses. In Section 3, we describe the data used, provides summary statistics for the variables of interest, and outlines the empirical methodology. In Section 4, we discuss our empirical results. Section 5 summarizes and concludes our paper.

2. Literature Review and Hypothesis Development

Media coverage is an important driver for firms to engage in corporate environmental responsibility. One of the most important theories related to media pressure on the firm is agenda-setting theory, which was developed in 1968 by McCombs and Shaw in an analysis of US presidential elections. The theory suggests that media has a great impact on the public and also transfers the media agenda to the public agenda. Firms, either close to the consumers or want to build up a good reputation, are likely to concern about media. The news media holds great influence on public attention and awareness (McCombs and Shaw, 1972; Carroll and McCombs, 2003) and drives corporate discussions toward contemporary social issues (Walls et al., 2012), and can be considered as an indicator of corporate legitimacy in society (Aerts and Cormier, 2009). The media also has monitoring effects on firm management that influence the extent of a firm's environmental disclosure. In particular, large firms tend to report more extensively because they are subject to more intense external monitoring

(Cormier and Magnan, 2003[2]; Dawkins and Fraas, 2011). Media pressures a firm to set and conduct their strategy geared toward meeting the expectations of what the media claims to be significant (i.e., corporate environmental issues).

The media has been particularly influential on corporate environmental responses relevant to business and CSR behavior (Ader, 1995; Bansal and Roth, 2000; Bansal and Clelland, 2004; Krüger, 2015). One paper argues that if firms are good CSR performers, they receive more favorable media coverage. Thus, managers have incentives to actively manage their media image by doing more socially responsible activities which leads to financial benefits for firms (El Ghoul et al., 2011).[3] In addition, prior studies have a view that media visibility deeply affects firm reputation and corporate value (Skinner, 1994; Brammer and Pavelin, 2006). More visible companies, such as listed and multinational companies, receive more media attention which pressures companies to engage in CSR to enhance corporate reputation (Garcia-Sanchez et al., 2014). In particular, there is a strong relationship between CSR and media favorability in the so-called sin industries (i.e., alcohol, gambling, and tobacco) that would create greater incentives to promote their positive firm image (Cai et al., 2012; Cahan et al., 2015).[4]

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[2] Media visibility is defined as the range of media coverage of corporate environmental activities. The paper applies cost and benefit analysis within French legal and regulatory contexts to assess whether media visibility reinforces the potential benefits of an open environmental reporting strategy and reveals more disclosure. They suggest the influence of media visibility on corporate environmental disclosure of French firms (Cormier and Magnan, 2003).

[3] They speculate that media coverage plays a role because investors cannot invest in securities that they do not know about. If the media provides broad coverage and more favorable coverage of good CSR firms, investors' awareness and interest in these firms will be increased (El Ghoul et al., 2011).

[4] CSR is strongly related to media favorability when the investor sentiment is low and CSR performance is high during the SEO period, consistent with firms trying to make a more positive image in the lead-up to the SEO (Cahan et al., 2015).

Further, public awareness and interest in corporate social and environmental issues, and growing attention by the mass media have resulted in increased the amount of CSR information disclosures in the last few decades (Guthrie and Parker, 1989; Hooghiemstra, 2000; Reverte, 2009). CSR is positively related to firm value when firms have high customer awareness and more beneficial in high advertising intensive industries (Servaes and Tamayo, 2013)[5]. Overall, this paper develops the hypothesis that firms with high media coverage are more likely to engage in CER activities and consequently reduce environmental costs. Prior studies find that media can play an active role in the reputation building process and CSR disclosure, however, there are few studies on CER activities and no clear empirical results between media coverage and environmental performance. Thus, this is the first attempt to examine the association between media coverage and environmental costs.

Hypothesis 1. Media coverage is negatively related to environmental costs as external monitoring of media coverage plays an important role in CER.

Managerial ownership has a significant effect on the context of corporate performance. A manager is more likely to increase long-term investments to enhance the long-term value of the firm (Porter, 1992). In particular, managers who are the large shareholding of their respective firms, a concentrated managerial ownership structure, have more incentives to expand long-term investment and high firm performance, which is consistent with the agency theory and convergence-of-interest hypothesis[6] unlike minority shareholders[7] (Jensen and

[5] Advertising expenditures are used as a proxy of customer awareness. The evidence is not consistent because the association is either negative or insignificant when firms have low customer awareness (Servaes and Tamayo, 2013).

[6] Agency theory is indicated as the magnitude of the agency problem in terms of the degree of separation interests between owner and manager. The convergence-of-interest hypothesis suggests that if a manager owns a

Meckling, 1976; Morck et al., 1988). As managers are responsible for the high value of their shares, an increased level of managerial ownership reduces agency costs (Jensen and Murphy, 1990; Barker III and Mueller, 2002).

On the contrary, prior literature finds that there is a curvilinear relation between managerial ownership and corporate value (Stulz, 1998; McConnell and Servaes, 1995). Managers get greater power within a company after obtaining a large stake of the firm and they tend to entrench and satisfy themselves, thereby causing agency problems such as empire building. As monitoring effectiveness diminishes, managers make self-maximizing decisions that are not in the best interest of shareholders. The market value of the firm can be negatively affected by a certain range of high ownership shares in accordance with the entrenchment hypothesis (Fama and Jensen, 1983; Morck et al., 1988). The agency problem arises leading to aggressive outcomes for firms and endangers their shareholders, reducing profitability and firm value (Jensen and Meckling, 1976; Fama and Jensen, 1983; Hope and Thomas, 2008). An increased level of managerial ownership causes a misallocation of resources in their firm and decreases investment in R&D (Jensen, 1997), and discourages investment in CER (Hart, 1995). Thus, effective monitoring activities and optimal levels of managerial ownership are necessary to induce CER activities and eliminate inefficiency in the firms.

Prior studies suggests that CER activities are the outcome of firms' strategic actions

large portion of the firm stock, the firm has high Tobin's Q and the market value of the firm should rise. (Jensen and Meckling, 1976).

[7] Minority shareholders are likely to pursue the maximization of short-term profits, as they are not typically interested in firms' long-term viability. They affect the long-term value of the firm by demanding high dividends and reducing investment in long-term projects. (Modigliani and Miller, 1958; Hart, 1995; Solomon and Solomon, 1999)

(Walls et al., 2011) and CER investments sacrifice short-term profits while enhancing firms' long-term performance and sustainability (Hart and Ahuja, 1996; Makni et al., 2009; Kim et al., 2015). As managers can strongly involve and influence on firm strategies and investment and pursue the long-term viability of firms, managerial ownership has an important role in CER which require long-term decisions and substantial initial investment. Some empirical results find that managerial ownership positively influences performance and investment in the environment (Walls et al., 2012) and charitable contributions of the firm (Wang and Dewhirst, 1992), in particular, within family firms (Berrone et al., 2010)[8], and not related to CSR (McGuire et al., 2003).

In addition, if managers receive stock options and grants as long-term compensation, they will engage in corporate environmental actions to mitigate product and environment weaknesses (Mahoney and Thorne, 2005), and increase corporate social performance (Deckop et al., 2006). Stock-based compensation also induces managers to increase R&D spending for sustainable growth of the firm (Ryan Jr and Wiggins III, 2002; Wu and Tu, 2007). Overall, firms are more likely to focus on CER activities when managers have a high level of ownership in their firms, however, there is a curvilinear relationship between managerial ownership and CER activities, so managerial ownership needs to be analyzed more precisely. Thus, this paper comprehensively examines the association between managerial ownership and environmental costs and suggests the optimal breakpoint of managerial ownership for a low level of environmental costs.

[8] They compare the environmental performance of family and non-family public firms in the U.S. and find that family-controlled public firms are more likely to protect socioemotional shareholder wealth through better corporate environmental performance than nonfamily firms, especially at the local level (Berrone et al., 2010).

Hypothesis 2. There is a curvilinear relationship between managerial ownership and total environmental costs. Environmental costs decrease with the increase of managerial ownership before reaching the point where the manager's position is entrenched, and then increase afterwards.

Moreover, prior studies suggest that corporate governance is positively related to corporate environmental performance (Francoeur et al., 2008; Sun et al., 2010; Jo and Harjoto, 2011; Jo et al., 2015; Kim et al., 2015). In particular, these papers emphasize the monitoring role of institutional investors and measure institutional ownership as external monitoring mechanism. As institutional investors are informed and sophisticated and have both incentives and abilities to monitor firms, they play an important role in effective monitoring. (Kang et al., 2018) and firms expecting the benefits of good environmental performance need to set a monitoring mechanism (Walls et al., 2012).

Monitoring incentives and effectiveness of institutional ownership vary with the percentage of shares held by institutional investors and previous literature suggests the different findings. The high level of institutional ownership of firms is significantly and positively associated with CSR strategies (Johnson and Greening, 1999; Neubaum and Zahra, 2006), while there is a significantly negative relationship with environmental strengths (Walls et al., 2012) and no significant relationship with corporate philanthropy and charitable foundation (Coffey and Fryxell, 1991; Brown et al., 2006), and social performance (Graves and Waddock, 1994)[9]. Although prior findings are controversial, if the monitoring role of

[9] Some literature review institutional shareholder concentration. The percentage of shares held by the top management is positively associated with product quality management (Johnson and Greening, 1999). The number of institutions holding the shares of a company has a significant and positive relationship with social

institution is dominant, there is a positive relationship between institutional ownership and corporate environmental responsibility.

Hypothesis 3. Institutional ownership is negatively related to environmental costs, which indicates a reduction in environmental costs.

3. Data Description and Methodology

3.1 Definition of Variables

To test our research hypotheses, our sample consisted of 4,067 firm-year observations from 550 firms in conventional industries (not including financial services industries) during the 2002 to 2014 period. We constructed an unbalanced panel dataset during the 2002 to 2014 period and include Fama-French 49 industries. Collected from multiple sources shown in Appendix A.

This paper measures corporate environmental responsibility activities as total environmental costs[10] and we collect data from Trucost database following prior literature (Thomas et al., 2007; Dawkins and Fraas, 2011; Jo et al., 2015; Kim et al., 2015).[11] Trucost database provides a large sample of the firm's external direct and indirect environmental

performance (Graves and Waddock, 1994).

[10] Environmental costs are a more accurate measure for CER than other datasets which is used in earlier studies such as FRDC (Russo and Fouts, 1997) and KLD (Chatterji et al., 2009; Deng et al., 2013; Di Giuli and Kostovetsky, 2014).

[11] Environmental costs positively affect financial performance and reputation building in manufacturing firms around the world (Jo et al., 2015). Lowering environmental costs has lots of advantages; high long-term financial performance, high firm reputation, improving production efficiency and competitiveness, and low the costs of capital (Kim et al., 2015).

costs in U.S. dollars for listed manufacturing firms around the world.[12] This numerical data, using a global input/output model, is calculated in dollar amounts by multiplying the environmental impact of each resource and emission by its social damage costs. Total direct environmental costs consist of six categories such as greenhouse gases direct cost, water direct cost, waste direct cost, land and water pollutants direct cost, air pollutants direct cost, and natural resource using direct cost. Total indirect environmental costs contain six categories such as greenhouse gases indirect cost, water indirect cost, waste indirect cost, water pollutants indirect cost, air pollutants indirect cost, and natural resource using indirect cost. We use the sum of total environmental external direct costs and total environmental external indirect costs as total environmental costs and standardized it scaled by total assets. Total asset data is available in the Compustat database.

$$\text{Total Environmental costs}_{\text{i,t}} = \frac{\text{Direct Environment costs}_{\text{i,t}} + \text{Indirect Environment costs}_{\text{i,t}}}{Total\ Asset_{i,t}}$$

Media Coverage is a numerical variable that represents the amount of news about each firm by year, which is conducted by text analysis. This paper uses the number of news articles as a proxy of media coverage. We hand-collected the number of total news articles and the number of environmental sector news articles for each firm from LexisNexis. Media coverage is measured by the log number of total news articles excluding the number of environmental sector news articles. We excluded the number of environmental sector from

[12] Total direct environmental costs represent direct external environmental impacts a company has on the environment through its activities. Total indirect environmental costs are results of the activities but incurred by sources owned or controlled by other entities (Jo et al., 2015).

total news articles and use 1-year lagged media coverage data to mitigate the endogeneity problem. This variable can be interpreted as media visibility of the company or public attention on the firm.

We use two ownership structure variables such as managerial ownership and institutional ownership. Managerial ownership in our model is the percentage of shares held by executives. We have looked at managerial ownership by using ExecuComp data, a Compustat's Executive Compensation Database. Institutional ownership is measured as the percentage of shares held by institutional investors (Walls et al., 2012). We obtain information from Thomson Reuters, which collects information from 13-F filing with the U.S. Security and Exchange Commission.

We gather a number of control variables concerning corporate financial data from Compustat database that have been used in prior research conducted on environmental activities (King and Lenox, 2002; Walls et al., 2012). We measured firm size as a log of total assets, ROA as the firm's return on assets, leverage as total debt over total assets, sales growth as the change in sales over the previous year, and capital intensity as capital expenditure over sales. Board independence is measured by the number of outside directors over total directors and board size is equal to the total number of board directors, and board diversity is the proportion of female directors on boards, obtained from Risk Metrics database. We also control for year and industry differences by including year dummies and industry dummies with Fama-French 49 industries.

3.2 Descriptive Statistics

Table 1 provides descriptive statistics for our main variables. Our final sample contained 4,067 firm-year observations from 550 firms in conventional industries (not including financial services industries) during the 2002 to 2014 period. The first row of the table shows the dependent variable of this paper, total environmental costs over total assets, has a mean value of 4.33 and a median value of 2.03. The next row is the primary variable of interest of this paper, media coverage, is the total number of news articles subtracted from the number of environmental sector news articles with a mean value of 2.82 and a median value of 2.86. In terms of ownership structure, the mean and median of managerial ownership structure are close to zero, which indicates the manager has a small fraction of share. Institutional ownership has a mean value of 0.75 and a median value of 0.77. As for the control variables, the mean of log total assets in our sample is 8.79, ROA 0.07, leverage 0.55, sales growth 0.08, capital intensity 0.09. On the average, the firms have 78 percent of outside director among their directors and about 10.06 board directors, and 14 percent of female directors on boards. Table 2 shows Pearson cross-correlations matrix of all variables used in our main analyses.

[Insert Table 1 here]

[Insert Table 2 here]

3.3 Methodology

To test our hypotheses on the association between media coverage and environmental costs and ownership structure (such as managerial and institutional ownership) environmental costs, and, we estimate using the equation given below:

$$\text{Total Environmental Costs} = \beta_0 + \beta_1 \text{Lag(Media Coverage)} + \beta_2 \text{Managerial Ownership} + \beta_3 (\text{Managerial Ownership}^2) + \beta_4 \text{Institutional Ownership} + \gamma^* \text{Controls} + \text{Year \& industry fixed effect} + \varepsilon_{it}$$

where, the dependent variable, Total Environmental Costs, is defined as the sum of direct and indirect environmental external costs over total assets. Our hypotheses predict that media coverage and ownership structure (such as managerial and institutional ownership) have a significantly negative association with environmental costs, resulting from the influence of the monitoring effect on corporate environmental activities and also expect a curvilinear relationship between managerial ownership and environmental costs.

4. Empirical Results

In this section, we comprehensively examine the relationship between corporate environmental responsibility (CER) and ownership structure (such as managerial and institutional ownership) along with the role of media coverage. We measure CER as total environmental costs and conduct multivariate regression analysis and piecewise linear regression to estimate entrenchment points between managerial ownership and total environmental costs. We also find marginal effects of media coverage on total environmental costs by industry and conduct a set of several robustness tests and find the qualitatively same results. Appendix A provides the definitions of variables used in our analysis and how we measure them.

4.1 Multivariate Tests

Table 3 reports the results of multivariate OLS regressions of lagged media coverage and ownership structure (such as managerial and institutional ownership) on environmental costs (total environmental costs over total assets). Total sample in this regression is 4,067 firm-year observations from 550 firms in conventional industries (not including financial services industries) during the 2002 to 2014 period. In all models, we include year and industry fixed effects with the Fama-French 49 industries because some industries may be more likely to react sensitively than others and also use firm-level clustered standard errors.

[Insert Table 3 here]

In column 1, our results show a significant and negative relationship between media coverage and total environmental costs. Each sub-component of ownership structure, managerial and institutional ownership, shows in columns 2 and 3, respectively. There is a significant nonlinear relationship between managerial ownership and total environmental cost and a negative but not significant association with institutional ownership. Column 5 of Table 3 represent that environmental costs are significantly and negatively related to media coverage, indicating that environmental costs are lower firms with higher media coverage. These results imply media coverage has external monitoring effect in business activities, which may encourage firms to engage more on corporate environmental responsibility activities that enhance the reduction of environmental costs.

We find that environmental costs have a curvilinear relationship with managerial ownership. At a relatively low level of managerial ownership, before reaching the point at which the manager's position is entrenched, managers are likely to set a long-term strategy

and invest more for fostering corporate environmental responsibility activities to enhance the firm's financial performance. As increased managerial ownership gives more incentives to managers and contributes to reducing agency costs in convergence-of-interest hypothesis view, environmental costs decrease as managerial ownership increases, suggesting that higher managerial ownership provides higher managerial encourage firms to invest more in CER activities to enhance a firm's long-term value. In contrast to the value-enhancing view of CER activities, at a relatively high-level managerial ownership, managerial ownership increase leads to higher environmental costs suggesting that the effect of managerial entrenchment outweighs that of long-term value creation incentives of managers. We show the applicability of agency theory in this certain context.

Our estimates suggest that corporate environmental costs are the lowest when managerial ownership is at a level of 20.8%, which seems to be the optimal level of management ownership to achieve CER activities. Figure 1 shows a U-shaped curvilinear association between total environmental costs and managerial ownership. Our findings support our hypothesis 1 and 2 and suggest that effective monitoring is critical to encouraging corporate environmental responsibility activities and ultimately saving the costs and enhancing long-term firm value. However, institutional ownership and total environmental costs are negatively but not significantly related as prior findings show (Coffey and Fryxell, 1991; Graves and Waddock, 1994; Brown et al., 2006).

[Insert Figure 1 here]

4.2 Piecewise Linear Regression

We find a curvilinear relationship between managerial ownership and total environmental costs in Table 3. In this session, to examine the effect of managerial ownership on total environmental costs, we use piecewise linear regression[13], conducted by several literature (Morck et al., 1988; Hermalin and Weisbach, 1991; Ferris and Park, 2005). We divide managerial ownership into seven ranges: less than 0.5%, between 0.5% and 1%, between 1% and 3%, between 3% and 7%, between 7% and 13%, between 13% and 21%, and over than 21%[14]. As the breakpoint of managerial ownership is 20.8% in our results (figure 1), the models that converged with a breakpoint of 21% have smaller MSE (Ryan and Porth, 2007). We use the variables to estimate piecewise linear regressions following the prior studies and report the detailed measurement in Table3. For example, when managerial ownership is equal to 0.1, we would have 0.005 in 0-0.5% range and 0.5-1% range, 0.02 in 1-3% range, 0.04 in 3-7% range, 0.03 (0.1-0.07) in 7-13% range, 0.06 in 13-21% range, and 0 in over 21% managerial ownership range. To conduct the piecewise linear regressions in this paper, we estimate and use the above variables as regressors.

[Insert Table 4 here]

Table 4 shows the results of piecewise linear regressions of lagged media coverage and ownership structure on total environmental costs and defined for managerial ownership is the

[13] Piecewise linear regression lets linear models to be fit to the data for different ranges of x variable. Where the slope of the linear function changes is the breakpoint of x variables and the model has the smallest MSE when it converged with a breakpoint, which is the best fit (Ryan and Porth, 2007).

[14] We divided managerial ownership into seven intervals, referring to referred to previous literature (Morck et al., 1988; Hermalin and Weisbach, 1991; Ferris and Park, 2005) and consider MSE.

percentage of shares held by executives. A number of firm characteristics are included as control variables and use year and industry fixed effects with firm cluster robust error in column 1, two-way cluster robust errors in column 2, and newey-west robust errors in column 3 and the tables shows the consistent results.

The results show that there is a positive and significant relation between managerial ownership and total environmental costs at the low levels of managerial ownership and the majority of managerial ownership exists in this range. Total environmental costs are negatively related to managerial ownership at intermediate levels of managerial ownership, ranging from 0.05% to 21%. In particular, the regression slope is the steepest with managerial ownership between 1% and 3%. When managerial ownership excesses 21%, managerial ownership is significantly and positively related to total environmental costs. Increases in managerial ownership above 21% cause managers to be more entrenched and less engaged in CER activities, increasing total environmental costs. Our findings of nonlinear relation between managerial ownership and CER activities are consistent with prior literature in the context of convergence-of-interest hypothesis and value-enhancing view (Stulz, 1998; McConnell and Servaes, 1995; Ferris and Park, 2005).

4.3 Marginal effects of media coverage

Table 5, we examine the marginal effect of media coverage on total environmental costs in each industry by using the Fama–French 49 industry classification. Our sample excludes the financial industries: Fama-French industry classifications from 45 to 48 industry (45 bank, 46 insurance, 47 real estate, and 49 financials) and consists of 4,067 firm-year observations from 550 firms during the 2002 to 2014 period with 44 industries (no observation in fabricated

products industry). To analyze the marginal effect of media coverage on environmental costs by industry, we set software industry, having almost zero marginal effects, (36 classifications) as base industry and use for this model.

[Insert Table 5 here]

We reveal that firms in so-called sin and controversial industries have higher marginal effects of media coverage. Among our sample, 7.51% are in sinful industries (such as alcohol, tobacco, and gamble) and not social or environmental-friendly industries (military, and oil)[15]. Some industries have significantly negative marginal effects, in particular, a 1% increase in media coverage results in an 11.29 decrease in total environmental cost in food industry that has the largest marginal effects of media coverage in our sample. Firms, either those industries are close to the consumers or firm reputation and brand effects are important in their sales, are more likely to be sensitive to the number of media coverage. Our results find that agriculture, food, beer, books (Printing and Publishing), chemicals, steel, mines, oil, utilities, chips (Electronic Equipment), and retail industry have significantly negative marginal effects of media coverage. On the contrary, clothes, healthcare, telecommunication, transport, and meal (Restaurants, Hotels, Motels) industry have significantly positive marginal effects of media coverage on total environmental costs.

[15] Fama-French 49 industry classification of above: 4 for alcohol, 5 for tobacco, 26 for military, 30 for oil, and no classification of gamble in this classification, however, it can be obtained from NAICS code.

4.4 Robustness Tests

We conduct regressions with Two-way clustering and Newey-West robust standard errors (use lag 3) to explore the robustness check for our main results (see Table 6, Panel A and B respectively) following the literature (Kim et al., 2015). We use Two-way clustering analyses to consider the correlations in all dimensions such as cluster-robust variance matrices from the firm dimension, time dimension, and the intersection of the firm and time demension, respectively. We also estimate the regression with Newey-West robust standard error, which overcomes heteroskedasticity and autocorrelation in the error terms. Table 6, both Panel A and Panel B show that environmental costs are significantly and negatively related to media coverage and there is a curvilinear relation with managerial ownership and environmental costs, consistent with the evidence presented in Table 3. Institutional ownership shows no relationship with environmental costs. Our overall findings imply that external monitoring effect by high media coverage and appropriate managerial ownership induces firms to pay more attention to improving their environmental performance and consequently lowering total environmental costs.

[Insert Table 6 here]

5. Conclusion

A global consensus has moved toward corporate social and environmental responsibility and sustainability in the last few decades. Increased media attention, corporate governance, and political regulation (e.g. the adoption of the Sarbanes-Oxley Act in 2001) pursue the firms to

involve environmental concerns as a part of their business strategies. To find what factors encourage firms to engage in CER such as the reduction of environmental costs, this paper explores the relationship between corporate environmental responsibility (CER) and ownership structure along with the role of media coverage, which is not the focus of previous literature, to the best of our knowledge. We use unique database sets, such as Trucost data to measure environmental costs and LexisNexis for hand-collected news data, measuring the level of media coverage.

Our results show that environmental costs measuring CER are lower for firms with higher media coverage (such as a large amount of news attention to the firm) and environmental costs have a statistically significant U-shaped curvilinear relationship with managerial ownership. At a relatively low level of managerial ownership, environmental costs decrease as managerial ownership increases, suggesting that higher managerial ownership provides higher managerial incentives to invest more in CER activities to enhance a firm's long-term value. In contrast, at a relatively high-level managerial ownership, managerial ownership increase leads to higher environmental costs suggesting that the effect of managerial entrenchment outweighs that of long-term value creation incentives of managers. We estimate corporate environmental costs are the lowest when managerial ownership is at a level of 20.8%, which appears to be the optimal level of managerial ownership to achieve CER. Our findings are consistent with the agency theory and convergence-of-interest hypothesis. Further, we estimate entrenchment points between managerial ownership and total environmental costs by conducting a piecewise linear regression. We also find marginal effects of media coverage on total environmental costs by industry and conduct a set of several robustness tests and find qualitatively the same results.

This paper is the first attempt in the literature to analyze how media coverage and ownership structure (managerial and institutional ownership) might matter for environmental activities. Our results imply media coverage has external monitoring effect on corporate environmental activities and improves a firm's CER activities and suggests firms to establish a proper level of managerial ownership for a low level of environmental costs. Overall, our results support the view that good governance by external monitoring and incentivized management improves a firm's CER activities and long-term viability of firms.

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Table 1 Summary statistics of samples in United States firms: the whole sample 2002–2014

The sample consists of 4,067 firm-year observations from 550 firms in conventional industries (not including financial services industries) during the 2002 to 2014 period. This table reports summary statistics of corporate environmental costs and firm characteristics for the sample that we use to examine the relationship between corporate environmental responsibility (CER) and ownership structure (such as managerial and institutional ownership) along with the role of media coverage. All variables are defined in Appendix A. The table provides the mean, standard deviation, 1st percentile value, first quartile, median, third quartile, and 99th percentile value for the variables used in our empirical tests.

Variable	Obs.	Mean	SD	P(1)	P(25)	Median	P(75)	P(99)
Total environmental costs	4913	4.33	7.06	0.17	0.97	2.03	4.85	31.22
Lag(Media Coverage)	4086	2.82	0.92	0.89	2.16	2.86	3.44	5.00
Managerial Ownership	4913	0.02	0.04	0.00	0.00	0.00	0.01	0.22
Institutional Ownership	4912	0.75	0.14	0.38	0.67	0.77	0.86	0.98
Ln Firm Size	4913	8.79	1.28	6.32	7.85	8.65	9.66	12.22
ROA	4913	0.07	0.09	-0.19	0.03	0.06	0.10	0.27
Leverage	4898	0.55	0.19	0.11	0.43	0.56	0.68	1.00
Sales Growth	4912	0.08	0.29	-0.53	0.00	0.07	0.14	0.58
Capital Intensity	4910	0.09	0.15	0.00	0.02	0.04	0.08	0.83
Board Independence	4913	0.78	0.13	0.40	0.70	0.80	0.89	0.92
Board Size	4913	10.06	2.15	5.00	9.00	10.00	11.00	16.00
Board Diversity	4913	0.14	0.09	0.00	0.09	0.13	0.20	0.38

Table 2 Pearson cross-correlations between variables

This table reports Pearson correlations matrix of the dependent and explanatory variables for our empirical tests. Total sample in this regression is 4,067 firm-year observations from 550 firms during the 2002 to 2014 period. All variables are defined in Appendix A.

No.		1	2	3	4	5	6	7	8	9	10	11	12
1	Total environmental costs	1											
2	Lag(Media Coverage)	-0.25	1										
3	Managerial Ownership	-0.08	0.05	1									
4	Institutional Ownership	-0.27	0.24	0.04	1								
5	Ln Firm Size	0.04	-0.28	-0.19	-0.41	1							
6	ROA	-0.01	0.11	-0.02	-0.02	-0.08	1						
7	Leverage	0.15	-0.26	-0.08	-0.21	0.30	-0.22	1					
8	Sales Growth	-0.01	0.07	-0.05	0.07	-0.07	0.19	-0.14	1				
9	Capital Intensity	-0.02	-0.24	0.02	0.00	0.08	-0.13	0.02	-0.01	1			
10	Board Independence	0.01	-0.13	-0.23	0.00	0.23	-0.05	0.19	-0.10	0.03	1		
11	Board Size	0.11	-0.21	-0.13	-0.39	0.51	-0.04	0.29	-0.10	-0.05	0.14	1	
12	Board Diversity	0.08	0.01	-0.07	-0.18	0.27	0.02	0.21	-0.08	-0.14	0.17	0.28	1

Table 3 Regressions of environmental costs

This table reports the results of regressions of lagged media coverage and ownership structure (such as institutional and managerial ownership) on environmental costs (total environmental costs over total assets). All variables are defined in Appendix A. Total sample in this regression is 4,067 firm-year observations from 550 firms during the 2002 to 2014 period. We include the Fama-French 49 industries and year fixed effects in all regressions. In each column, we report estimated coefficients from OLS regression and standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote the statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable	Total environmental costs				
Functional Form	(1)	(2)	(3)	(4)	(5)
Lag(Media Coverage)	-0.815***			-0.817***	-0.781***
	(-2.98)			(-2.98)	(-2.78)
Managerial Ownership		-7.189*		-7.627*	-9.615**
		(-1.72)		(-1.75)	(-2.13)
(Managerial Ownership)^2		20.646*		20.850*	23.120**
		(1.97)		(1.90)	(2.26)
Institutional Ownership			-4.346		-4.187
			(-1.38)		(-1.32)
Control variables	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm
Observations	4,067	4,067	4,067	4,067	4,067
Adj. R^2	0.508	0.501	0.505	0.508	0.511

Figure 1 U-shaped Curvilinear relationship between environmental costs and managerial ownership

This figure presents the U-shaped curvilinear relationship between total environmental costs and managerial ownership. Total sample in this regression is 4,067 firm-year observations from 550 firms during the 2002 to 2014 period. The y-axis is environmental costs and the x-axis is manager ownership. The red dash line indicates the optimal breakpoint, that is, firms have the lowest environmental costs when manager ownership is 20.8%.

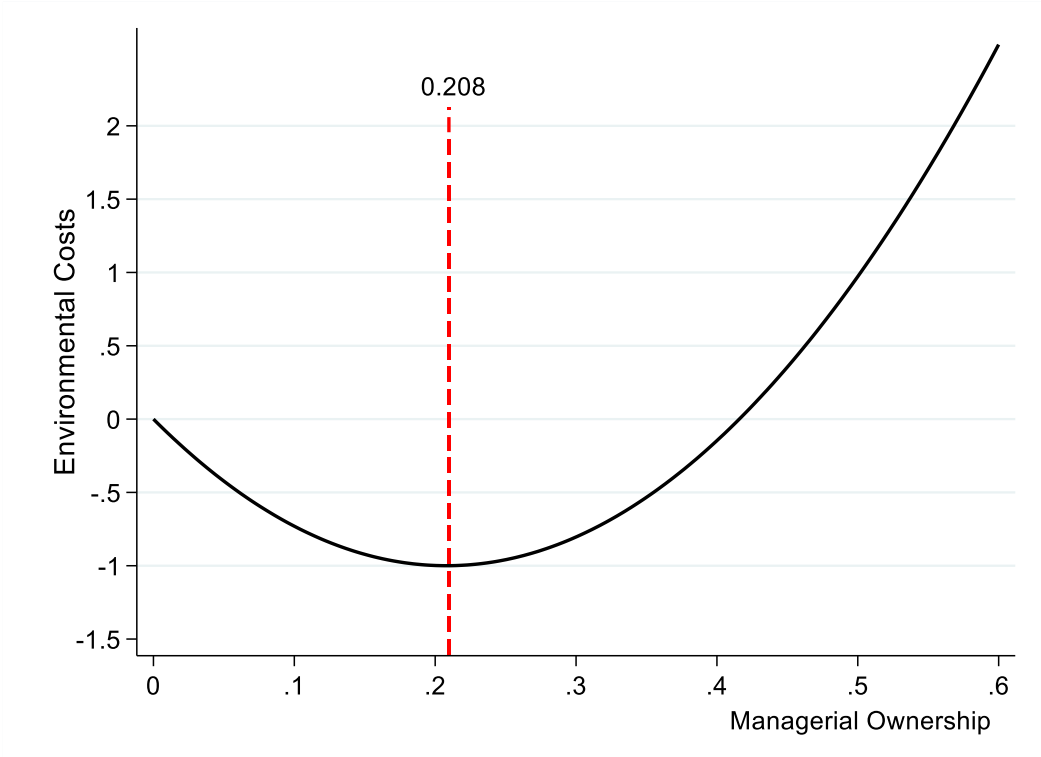

Table 4 Piecewise Linear Regressions of environmental costs on Managerial Ownership

This table reports the results of piecewise linear regressions of lagged media coverage and ownership structure (such as managerial and institutional ownership) on environmental costs (total environmental costs over total assets). Defined for managerial ownership is the percentage of shares held by executives. All variables are defined in Appendix A. Total sample in this regression is 4,067 firm-year observations from 550 firms during the 2002 to 2014 period. We include the Fama-French 49 industries and year fixed effects in all regressions. In each column, we report estimated coefficients from regression and standard errors are in parentheses. Column (1) frim cluster robust errors, (2) two-way cluster robust errors, and (3) newey-west robust errors. ***, **, and * denote the statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable	Total environmental costs		
Functional Form	(1)	(2)	(3)
Lag(Media Coverage)	-0.775***	-0.775***	-0.775***
	(-2.75)	(-2.84)	(-4.24)
0.5-1% Managerial Ownership [b]	-65.316	-65.316	-65.316
	(-0.67)	(-0.74)	(-0.81)
1-3% Managerial Ownership[c]	-71.761***	-71.761***	-71.761***
	(-2.88)	(-2.17)	(-2.76)
3-7% Managerial Ownership[d]	-14.134	-14.134	-14.134*
	(-1.35)	(-1.34)	(-1.73)
7-13% Managerial Ownership[e]	-0.272	-0.272	-0.272
	(-0.05)	(-0.05)	(-0.06)
13-21% Managerial Ownership [f]	-11.524	-11.524	-11.524
	(-0.86)	(-0.91)	(-1.02)
Over 21% Managerial Ownership[g]	11.423**	11.423**	11.423**
	(2.11)	(2.40)	(2.27)
Institutional Ownership	-4.413	-4.413	-4.413*
	(-1.42)	(-1.42)	(-1.96)
Control variables	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes
Standard error	Firm Cluster	Two-way cluster	Newey –West
Observations	4,067	4,067	4,067
Adj. R^2	0.513	0.501	0.513

Table 4 Piecewise Linear Regressions of environmental costs on Managerial Ownership
(Continued)

[a] If the fraction of the company's stock held by the manager is less than 0.005, the variable equals the fraction itself and 0.005 otherwise.
[b] If the fraction of the company's stock held by the manager is less than 0.005, the variable equals 0. If the fraction of the company's stock held by the manager is greater than 0.005 and less than 0.01, the variable equals the fraction minus 0.005. If the fraction of the company held by foreigners is greater than 0.01, variable equals 0.005.
[c] If the fraction of the company's stock held by the manager is less than 0.01, the variable equals 0. If the fraction of the company's stock held by the manager is greater than 0.01 and less than 0.03, the variable equals the fraction minus 0.01. If the fraction of the company held by foreigners is greater than 0.03, variable equals 0.02.
[d] If the fraction of the company's stock held by the manager is less than 0.03, the variable equals 0. If the fraction of the company's stock held by the manager is greater than 0.03 and less than 0.07, the variable equals the fraction minus 0.03. If the fraction of the company held by foreigners is greater than 0.07, variable equals 0.04.
[e] If the fraction of the company's stock held by the manager is less than 0.07, the variable equals 0. If the fraction of the company's stock held by the manager is greater than 0.07 and less than 0.13, the variable equals the fraction minus 0.07. If the fraction of the company held by foreigners is greater than 0.13, variable equals 0.06.
[f] If the fraction of the company's stock held by the manager is less than 0.13, the variable equals 0. If the fraction of the company's stock held by the manager is greater than 0.13 and less than 0.21, the variable equals the fraction minus 0.13. If the fraction of the company held by foreigners is greater than 0.21, variable equals 0.08.
[g] If the fraction of the company's stock held by the manager is less than 0.21, the variable equals 0. Otherwise, the variable equals the fraction minus 0.21.

Table 5 Marginal Effects of Media Coverage on Environmental Costs

This table reports the marginal effects of lagged media coverage on environmental costs (total environmental costs over total assets) for each Fama-French 49 industries. Base industry is software (36 classification) in this analysis. We exclude the financial industries: industry classification from 45 to 48 (45 bank, 46 insurance, 47 real estate, and 49 financials). Total sample in this regression is 4,067 firm-year observations from 550 firms during the 2002 to 2014 period with 44 industries. We summarize the observation, mean, and standard deviation and report estimated coefficients from OLS regression with year-fixed effects and standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote the statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable		Total environmental costs				
Industry Classification		Obs.	Mean	SD	Marginal Effects	
1	Agriculture	21	14.40	14.66	-8.74	***
2	Food	135	25.97	20.21	-11.29	*
3	Soda	9	4.39	0.99	-2.87	
4	Beer	46	6.87	4.21	-3.76	**
5	Smoke	30	7.19	4.13	7.32	
6	Toys	23	2.79	0.44	-0.53	
7	Fun	39	0.72	0.35	-0.13	
8	Books	39	0.88	0.34	-0.40	*
9	Household	115	4.14	2.10	0.22	
10	Clothes	59	3.59	2.23	2.09	***
11	Healthcare	59	0.95	0.43	1.24	*
12	Medical	126	1.13	0.67	-0.12	
13	Drugs	160	1.27	0.70	-0.22	
14	Chemicals	172	7.08	3.38	-1.39	**
15	Rubber	18	3.29	1.10	0.88	
16	Textiles	22	6.22	2.86	1.62	
17	Building	106	4.33	3.05	-0.01	
18	Construction	118	2.17	1.40	0.84	
19	Steel	83	12.34	8.67	-3.39	**
21	Machinery	271	3.01	1.87	-0.31	
22	Electrical	61	1.92	0.94	-0.25	
23	Autos	87	4.02	2.61	0.63	
24	Aero	58	1.99	1.13	-0.39	
25	Ships	22	2.32	0.77	-0.63	
26	Defense	8	1.48	0.33	-1.76	
27	Gold	12	5.75	1.50	-0.19	
28	Mines	46	11.31	8.75	-4.03	*

Table 5 Marginal Effects of Media Coverage on Environmental Costs (Continued)

29	*Coal*	*13*	*25.77*	*8.30*	*-6.85*	
30	*Oil*	*285*	*3.40*	*3.61*	*-0.89*	**
31	Utilities	438	9.27	9.54	-2.64	**
32	Telecommunication	90	0.33	0.12	0.70	*
33	Personal services	49	2.72	2.44	0.60	
34	Business services	223	0.70	0.80	-0.07	
35	Computers	118	1.29	0.91	-0.24	
36	Software	287	0.40	0.39	0.00	
37	Chips	325	1.26	0.63	-0.55	**
38	Laboratory equipment.	128	1.02	0.59	-0.01	
39	Paper	106	5.96	2.73	-0.49	
40	Boxes	40	9.59	3.41	0.70	
41	Transport	169	4.31	4.40	2.13	**
42	Wholesale	163	3.40	3.78	-0.63	
43	Retail	397	2.76	1.56	-0.55	**
44	Meals	90	4.94	1.96	1.09	**
49	Other	44	2.98	1.47	-0.85	

Table 6 Robustness Check: Regressions of environmental costs

This table reports the robustness check results of regressions of lagged media coverage and ownership structure (such as managerial and institutional ownership) on environmental costs (total environmental costs over total assets) with Two-way cluster-robust standard errors in Panel A and Newey–West standard errors (use lag 3) in Panel B. All variables are defined in Appendix A. Total sample in this regression is 4,067 firm-year observations from 550 firms during the 2002 to 2014 period. We include the Fama-French 49 industries and year fixed effects in all regressions. In each column, we report estimated coefficients from OLS regression and standard errors are in parentheses. ***, **, and * denote the statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A: Two-way cluster-robust standard errors

Dependent Variable	Total environmental costs				
Functional Form	(1)	(2)	(3)	(4)	(5)
Lag(Media Coverage)	-0.815***			-0.817***	-0.781***
	(-3.08)			(-3.08)	(-2.78)
Managerial Ownership		-7.189*		-7.627*	-9.615**
		(-1.75)		(-1.76)	(-2.14)
(Managerial Ownership)^2		20.646**		20.850*	23.120**
		(2.00)		(1.86)	(2.27)
Institutional Ownership			-4.346		-4.187
			(-1.45)		(-1.39)
Control variables	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes
Two-way cluster S.E	Yes	Yes	Yes	Yes	Yes
Observations	4,067	4,067	4,067	4,067	4,067
Adj. R^2	0.515	0.509	0.513	0.516	0.519

Panel B: Newey-West standard errors					
Dependent Variable	Total environmental costs				
Functional Form	(1)	(2)	(3)	(4)	(5)
Lag(Media Coverage)	-0.815***			-0.817***	-0.781***
	(-4.51)			(-3.08)	(-2.78)
Managerial Ownership		-7.189**		-7.627*	-9.615**
		(-2.06)		(-1.76)	(-2.14)
(Managerial Ownership)^2		20.646**		20.850*	23.120**
		(2.24)		(1.86)	(2.27)
Institutional Ownership			-4.346*		-4.187
			(-1.93)		(-1.39)
Control variables	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes
Newey-West S.E	Yes	Yes	Yes	Yes	Yes
Observations	4,067	4,067	4,067	4,067	4,067
Adj. R^2	0.508	0.501	0.505	0.508	0.511

Appendix A

Variable definitions and measures

Variable	Definitions
Total Environmental Costs	Total environmental costs are measured as the sum of total direct environmental external costs and total indirect environmental external costs over total asset. (Total direct environmental costs = greenhouse gases direct cost + water direct cost + waste direct cost + land and water pollutants direct cost + air pollutants direct cost + natural resource using direct cost). (Total indirect environmental costs = greenhouse gases indirect cost + water indirect cost + waste indirect cost + land and water pollutants indirect cost + air pollutants indirect cost + natural resource using indirect cost).
Media Coverage	The number of total news articles excluding the number of environmental sector news articles
Institutional Ownership	The percentage of shares held by institutional investors
Managerial Ownership	The percentage of shares held by executives
Ln Firm Size	Log of total assets
ROA	The firm's return on assets
Leverage	Total debt over total assets
Sales Growth	The change in sales over the previous year
Capital Intensity	Capital expenditure over sales
Board Independence	The number of outside directors over total directors
Board Size	The total number of board directors
Board Diversity	The proportion of female directors on boards