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# Good news for environmental self-regulation? Finding the right link



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# ABSTRACT

We investigate the stock market response to firm disclosure of positive environmental information and the link from that information to environmental outcomes. We classify environmental media releases by informational content and value relevance, and assess the abnormal stock returns of each type of event. While announcements of future environmental activities lead to the largest favorable stock market reactions, there is no guaranteed link from this type of information to environmental outcomes. Further analysis of the abnormal returns shows that the magnitude of the stock market reaction depends on firm financial characteristics across all event types rather than on firm environmental performance. Our results indicate that the ability for voluntary environmental information disclosure to induce environmental self-regulation is limited to the extent that firms are able to follow through with their announcements of planned environmental activities.

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# 1. Introduction

Environmental economists have generated nearly unanimous empirical evidence that public news regarding negative environmental performance of a firm leads to significantly negative financial outcomes for the firm. For example, the initial response of the stock market to mandatory reporting of pollution data in the Toxics Release Inventory was a significantly negative shock to firm returns (Hamilton, 1995), and the stock market loss was larger for more polluting firms relative to firms with better environmental performance (Khanna et al., 1998; Lanoie et al., 1998). Capelle-Blancard and Laguna (2010) find that the stock market reacts significantly to news of chemical disasters, and that the loss in value is related to the seriousness of the disaster. Konar and Cohen (2001) show that poor environmental performance has a significant effect on a firm's intangible asset value, or environmental reputation.

A quite powerful implication of these empirical findings is the opportunity for public information regarding a firm's environmental performance to serve as a lever through which environmental policymakers can augment existing regulations (Konar and Cohen, 1997; Khanna et al., 1998). A firm responds to financial incentives – if environmental liabilities lead to financial

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liabilities, a firm adjusts its behavior to improve performance. Policymakers can exploit the firm's incentive to reduce pollution (Konar and Cohen, 1997; Khanna et al., 1998) and improve its environmental reputation (Konar and Cohen, 2001; Flammer, 2013). For example, Khanna et al. (1998) show that the release of public information on toxic releases can effectively induce firms to reduce on-site releases and increase off-site transfer of waste.

Our contribution is to assess the extent to which public information regarding *positive* environmental news can also serve as a policy lever to induce firm self-regulation. However, unlike in the case of negative environmental information, the links between positive environmental activities, financial performance, and environmental improvements are not always clear. Negative information (e.g., pollution figures or a chemical disaster) signals responsibility for direct costs of clean up as well as indirect costs of long-term compliance, possible tightening of regulations, and issues related to management inefficiency. Yet, in the case of positive environmental information, these links are not well-defined. Should investors view positive environmental activities as long run costs, and respond adversely (Friedman, 1970)? Or, should investors applaud improved production efficiency and/or a strengthened corporate reputation, and look forward to higher profits from increased product differentiation, consumer demand, and loyalty (Ambec and Lanoie, 2008)? We discuss these issues, and empirically examine the extent to which positive information might induce self-regulation.

Our work is related to the literature investigating firm motivation for participating in voluntary pollution abatement programs (Khanna and Damon, 1999; Vidovic and Khanna, 2007; Ervin et al., 2013) as well as the impact on firm value of environment-related activities (Klassen and McLaughlin, 1996; Khanna and Damon, 1999; Fisher-Vanden and Thorburn, 2011; Lyon and Shimshack, 2012; Oberndorfer et al., 2013). In line with our intuition that the links between environmental information, financial performance, and environmental quality are not always clear, is a lack of consensus as to firm motivation for participating in voluntary pollution abatement programs, the impact of voluntary abatement initiatives on environmental outcomes, and the impact of these activities on firm financial performance.

Our work builds on previous research in several important ways. Instead of focusing exclusively on environmental activities of a particular type such as winning an environmental award (e.g., Klassen and McLaughlin, 1996; Lyon and Shimshack, 2012; Lyon et al., 2013) or related to participation in a particular program (e.g., Fisher-Vanden and Thorburn, 2011), we focus on a wide array of environmental activities. We use the scope of these activities to explore differences in information contained in different types of events, so that we can better understand the signal that public information regarding different positive environmental activities transmits to investors as well as environmental policymakers. The scope of our analysis allows us to identify factors contributing to the lack of consensus in previous research and to create a framework under which we begin to understand the inconsistent findings within the literature.

Using information from 308 media releases between January 2005 and December 2014, we conduct an event study to assess the magnitude of the stock market response to the release of information regarding positive environmental activities. In addition to standard conditional mean regressions and normally distributed test statistics, we use standardized and nonparametric test statistics that are designed to address poor performance issues commonly associated with standard statistical tests (Corrado, 1989; Cowan, 1992; Acharya, 1993; Corrado, 2011). We find that self-made announcements of planned future activities generate a significant stock market reaction and bear the largest increase in stock returns among all environmental media releases in our sample. We investigate whether firms release positive environmental information strategically, and we find some evidence that positive environmental news may be released strategically to offset the potentially unfavorable stock market reaction to negative information.

From a policy perspective, the disclosure of environmental information can augment formal environmental regulation by inducing a firm to improve its environmental performance above and beyond what is legally mandated. For this to happen, it is necessary that the event describes an activity that likely leads to environmental change, and that the link between positive environmental activities and financial incentives depends significantly on actual environmental performance. That is, positive environmental information can induce firm self-regulation and augment traditional regulation only if such information is associated with realized environmental outcomes. We assess the link between news about positive environmental activities and environmental performance in two ways. First, in examining the stock market response to the events, we focus on the nature of the information in different types of events – such as the degree of details about the environmental activity, and the timing/stage of the activity being described – to assess which types of events most likely indicate actual environmental change. Second, when explaining the association between the magnitude of the stock market reaction and various firm characteristics, we incorporate four different firm-level indices that measure firm transparency in environmental activities and environmental, social, and corporate governance (ESG) activities, firm environmental performance, and overall ESG performance (Flammer, 2013).<sup>1</sup> This allows us to ascertain whether investors are more likely to respond favorably to news of positive environmental activities for firms that are merely transparent in their environmental activities, or to firms that have established a track record of environmental improvements.

Among all the media release types that we consider – descriptions of past actions, announcements of planned future activity, recognition by a third party for environmental stewardship, and annual reports describing environmental goals and accomplishments – we find that the market reacts most strongly to announcements of planned future activity because these announcements contain the most new information content. We also find that the primary determinants of the magnitude of the stock

<sup>&</sup>lt;sup>1</sup> Environmental and ESG disclosure measure only transparency in the environmental and ESG activities of the firm, respectively, which may be negative, and may not reflect actual environmental and ESG performance.

market reaction are firm financial characteristics; among firm environmental characteristics, the stock market reaction depends on firm overall corporate social responsibility performance, rather than environmental performance per se.

# 2. Theoretical and empirical perspectives

#### 2.1. Theoretical perspectives

The traditional perspective on firm environmental responsibility is that voluntary environmental action comes at a cost to the firm. The firm's objective is to maximize profits, and an executive that directs a firm towards any other goal is not working in the best interest of the firm's shareholders (Friedman, 1970). However, this view has been challenged because firm self-regulation and positive environmental activities may lead to a competitive advantage through bene-fits such as customer loyalty, reduced conflicts, and generate revenues that offset the costs of undertaking environmental activities.

The stakeholder theory (Freeman, 1984) states that a firm should consider the interests of all stakeholders, including employees and customers. Different stakeholders have different interests in the firm, and may not be exclusively focused on (short-run) profitability. For instance, long run profitability may be driven by consumer loyalty, which may be a function of voluntary environmental action that may or may not maximize short-run profits. The instrumental stakeholder theory (Jones, 1995) contends that ethical firm behavior establishes a lasting relationship between the firm and stakeholders by improving firm reputation. The "Porter Hypothesis" aligns a firm's environmental goals with its industrial competitiveness (Porter and Van der Linde, 1995), and the theory of firm resources (Russo and Fouts, 1997) argues that the firm's ability to manage its tangible and intangible resources related to the environment can affect its competitiveness. Environmental responsibility may also be a strategy for product differentiation (McWilliams and Siegel, 2001), or a strategy to preempt stringent government regulation when environmentally aware consumers are faced with costs to influence government actions (Maxwell et al., 2000). Heal (2005) perceives firm environmental responsibility in a Coasian framework and contends that firm environmental responsibility removes conflict between the firm and society, internalizing the differences between private and social costs associated with pollution, and therefore reduces firm costs. This framework also, to an extent, reconciles the different perspectives regarding firm environmental responsibility between Friedman (1970) and the others. Heal (2005) argues that Friedman (1970) assumes that the government resolves the negative environmental externalities associated with firm operations, in which case the firm's only goals would be shareholder value maximization. In reality, however, firm environmental responsibility plays a role in addressing such externalities, and benefits both shareholders and other stakeholders. McWilliams et al. (2006) and Kitzmueller and Shimshack (2012) provide comprehensive reviews of the literature.

#### 2.2. Empirical evidence

Empirical findings in terms of the financial impact of positive environmental activities are mixed.<sup>2</sup> Several studies find a negative financial impact of positive environmental activities that imply clear costs to the firm. Gilley et al. (2000) examine product-driven and process-driven corporate environmental actions separately, and find that process-driven activities generate significantly negative abnormal returns.<sup>3</sup> Fisher-Vanden and Thorburn (2011) find shareholder wealth *loss* following news that a firm voluntarily joined the EPA's "Climate Leaders" program, which commits a firm to reducing greenhouse gas emissions. Oberndorfer et al. (2013) find a significantly negative stock market reaction to the inclusion of German firms in the Dow Jones Sustainability World Index, and conclude that the negative reaction indicates financial penalty rather than reward for environmental commitment due to the operating costs. Lyon et al. (2013) find that environmental awards to firms in China are met with a negative stock market reaction, because environmental management is widely considered as a cost to economic growth in China, and that consumer income is not yet able to afford products bundled with environmental amenities. Hassel et al. (2005) find a negative relationship between firm environmental performance and market value of equity, and conclude that investors do not value environmental performance for public utilities and find the relationship to be negative.

Gilley et al. (2000) do not find a significant stock market reaction to product-driven corporate environmental activities, though a positive financial impact is expected through increased consumer demand and revenue. Fisher-Vanden and Thorburn (2011) also find an insignificant stock market reaction following news of firms joining the EPA's "Ceres" program which advocates sustainable business practices. Lioui and Sharma (2012) show that although environmental initiatives are negatively associated with firm financial performance, there is a positive indirect effect of such initiatives through firm research and development which may benefit the firm through increased efficiency. This is consistent with Bushnell et al. (2013) in the context of environmental regulations: investors understand the positive revenue impact of certain environmental regulations, instead of focusing on the compliance cost, and in industries such as electricity, investors realize the revenue increase can largely offset

<sup>&</sup>lt;sup>2</sup> For a review of the empirical literature on corporate social responsibility, see McWilliams et al. (2006).

<sup>&</sup>lt;sup>3</sup> Although some process-driven environmental initiatives aim at reducing costs, the implementation of the initiatives is associated with direct costs, for example, through redesigning the firm's production system.

the regulatory cost. While improving environmental performance may be costly to the firm, investors see beyond the direct cost and incorporate into their valuation of the firm the impact of superior environmental performance on the firm's ability to generate longer term profit, through channels such as increased revenue and lower risk.

Several studies find a positive stock market reaction to news of an environmental award on firm environmental performance. Klassen and McLaughlin (1996) find that a media release of winning an environmental award generates a positive and significant stock market reaction, and Lyon and Shimshack (2012) find that firms ranked in the top 100 (of 500 greenest companies) in Newsweek Magazine's "Greenest Companies ratings" in 2009 have significantly greater abnormal stock returns than the bottom 400. Besides, Wu (2009) finds that competitive strategies that contribute to firm economic performance, such as product differentiation and retaining quality employees, deter environmental violations and improve environmental performance, and Albuquerque et al. (2014) find evidence that firms with corporate social responsibility attributes have more loyal demand, which in turn increases firm value. These findings are consistent with the stakeholder theory (Freeman, 1984).

Empirically, there is considerable evidence supporting both a negative and a positive effect on firm value due to environmental activities. In some cases there are clearly different signals of information transmitted to investors, which leads to significantly different stock market reactions. For example, events implying clear costs to the firm tend to lead to a negative financial impact, while environmental awards tend to generate a positive effect. In other cases, there is a lack of solid theoretical explanation to support the empirical findings. We add to the literature by investigating financial incentives for firm disclosure of environmental information by type of information and firm characteristics such as past environmental performance and environmental disclosure.

## 3. Types of environmental news and information

We expect the stock market to respond to events that are both new and value relevant. An event is new if the event brings information to the market that is not yet known and therefore has not yet been incorporated into current stock prices. This follows the Efficient Market Hypothesis: stock prices incorporate and reflect all relevant information that is available to the market. We therefore expect the magnitude of the stock market reaction to positive environmental news to depend on the extent to which the information conveyed is new, or unexpected by the market – all else equal, news that contains a larger amount of new information generates a larger stock market response (MacKinlay, 1997). Value relevance means that the event is describing (new) information that is relevant to the financial health of the firm. A rational investor values an event based on the expected sign and magnitude of the net present value of the underlying activity that influences the firm's financial performance.

While we expect the market reaction to depend on the amount of new information and the expected net financial benefit associated with the environmental activity, we do not expect the stock market to directly respond to the environmental outcome associated with the activity. Rather, potential environmental improvements are indirectly evaluated via impacts such as increased energy efficiency, reduced waste, and lower compliance costs that also influence firm financial performance. From a policy perspective, however, the extent to which the environmental activities reported in the news may lead to actual environmental improvemental improvement determines whether disclosure of positive environmental information can be linked to environmental self-regulation.

We focus on three separate dimensions of media releases containing positive environmental information. In terms of the stock market reaction, we consider both the degree of newness of the information, and the expected net financial benefit of the environmental activity to the firm. In terms of the policy implications of the positive environmental information, we consider the expected environmental improvement. We categorize the positive environmental news into four types depending on the nature of the underlying environmental activity, and assess the difference in the degree of newness of information, the expected net financial benefit, and the certainty of environmental improvement across the four types of events.<sup>4</sup> Whether an event leads to environmental improvements is of primary interest to policymakers and environmental stakeholders.<sup>5</sup>

We classify news of positive environmental activities into four types:

**Action** - a current or completed activity that leaves a positive environmental impact or demonstrates firm environmental responsibility.

While it is possible that the information contained in action events may be completely new to the market, because action events relate to past or contemporaneous environmental activity, it is likely that news about the environmental activity was made available to the market at an earlier time, for example, at the planning stage. Hence the newness of information for action events lies primarily in the update regarding the stage of the environmental activity, which may also remove some uncertainty

<sup>&</sup>lt;sup>4</sup> Because quantifying each media release along the three dimensions would require substantial subjective judgment, we avoid doing so; instead, we categorize environmental information by the nature of the underlying activity, which varies along the three dimensions.

<sup>&</sup>lt;sup>5</sup> Very few studies differentiate between types of environmental events (e.g., Gilley et al., 2000). On the contrary, most studies examine stock market reactions to a particular type of positive environmental information (Klassen and McLaughlin, 1996; Fisher-Vanden and Thorburn, 2011; Lyon and Shimshack, 2012). Not only does the variation in event type across studies limit our understanding of the relationship between positive environmental information, financial incentives, and firm environmental performance, this also potentially explains why different studies reach different conclusions.

regarding whether the firm has undertaken or completed the activity.<sup>6</sup> From a policy perspective, these events imply current environmental improvements, and with reasonable certainty. With information about the environmental activity previously available to the stock market, the costs and benefits associated with the environmental activity are already embedded in the firm's stock price prior to the media release. As such, action events are characterized by a low newness of information combined with a low expected net financial benefit of the environmental activity.

Announcement - a forthcoming activity initiated by the firm that demonstrates environmental responsibility.

Announcement events are forward-looking and contain information that is completely new to the market. For example, a firm plans to launch a new environmental program.<sup>7</sup> By the Efficient Market Hypothesis, we expect these events to generate the largest stock market reaction. Because investors are able to assess the future net financial benefit of the environmental activity based on the information from the media release, announcement events bear strong implications for the future financial performance of the firm. Since the announcement events communicate environmental stewardship by the firm, and likely go a long way in establishing a positive environmental reputation for the firm, the expected net financial benefit of these events are likely to be relatively high. Being forward-looking, however, the underlying environmental activity may only take place in the future with some probability, with no guarantee of fulfillment, which means that these events are less likely to lead to realized environmental improvements.

**Recognition** - recognition of a firm by a third party for its environmental performance.

Recognition events inform the market of firm merits in environmental stewardship. Although recognitions are based on past environmental activities, the newness of this type of event lies in the acknowledgment and novelty of the achievement. The additional verification from a third party makes the information contained in an external recognition the most credible (Lyon et al., 2013). A recognition event also indicates actual environmental improvements, as the environmental activities have already taken place. Similar to action events, the stock price of a firm prior to the event most likely already reflects the costs and benefits of the environmental activities that amount to the recognition, so information about the recognition itself bears little implication for the future financial performance of the firm. Therefore, while recognition events may have a relatively high content of new information, the expected net financial benefit of a recognition event is relatively low to a firm.

**Report** - the release of a firm's environmental report or a corporate social responsibility report that highlights its environmental activities.

Environment-related reports are typically issued annually. A firm summarizes its efforts and achievements in environmental responsibility over the past year. Since the information may have been public prior to the report, the new information content in report events is low. Plans and outlooks for environmental commitment, which comprise the newness of information in this type of event, are often provided as well, though not as the major component. Since the environmental activities summarized in a report have already taken place (and thus there is high certainty for environmental improvement), and investors have already accounted for the value-relevant information about the activities in the stock price prior to the media release, report events bear little implication for firm future financial performance, and the expected net financial benefit of these events is relatively low.

Table 1 provides an example of each type of media release from our sample. Across all types, the content of the stories indicates substantial commitment by the firm to protect the environment. For the action type, Dean Foods' new refrigerated transportation fleet significantly reduces the firm's carbon footprint. Under the announcement type, Bank of America plans to invest a sum of \$20 billion in environmental programs. Computer Science Corporation's press release for its recognition by FTSE4Good Index uses strong words such as "stringent" and "positioned to capitalize", indicating the firm's superior social and environmental performance is expected to benefit the firm considerably. For the report type, Chevron Corporation informed investors of its performance related to environmental issues that are frequently topics of broad public interest: greenhouse gas emissions and disaster recovery.

Table 2 provides a summary of the differences in terms of newness of information, expected net financial benefit, and certainty of environmental improvement across the four event types, with the first two dimensions concerning the market mechanism regarding positive environmental information, and the last dimension concerning the policy implications of such infor-

<sup>&</sup>lt;sup>6</sup> For example, in a media release that we classify as an action event, Hewlett-Packard discloses details regarding its recycling program in the past fiscal year, comparing the company's recycling achievements to the previous year, and updating its progress towards its global recycling goal. While it is likely that stakeholders such as employees and clients of the company have been aware of its prior recycling activities, the specific progress of the recycling program is still information that is not generally known. Via the media release of the action event, the company makes its progress towards the recycling goal fully known. As such, the action event still contains new information through an update on the environmental activity.

<sup>&</sup>lt;sup>7</sup> It is also possible for announcement events to be associated with continued commitments that are a part of a longer term agenda (for example, a firm renews its commitment to an existing environmental program). The difference between this case and an ongoing action is that the former activity will take place at a future time, and the latter is happening at the time of the news release. In our sample, about 82 percent of the announcement type events imply only future commitments.

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Examples of po	sitive environme	ntal media relea	se by type.

Туре	Event Date	Event Description
Action	July 9, 2010	<b>Dean Foods</b> unveils a new diesel-free, hybrid electric-powered truck refrigeration system which is cost-efficient and environmentally-sustainable, and significantly reduces emissions.
Announcement	March 6, 2007	Bank of America announces its launching of a 20 billion USD Environmental Program on various business activities that include energy efficiency and emissions offsets.
Recognition	July 19, 2010	<b>Computer Science Corp</b> is recognized by the FTSE4Good Index Series. Companies in the Series have met stringent social and environmental criteria, and are positioned to capitalize on the benefits of responsible business practice.
Report	April 24, 2006	<b>Chevron Corporation</b> issues Corporate Responsibility Report 2005, which provides details on the company's environmental performance, such as natural disaster recovery assistance and greenhouse gas emissions reduction.

Table 2
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Table 1

Newness of information and expected net financial benefit by event type.

Туре	Newness	Expected Net Financial Benefit	Certainty of Environmental Improvement
Action	Low	Low	High
Announcement	High	High	Low
Recognition	High	Low	High
Report	Low	Low	High

mation. Although based on this summary, action and report events fall into the same categories along all dimensions, the two types of events are distinct in that while action events communicate one particular environmental activity, report events contain a collection of activities that could generate multiple dimensions of environmental improvement. As such, although both types of events imply high certainty of actual environmental improvement, the scope of the improvement can be very different. Therefore, we consider action and report as separate types of events.

Since media releases convey new information to the market, and the environmental commitments communicated in the news constitute a financial commitment as well as the potential for the firm to capitalize on the environmental opportunities, we hypothesize that these events generate a statistically significant stock market response. In addition, we expect that investors react differently to different types of events that bear qualitative differences in terms of the newness and value relevance of the information. In the context of the Efficient Market Hypothesis, these qualitative differences in information point towards the following hypotheses that underlie our empirical analysis. Specifically, we make the following hypotheses:

- 1. Positive environmental information with a relatively low newness of information and a low expected net financial benefit, namely action and report events, generate a relatively smaller stock market reaction.
- Positive environmental information with a relatively high newness of information and a high expected net financial benefit, namely announcement events, generate a relatively larger stock market reaction.

What remains to be seen is whether the stock market response is positive, and if so, whether the magnitude of the response is correlated with firm environmental performance or transparency on environmental issues so that the financial incentives might align with improvements in environmental quality.

# 4. Data and methodology

### 4.1. Media release and stock returns

We generate our sample through a keyword search in Factiva and LexisNexis Academic designed to identify all news releases and articles related to the environmental responsibility of public firms listed on the New York Stock Exchange from January 2005 to December 2014.<sup>8</sup> The keywords we use are "environmental responsibility", "environmental stewardship", and "environment AND sustainability". While these are our preferred keywords, since firms' environmental responsibility often falls into the broader context of corporate social responsibility, we include another keyword "corporate social responsibility AND environment" to avoid missing media releases on the environmental aspect of corporate social responsibility. As we broaden the search, however, a number of irrelevant media releases appear in the results, as in some cases "environment" only appears in the news to describe the various dimensions that corporate social responsibility covers, yet the news is about a non-environment dimension. We therefore exclude these releases and only focus on events with an emphasis on environmental issues. For envi-

<sup>&</sup>lt;sup>8</sup> These databases are widely used in event studies for identifying events, for example, see Ahern and Sosyura (2014).



Fig. 1. Distribution of the media releases in the sample over time and by type.

ronmental recognition, we find that when a third party grants a recognition, such as an environmental award to multiple firms, some firms release the news on the same day that the recognition is granted, while others release at a later time even though the third party has made the recognition public. In the latter cases, we record the date when the recognition is made public for the first time. We exclude events for which we cannot determine whether a press release of a recognition made by the firm is the original date that the recognition is made public.

We obtain 327 media releases related to positive environmental activities. Because of the extreme stock market volatility during the 2008 financial crisis that may obscure the effect of value-relevant events during this period, we follow Fisher-Vanden and Thorburn (2011) and focus our analysis on the subsample of events that excludes 19 events for which the estimation period overlaps with the period between March 2008 and December 2008. Our final sample of 308 events include 49 actions, 39 announcements, 100 recognitions, and 120 reports. Fig. 1 shows the distribution of the media releases in our sample by type and across years. Overall there is an increasing trend in the total number of media releases over time, as well as in the number of recognitions and reports, while actions and announcements remain relatively flat.

For each media release, we obtain the firm's ticker symbol from Bloomberg and the daily stock returns, defined as the holding period return, from the Center for Research in Security Prices (CRSP) for both the estimation window and event window (defined below). We also obtain the benchmark equal-weighted market return from CRSP which is preferred to the value-weighted market return in empirical analyses (Brown and Warner, 1985; Corrado, 2011). The firms in our sample span all 11 Standard and Poor Economic Sectors, including Consumer Staples (17 percent of our sample), Technology (13 percent), Consumer Cyclicals (12 percent), Utilities (10 percent), Basic Materials (9 percent), Capital Goods (7 percent), Transportation (6 percent), and the rest being Communication Services, Energy, Financials, Healthcare, and Technology.

#### 4.2. Assessing the market reaction

We perform an event study to estimate the abnormal return, or the extent to which the observed stock return deviates from the expected rate of return, using the single-factor market model (MacKinlay, 1997).<sup>9</sup> Let the date of the event, i.e., the date of the environmental media release, be day 0. We use an estimation window of 120 trading days which is 16 trading days prior to the event date, i.e., day -135 to day -16. To estimate the normal stock return, the daily returns of stock *i* are regressed on the market return over the estimation window:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it}, \quad t \in [-135, -16], \quad i = 1, 2, \dots, N,$$
(1)

where  $R_{it}$  is the return of stock *i* on day *t*,  $R_{mt}$  is the equal-weighted market return on day *t*,  $\beta_i$  and  $\alpha_i$  are parameters to be estimated from the regression, and  $\epsilon_{it}$  is the error term such that  $E(\epsilon_{it}) = 0$  and  $Var(\epsilon_{it}) = \sigma_{\epsilon_i}^2$ . The abnormal return (*AR*) for stock *i* on day *t* is given by

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}, \qquad t \in [\tau_1, \tau_2], \tag{2}$$

where  $\tau_1$  and  $\tau_2$  denote the beginning and the end of the event window. We start our analyses with the event windows spanning the first seven days following the media release: [0, 1] through [0, 7]. To estimate the total impact of the event, the daily abnormal returns are aggregated into the cumulative abnormal return (*CAR*) for stock *i* 

<sup>&</sup>lt;sup>9</sup> As a robustness check, we also use two alternative models – the single factor CAPM model and the Fama-French three-factor model – to predict the normal returns. The event study results of these models are qualitatively similar to the market model.

$$CAR_{i}(\tau_{1},\tau_{2}) = \sum_{t=\tau_{1}}^{\tau_{2}} AR_{it}.$$
(3)

Assuming that the abnormal returns are independent across securities, we obtain the sample average CAR

$$\overline{CAR}(\tau_1, \tau_2) = \frac{1}{N} \sum_{i=1}^{N} CAR_i(\tau_1, \tau_2).$$
(4)

Given the standard assumption that  $\overline{CAR}(\tau_1, \tau_2) \sim N\left[0, \operatorname{Var}(\overline{CAR}(\tau_1, \tau_2))\right]$ , the test statistic is

$$\theta = \frac{CAR(\tau_1, \tau_2)}{\left[\operatorname{Var}(\overline{CAR}(\tau_1, \tau_2))\right]^{\frac{1}{2}}} \sim N(0, 1).$$
(5)

With the null hypothesis of  $\theta = 0$ , a significantly positive  $\theta$  suggests that positive environmental media releases have a positive and significant effect on a firm's stock value (MacKinlay, 1997).

The standard event study approach has been criticized because it assumes that stock returns are normally distributed, when often empirical evidence does not support this assumption. One important consequence of violating this assumption is that the standard hypothesis test has low power (Corrado, 1989; Cowan, 1992), which means that when stock returns are not normally distributed, the standard method is not able to reliably detect deviations from the null hypothesis. The standard approach is also likely to falsely reject the null hypothesis when there is event-induced variance, that is, when events have differing effects on firms which increases the cross-sectional dispersion of stock returns (Brown and Warner, 1985; Boehmer et al., 1991). To test our hypothesis in a framework that is robust to these potential issues, we include two alternative tests, the generalized sign test and the standardized cross-sectional test.<sup>10</sup>

The generalized sign test addresses the issue of non-normality in the distribution of stock returns by comparing the number of the securities with positive cumulative abnormal returns in the event window and the number of expected positive cumulative abnormal returns had the event not occurred. The expected number of positive cumulative abnormal returns is based on the fraction of positive abnormal returns (positive residuals) over the estimation window,

$$\widehat{p} = \frac{1}{N} \sum_{i=1}^{N} \frac{1}{120} \sum_{t=-135}^{-16} S_{it},\tag{6}$$

where  $S_{it} = 1$  if  $AR_{it} > 0$  and  $S_{it} = 0$  otherwise. The test statistic is

$$Z_G = \frac{w - N\hat{p}}{[N\hat{p}(1-\hat{p})]^{1/2}} \sim N(0,1),$$
(7)

where w denotes the number of securities with positive cumulative abnormal returns over the event window. Though  $Z_G$  has a standard normal distribution, the construction of the test statistic does not depend on normality of stock returns.

We use the standardized cross-sectional test (Boehmer et al., 1991) to correct for the potential cross-sectional increase in the variance of the stock returns on the event date. The test statistic is the ratio of  $\overline{SCAR}$ , the average standardized CAR, to its contemporaneous cross-sectional standard error

$$T_{std-CS} = \overline{SCAR} / \sqrt{\frac{1}{N(N-1)} \sum_{i=1}^{N} (SCAR_i - \overline{SCAR})^2},$$
(8)

where  $SCAR_i = CAR_i / \hat{s}_i Adj$ ,  $\hat{s}_i$  is the standard deviation of stock *i*'s returns over the estimation window, and *Adj* is an adjustment term. In order to apply the test to a multiple-day event window, we follow Mikkelson and Partch (1988) and modify the adjustment for forecast error to be

$$Adj = \left(L_2 + \frac{L_2^2}{L_1} + \frac{\left(\sum_{t=\tau_1}^{\tau_2} R_{mt} - L_2 \overline{R}_m\right)^2}{\sum_{t=-135}^{-16} \left(R_{mt} - \overline{R}_m\right)^2}\right)^{\frac{1}{2}},\tag{9}$$

where  $L_2 = \tau_2 - \tau_1 + 1$ ,  $L_1 = 120$ , and  $\overline{R}_m$  is the average market return over the estimation window. The test statistic has a *t*-distribution with 118 degrees of freedom for our sample.

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<sup>&</sup>lt;sup>10</sup> All of these three testing procedures are consistent with a standard event study approach, in that we construct a test statistic based on the abnormal returns. An alternative approach would be to use a regression to directly parameterize the abnormal returns (Binder, 1998), which is primarily applicable in cases where multiple firms experience the same event, as the regression approach is one way to address the contemporaneous correlation in stock returns. In our case, different firms have different event dates that are spread across a ten-year horizon, and thus contemporaneous correlation is not a major concern for our analysis.

Table 3				
Average cumulative abnormal	return	and	test sta	tistics.

Event Window	Туре	Ν	CAR	θ	$Z_G$	$T_{std-CS}$
[0, 1]	All	308	0.17	1.45	1.89*	1.37
	Action	49	0.03	0.09	0.08	-0.16
	Announcement	39	0.73	2.19**	2.33**	2.65***
	Recognition	100	0.22	1.11	1.65*	1.29
	Report	120	-0.01	-0.04	0.13	-0.07
[0, 2]	All	308	0.11	0.76	1.66*	0.75
	Action	49	0.09	0.22	-0.2	-0.14
	Announcement	39	0.85	2.09**	2.97***	2.88***
	Recognition	100	0.04	0.18	1.05	0.44
	Report	120	-0.08	-0.36	0.13	-0.66
[0, 3]	All	308	0.2	1.24	2.68***	1.16
	Action	49	0.15	0.34	-0.2	-0.02
	Announcement	39	1.03	2.19**	2.97***	2.75***
	Recognition	100	0.08	0.29	2.65***	0.65
	Report	120	0.05	0.18	0.32	-0.15
[0, 4]	All	308	0.27	1.5	1.2	1.41
	Action	49	0.52	1.05	0.37	0.45
	Announcement	39	1.19	2.25**	2.01**	3.07***
	Recognition	100	0.04	0.14	1.05	0.72
	Report	120	0.06	0.2	-0.41	-0.14
[0, 5]	All	308	0.28	1.44	0.75	1.45
	Action	49	0.62	1.14	0.37	0.62
	Announcement	39	1.06	1.82*	2.01**	2.65***
	Recognition	100	0.04	0.11	0.05	0.7
	Report	120	0.1	0.33	-0.23	0.16
[0, 6]	All	308	0.28	1.31	1.66*	1.28
	Action	49	0.94	1.59	0.65	0.82
	Announcement	39	0.75	1.19	2.33**	2.01**
	Recognition	100	0.08	0.23	0.85	0.73
	Report	120	0.02	0.07	0.13	-0.1
[0, 7]	All	308	0.2	0.9	1.2	1.1
	Action	49	0.73	1.16	1.22	0.75
	Announcement	39	0.9	1.35	2.33**	2.34**
	Recognition	100	-0.01	-0.04	0.65	0.56
	Report	120	-0.05	-0.16	-0.78	-0.32

Columns 4–7 report the estimated average cumulative abnormal return (%), and test statistics from the standard z-test ( $\theta$ ), the generalized sign test ( $Z_G$ ), and the standardized cross-sectional test ( $T_{std-CS}$ ). \*, \* \*, \* \* \* denote statistical significance at the 10%, 5%, and the 1% levels, respectively.

# 5. What type of information does the market value?

In this section we present the results of the event study on all types of positive environmental information release as well as on each type separately. In light of the possibility that firms disclose environmental information strategically, we identify the events that have potentially confounding events near the event window, and perform the same set of event studies on the potentially confounded subsample and the unconfounded subsample separately. We also perform temporal placebo tests to examine whether the market reaction captured in the event studies is induced by random fluctuations in the stock prices rather than environmental information.

#### 5.1. Significance of abnormal market returns

Table 3 reports the estimated  $\overline{CAR}$  and test statistics from the standard z-test, the generalized sign test, and the generalized standardized cross-sectional test, for all four types of media releases jointly and each type separately, over the event windows [0, 1] through [0, 7]. Considering all types of event jointly, the positive environmental media releases in our sample generate  $\overline{CARs}$  ranging between 0.11 percent and 0.28 percent, but is only statistically significant according to the generalized sign test over the event windows [0, 1] through [0, 3] and [0, 6]. Separating the events by type, action and report events do not generate any statistically significant market reaction over any of the event windows,<sup>11</sup> while the  $\overline{CAR}$  for announcement events is significant throughout all the event windows by the generalized sign test and the standardized cross-sectional test, and is significant by the standard test over [0, 1] through [0, 5]. The magnitude of the stock market reaction towards announcement events is also

<sup>&</sup>lt;sup>11</sup> In light of the classification in Table 2 which indicates action and report events both have low newness of information and low expected net financial benefit, we re-estimate the *CAR* with action and report events pooled together. The *CAR* is not statistically significant over any event window regardless of whether we consider actions and reports jointly or as two separate types of events.

the highest among the four types of events, with  $\overline{CAR}$  ranging from 0.73 to 1.19 percent. There is some evidence of a significant market reaction to recognition events by the generalized sign test over the event windows [0, 1] and [0, 3]. However, the magnitude of  $\overline{CAR}$  for recognition is much smaller than that of announcement, ranging from -0.01 to 0.22.

Our event study results indicate that the announcement type generates the largest stock market reaction among all four event types in our sample. This is consistent with our hypothesis that events with a larger amount of new information and a higher expected net financial benefit generate a relatively greater stock market reaction. As we discuss in Section 3, announcement events are the initial public disclosures of planned future activities and thus have the highest degree of newness of information. In addition, since firms are likely to disclose such activities only when they expect a benefit, the market is more likely to associate a positive expected net financial benefit with the events, represented by a positive *CAR*. On the other hand, the market reacts less strongly, if at all, towards events that contain less new information and imply a relatively lower expected net financial benefit, i.e., action and report events. It is likely that information about an action or a report event was available to the market prior to this specific media release.<sup>12</sup> Moreover, action and report events are associated with a limited expected net financial benefit that would impact firm financial performance, and thus generate a relatively smaller stock market reaction.

To examine the longer term trends in the  $\overline{CAR}$ , we provide a graphical presentation of the market reaction to all types of media release jointly and by each type individually, following recent studies (e.g., Dube et al., 2011; Luechinger and Moser, 2014). Fig. 2 represents the  $\overline{CAR}$  over the 20 days surrounding the event date by aggregating the  $\overline{CAR}$  backward and forward from the event date (day 0) to each of the 20 days on the horizontal axis. The values on the vertical axis for day 1 through day 7 correspond to the  $\overline{CAR}$  (scaled by 100) of the seven event windows in Column 4 of Table 3. The dotted lines represent the 90 percent confidence interval based on the standard z-test of the event study. Prior to the event dates, there are no clear patterns or statistical significance in the abnormal returns, indicating that there is no evidence of information leak-age.<sup>13</sup> Following the environmental media release, only announcement events incur a statistically significant market reaction through day 5. Although the  $\overline{CAR}$  displays a rising trend between day 6 and day 9, the trend over these days is not statistically significant because of the increased variance. Thus, the market reaction to positive environmental news is relatively short lived.

#### 5.2. The potential for strategy in release of information

In this subsection we investigate the possibility that the  $\overline{CAR}$  is influenced by confounding events that also affect firm stock price in addition to the positive environmental information. Since firms have flexibility in choosing the date on which to post a media release about action, announcement, and report, and to some extent recognition events, it is possible that firms strategically choose the date of the media release to maximize the expected benefit from releasing the environmental news. For example, firms may use the positive environmental news to offset the negative effect on stock returns of other negative news, or to maximize the gain in stock price increase of other positive news. As a result, the  $\overline{CAR}$  would capture the net effect of the environmental event plus the confounding events. To investigate the extent to which the results in Table 3 are affected by confounding events, for each event, we search within the [-7, 7] window surrounding the event date for potentially confounding events that influence firm stock prices: mergers and acquisitions, earnings announcements, issuance of dividends, and analysts' rating change. For 19 out of the 49 action events, 14 of the 39 announcement events, 21 of the 100 recognition events, and 57 of the 120 report events, we find at least one confounding event in the search window. Additionally, we perform event studies with only the unconfounded sample and event studies by type with both the confounded sample and the unconfounded sample. Using only the unconfounded sample of all types of events (Table A1), we continue to find a statistically significant abnormal return to announcement and recognition events. Separating events by type, for action and report events, we do not find any statistical significance using either the confounded or the unconfounded sample (Table A2 and Table A3). We next present the extent to which the significance of announcement and recognition events are driven by confounding events.

Table 4 presents the event study results for the subsamples of confounded and unconfounded announcements along with the full sample of all announcement events over the seven event windows. Over the event windows [0, 1] through [0, 3], the  $\overline{CAR}$  of the unconfounded events increases along with increased statistical significance across the three tests. Beyond [0, 3], the  $\overline{CAR}$  of this subsample starts to decrease, and the statistical significance disappears starting from [0, 4]. On the other hand, for the confounded subsample, the  $\overline{CAR}$  peaks over [0, 4] and is statistically significant across all tests, and the significance remains until [0, 7]. In other words, while it appears in our estimates in Table 3 that announcement events incru a consistent, positive stock

<sup>&</sup>lt;sup>12</sup> In some cases, news about some of these activities was previously released in the form of announcements in the planning stage, and the market does not react to media releases at a later date about the same activities with the same magnitude as brand new information. Of the types of events in our sample that are not announcements, only 15 correspond to announcements in our sample that occurred at a previous point in time. While it is possible that some events correspond to an announcement that predates our sample period, at least some non-announcement type events represent new information.

<sup>&</sup>lt;sup>13</sup> An exception is a positive and significant CAR on day -2 for report, driven by acquisition and stock upgrade news of two firms, respectively, that created a surge in each of the firms' stock prices by around 10 percent. The abnormal returns in report events also drive the significant CAR of all types of events on day -2. The significance does not persist once we exclude these confounded events.



Fig. 2. Time plots of the CAR and the 90 percent confidence interval.

price effect throughout the seven trading days following the event dates, the effect is in fact dominated by the unconfounded events through [0, 3], and by the confounded events beyond day 4.

Given that the significant market reaction to announcement events for the unconfounded subsample is primarily through day 3, hereafter we focus our analysis on the [0, 3] event window to examine the market reactions most relevant to the positive environmental information.

Table 5 shows the separate event study results for the confounded and unconfounded recognition events. Contrary to the announcement events, the statistical significance of recognition events are primarily driven by the confounded events through day 3. In other words, the significant effect of recognition events seen in Table 3 is possibly driven by events that are unrelated to the positive environmental news in our sample. We test this by removing two confounding events that usually create large stock market reactions, an acquisition and an announcement of earnings that are higher than expectations right before the event windows, and the *CAR*s are no longer significant at the traditional levels of significance.

As described earlier, in our baseline event studies we test the effects of the recognition events using the date that the news is first made public. In some cases the firm publicly discloses the news via a press release, while in other cases the news is first made public by the party that grants the recognition. In the latter cases, news of the recognition is often released again by

#### Table 4

Average cumulative abnormal return and test statistics for announcement events by subsamples of unconfounded and confounded events.

Event Window	Туре	Ν	CAR	θ	$Z_G$	$T_{std-CS}$
[0, 1]	All Announcement	39	0.73	2.19**	2.33**	2.65***
	Unconfounded	25	0.68	1.56	1.96**	3.0***
	Confounded	14	0.83	1.61	1.27	0.98
[0, 2]	All Announcement	39	0.85	2.09**	2.97***	2.88***
	Unconfounded	25	0.86	1.62	3.16***	3.1***
	Confounded	14	0.85	1.33	0.73	1.15
[0, 3]	All Announcement	39	1.03	2.19**	2.97***	2.75***
	Unconfounded	25	1.01	1.66*	1.96**	2.74***
	Confounded	14	1.07	1.45	2.34**	1.36
[0, 4]	All Announcement	39	1.19	2.25**	2.01**	3.07***
	Unconfounded	25	0.86	1.26	0.76	2.04**
	Confounded	14	1.77	2.16**	2.34**	2.32**
[0, 5]	All Announcement	39	1.06	1.82*	2.01**	2.65***
	Unconfounded	25	0.7	0.93	0.76	1.36
	Confounded	14	1.69	1.88*	2.34**	2.51**
[0, 6]	All Announcement	39	0.75	1.19	2.33**	2.01**
	Unconfounded	25	0.27	0.33	1.16	0.79
	Confounded	14	1.6	1.65*	2.34**	2.16**
[0, 7]	All Announcement	39	0.9	1.35	2.33**	2.34**
	Unconfounded	25	0.84	0.97	1.16	1.42
	Confounded	14	1.01	0.98	2.34**	1.94*

Columns 4–7 report the estimated average cumulative abnormal return (%), and test statistics from the standard z-test ( $\theta$ ), the generalized sign test ( $Z_G$ ), and the standardized cross-sectional test ( $T_{std-CS}$ ). \*, \* \*, \* \* \* denote statistical significance at the 10%, 5%, and the 1% levels, respectively.

#### Table 5

Average cumulative abnormal return and test statistics for recognition events by subsamples of unconfounded and confounded events.

Event Window	Туре	Ν	CAR	$\theta$	$Z_G$	$T_{std-CS}$
[0, 1]	All Recognition	100	0.22	1.11	1.65*	1.29
	Unconfounded	79	0.0	0.01	0.78	0.25
	Confounded	21	1.02	2.0**	2.09**	2.28**
[0, 2]	All Recognition	100	0.04	0.18	1.05	0.44
	Unconfounded	79	-0.21	-0.82	0.33	-0.32
	Confounded	21	0.99	1.58	1.66*	2.18**
[0, 3]	All Recognition	100	0.08	0.29	2.65***	0.65
	Unconfounded	79	-0.18	-0.62	2.13**	-0.07
	Confounded	21	1.08	1.49	1.66*	2.0**
[0, 4]	All Recognition	100	0.04	0.14	1.05	0.72
	Unconfounded	79	-0.08	-0.24	1.46	0.36
	Confounded	21	0.5	0.62	-0.53	0.93
[0, 5]	All Recognition	100	0.04	0.11	0.05	0.7
	Unconfounded	79	-0.13	-0.36	-0.12	0.36
	Confounded	21	0.66	0.75	0.35	0.96
[0, 6]	All Recognition	100	0.08	0.23	0.85	0.73
	Unconfounded	79	-0.17	-0.45	1.01	0.3
	Confounded	21	1.05	1.09	-0.09	1.15
[0, 7]	All Recognition	100	-0.01	-0.04	0.65	0.56
	Unconfounded	79	-0.26	-0.62	0.78	0.04
	Confounded	21	0.9	0.88	-0.09	1.12

Columns 4–7 report the estimated average cumulative abnormal return (%), and test statistics from the standard z-test ( $\theta$ ), the generalized sign test ( $Z_G$ ), and the standardized cross-sectional test ( $T_{std-CS}$ ). \*, \* \*, \* \* \* denote statistical significance at the 10%, 5%, and the 1% levels, respectively.

the firm at a later date via a press release, with the time lag on these re-releases ranging from several days to a few months. In the re-releases, firms often augment the recognition with additional information, such as emphasizing the firm's past effort or achievements in environmental stewardship, rather than simply reporting the recognition. It is possible that firms expect additional gain in the stock price by making a separate press release after the initial public release. To explore if these events show a different pattern in the  $\overline{CAR}$  from the full sample of recognitions, we perform a separate set of event studies on the subsample of 63 out of the 100 recognition events that were re-released by the firms at a later time from the original release but using the original date that the news was made public. Table 6 shows that while the  $\overline{CAR}$  for the re-released events are higher than in the full sample of recognitions in Table 5, the statistical significance follows the same pattern. We also perform event studies for the re-release dates of these events, and the results (unreported) do not show any statistical significance. These findings are consistent with the Efficient Market Hypothesis in that although firms tend to re-release environmental recognition

#### Table 6

Event Window	Туре	Ν	CAR	θ	$Z_G$	$T_{std-CS}$
[0, 1]	All Re-released	63	0.46	1.73*	1.56	2.05**
	Unconfounded	43	0.18	0.58	0.59	0.84
	Confounded	20	1.06	2.09**	1.9*	2.27**
[0, 2]	All Re-released	63	0.45	1.4	1.06	2.2**
	Unconfounded	43	0.18	0.47	-0.02	1.11
	Confounded	20	1.05	1.68*	1.9*	2.21**
[0, 3]	All Re-released	63	0.52	1.38	2.06**	2.19**
	Unconfounded	43	0.23	0.53	1.51	1.24
	Confounded	20	1.13	1.57	1.45	2.0**
[0, 4]	All Re-released	63	0.44	1.05	1.31	1.99**
	Unconfounded	43	0.37	0.76	1.82*	1.74*
	Confounded	20	0.6	0.74	-0.34	0.98
[0, 5]	All Re-released	63	0.54	1.17	0.55	2.21**
	Unconfounded	43	0.49	0.91	0.59	2.03**
	Confounded	20	0.65	0.74	0.11	0.93
[0, 6]	All Re-released	63	0.65	1.32	1.06	2.3**
	Unconfounded	43	0.49	0.85	1.51	2.05**
	Confounded	20	1	1.05	-0.34	1.08
[0, 7]	All Re-released	63	0.55	1.03	0.8	1.92*
	Unconfounded	43	0.42	0.68	1.21	1.62
	Confounded	20	0.81	0.8	-0.34	1.05

Average cumulative abnormal return and test statistics for re-released recognition events by subsamples of unconfounded and confounded events.

with additional historic information, the market does not react to such re-releases as the information was previously made available.

## 5.3. Time-shifted placebo tests

To test whether the statistically significant  $\overline{CAR}$  in Table 3 is due to random fluctuations in the stock prices rather than the positive environmental information, in Table 7 we report a set of placebo tests conducted by shifting the [0, 3] event window backwards by 5, 10, 15, and 20 days, and re-estimate the abnormal returns over the placebo dates.<sup>14</sup> Results show that over the shifted event windows, the  $\overline{CAR}$  are of much smaller magnitude, in particular for announcements, and are largely statistically insignificant. An exception is recognition over the 15-day shift of the event window, with a significantly negative  $\overline{CAR}$  across all three tests for recognition events. An additional search for media releases surrounding day -15 suggests that this result is driven by one event with a large negative abnormal return (around -8 percent). The test statistics are not statistically significant once we exclude this event. The placebo tests confirm that the  $\overline{CAR}$  we estimate over the original event window indeed arise from the environmental information influencing the firm's stock price.

#### 6. The market reaction

Our finding that the stock market reacts differently to different types of events bears important implications for firm environmental self-regulation. On the one hand, with an efficient market, a firm is rewarded as soon as it makes a forward-looking statement disclosing its environmental initiatives. Such statements enhance a firm's pro-environmental image, facilitate product differentiation, and gain consumer loyalty; and the stock market reacts accordingly. However, there is no guarantee that the market follows up on forward-looking announcements, or that a firm is (or should be) punished for not making good on its announcements.<sup>15</sup> Therefore, the stock market incentives are not enough to guarantee announcements lead to actual environmental outcomes.<sup>16</sup>

In this section we explore the factors related to the magnitude of the *CARs* upon release of positive environmental information in a set of firm-level cross-sectional regressions. In addition to the value-relevant features of the environmental information, namely the degree of newness of information and the expected net financial benefit, the stock market reaction may vary across

Columns 4–7 report the estimated average cumulative abnormal return (%), and test statistics from the standard z-test ( $\theta$ ), the generalized sign test ( $Z_G$ ), and the standardized cross-sectional test ( $T_{std-CS}$ ). \*, \* \*, \* \* \* denote statistical significance at the 10%, 5%, and the 1% levels, respectively.

<sup>&</sup>lt;sup>14</sup> Another motivation for the placebo tests is the relatively small sample for action and announcement events. For the event studies of these types, the placebo tests help verify that the statistical significance we detect is indeed driven by environmental information.

<sup>&</sup>lt;sup>15</sup> Although it is possible that firms are censured by environmentally conscious citizens when they make announcements that fail to generate real environmental improvements, instead of forming a mechanism that enforces fulfillment of forward-looking statements, the penalty may lead firms to disclose less environmental information (Lyon and Maxwell, 2011).

<sup>&</sup>lt;sup>16</sup> We remain agnostic as to why forward-looking statements may go unfulfilled. It may be an issue of green-washing; it also may be that unanticipated factors force the firm to deviate from its expected path.

Event Window Shift	Туре	Ν	CAR	θ	$Z_G$	$T_{std-CS}$
5 days	All	308	0.03	0.22	0.18	-0.08
-	Action	49	-0.14	-0.32	-1.92*	-0.83
	Announcement	39	-0.06	-0.14	-2.16**	-0.52
	Recognition	100	0.28	1.02	1.85*	1.19
	Report	120	-0.07	-0.28	1.05	-0.21
10 days	All	308	-0.03	-0.21	0.4	0.28
	Action	49	-0.25	-0.56	-0.2	-0.46
	Announcement	39	-0.1	-0.21	0.4	-0.31
	Recognition	100	0.11	0.39	0.45	0.88
	Report	120	-0.04	-0.18	0.13	0.09
15 days	All	308	-0.23	-1.4	-1.53	-1.47
	Action	49	-0.15	-0.34	-0.2	0.07
	Announcement	39	0.56	1.2	0.72	1.22
	Recognition	100	-0.46	-1.66*	-1.75*	-2.11**
	Report	120	-0.31	-1.28	-1.14	-1.39
20 days	All	308	-0.07	-0.44	1.54	0.42
	Action	49	0.36	0.8	0.94	1.46
	Announcement	39	-0.11	-0.24	0.4	-0.05
	Recognition	100	-0.18	-0.64	0.65	-0.54
	Report	120	-0.14	-0.58	1.05	0.33

Time-shifted	nlacebo tests	for the [	0 31	event study model
THILE-SHILLEU		ioi uie p	0, 51	event study model.

Placebo tests based on event window [0, 3]. Columns 4–7 report the estimated average cumulative abnormal return (%), and test statistics from the standard z-test ( $\theta$ ), the generalized sign test ( $Z_G$ ), and the standardized cross-sectional test ( $T_{std-CS}$ ). \*, \* \* \*, \* \* \* denote statistical significance at the 10%, 5%, and the 1% levels, respectively.

firm financial performance, environmental performance, and transparency in environmental issues.

#### 6.1. Motivation and data

We obtain data on firm financial characteristics from Compustat, using quarterly data for the most recent quarter prior to the event. These characteristics include firm size, profitability, market-to-book ratio, leverage ratio, and market capitalization of equity. Detailed definitions of these variables as well as Compustat codes are available in Table A4 of the Appendix.

Unexpected news from a larger firm or a firm with higher profitability is more likely to generate a greater market reaction, since these firms have relatively greater public visibility, and are more likely to attract attention of the media and investors.<sup>17</sup> Conversely, investors may perceive firms with more debt (a higher leverage ratio) to be more costly or risky, and thus positive environmental news may encounter less favorable investor reaction. A firm with greater market capitalization usually has greater analyst coverage (Chan and Hameed, 2006) and more information available to the market (Gebhardt et al., 2001), which implies that positive environmental news represents a smaller amount of new information relative to the firm's total information available. Thus we expect that the stock market reaction to environmental news of firms with greater market capitalization is less strong. Finally, investors may perceive engagement in positive environmental activities to be more costly for a firm with more growth opportunities (a higher market-to-book ratio) because of the opportunity cost of not engaging in other investment opportunities.

In addition to the financial characteristics, we include an index measuring the degree of environmental disclosure by each firm, an index of firm overall environmental, social, and corporate governance (ESG) disclosure, an index of environmental performance, and an equal-weighted rating of the firm's ESG performance which have been adopted in several empirical studies (e.g., Wang and Sarkis, 2013; Ortas et al., 2015).<sup>18</sup> The firm environmental performance score and equal-weighted ESG rating are obtained from Datastream's ASSET4 ESG database, which provides objective and systematic measures of firm ESG performance (Ortas et al., 2015). The environmental performance score which measures the extent that a firm "uses best management practices to avoid environmental risks and capitalize on environmental opportunities", is based on firm performance in three categories – emissions reduction, resource reduction, and product innovation – and covers 46 sub-categories. The score ranges from 0 to 100, with 100 indicating best performance.<sup>19</sup> The equal-weighted ESG rating measures a firm's overall performance in all three ESG categories. The score is an average of a firm's environmental performance score, social performance score, and governance performance score, with the latter two scores constructed in a similar fashion as the environment

Table 7

<sup>&</sup>lt;sup>17</sup> In the context of environmental media releases, Lyon and Shimshack (2012) find suggestive evidence that positive environmental disclosure has a greater impact on the stock price of larger firms because larger firms are more visible.

<sup>&</sup>lt;sup>18</sup> Since data on firm environmental characteristics are updated on an annual basis, we use measures from the most recent year prior to the event to account for past environmental characteristics.

<sup>&</sup>lt;sup>19</sup> Although a number of previous studies have adopted more direct measures of environmental performance such as emissions data from the Toxics Release Inventory (e.g., Hamilton, 1995; Khanna et al., 1998; Capelle-Blancard and Laguna, 2010), such measures are available for a subset of industries in our sample. The environmental performance score accounts for firm environmental impact including pollution and emission levels, and covers a broader scope of industries.

mental score. The environmental disclosure score is obtained from Bloomberg's ESG database, which provides detailed scores on corporate ESG sustainability management and reporting performance (Wang and Sarkis, 2013). The score measures the transparency of, or the extent to which a firm discloses environmental activities, ranging from 0.1 to 100, with a full score indicating complete disclosure regarding every data point collected by Bloomberg.<sup>20</sup> The ESG disclosure score is constructed in a similar fashion but is based on the overall information disclosure on all three dimensions of environmental, social, and corporate governance. It is important to note that a higher disclosure score does not imply superior environmental performance; the correlation between the environmental disclosure score and environmental performance score for our sample is 0.40.

These variables are important in our analysis for two reasons. First, we expect that investors use a firm's existing environmental transparency or performance as a benchmark when receiving news of positive environmental activities. For firms that are relatively transparent in environmental information disclosure, we expect the market would have a relatively weaker reaction towards new environmental information. On the other hand, firms with better environmental performance may be in a better position to capitalize on the benefits of environmental projects, face lower costs for new environmental initiatives because of their technological advantage, and we expect that the market responds more favorably. Since firm ESG performance is often considered in the same context – for instance, the screening criteria for socially responsible investment funds usually cover all of the three ESG aspects – investors may also value the firm's overall ESG performance. Second, these variables shed light on the link between the financial incentives through the abnormal returns identified via our event studies and measured environmental performance. A significantly positive relationship between the performance measures and the magnitude of the abnormal stock return indicates that the financial incentives align with realized environmental improvements. If, however, environmental performance is not significantly related to the magnitude of the abnormal returns, but environmental disclosure is significantly related, the story is that financial incentives are aligned with environmental transparency only, and not necessarily with actual environmental improvements.

It is also possible that investors evaluate environmental responsibility differently for firms from different industries. Therefore, we include industry effects as explanatory variables in the regression models. Specifically, we use the Standard & Poor economic sectors to categorize different industries; the omitted category is Communication Services. Descriptive statistics for the continuous variables are shown in Table A5 of Appendix A.

#### 6.2. Stock market response and firm characteristics

To evaluate the relationship between the firm and event characteristics and the  $\overline{CAR}$ , we estimate the following model

$$CAR_i = X'_i \gamma + u_i, \quad u_i \sim N(0, \sigma^2), \quad i = 1, 2, \dots, N,$$
(10)

where  $X_i$  is a vector of firm characteristics and event type and industry indicators that potentially influence the market reaction to positive environmental news,  $\gamma$  is a vector of parameters, and  $u_i$  is the error term. We estimate the model using the *CARs* from the full sample and the confounded and unconfounded subsamples separately over the event window [0, 3]; Table 8 shows the results.

Firm size is significantly positive for the full sample and the unconfounded sample, consistent with the general belief that all else equal, a larger firm generates a greater stock market reaction. Leverage and market capitalization of equity are significantly negatively related to the  $\overline{CAR}$  for the full sample and the unconfounded sample. For the confounded sample, the firm financial characteristics are not significantly related to the market reaction to positive environmental news.

The environmental disclosure score is negative and significant in all samples. *Ceteris paribus*, the magnitude of the market reaction towards environmental information is 0.1–0.2 percent lower with an increase of environmental disclosure score by 1 percent. The disclosure of environmental information helps to reduce uncertainty regarding future firm environmental performance and potential liabilities, and thus holding past ESG and environmental performance constant, the market reacts with a smaller magnitude towards new information when there is a relatively greater amount of environmental information available to the public. ESG disclosure is positive and significant for the full sample and the confounded sample, suggesting that the market still rewards positive environmental information from firms with relatively more overall ESG information available to the market; however, we interpret this with caution because these results may be particular to confounded events. The equal-weighted ESG rating is positive and significant for the full sample and the confounded sample, while the environmental performance score is not significantly different from zero in any of the samples. This indicates that while the stock market may favor positive environmental information for a firm with better past ESG performance, likely because these firms are expected to be able to better capitalize on environmental projects, it does not separately value environmental performance.

Since the coefficient of correlation between the environmental performance score and the ESG performance score is relatively high (0.77), we also examine two sets of models that each have one of the two scores taken out. Regression results show that the environmental performance score is never significant when the ESG performance score is excluded, while the ESG performance

<sup>&</sup>lt;sup>20</sup> Bloomberg collects data on fields such as greenhouse gas emissions, water use, and oil spills based on firms' publicly available environmental information. The dataset is proprietary, and Bloomberg does not publicly disclose the exact scoring rubrics.

Tabl	e 8
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Results from regressions	of	CARs	on	firm	characteristics.
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	Full Sample	Confounded	Non-confounded
Size	0.009**	0.012	0.007*
	(0.004)	(0.011)	(0.004)
Profitability	0.104	0.266	0.097
-	(0.089)	(0.507)	(0.089)
Market to book	0.001	0.001	0.0003
	(0.001)	(0.002)	(0.001)
Leverage	-0.047**	-0.050	-0.039*
	(0.018)	(0.039)	(0.021)
Market Cap	-0.011***	-0.008	-0.011**
	(0.004)	(0.011)	(0.004)
Env. Disclosure	-0.001**	-0.002***	-0.001*
	(0.0004)	(0.001)	(0.0005)
ESG Disclosure	0.001*	0.002*	0.001
	(0.0005)	(0.001)	(0.001)
Env. Performance	-0.0002	-0.001	-0.0001
	(0.0002)	(0.0003)	(0.0002)
ESG Performance	0.0004*	0.001**	0.0002
	(0.0002)	(0.0005)	(0.0002)
Announcement	0.007	0.007	0.004
	(0.007)	(0.012)	(0.008)
Recognition	0.005	0.027**	0.003
	(0.005)	(0.012)	(0.006)
Report	-0.003	-0.008	0.003
	(0.005)	(0.009)	(0.007)
Basic Materials	-0.008	0.007	-0.017**
	(0.007)	(0.011)	(0.008)
Capital Goods	-0.003	0.014	-0.012
	(0.007)	(0.022)	(0.008)
Energy	-0.015	-0.023	-0.017
	(0.011)	(0.019)	(0.015)
Consumer Cyclicals	-0.003	0.008	-0.008
	(0.006)	(0.012)	(0.008)
Financials	-0.012	0.023	-0.019
	(0.012)	(0.031)	(0.013)
Health Care	-0.018**	-0.003	-0.023***
	(0.008)	(0.027)	(0.008)
Technology	-0.001	-0.005	-0.001
	(0.006)	(0.011)	(0.008)
Transportation	0.011	0.051***	-0.002
	(0.007)	(0.016)	(0.008)
Utilities	-0.001	0.006	-0.006
	(0.007)	(0.012)	(0.009)
Observations	222	72	150
R <sup>2</sup>	0.150	0.501	0.152
Adjusted R <sup>2</sup>	0.060	0.291	0.012
F Statistic	1.677**	2.388***	1.089

Conditional mean regressions based on event window [0, 3]. Columns 2–4 report coefficient estimates and standard errors (in parentheses) from regressions of *CARs* on firm characteristics. \*, \* \*, \* \* \* denote statistical significance at the 10%, 5%, and the 1% levels, respectively. All models include a constant. The number of observations in the full sample is reduced from 308 to 222 due to the limitations in the financial and environmental characteristics data.

score is significant. This provides further evidence that the market evaluates overall ESG performance instead of environmental performance alone when valuing positive environmental information.

These results indicate that there is a strong link between financial outcomes and firm environmental transparency, but only a tentative link between financial outcomes and both ESG disclosure and ESG performance. For the latter, it is important to note that the financial incentives align with good ESG performance as a whole, rather than solely with good environmental performance. That is, investors react more favorably to news from a firm that not only has better environmental performance, but is also well-governed and has better social performance.<sup>21</sup> This is relevant to findings in Kotchen and Moon (2012) that corporate social responsibility activities in certain dimensions, such as environment, are related to corporate social irresponsibility in other dimensions, such as corporate governance, and findings in Wu (2009) and Ervin et al. (2013) that the environmental attitude of a firm's upper management plays an important role in firm environmental behavior. Our findings show that at best

<sup>&</sup>lt;sup>21</sup> For example, if a firm's good environmental performance is for the manager's own benefit instead of shareholders' wealth, which reflects poor governance of the firm (i.e., superior environmental performance but relatively lower ESG performance), then the market would not favor the positive environmental news because the environmental activity is at the cost of shareholder value.

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investors value firm performance in all ESG dimensions when responding to news concerning the environmental dimension, and at worst the stock market reaction is unrelated to past environmental performance.

Recognition events generate significantly larger market reaction than the base type, action, in the confounded sample, while the other types of events do not generate market reactions that are statistically different from action events when we control for firm characteristics and industry group effects. There is some evidence that the market reacts less favorably towards environmental information from firms in basic material and health care industries.

Digging deeper and comparing the results between the confounded and unconfounded samples, we find that environmental disclosure, ESG disclosure, and ESG performance have significant effects on the magnitude of the stock market reaction to positive environmental news when events are potentially confounded, but the financial characteristics are insignificant. On the other hand, with the unconfounded sample, firm size, leverage, and market value of equity are statistically significant with signs consistent with those for the full sample, while the only environmental characteristics variable that is significant is environmental disclosure. Taken together, these results inform us that when positive environmental information is the only information released to the market, the magnitude of the market reaction is primarily related to firm financial characteristics – all else equal, the market reaction is stronger towards environmental information of larger firms, and those with less debt and less information (financial and environmental) available to the market. However, when there are potentially confounding events near the event date, environmental characteristics are related to the market reaction. Yet, recall that with confounding information, the market reaction captured in the event study may not be solely in response to the environmental information; in this case the result is not sufficient to establish a link between firm environmental characteristics and the stock price impact of positive environmental information. Therefore, while we find evidence for a link between the stock market reaction to positive environmental information and firm financial characteristics as well as firm environmental characteristics based on our full sample, comparing results for the confounded sample and the unconfounded sample suggests that only financial characteristics are clearly related to the magnitude of the significant market reaction to positive environmental information.

#### 7. Policy implications and discussion

The effectiveness of positive environmental information in augmenting traditional environmental regulation relies on a simultaneous link from environmental information disclosure to financial outcomes and from environmental information to environmental outcomes. If the financial incentives associated with positive environmental information motivate firms to self-regulate environmental impacts, leading to improved environmental quality, then positive environmental information may be an effective policy tool. Based on our findings, we draw two policy implications.

First, while there is a link between positive environmental information and financial outcomes, particularly for the announcement type of information, the link to environmental outcomes is not always apparent. While the announcement type is associated with a larger cumulative abnormal return, it is forward-looking with a relatively weak link to actual environmental improvement.<sup>22</sup> From an environmental policy perspective, in order for this type of environmental information to elicit environmental improvements, there needs to be a mechanism that strengthens the link to environmental outcomes (i.e., one that ensures that firms will adhere to their stated goals). Yet, such a mechanism does not naturally exist in the market. While there is some evidence of a market reaction towards the recognition type of information, it is primarily driven by the confounding events surrounding the event windows. Besides, while many firms in our sample choose to re-release the recognition after the news is made public, we do not find evidence that such re-releases are rewarded in the stock market. Therefore, compared to announcement events, while recognition events are more likely linked to actual environmental improvements, there is a weak link to financial outcomes, and thus the motivation from the stock market for this type of information is limited. Overall, we do not simultaneously observe a link from positive environmental information to financial outcomes and from environmental information to environmental outcomes for any type of event. For announcement events, there is a link to financial outcomes, yet the link to environmental outcomes is weak; for the other three types of events, while the link to environmental outcomes is stronger, we find a weak or no link to financial outcomes. As such, there is limited evidence that positive environmental information motivates a firm to self-regulate its environmental impacts.

Second, positive environmental information may be used by environmental policymakers to buttress existing regulations only if the financial market incentives to engage in positive environmental activities are closely aligned with environmental outcomes. While we find that firm environmental performance influences the magnitude of the stock market reaction to positive environmental information, it is primarily relevant in the presence of confounding events, and it is within the context of the whole package of environmental, social, and corporate governance performance. Thus, as indicated by a statistically insignificant effect of firm environmental performance on the magnitude of stock market reaction, the market does not reward environmental performance alone. This finding weakens the link between environmental performance and stock market incentives for self-regulation. To the extent that firms use positive environmental news strategically, the link between such news and firm financial outcomes is important in a policy context. Because the market does not value positive environmental information by itself, it

<sup>&</sup>lt;sup>22</sup> For example, Kim and Lyon (2011) find empirical evidence that firms that join certain emission reduction programs, such as the 1605(b) program under the U.S. Department of Energy's Voluntary Greenhouse Gas Registry, do not substantially reduce emissions. Moreover, the literature on corporate symbolic management (Westphal and Zajac, 1993; Delmas and Montes-Sancho, 2010) shows that certain benefits associated with adopting a plan or joining a program can be realized by the announcement alone.

is important to promote the simultaneous adoption of standards in all three dimensions of environmental, social and corporate governance performance.

It is important to bear in mind that our results measure investor response to positive environmental information as of the time of information disclosure. As such, it is beyond the scope of our study to test whether the stock market reaction to announcement information is because investors are misled by green-washing.<sup>23</sup> The stock market reaction simply incorporates all available public information at the point of disclosure, and it is possible for the observed stock market reaction towards announcements to be a reaction to events of green-washing (Westphal and Zajac, 1993). Yet, scrutiny by environmentally concerned citizens and adoption of environmental management systems may prevent a firm from green-washing (Lyon and Maxwell, 2011). An interesting extension of our work would be to examine the effect of scrutiny by environmentally concerned citizens and environmental management systems on the amount of forward-looking environmental information a firm voluntarily discloses.

## 8. Conclusions

We investigate the extent to which positive environmental information may stimulate firm self-regulation of environmental outcomes by assessing the financial incentives underlying the release of positive environmental information and the link from positive environmental information to environmental outcomes. Our analyses are composed of two parts. First, we examine the stock market reaction towards media releases of firm environmentally responsible activities, paying particular attention to the differential financial outcomes of different signals, represented by four types of environmental news, and the possibility that environmental news is released strategically. Then, we examine factors that are potentially linked to the magnitude of the market reaction, including firm financial characteristics, firm environmental characteristics, and event type effects.

We find evidence of a positive market reaction towards forward-looking statements representing new information about a planned environmental activity (the announcement type). There is only weak indication of a positive market reaction to the release of recognition of environmental responsibility by a third party (the recognition type), and no evidence of a stock market reaction towards the action and report types. Overall, we find only tentative evidence of a significantly positive stock market reaction towards positive environmental information without separating the events by type.

Our classification of environmental media releases formalizes a framework that allows us to assess the environmental and financial impacts of different events, and to shed light on the mixed findings in the existing literature on the financial impact of positive environmental information. The varying market reactions to the different types of events in terms of expected net financial benefit and newness of information that we identify help to explain why previous studies that each focus on a particular type of positive environmental information yield inconsistent findings, since the events considered in these studies, such as joining voluntary environmental programs, stating goals for emission reduction, and being recognized for superior environmental performance, vary along the two dimensions as well.

Digging deeper, we find that *ceteris paribus*, firms with lower past environmental transparency, higher overall ESG transparency, and better ESG performance are likely to receive a more favorable stock market reaction in the form of higher *CARs*. Furthermore, we find that when there is no confounding information, firm financial characteristics are strongly linked to the market reaction, while environmental characteristics are strongly linked to the market reaction only when there is confounding information near the event date. We conclude that there is evidence that the primary determinants of the stock market reaction towards positive environmental information concern a firm's financial performance, while the effect of its environmental characteristics may only be secondary.

A forward-looking announcement is the only type of positive environmental information that consistently provides financial incentives in terms of a favorable stock market reaction, yet such financial incentives do not necessarily align with environmental improvements. Moreover, the link between the financial incentives and firm environmental performance lies in the overall performance in environmental, social, and corporate governance issues. From a policy perspective, we conclude that the lack of a strong link between financial incentives and environmental outcomes in all types of positive environmental information limits its effectiveness in serving as a policy tool that stimulates firm environmental self-regulation. However, promoting firm environmental, social, and corporate governance strengthens the link between firm positive environmental activities and financial incentives to the extent that firms release positive environmental news strategically, though ultimately the relevant link to environmental outcomes remains tenuous.

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<sup>&</sup>lt;sup>23</sup> Green-washing is commonly considered as the case when a firm makes statements or visible efforts to build an environmentally positive image, with no substantial change in its environmental outcome. Lyon and Maxwell (2011) also define green-washing as events where a firm withholds information about activities with potentially negative environmental impact while only disclosing positive environmental information. In either case, at the time of an announcement we do not observe the realized environmental outcome, or whether the firm withholds negative environmental information; nor is the information available to investors.

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