# Directors' Disaster Experience and Corporate Environmental Performance[*]

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## Abstract

In this paper, we examine how corporate policymakers' personal experience of extreme weather events affects corporate environmental performance. We find that after a firm's directors experience natural disaster shocks at an interlocking firm, the focal firm improves its environmental performance in the following years. The impact is about two times larger for female directors and is stronger when it is easier for affected directors to promote environmentally friendly policies. The results are not driven by changes in directors' risk preference, but rather more likely by changes in their climate change beliefs. Further analysis suggests that firms advance their environmental performance not for climate risk management purpose. We find similar results when using disaster shocks at directors' area of residence. Overall, this paper shows that personal experience of extreme weather events affects directors' beliefs in climate change risk and consequently corporate sustainability policy.

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## 1. Introduction

Climate change has become one of the most pervasive challenges of our time. Recent spikes in extreme weather events, such as wildfires, floods, and tropical storms, have made both policy makers and researchers more concerned about the impact of climate change risk on the economy.[1] In finance, there is a burgeoning literature exploring how extreme weather events affect people's risk perception and decision making (Bernile, Bhagwat, and Rau, 2017; Dessaint and Matray, 2017; Bernile, Bhagwat, Kecskes, and Nguyen, 2020; Alok, Kumar, and Wermers, 2019; Choi, Gao, and Jiang, 2020). However, there is no study exploring how corporate policymakers' personal experience of extreme weather events affects corporate environmental policies.

As the public's concern about climate risk increases, the demand for corporate sustainability also rises significantly (Hartzmark and Sussman, 2019). Since social responsibility policies have become the forefront of corporate decision making, board of directors—the representative of shareholders—are likely to play an important role in determining these policies. Though climate change is sometimes perceived as abstract and distant, there are moments when the consequences of climate change are readily apparent. Scientific studies on climate change show that personal experience with extreme weather-related phenomena can lead to an increased perception of climate change risk (Myers et al., 2013; Albright and Crow, 2019) and greater support for the adoption of climate mitigation policies (Spencer et al., 2011; Broomell et al, 2015; Demski et al, 2017; Ray et al., 2017; Osberghaus and Demsk, 2019).[2] In this paper, we explore whether corporate directors' personal experience of weather related natural disasters also shapes their firms' environmental policies.

To examine whether and how directors respond to weather-related disaster events is challenging because firm fundamentals are likely to be directly affected by severe disasters.

[1] See https://www.weforum.org/agenda/2021/09/extreme-weather-events-show-that-climate-change-comes-at-a-cost/.

[2] For example, Spencer et al (2011) conduct a national survey across UK and find that first-hand experience of flooding was positively linked to environmental concern and greater willingness to save energy to mitigate climate change.

Therefore, in this paper, we focus on firms located in non-disaster area (e.g., remote firms). We conjecture that when a firm is hit by a severe natural disaster event, it would affect corporate directors' opinion on eco-friendly policy, and such exogenous shock would affect other firms located in remote non-disaster area through board connections.

We use a difference-in-differences (DID) design to estimate the effect of directors' personal experience on a firm's environmental performance. The treatment group includes firms that do not experience any major disasters in recent years but are interlocked with firms in disaster area, and the control group includes similar firms but without such board links. To ensure that a firm's environmental performance is not affected by other stakeholders in the local community, such as local government, local customers, or corporate employees, we further remove firms located in the neighboring area of the disaster from our analysis (Dessaint and Matray, 2017).

Using sustainability data from MSCI ESG KLD database, we find that after weather-related natural disaster events, firms located in non-disaster area but are exposed to environmental shocks through interlocking directors improve their environmental performance by 4.7%. Note that we do not observe any significant differences in environmental performance between these two groups of firms before the disaster shock. Moreover, we do not observe significant changes in treatment firms' social performance, suggesting that extreme weather-related experience changes directors' attitude towards environmental issues, but not necessarily their attitude towards other social responsibility issues.

Prior studies show that corporate policies spill over across firms through board interlocks (Bouwman, 2011). After experiencing a disaster, managers and directors of disaster-affected firms are likely to become more aware of climate change risk. These firms may subsequently change their corporate environmental policies, which can propagate to remote firms through board interlocks. This is consistent with our argument that corporate decision makers' personal experience affects corporate sustainability policies. However, changes in environmental policies of disaster-affected firms may also be due to other factors, such as demand from local stakeholders or new policies adopted by the disaster-affected local government. To isolate the impact of corporate policymakers' personal experience, we conduct a subsample analysis by removing treatment firms whose interlocked (disaster-affected) firms experience any improvement in their environmental performance after the disaster. Our results remain in this subsample.

We also test whether female directors are more responsive than male directors to weather-related disasters. We find that after a female director experiences a disaster in a remote interlocking firm, the focal firm improves its environmental performance (e.g., E-score) by 10.4%, which is about two times larger than the impact (3.9%) of a male director experiencing such an event. As "few studies have examined the effects of board diversity on the company's stakeholders" (Knyazeva, Knyazeva, Naveen, 2021), our results uncover one novel channel through which female directors affect stakeholders. That is, female directors react to personal disaster experience by improving remote firms' corporate environmental performance more significantly.

We uncover several important cross-sectional variations in the relation between directors' disaster experience and corporate environmental performance. We find that the documented effect is stronger when the disaster is more severe, e.g., disasters with greater local property damage or higher local fatalities, when treatment firms have more disaster-affected directors, and when these directors are more senior. In addition, our results are found to be stronger among firms operating in industries with more sustainability-related environmental issues and firms with less financial constraints. Collectively, these results suggest that the improvement in a focal firm's environmental performance is more pronounced when directors' attitude towards environmental issues is more likely to be affected and when it is easier for focal firms to promote their new sustainability polices.

We next explore the specific mechanism through which an extreme weather shock affects directors' attitude towards eco-friendly policy. Our analysis reveals that weather-related disasters do not affect a firm's overall risk taking, suggesting that changes in directors' risk-taking preference is unlikely to be the main explanation for our findings. We also find that the documented impact is much stronger if the affected directors have some prior beliefs in climate change. As prior awareness of climate change is significantly related to the extent to which personal experience affects a person's climate beliefs, our results are more consistent with the argument that personal experience of extreme weather events can advance directors' beliefs in climate change. Our further analysis shows that the impact is similar among firms with low climate risk exposure, such as firms located in areas with very low natural disaster risk and firms operating in industries invulnerable to climate risk. These results indicate that climate risk management is not the major consideration when directors promote more eco-friendly policy. Taken together, our results support the notion that updated climate change beliefs due to personal experience prompt directors to take sustainable actions at the firm level.

As a robustness test, we also use Thomson Reuters ASSET4 environmental score as an alternative measure of environmental performance. Our results remain. Like most ratings, there is a black-box aspect to the KLD and ASSET4 scores. Therefore, we also utilize the Toxic Release Inventory database maintained by U.S. Environmental Protection Agency and examine a firm's toxic emissions. We find that firms reduce their total toxic emissions after their directors' experience natural disaster events in other interlocked firms, consistent with our earlier findings.

Finally, we employ an alternative setting to estimate the effect of directors' disaster-related experience on a firm's environmental performance. Instead of focusing on firms that are interlocked with firms in disaster area, we examine firms that do not experience any major disasters themselves but having directors whose residential address location is hit by a severe natural disaster. We show that, after directors experiencing weather-related disaster shocks in their area of residence, firms improve their environmental performance in the following years. Since the treatment group in this analysis does not have directors sitting on any disaster-affected firm, our results suggest that it is not peer or contagion effect through board interlocks that affect firm's environmental policies. Overall, these findings are consistent with the notion that shocks to board of directors' beliefs of climate change can significantly affect firms' sustainability policies.

Our paper contributes to the literature in a number of dimensions. First, our paper contributes to the literature on how personal experience of extreme natural disasters affect people's beliefs and their decision making. Studies find that such experience affects corporate managers' risk perception and decision-making (Bernile, Bhagwat, and Rau, 2017; Dessaint and Matray, 2017). It also affects mutual fund managers and retail investors' decisions and investment performance (Alok, Kumar, and Wermers, 2019; Choi, Gao, and Jiang, 2020; Bernile, Bhagwat, Kecskes, and Nguyen, 2020). We complement these papers by providing evidence that corporate policymakers' personal experience of extreme weather events can affect a firm's environmental policies.

Second, our paper also adds to the literature on the effects of board diversity. As Knyazeva, Knyazeva, Naveen (2021) have pointed out, there is a large body of research on diversity and performance but few studies on the effects of board diversity on the company's stakeholders. Our work supports their call for more research on this important area. We offer novel evidence that female directors react to personal disaster experience by improving corporate environmental performance more significantly.

Third, our paper is also related to the literature on how personal beliefs affect people decisions (Hong and Kacperczyk, 2009; Hong and Kostovetsky, 2012; Di Giuli and Kostovetsky, 2014; Dyck et al., 2019) and particularly how people react to climate beliefs. Studies show that personal experience with global warming leads to an increased perception of climate risk (Joireman, Truelove, and Duell, 2010; Myers et al., 2013; Akerlof et al., 2013; Konisky, Hughes, and Kaylor, 2016; Albright and Crow, 2019), and that such experience is followed by people's actions (Spencer et al., 2011; Broomell et al, 2015; Demski et al, 2017; Ray et al., 2017; Osberghaus and Demsk, 2019). For example, Li, Johnson, and Zaval (2011) show that participants are more likely to donate their earnings to a global warming charity following perceived deviations from normal temperature. We extend this literature by providing evidence on how potential shocks to climate change beliefs affect corporate environmental policies. Our results indicate that as severe weather events continue to increase in intensity and frequency, corporate decision makers might have greater incentive to improve their environmental sustainability.

Fourth, our paper also adds to the growing literature on the determinants of firms' corporate sustainability policies. The literature has identified many factors that could affect a firm's social responsibility performance, including national institutions (Ioannou and Serafeim, 2012; Liang and Renneboog, 2017), institutional investors (Dimson et al., 2015; Dyck et al., 2019; Chen, et al., 2020), corporate governance (Ferrell et al., 2016), executive characteristics (Cronqvist and Yu, 2017), and interactions with other firms (Flammer, 2015b; Cao et al., 2019; Dai et al 2020). In this paper, we show that corporate policymakers' personal experience and beliefs are also an important factor.

Finally, our paper also contributes to the large literature on the role of the corporate boards (see the survey by Adams, Hermalin, and Weisbach, 2010). Our study focuses on a shock in directors' disaster-related experience. Since disaster events are largely unpredictable, our setting is subject to less concern of the endogenous matching between directors and firms.

The rest of the paper is organized as follows. Section 2 describes our data and sample construction. Section 3 discusses the empirical strategy. Section 4 presents our empirical results. Section 5 concludes.

## 2. Data and sample

To construct our sample, we start with all U.S. firms that have financial information available from Compustat and board information from BoardEx during the period of 2001–2018. From the sample we exclude financial firms (SIC 6000–6999) and regulated utilities (SIC 4900–4949).

### 2.1. Data on weather-related natural disasters

We obtain data on natural disasters from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) at Arizona State University. For each disaster event, SHELDUS provides detailed information on event names, dates, property damages, fatalities, and affected locations of counties and states in the U.S. In our analysis, we only include weather-related disasters, such as flooding, hurricane, tropical storm, wildfire, and blizzard. To ensure that an event is severe enough, we focus on disasters with total estimated damages above 1 billion 2018 dollars. This filtering procedure leaves us with 30 major weather-related disasters during 2001-2018.[3] Table 1 reports summary statistics for these disasters.

We follow the literature and determine whether a firm is affected by a disaster event based on its headquarter location (Chaney, Sraer, and Thesmar, 2012; Dessaint and Matray 2017). We obtain information on the historical locations of each firm's headquarters during our sample period from the 10-X Header Database constructed by Bill McDonald.[4]

—Insert Table 1 about here—

### 2.2. Data on firms' environmental and social performance

To measure a firm's environmental and social performance, we use data from the MSCI ESG KLD database, a very commonly used dataset for studying corporate sustainability (e.g. Di Guili and Kostovetsky, 2014; Cronqvist and Yu, 2017; Chen, Dong and Lin, 2020). As KLD expanded its coverage significantly in 2003, our main analysis is concentrated on the period of 2003-2018.[5] KLD provides the most comprehensive data on firm-level social ratings along various dimensions, including community, diversity, employee relations, human rights, product, environment, etc. Within each dimension, KLD reports indicator variables for a set of corresponding "strengths" and "concerns", capturing firm practices that produce positive or negative externalities. For example, in the environmental category, KLD assigns a value of one

[3] We used both SHELDUS™ release 17.0 and SHELDUS™ release 18.0. Due to various reasons, SHELDUS™ release 18.0 does not provide names for disaster events, so for post-2016 events, we use the event names provided by Nigeria Centre for Disease Control (NCDC).

[4] The database is available at https://sraf.nd.edu/data/augmented-10-x-header-data/. We thank Bill McDonald for making the data publicly available.

[5] In 2003, the approximate total number of companies covered by KLD increases from 1,100 to 3,100 firms.

for the “Toxic Emissions and Waste (Strength)” if a company has strong programs and performance in reducing toxic emissions, and zero otherwise.

Following prior literature, we use the indicator variables and compute a firm-level environmental score (Hong and Kostovetsky, 2012; Cronqvist and Yu, 2017). Specifically, we sum the number of “strengths” for each firm in a given year and then deduct the total sum of “concerns” from the “strengths” to get a firm’s environmental score. For easier interpretation, we standardize a firm’s environment score to have a minimum value of zero by adding the absolute value of the lowest score. Detailed descriptions of the KLD environmental indicator variables are presented in Appendix B.

We also measure a firm’s social performance using its scores in the following five dimensions of corporate social responsibility: community, human rights, employee relations, diversity and product. For each category, we compute its KLD scores following our earlier approach, where the minimum value is normalized to be zero. We then sum the five adjusted scores to obtain the overall KLD social scores.

We use performance scores provided by the Thomson Reuters ASSET4 ESG Scores database as alternative measures (Ferrell et al., 2016). Thomson Reuters ASSET4 constructs its ESG scores based on over 400 self-defined metrics. Note that ASSET4 starts its coverage in 2002 but covers a much smaller sample of U.S. firms relative to the KLD dataset, so our sample size is significantly smaller in this analysis.[6]

In addition to a firm’s performance score rated by analysts, we also obtain data on pollutant emissions at the plant-level from the Toxic Release Inventory (TRI) Program over the period 2001-2018. TRI Program is regulated by the U.S. Environmental Protection Agency (EPA) and currently covers 767 individually listed chemicals and 33 chemical categories. Facilities that produce, store, and release these chemicals above certain established levels must submit an annual report for each chemical. Following other studies, we measure a plant’s pollutant emissions in a year using *Total*

[6] For example, KLD covers over 3000 U.S. firms over the period of 2001-2018, while ASSET4 covers fewer than 1000 U.S. firms over the period of 2002-2018.

*Toxic Releases* (e.g. Shive and Forster, 2019), calculated as the total amount of toxic releases, including all solid, liquid, and gaseous releases. We then aggregate the plant-level toxic release data to the parent company level and match the data to firms in Compustat.[7]

### 2.3. Data on board of directors

We obtain information on a firm's board of directors from the BoardEx database, which provides extensive data on the service history and biographical data for individuals who serve as directors or senior managers of large U.S. corporations.[8] For each firm, we use its directors' employment history to construct an annual matrix of firm networks that maps the board connections among all firms in the sample. Two firms are defined as interlocked if at least one director simultaneously serves on the boards of these two firms.

## 3. Empirical strategy

Prior studies show that natural disaster experience affects people's beliefs and their consequent decision-making. In this paper, we exploit a quasi-experiment to generate plausibly exogenous variation in corporate decision makers' attitude towards environmental policy. Specifically, we construct two groups of firms and implement a DID estimation. The treatment group is a group of firms that do not experience any major disasters themselves but have directors (internal or external directors) experiencing certain environmental shocks, i.e., extreme weather events, at another firm located in the disaster area. The control group consists of firms with similar characteristics but without directors experiencing disasters in another location. Specifically, for

[7] To match the data from the TRI Program with the Compustat data, we use the linking table to map the Dun & Bradstreet D-U-N-S Number (DUNS) to Compustat's GVKEY. For observations with missing identifier in the TRI data, we manually match them using historical company names from CRSP.
[8] BoardEx starts its coverage in 1999. Its coverage of U.S. firms is more complete after 2003. Our results are the same if we choose 2003 as the start of our sample period.

each treatment firm, we identify a matched firm with similar firm characteristics in the same industry and same year but have no directors siting on the board of a disaster-affected firm during our sample period.

Studies show that people also respond to natural disasters happening in neighboring areas (e.g. Dessaint and Matray, 2017; Alok et al., 2019). To ensure that a firm's environmental performance is not affected by other stakeholders in the local community, such as local government, local customers, or corporate employees, we further remove firms located in the neighboring area of the disaster from our analysis. In particular, for each disaster event, we identify the neighborhood area by matching each affected county with its five closest non-affected counties and remove all firms located in these counties.[9] Therefore, firms in the final sample are located in neither disaster-affected counties nor their neighboring counties and thus are unlikely to be directly affected by these disaster events.

As discussed earlier, we conjecture that personal experience of extreme weather events affects directors' decision-making on corporate environmental policy. To test this conjecture, we estimate the following DID regression on a sample comprising only treatment and control firms:

$$Enviromental\ performance_{i,t} = \alpha + \beta\ Post_{i,t} + \gamma\ Treat \times Post_{i,t} + \zeta Controls_{i,t-1} + \delta_i + \mu_{j,t} + \varepsilon_{i,t}.$$

The dependent variable is the environmental performance of firm $i$ in year $t$. In our baseline analysis, we focus on a five-year span, i.e., two years before, the year of the event, and two years after ($t$-2, $t$+2).[10] If a focal firm is interlocked with multiple firms that experience natural disasters, we use the earliest event as the treatment event. To ensure that our results are not contaminated by overlapping disaster events, we also require that firms in our sample are neither located in counties that have experienced any major disasters in the past 2 years nor will experience within the next 2 years.

[9] The information on county adjacency is obtain from the National Bureau of Economic Research (NBER) database: http://www.nber.org/data/county-adjacency.html. On average, a U.S. county has approximately five adjacent counties.
[10] Our results are similar if we use seven-year window around the disaster event.

The variable of interest, *Treat* × *Post* equals one if a firm is interlocked with another firm that is hit by a major weather-related disaster and zero otherwise. Hence, for each event, *Treat* × *Post* equals one for treatment firms in year $t$+1 and $t$+2, and equals zero for all remaining firm years. If a firm improves its environmental performance after its directors experiencing weather shocks at an interlocking firm, $\beta$ should be positive and significant.

We include a number of firm characteristics that might affect a firm's environmental performance, including firm size, ROA, financial leverage, market-to-book ratio, asset tangibility, research and development expense, cash holding, and firm age. Since our variable of interest is constructed based on board interlocking, to make sure that it does not pick up other board attributes that might be relevant to a firm's environmental policies, we additionally control for a number of board-related characteristics throughout our analyses. We include board size, board tenure and board independence because corporate governance is found to be related to a firm's corporate social responsibility (Ferrell, Liang, and Renneboog, 2016). Studies show that women are more socially-orientated and female directors can improve the boards' quality of advice (Kim and Starks, 2016), we thus include the ratio of female directors in the analysis. We also control for the total number of interlocking boards of each firm, a measure of a firm's overall board connection. Prior literature shows that firms' policies can be affected by their interlocked peer firms (Bouwman, 2011). To control for this effect, we include the average environmental performance of all interlocking firms.[11] Finally, we include various fixed effects in our regressions to reduce the omitted variable concern. We include firm fixed effects ($\delta$i) to control for time-invariant heterogeneity across firms and industry-by-year fixed effects ($\mu_{j,t}$) to control for industrial trend caused either by industrial regulation or by peer effects (Cao, Liang, and Zhan, 2019).

After deleting observations with missing values of regression variables, for our main analysis on KLD ratings, we obtain a sample consisting of 5,313 firm-year observations over the sample period of 2003–2018. Table 2 reports the summary statistics. Detailed definitions of all

[11] If a firm has no interlocking firms as shown in BoardEx or its interlocking firms have missing KLD scores, we use the firm's industry average KLD scores.

variables are given in Appendix A. Financial variables are adjusted to the dollar value in 2019 using Consumer Price Index data from the Bureau of Labor Statistics. To mitigate the influence of outliers, all continuous variables are winsorized at the 1st and 99th percentiles. In our main sample, the average KLD environmental score (*KLD E-Scores*) is 5.03 and the average social score (*KLD S-Scores*) is 13.53.

—Insert Table 2 about here—

## 4. Empirical results

### 4.1. Univariate analysis

In Figure 1, we present the differences in average *KLD E-Scores* and *KLD S-Scores* between the treatment group and the control group. Panel A shows that both groups have similar *E-Scores* before the treatment event year. After the treatment, the average environmental rating for the treatment group increases significantly while that for the control group remains largely unchanged. We do not observe significant changes in the average *S-Scores* for either group, as shown in Panel B. These results are consistent with our conjecture that extreme-weather related shocks to corporate directors affect their decision making on corporate environmental policies. We next conduct multivariate analysis on the impact of director personal experience on corporate environmental performance.

### 4.2. Baseline regression

Table 3 presents the results from our baseline DID analysis. In column (1), we control for a set of firm characteristics, as well as firm and year fixed effects.[12] The estimated coefficient on

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[12] The effect of *POST* is not absorbed by year fixed effect because we perform a match with replacement and one control firm-year can be paired with multiple treatment firms and have different values of *POST* (i.e., both 0 and 1).

*Treat* × *Post* is positive and statistically significant at 1% level. The point estimate suggests that, on average, the KLD environmental scores of treatment firms are 0.235 units higher during the two years following the disaster event that happens at an interlocking firm's location. For an average firm with a KLD environmental score of 5.03, the impact corresponds to a 4.7% increase in its overall environmental rating. The effect also represents 38% of the standard deviation of firms' *KLD E-Score*. In column (2), we replace year fixed effects with industry-by-year fixed effects to control for industrial trend. Our results are the same.

After experiencing a disaster shock, managers and directors of disaster-affected firms are likely to become more aware of climate change risk. These firms may subsequently change their corporate environmental policies, which can propagate to remote firms through board interlocks. Such mechanism is still consistent with our argument that corporate decision makers' personal experience affects corporate sustainability policies. However, changes in environmental policies of disaster-affected firms may also be due to other factors, such as demand from local stakeholders or new policies adopted by the local government. To isolate the impact of corporate policymakers' personal experience, we conduct a subsample analysis. Specifically, for each treatment firm, we examine the environmental ratings of firms located in the disaster area, with which the treatment firms are interlocked.[13] We then identify firms that experience positive changes in their ratings and remove their corresponding treatment firms from our analysis. Columns (3) and (4) show that our results remain in this subsample.

The estimated coefficients of other control variables are largely consistent with prior literature (e.g. Ferrell, Liang, and Renneboog, 2016). We find that younger firms, firms with more independent and senior board, and firms with more female directors have better environmental performance. As expected, we also find a significant positive coefficient on *E-Score_interlock*, suggesting a positive relation among interlocking firms' environmental performance.

—Insert Table 3 about here—

[13] Untabulated tests show that after severe natural disasters, affected firms do improve their environmental performance marginally. The average E-scores increases by 0.06, about 1% increase in magnitude.

To better establish the causality, we next study the dynamic effects of the shock on firms' environmental performance. Specifically, we replace the *Post* dummy in the baseline model with four dummies: *Pre2*, *Pre1, Post1*, and *Post2*. Hence, in the regression we have four event-year time dummies and their interaction with the *Treat* variable. *Treat* × *Pre2* and *Treat* × *Pre1* are indicator variables that equal one for the two years before the disaster at an interlocking firm, i.e., *t*-2 and *t*-1. These two indicators allow us to assess whether any significant trend can be found before the treatment. *Treat* × *Post1* and *Treat* × *Post2* are indicator variables that equal one for the two years after the disaster at an interlocking firm, i.e., *t*+1 and *t*+2. For the dependent variable, in additional to *KLD E-Score*, we also break down the overall *E-Score* into the number of environmental "strengths" (*E-Strength*) and the number of environmental "concerns" (*E-Concern*). These tests can help us understand whether affected firms improve their environmental performance by proactively launching more initiatives or by reducing their production of negative externalities.

The results are reported in Table 4. We find that the estimated coefficients on *Treat* × *Pre2* and *Treat* × *Pre1* are small in magnitude and not significantly different from zero in all three models, suggesting that there is no significant differences in environmental ratings between the treatment and control groups before the disasters. Meanwhile, the coefficients on *Treat* × *Post1* and *Treat* × *Post2* dummies are significantly positive for *E-Score* or *E-Strength*, and negative for *E-Concern*. Collectively, the results from the dynamic analysis are consistent with our conjecture that firms that have an interlocking board with disaster-affected firms advance their environmental performance after the disaster event.

—Insert Table 4 about here—

### 4.3. Impact on social performance

We next explore the impact of directors' disaster experience on a firm's non-environmental sustainability policies, i.e., a firm's social performance. If directors' disaster experience affects their attitude toward environmental issues and consequently a firm's environmental performance, then we expect a weaker (or indiscernible) effect of such experience on the firm's social performance. Therefore, this test can serve as a placebo test.

We report the results in Table 5 Panel A, where the dependent variable is a firm's KLD social score. The same set of controls from Table 3 are included, except that we replace interlocking firms' average *E-Score* with their average *S-Score*. Similarly, we find that firms with a higher ratio of female directors and firms with more better-performing interlocking firms have better social performance. However, we do not find a significant relation between directors' disaster experience and the focal firm's overall social performance. The coefficient on *Treat* × *Post* is positive but not statistically different from zero.

In Panel B, we study each of the five dimensions of social performance using KLD subcategory scores. The effect of director disaster experience is insignificant for each category, except for the Product issue area. Since a firm's product score is related to its product and process innovation and chemical safety, it might be affected by a firm's overall environmental policy. Collectively, our results suggest that extreme weather-related experience changes directors' opinions on environmental policies, but not necessarily their attitudes towards non-environmental issues.

—Insert Table 5 about here—

### 4.4. The gender of disaster-affected directors

We find that about 13% of the treated firms in our sample have female directors experiencing a disaster in interlocking firms. We therefore test whether female directors are more responsive than male directors to weather-related disasters. To do so, we first introduce a dummy variable, *Female_director*, that is equal to one if a treated firm has at least one female director sitting on disaster-affected interlocking firms and zero otherwise. Then we conduct a triple difference test that includes a triple interaction term *Treat* × *Post* × *Female_director*.

The results are reported in Table 6. We find that the coefficient on the triple interaction term is significantly positive, suggesting that the effect of disaster-affected female directors is greater than that of male directors. In terms of economic magnitude, we estimate that, after a female director experiences a disaster in a remote interlocking firm, the focal firm improves its environmental performance (e.g., E-score) by 10.4%, which is about two times larger than the impact (3.9%) of a male director experiencing such an event.

—Insert Table 6 about here—

### 4.5. Heterogeneous effect of disaster experience

Next, we explore cross-sectional variations in the relation between director extreme weather experience and corporate environmental performance. Specifically, we investigate whether the improvement in environmental performance is more pronounced when directors' attitude towards environmental issues is more likely to be affected by the disaster event and when it is easier for affected directors to promote new sustainability polices.

#### 4.5.1. Cross-sectional analyses based on disaster characteristics

We first examine whether and how the impact of directors' personal catastrophic experience varies with the severity of the disaster. If our results are indeed driven by corporate decision makers' disaster experience at the interlocking firm, we conjecture that the effect should be more pronounced when the disaster is more severe. We first use the adjusted property damage at the county level to measure the severity of a disaster (Cortes and Strahan, 2017). A major disaster event, such as hurricane, is likely to affect hundreds of counties. However, the property damage varies widely across different countries. Hence, we define a dummy variable, *High_damage*, which equals one if the property damage of the disaster at the interlocking firm's county is greater than the median value and zero otherwise. If a treatment firm is interlocked with more than one disaster-affected firms in the same year, we use the disaster with the highest county damage to generate the indicator.

We also use fatalities at the county level to measure the magnitude of a disaster event (Gao, Liu, and Shi, 2020). Similarly, if there are multiple disasters affect interlocking firms, we keep the disaster with the most fatalities. We then generate an indicator *High_fatality* that equals one if the fatalities associated with the disaster is greater than the median value and zero otherwise.

Columns (1) and (2) in Table 7 report the results based on disaster characteristics. We find that the positive effect of weather-related disaster at an interlocking firm is greater when the disaster results in higher property damage or more fatalities. This is consistent with our conjecture that when directors' beliefs towards environmental issues is more likely to be affected, the subsequent improvement in environmental performance is more significant.

—Insert Table 7 about here—

#### 4.5.2. Cross-sectional analyses based on characteristic of interlocking directors

If it is personal disaster experience that affects firms' environmental strategies, then we conjecture that the effect should be stronger when more directors of a firm experience such weather shocks. Moreover, the impact should be more pronounced when these affected directors have greater ability to prompt their preferred environmental policy. Therefore, we expect that the effect should be stronger when these interlocking directors are more senior.

Using information on board interlocking, we first construct an indicator variable, *High_interlock*, which equals one if a treatment firm has more directors (i.e., higher than the median of the treatment group) sitting on disaster-affected interlocking firms. Table 7 column (3) reports the results. Consistent with our conjecture, the estimated coefficient on both *Treat* × *Post* and *Treat* × *Post* × *High_interlock* are positive and highly significant, suggesting that the improvement in environmental performance is greater when more directors in the treatment firms experience major disasters at interlocking firms.

To examine whether the effect we document is stronger when affected directors are more senior, we use the average tenure of these interlocking directors. *Senior_interlock* is a dummy variable equal to one if the maximum tenure of affected directors is higher than the median value among all treatment firms and zero otherwise. Table 7 column (4) reports the results. The positive and significant coefficient on *Treat* × *Post* × *Senior_interlock* is consistent with our conjecture. It is consistent with our conjecture that more senior directors have greater ability to prompt firms to be more environmentally friendly after they experience disaster shocks at other interlocking firms.

#### 4.5.3. Cross-sectional analyses based on firm characteristics

In this section, we investigate how other firm characteristics may affect the relation we document. As the society observes the substantial economic costs generated by severe natural disasters in recent decades, it has urged corporations to take more active roles in improving their sustainability profiles, especially for firms operating in industries with greater environmental impact. We therefore examine whether the improvement in environmental performance is greater for firms in environmentally sensitive industries.

We use a firm's Fama French 49 industry classification and the Sustainability Accounting Standards Board (SASB) Materiality Map to assign each firm into either environmentally sensitive industry or non-environmentally sensitive industry.[14] SASB is a non-profit organization that identifies material issues by industry in order to help corporations disclose material sustainability factors in compliance with U.S. Securities and Exchange Commission (SEC) requirements. To

[14] SASB Materiality Map is available at https://materiality.sasb.org/

determine whether an industry is environmentally sensitive or not, we focus on the 6 sustainability-related environmental issues. Specifically, if SASB classifies an industry as "material for more than 50% of the industry" for a particular environmental issue, we assign 2 points to that industry for that issue. If it is "material for less than 50% of industry" or "issue not likely to be material", then the industry receives 1 point and 0 point, respectively. We then sum the numbers to get an industry's overall material rating.

A firm is then defined as operating in an environmentally sensitive industry if its industry's material rating is above the sample median (i.e., *Environmentally sensitive* = 1). Results from difference-in-difference-in-differences (DDD) analysis are reported in Table 8 column (1). The coefficient on *Treat* × *Post* × *Environmentally sensitive* is positive and statistically significant, suggesting that the positive effect of directors' environmental shock on the *KLD E-Score* is higher for firms operating in environmentally sensitive industries.

Second, we consider the impact of financial constraints. Xu and Kim (2020) find that financial constraints have real impacts on a firm's environmental performance and that relaxing financial constraints reduces U.S. public firms' toxic releases. As improvements in a firm's environmental performance requires substantial inputs and efforts, we expect that our documented effect should be greater when firms face less financial constraints.

To test our conjecture, we use the SA index derived by Hadlock and Pierce (2010), who show that firm size and age are the most useful proxy for financial constraints. Firms with a higher value of the SA index are more constrained. We thus define a firm as financially unconstrained if its SA index is below the sample median (i.e., *Financially unconstrained* = 1). Table 8 column (2) reports the results. As expected, we find that our documented positive effects are primarily concentrated in firms with less financial constraints.

—Insert Table 8 about here—

**4.6. Mechanisms**

Thus far, our results show that after a firm's directors experience natural disaster shocks at an interlocking firm, the focal firm improves its environmental performance in the following years. The impact is stronger when directors' attitude towards environmental issues is more likely to be affected by the disaster and when it is easier for firms to adjust their environmental policies. Since extreme weather events can affect directors in many ways, in this section, we explore the specific mechanism through which director's disaster experience affects corporate environmental performance.

#### 4.6.1. Disaster experience and risk preference

First, it's plausible that experiencing extreme weather shocks at the interlocking firm may change directors' risk preference, leading to reduced risk-taking of treatment firms. Prior studies have identified the risk-management benefit of corporate social responsibility and show that CSR activities can provide insurance-like effects in adverse corporate events (Godfrey, Merrill, and Hansen, 2009; Lins, Servaes, and Tamayo, 2017). If first-hand disaster experience lowers directors' risk preference, it may result in more socially responsible behaviors of treatment firms. However, this argument would suggest improvements in both environmental performance and non-environmental dimensions of corporate social performance for these firms, which is inconsistent with our earlier findings. As shown in Figure 1 and Table 5, we don't observe a significant change in treatment firms' social performance after the shock.

In Table 9, we examine the impact of directors' extreme-weather experience on a firm's risk-taking directly. The dependent variables are a firm's financial policy (leverage and cash holding), investment decision (capital expenditure and R&D investment), and return volatility (stock return volatility and earnings volatility). Detailed variable definitions are provided in Appendix A. We do not find significant changes in these firm decisions and outcomes, except for capital expenditure. Results in column (3) show that there is actually an increase in total capital expenditure for treatment firms. Our results also remain the same if we remove firm fixed effects or remove lagged explanatory variable (e.g., in the leverage and cash regressions) from the regressions. Taken together, these results suggest that greater risk aversion is unlikely to be the main drivers of our primary findings.

—Insert Table 9 about here—

### 4.6.2. Disaster experience and climate change beliefs

Existing studies on climate change show that personal experience of extreme weather can increase people's perceptions of climate change risk and their support for the adoption of climate mitigation policies. Therefore, it's very plausible that extreme weather event influences directors' beliefs about climate change and their intentions to take actions. Prior studies find that political affiliation and prior awareness of climate change is related to the extent to which personal experience affects a person's climate beliefs. If it is indeed updated director beliefs that affect corporate environmental policies, then the impact should be greater when affected directors have some pre-existing beliefs in climate change.

We measure directors' prior beliefs using their political ideologies. It is well known that in the United States, the Democratic Party has more environmental and sustainable political positions than the Republican Party. Therefore, it is reasonable to assume that people who have donated to the Democratic Party are more likely to have some prior beliefs in climate issues than those who have only donated to the Republican Party. We collect data on individual campaign donation from Federal Election Commission (FEC) database following prior studies (Duchin et al., 2019; M. Wintoki et al. 2019; Brogaard et al. 2019). Specifically, we match directors in BoardEx with individuals in the FEC database using both director and employer names. After manual cleaning, we obtain donation information for 223 affected directors (out of 992 unique affected directors). If a director has supported the Democratic Party from 2000 to the event time, we consider her to be having some prior climate change beliefs. Among our treatment firms, 17.5% have such "Democratic" disaster-affected directors.

In Table 10, column (1), we keep treatment firms that have director donation information and examine whether our documented effect is stronger when affected directors are more likely to have some prior awareness of climate change. As shown, the coefficients on both *Treat* × *Post* and *Treat* × *Post* × *Donation_Democratic* are positive and significant. In column (2), we keep all treatment firms by assuming that directors with no donation information has no prior beliefs in climate change. Our results are similar. Taken together, this test suggests that it is more likely to be changes in climate beliefs that affect directors' attitude towards pro-environmental behavior.

—Insert Table 10 about here—

#### 4.6.3. Risk-hedging or social responsibility consideration

We next explore how changes in beliefs affect directors' decisions on eco-friendly policy. Do directors promote better environmental policies because they understand the climate risk better and want to hedge climate change risk to protect shareholder value, or because they believe that the firm should take social responsibility to prevent climate change? To distinguish between these two motives, we conduct some subsample analysis. We conjecture that, if hedging consideration is the primary factor influencing corporate environmental policies, then we shall not observe a significant impact among firms that have very low exposure to climate change risk.

We use two approaches to identify firms with low climate risk exposure. First, we use a firm's geographic location. If a firm is located in an area with low natural hazard risk, we consider it to have low climate risk exposure and thus lower need for climate risk management. To identify low climate risk areas, we use the National Risk Index (NRI) provided by the Federal Emergency Management Agency (FEMA), an agency of the U.S. Department of Homeland Security. NRI is constructed using data on natural disasters, social vulnerability, and community resilience. The index provides a quantified estimation of exposure to natural disaster risk for each U.S county. We then restrict our analysis to firms headquartered in counties with "Relatively Low" or "Very Low" NRI.

The results are reported in column (1) of Table 11. As shown, we continue to find significant results in this much smaller subsample. The estimated effect is also comparable to that in the baseline regression. We also use data from SHELDUS to identify low climate risk areas, i.e., counties that are not affected by any of these major disasters. Untabulated tests show the same results.

The second approach we use to identify firms with low climate risk exposure is industry classification. Following Huang, Kerstein and Wang (2018), we consider an industry to be climate vulnerable if it has heavier non-deployed and long-lived capital assets or is dependent more on mild weather. We next remove firms in these industries, including agriculture, food products, energy (mines, coal, and oil), healthcare, communications, business services, and transportation, and conduct a subsample analysis in column (2) of Table 11. We find that our results remain in this subsample. Taken together, these results suggest that climate risk management is unlikely to be the main consideration under improved environmental performance.

—Insert Table 11 about here—

### 4.7. Additional analysis

#### 4.7.1. Alternative measures of environmental and social performance

We use KLD as our main source of sustainability data, as it covers a large number of U.S. firms over a long period of time. We next use Thomson Reuters ASSET4 environmental score as an alternative measure of a firm's environmental performance. The sample period is from 2002-2018. Results are reported in Table 12 column (1). We find that, after a firm's directors experience environmental shocks at their interlocking firms, the focal firm's ASSET4 environmental score is increased by 2.392 in the subsequent two years. The impact is economically significant, corresponding to a 9.95% (18.9%) increase in the environmental score for an average (median) firm in our sample. In column (2), we use ASSET4 social score as an alternative measure of a firm's social performance. Similar to our earlier finding, we do not see a significant impact of environmental shocks at interlocking firms on a focal firm's overall social score.

In addition, we also use the pollutant emissions data from the TRI database maintained by U.S. EPA over the period of 2001-2018 to generate an alternative measure of a firm's environmental performance. We present the results in column (3), where the dependent variable is *Total Toxic Releases.* The negative and statistically significant coefficient on *Treat* × *Post* indicates that a firm reduces its total emissions in the two years following its directors' environmental shock, consistent with our earlier findings.

—Insert Table 12 about here—

#### 4.7.2. Alternative setting: disaster shock at directors' residential locations

In this section, we use a different setting to explore the effect of directors' disaster-related experience. Instead of examining firms that have directors sitting on the board of another firm in the disaster area, we focus on firms that have directors residing in places hit by a salient natural disaster.

We collect data on directors' residential address from the LexisNexis Online Public Records database. This dataset extracts information from public records and provides detailed history of addresses associated with 150 million individuals residing in the United States. To ascertain directors' locations of residence, we follow the approach used in Alam, Chen, Ciccotello, and Ryan (2014, 2018). First, we collect each director's birthdate information from BoardEx and other online sources including Notable Names Database, *PeopleFinders*, and websites such as *Google*, *Wikipedia,* and *BusinessWeek.com.* Second, we search for each director in LexisNexis Public Records using names and birthdates and collect that director's residential address. For directors with multiple outputs, we use additional information, i.e., their work location and reported address in SEC Form 4 insider trading filings, to manually locate the correct record.

We then implement similar DID methodology. The treatment group is a group of firms that do not experience any major disasters themselves, do not have directors sitting on a disaster-affected firm, but have directors residing in a disaster area. The control group consists of similar firms but without directors experiencing disasters in their area of residence.

Table 13 reports the multivariate regression results. The model specifications in columns (1) and (2) are the same as those in Table 3. Results show that directors' disaster experience at their residential locations is positively associated with firms' subsequent environmental performance, further confirming that extreme weather events are likely to affect directors' attitude towards environmental issues and consequently affect corporate environmental policies. In column (3), we examine the dynamic effects of disaster experience on a firm's *KLD E-score*. As shown, the coefficients on *Treat* × *Pre2* and *Treat* × *Pre1* are statistically indifferent from zero, while the coefficients on *Treat* × *Post1* and *Treat* × *Post2* are both positive and significant, confirming again that the effect of directors' disaster experience on a firm's environmental rating only exists after the disaster shock.

Taken together, results from this alternative setting suggest that our findings from the main setting are unlikely to be driven by board contagion. The observed increase in environmental rating really stems from directors' personal experience and their attitude towards climate and environmental issues.

—Insert Table 13 about here—

## 5. Conclusion

In this paper, we examine how directors' personal experience of extreme weather events affects a firm's environmental performance. We conjecture that a severe weather-related disaster event would affect people's attitude towards environmental issues and that such exogenous shock affect other firms located in non-disaster area through board seats.

Using information on board of directors of a sample of U.S. firms for the period 2003–2018, we find that after a firm's directors experience environmental shocks in an interlocking firm, the firm improves its sustainability policies and achieves better KLD environmental scores in the years following the shock.

We further find that the improvement in a focal firm's environmental performance is more pronounced for female directors and when it is easier for affected directors to promote their preferred sustainability polices. Specifically, the positive effect is stronger when the disaster is more severe, when treatment firms have more board connections with firms in disaster area, and when interlocking directors are more senior. In addition, we find that our results are stronger among firms operating in industries with more sustainability-related environmental issues and firms with less financial constraints.

We next explore the specific mechanism through which an extreme weather shock affects directors' attitude towards eco-friendly policy. Our analysis shows that better environmental performance is not driven by changes in directors' risk-taking preference or climate risk management consideration. We find that the documented impact is stronger if the affected directors have some prior beliefs in climate change, suggesting that updated climate change beliefs are more likely to be the main channel.

We find consistent results when using alternative performance measures, including Thomson Reuters ASSET4 environmental score and the pollutant emissions data from the EPA. Finally, we find similar results when we use natural disasters at directors' area of residence as exogenous shocks. Overall, our results indicate that personal experience of extreme weather events prompts directors to take sustainable actions at the firm level.

## Appendix A. Variable definitions

This table lists the definitions and sources of all variables used in this paper.

| Variable | Definition | Data source |
|---|---|---|
| *Firms' ESG performance measures* | | |
| KLD E-Score | Annual score of a firm's environmental performance constructed following Hong and Kostovetsky (2012). | KLD database |
| KLD S-Score | Annual score of a firm's social performance constructed following Hong and Kostovetsky (2012). Including five categories of KLD: community, human rights, employee relations, diversity and product. | KLD database |
| TTR | Natural log of one plus the amount of a firm's total toxic releases in kilo-pound during the year. | EPA TRI Program |
| ASSET4 E-Score | Annual score of a firm's environmental performance calculated by Thomson Reuters ASSET4. | TR ASSET4 |
| ASSET4 S-Score | Annual score of a firm's social performance calculated by Thomson Reuters ASSET4. | TR ASSET4 |
| *Treatment characteristics* | | |
| Female_director | Dummy variable equal to one if a treated firm has at least one female director sitting on disaster-affected interlocking firms and zero otherwise. | SHELDUS & BoardEx |
| High_interlock | Dummy variable equal to one if a treated firm has more than median directors that are sitting on disaster-affected interlocking firms and zero otherwise. | SHELDUS & BoardEx |
| Senior_director | Dummy variable equal to one if the maximum tenure of affected directors is higher than the median value among all treated firms and zero otherwise. | SHELDUS & BoardEx |
| Donation_Democratic | Dummy variable equal to one if the affected directors has ever made any campaign donation to Democratic Party before the treatment and zero otherwise. | Federal Election Committee |
| High_damage | Dummy variable equal to one if the adjusted property damage of the disaster at the interlocking firm's county is greater than the median value and zero otherwise. | SHELDUS & BoardEx |
| High_fatality | Dummy variable equal to one if the fatalities associated with the disaster is greater than the median value and zero otherwise. | SHELDUS & BoardEx |
| *Firm characteristics* | | |
| Log (Assets) | Natural log of book value of total assets. | COMPUSTAT |
| ROA | Operating income before depreciation, scaled by total assets. | COMPUSTAT |
| Leverage | Book value of total debt, scaled by total assets. | COMPUSTAT |

| Variable | Definition | Data source |
|---|---|---|
| Market-to-book | Market value of equity, divided by book value of equity. | COMPUSTAT |
| Tangibility | Property, plant, and equipment, scaled by total assets. | COMPUSTAT |
| R&D | R&D expense, scaled by total assets. | COMPUSTAT |
| Cash | Cash and short-term investments, scaled by total assets. | COMPUSTAT |
| Log (Firm age) | Natural log of one plus the number of years listed on COMPUSTAT. | COMPUSTAT |
| Sales growth | Annual percent growth in sales. | COMPUSTAT |
| ROA Vol | Earnings volatility over the most recent four years. | COMPUSTAT |
| Ret Vol | Daily stock price volatility. | CRSP |
| Environmentally sensitive | Dummy variable equal to one if a firm is operating in an environmentally sensitive industry and zero otherwise. Specifically, if SASB classifies an industry as "material for more than 50% of the industry" for one of the six sustainability-related environmental issues, the industry receives 2 points for that particular issue. If it is "material for less than 50% of industry" or "issue not likely to be material", then the industry receives 1 point and 0 point, respectively. A firm is defined as operating in an environmentally sensitive industry if its industry's total score is higher than the sample median. | SASB |
| Financially unconstrained | Dummy variable equal to one if a firm's SA-index score is smaller than the sample median and zero otherwise (Hadlock and Pierce, 2010). SA-index is calculated as (-0.737 × Size) + (0.043 × Size$^2$) – (0.040 × Age), where Size is the natural log of a firm's inflation-adjusted book assets, and Age is the number of years that a firm has been listed in COMPUSTAT. | COMPUSTAT |
| *Board characteristics* | | |
| Log (Board size) | Natural log of one plus the number of directors serving on a board. | BoardEx |
| Board tenure | Average tenure of all directors on a board. | BoardEx |
| Female ratio | Ratio of female directors on a board. | BoardEx |
| Board independence | Ratio of independent directors on a board. | BoardEx |
| No. of interlocking boards | A firm's total number of interlocking boards. | BoardEx |

## Appendix B. KLD environmental performance indicators

This table lists the description of all positive and negative indicators from the KLD environmental category.

| **Positive Environments Performance Indicators** | **Indicate Variables** | **Negative Environments Performance Indicators** | **Indicate Variables** |
|---|---|---|---|
| Environmental Opportunities – Clean Tech | ENV-str-A | Regulatory Compliance | ENV-con-B |
| Waste Management – Toxic Emissions and Waste | ENV-str-B | Toxic Emissions and Waste | ENV-con-D |
| Waste Management – Packaging Materials & Waste | ENV-str-C | Energy & Climate | ENV-con-F |
| Climate Change – Carbon Emissions | ENV-str-D | Impact of Products and Serves | ENV-con-G |
| Environmental Management Systems | ENV-str-G | Biodiversity & Land Use | ENV-con-H |
| Natural Resource Use – Water Stress | ENV-str-H | Operational Waste | ENV-con-I |
| Natural Resource Use – Biodiversity & Land Use | ENV-str-I | Supply Chain Management | ENV-con-J |
| Natural Resource Use – Raw Material Sourcing | ENV-str-J | Water Stress | ENV-con-K |
| Natural Resource Use – Financing Environmental impact | ENV-str-K | Environment – Other Concerns | ENV-con-X |
| Environmental Opportunities – Green Buildings | ENV-str-L | | |
| Environmental Opportunities in Renewable Energy | ENV-str-M | | |
| Waste Management – Electronic Waste | ENV-str-O | | |
| Climate Change – Energy Efficiency | ENV-str-P | | |
| Climate Change – Insuring Climate Change Risk | ENV-str-Q | | |
| Environment – Other Strengths | ENV-str-X | | |

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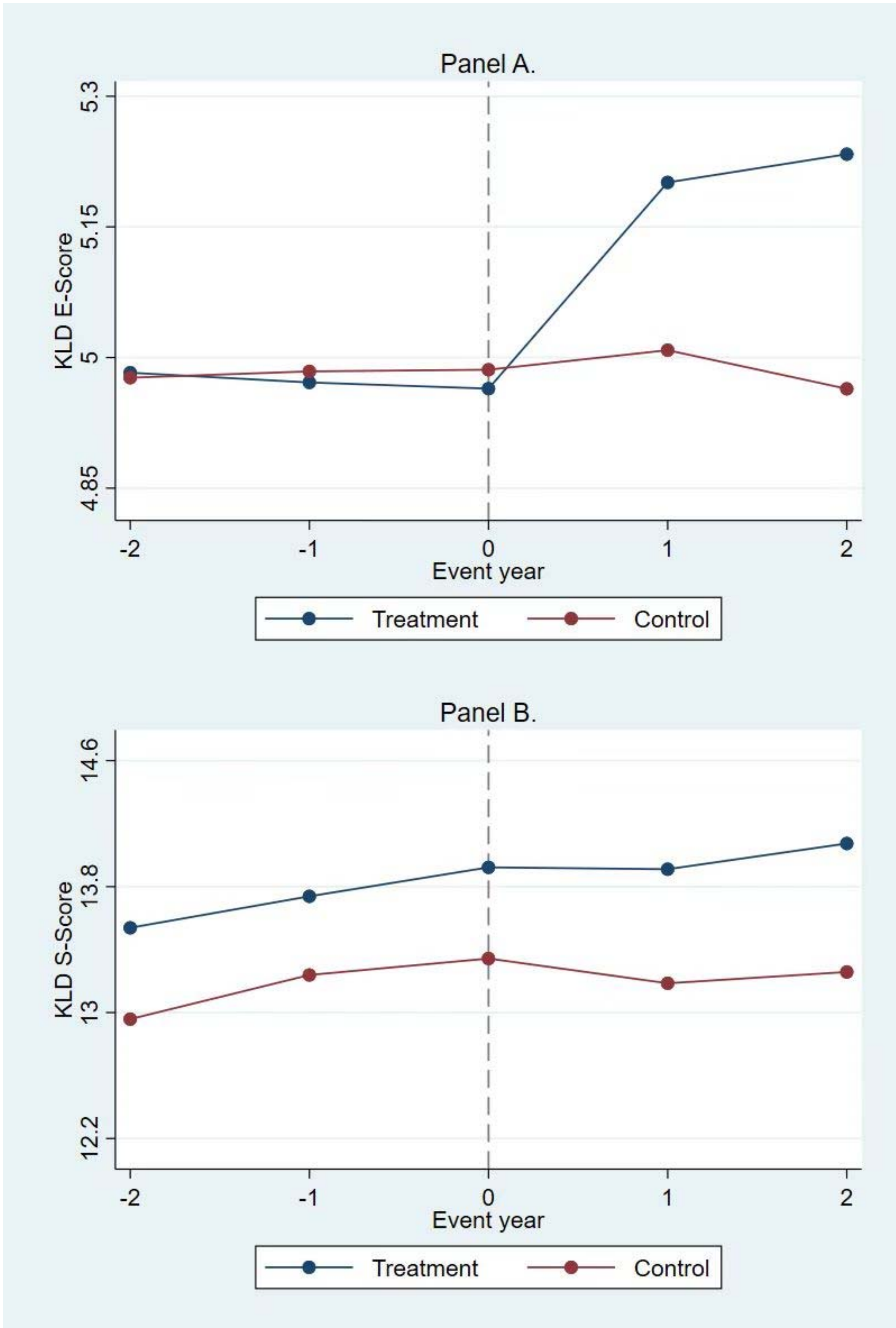
## Figure 1. Univariate analysis

This figure presents the differences in average KLD E-Scores and KLD S-scores between the treatment group and the control group during the two years before and the two years after the treatment.



## Table 1. Disaster events

This table reports the list of major disaster events in the United States from 2001 to 2018, with the dates when the event started and ended and the length of the event. Disaster data is obtained from Spatial Hazard Events and Losses Database for the United States (SHELDUS) database.

| No. | Event Name | Start Date | End Date | Duration |
|---|---|---|---|---|
| 1 | Tropical Storm 2001 Allison | 06/11/01 | 06/11/01 | 1 |
| 2 | Wildfires 2003 California | 06/06/03 | 07/31/03 | 56 |
| 3 | Hurricane 2003 Isabel | 09/18/03 | 09/19/03 | 2 |
| 4 | Hurricane 2004 Charley | 08/12/04 | 08/12/04 | 1 |
| 5 | Hurricane 2004 Frances | 09/07/04 | 09/07/04 | 1 |
| 6 | Hurricane 2004 Ivan | 09/16/04 | 09/16/04 | 1 |
| 7 | Hurricane 2004 Jeanne | 09/28/04 | 09/28/04 | 1 |
| 8 | Hurricane 2005 Dennis | 07/10/05 | 07/10/05 | 1 |
| 9 | Hurricane 2005 Katrina | 08/29/05 | 08/30/05 | 2 |
| 10 | Hurricane 2005 Rita | 09/25/05 | 09/25/05 | 1 |
| 11 | Hurricane 2005 Wilma | 10/23/05 | 10/24/05 | 2 |
| 12 | Flooding 2008 Midwest | 06/03/08 | 06/30/08 | 28 |
| 13 | Hurricane 2008 Gustav | 08/25/08 | 09/01/08 | 8 |
| 14 | Hurricane 2008 Ike | 09/11/08 | 09/12/08 | 2 |
| 15 | Blizzard 2011 Groundhog Day | 02/09/11 | 02/09/11 | 1 |
| 16 | Hurricane 2011 Irene | 08/28/11 | 08/28/11 | 1 |
| 17 | Tropical Storm 2011 Lee | 09/05/11 | 09/05/11 | 1 |
| 18 | Hurricane 2012 Isaac | 08/26/12 | 08/27/12 | 2 |
| 19 | Hurricane 2012 Sandy | 10/29/12 | 10/29/12 | 1 |
| 20 | Flooding/Severe Weather 2013 | 04/18/13 | 04/18/13 | 1 |
| 21 | Flooding 2013 Colorado | 09/12/13 | 09/14/13 | 3 |
| 22 | Tornadoes/Flooding 2014 | 04/29/14 | 04/30/14 | 2 |
| 23 | Flooding 2015 East/SC | 10/04/15 | 10/04/15 | 1 |
| 24 | Flooding 2016 Louisiana | 08/12/16 | 08/27/16 | 16 |
| 25 | Hurricane 2016 Matthew | 10/02/16 | 10/25/16 | 24 |
| 26 | Hurricane 2017 Harvey | 08/25/17 | 08/31/17 | 7 |
| 27 | Wildfires 2017 California | 07/07/17 | 12/31/17 | 177 |
| 28 | Hurricane 2018 Florence | 09/13/18 | 09/30/18 | 144 |
| 29 | Hurricane 2018 Michael | 10/10/18 | 10/11/18 | 54 |
| 30 | Wildfires 2018 California | 06/02/18 | 11/25/18 | 32 |

## Table 2. Summary statistics

This table presents summary statistics for our main variables. The final sample comprises of 5,313 observations over the period of 2003-2018. The definitions of these variables are provided in Appendix A. All firm-level financial variables are winsorized at the 1st and 99th percentiles, and all dollar values are adjusted to 2019 dollars.

| Variable | Obs | Mean | Std. Dev | P25 | Median | P75 |
|---|---|---|---|---|---|---|
| KLD E-Score | 5,313 | 5.03 | 0.62 | 5.00 | 5.00 | 5.00 |
| KLD E-Strength | 5,313 | 0.15 | 0.53 | 0.00 | 0.00 | 0.00 |
| KLD E-Concern | 5,313 | 0.12 | 0.47 | 0.00 | 0.00 | 0.00 |
| KLD S-Score | 5,313 | 13.53 | 1.71 | 12.00 | 13.00 | 14.00 |
| KLD E-Score interlock | 5,313 | 5.15 | 0.67 | 5.00 | 5.00 | 5.33 |
| KLD S-Score interlock | 5,313 | 14.15 | 1.70 | 13.00 | 14.00 | 15.00 |
| KLD Community Score | 5,313 | 2.04 | 0.32 | 2.00 | 2.00 | 2.00 |
| KLD Human Rights Score | 5,313 | 3.00 | 0.21 | 3.00 | 3.00 | 3.00 |
| KLD Employee Relations Score | 5,313 | 3.89 | 0.81 | 4.00 | 4.00 | 4.00 |
| KLD Diversity Score | 5,313 | 1.65 | 1.20 | 2.00 | 2.00 | 2.00 |
| KLD Product Score | 5,313 | 2.95 | 0.53 | 3.00 | 3.00 | 3.00 |
| Total Toxic Release | 539 | 3.70 | 2.35 | 1.77 | 3.85 | 5.20 |
| ASSET4 E-Score | 749 | 24.05 | 27.00 | 0.00 | 12.64 | 43.21 |
| ASSET4 S-Score | 749 | 40.56 | 17.62 | 27.06 | 38.62 | 51.79 |
| Total Assets | 5,313 | 2597.90 | 6262.59 | 404.96 | 873.70 | 2182.40 |
| ROA | 5,313 | 0.10 | 0.16 | 0.07 | 0.12 | 0.17 |
| Leverage | 5,313 | 0.20 | 0.22 | 0.00 | 0.13 | 0.32 |
| Market-to-book | 5,313 | 2.23 | 1.64 | 1.24 | 1.69 | 2.61 |
| Tangibility | 5,313 | 0.24 | 0.24 | 0.07 | 0.15 | 0.36 |
| R&D expense | 5,313 | 0.06 | 0.11 | 0.00 | 0.01 | 0.08 |
| Cash | 5,313 | 0.23 | 0.22 | 0.05 | 0.14 | 0.36 |
| Firm age | 5,313 | 17.14 | 12.99 | 7.00 | 14.00 | 22.00 |
| Sales growth | 5,313 | 0.18 | 0.46 | 0.00 | 0.10 | 0.23 |
| Board size | 5,313 | 8.00 | 1.90 | 7.00 | 8.00 | 9.00 |
| Board tenure | 5,313 | 7.77 | 4.34 | 4.73 | 7.00 | 10.34 |
| Board independence | 5,313 | 0.81 | 0.09 | 0.75 | 0.86 | 0.88 |
| Female ratio | 5,313 | 0.09 | 0.10 | 0.00 | 0.08 | 0.14 |
| No. of interlocking boards | 5,313 | 4.61 | 4.12 | 1.00 | 4.00 | 7.00 |

## Table 3. Natural disaster experience and corporate environmental performance

This table reports results from the difference-in-differences analyses. The dependent variable is *KLD E-score* and the key explanatory variable is *Treat × Post*. All other control variables are defined in Appendix A. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | KLD E-Score | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Post | -0.022 | -0.030 | -0.007 | -0.011 |
| | (-0.600) | (-0.939) | (-0.213) | (-0.431) |
| Treat × Post | 0.235*** | 0.236*** | 0.172*** | 0.165*** |
| | (3.682) | (3.843) | (3.060) | (3.379) |
| Log (Assets) | 0.047 | 0.022 | 0.044 | -0.006 |
| | (1.112) | (0.478) | (1.065) | (-0.126) |
| ROA | 0.018 | -0.037 | 0.085 | 0.097 |
| | (0.119) | (-0.287) | (0.593) | (0.816) |
| Leverage | 0.017 | 0.056 | -0.035 | -0.009 |
| | (0.130) | (0.461) | (-0.277) | (-0.083) |
| Market-to-book | 0.014 | 0.015 | 0.013 | 0.009 |
| | (1.603) | (1.516) | (1.448) | (1.150) |
| Tangibility | 0.083 | 0.070 | 0.286 | 0.287 |
| | (0.337) | (0.281) | (1.310) | (1.184) |
| R&D | -0.291 | -0.293 | -0.171 | -0.133 |
| | (-1.257) | (-1.427) | (-0.737) | (-0.717) |
| Cash | -0.130 | -0.110 | -0.192 | -0.074 |
| | (-0.707) | (-0.895) | (-1.025) | (-0.686) |
| Log (Firm age) | -0.119** | -0.106 | -0.099* | -0.099* |
| | (-2.030) | (-1.558) | (-1.922) | (-1.837) |
| Sales growth | 0.012 | 0.002 | 0.002 | -0.002 |
| | (0.892) | (0.138) | (0.154) | (-0.128) |
| Log (Board size) | 0.058 | 0.057 | 0.052 | 0.037 |
| | (0.613) | (0.563) | (0.557) | (0.375) |
| Board tenure | 0.017** | 0.013 | 0.012* | 0.007 |
| | (2.067) | (1.339) | (1.656) | (0.768) |
| Board independence | 0.674*** | 0.578* | 0.467* | 0.415 |
| | (2.790) | (1.947) | (1.886) | (1.246) |
| Female ratio | 0.415* | 0.184 | 0.444** | 0.247 |
| | (1.906) | (0.862) | (2.091) | (1.180) |
| No. of interlocking boards | -0.011 | -0.015** | -0.007 | -0.012 |
| | (-1.519) | (-1.981) | (-0.909) | (-1.332) |
| E-Score interlock | 0.169** | 0.166*** | 0.088 | 0.128** |
| | (2.238) | (3.405) | (0.940) | (2.444) |
| Firm FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | No | Yes | No |
| Industry-year FE | No | Yes | No | Yes |
| Observations | 5,291 | 5,260 | 4,574 | 4,533 |
| $R^2$ | 0.679 | 0.726 | 0.672 | 0.740 |

## Table 4. Dynamic effects

This table reports the dynamic effects of the disaster experience at interlocking firms. The dependent variable is *KLD E-Score*, *KLD E-Strength*, and *KLD E-Concern* in columns (1) – (3), respectively. The key explanatory variables are *Treat × Pre2*, *Treat × Pre1*, *Treat × Post1*, and *Treat × Post2*. The regression includes the same set of control variables as in Table 3 column (2), whose coefficients are omitted for brevity. Detailed definitions of all variables are provided in Appendix A. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | KLD Environmental Score | | |
|---|---|---|---|
| | E-Score | E-Strength | E-Concern |
| | (1) | (2) | (3) |
| Treat × Pre2 | -0.061 | -0.045 | 0.016 |
| | (-1.558) | (-1.497) | (0.812) |
| Treat × Pre1 | 0.035 | 0.010 | -0.025 |
| | (1.165) | (0.458) | (-1.522) |
| Treat × Post1 | 0.208*** | 0.131*** | -0.077** |
| | (3.474) | (3.207) | (-2.453) |
| Treat × Post2 | 0.267*** | 0.168*** | -0.099*** |
| | (3.963) | (3.700) | (-2.833) |
| Pre2 | 0.020 | 0.014 | -0.006 |
| | (0.658) | (0.527) | (-0.455) |
| Pre1 | -0.034 | -0.016 | 0.018 |
| | (-1.483) | (-0.858) | (1.601) |
| Post1 | -0.029 | -0.004 | 0.025 |
| | (-0.838) | (-0.151) | (1.585) |
| Post2 | -0.026 | -0.002 | 0.024 |
| | (-0.703) | (-0.053) | (1.350) |
| Control variables | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Industry-year FE | Yes | Yes | Yes |
| Observations | 5,260 | 5,260 | 5,260 |
| $R^2$ | 0.727 | 0.750 | 0.889 |

## Table 5. Natural disaster experience at interlocking firms and corporate social performance

This table reports results from the difference-in-differences analyses. The dependent variable is the KLD social score in Panel A, and the five subcategory scores in Panel B. All other control variables are defined in Appendix A. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Disaster experience and overall social performance

| | MSCI KLD S-Score | |
|---|---|---|
| | (1) | (2) |
| Post | 0.034 | 0.026 |
| | (0.372) | (0.421) |
| Treat × Post | 0.160 | 0.127 |
| | (1.368) | (1.334) |
| Log (Assets) | 0.027 | 0.125 |
| | (0.187) | (1.026) |
| ROA | -0.254 | -0.578* |
| | (-0.537) | (-1.866) |
| Leverage | 0.473 | 0.098 |
| | (1.363) | (0.347) |
| Market-to-book | 0.061* | 0.082*** |
| | (1.672) | (3.020) |
| Tangibility | -0.754 | -0.677 |
| | (-1.211) | (-1.075) |
| R&D | 0.151 | 0.138 |
| | (0.206) | (0.205) |
| Cash | -0.648 | -0.487 |
| | (-1.526) | (-1.597) |
| Log (Firm age) | 0.185 | 0.072 |
| | (1.201) | (0.493) |
| Sales growth | 0.032 | 0.030 |
| | (0.753) | (0.711) |
| Log(Board size) | -0.361 | -0.178 |
| | (-1.036) | (-0.565) |
| Board tenure | -0.019 | -0.024 |
| | (-0.659) | (-0.911) |
| Board independence | 1.192 | -0.181 |
| | (1.528) | (-0.276) |
| Female ratio | 2.739*** | 2.330*** |
| | (4.490) | (4.180) |
| No. of interlocking board | 0.006 | -0.006 |
| | (0.314) | (-0.346) |
| S-Score interlock | 0.070* | 0.056* |
| | (1.714) | (1.751) |
| Firm FE | Yes | Yes |
| Year FE | Yes | No |
| Industry-year FE | No | Yes |
| Observations | 5,291 | 5,260 |
| $R^2$ | 0.767 | 0.820 |

Panel B. Disaster experience and subcategory social performance

| | MSCI KLD Subcategory S-scores | | | | |
|---|---|---|---|---|---|
| | Community | Human Rights | Employee Relations | Diversity | Product |
| | (1) | (2) | (3) | (4) | (5) |
| Post | 0.009 | 0.004 | 0.092*** | -0.060 | -0.021 |
| | (0.452) | (0.538) | (2.586) | (-1.287) | (-0.965) |
| Treat × Post | 0.043 | -0.009 | -0.081 | 0.078 | 0.096*** |
| | (1.613) | (-0.538) | (-1.633) | (1.264) | (2.961) |
| Control variables | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes |
| Industry-year FE | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,260 | 5,260 | 5,260 | 5,260 | 5,260 |
| $R^2$ | 0.693 | 0.712 | 0.768 | 0.854 | 0.782 |

## Table 6. Analyses based on the gender of disaster-affected directors

This table reports results from the analyses based on the gender of affected interlocking directors. The dependent variable is *KLD E-score.* The explanatory variable of interest is *Treat × Post × Female_director*. *Female_director* is a dummy variable that is equal to one if a treated firm has at least one female director sitting on disaster-affected interlocking firms and zero otherwise. All regressions include the same set of control variables as in Table 3 column (2). Detailed definitions of all variables are provided in Appendix A. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | KLD E-score | |
|---|---|---|
| | (1) | (2) |
| Post | -0.021 | -0.030 |
| | (-0.573) | (-0.951) |
| Treat × Post | 0.190*** | 0.196*** |
| | (3.093) | (3.460) |
| Treat × Post × Female_director | 0.368** | 0.328* |
| | (2.242) | (1.959) |
| Log (Assets) | 0.053 | 0.027 |
| | (1.264) | (0.588) |
| ROA | -0.000 | -0.039 |
| | (-0.002) | (-0.312) |
| Leverage | 0.005 | 0.050 |
| | (0.036) | (0.415) |
| Market-to-book | 0.015* | 0.014 |
| | (1.695) | (1.482) |
| Tangibility | 0.096 | 0.079 |
| | (0.397) | (0.315) |
| R&D | -0.311 | -0.294 |
| | (-1.330) | (-1.445) |
| Cash | -0.127 | -0.101 |
| | (-0.688) | (-0.819) |
| Log (Firm age) | -0.110* | -0.096 |
| | (-1.886) | (-1.407) |
| Sales growth | 0.014 | 0.005 |
| | (1.061) | (0.366) |
| Log (Board size) | 0.068 | 0.060 |
| | (0.732) | (0.590) |
| Board tenure | 0.019** | 0.015 |
| | (2.215) | (1.532) |
| Board independence | 0.653*** | 0.558* |
| | (2.735) | (1.914) |
| Female ratio | 0.442** | 0.235 |
| | (2.040) | (1.093) |
| No. of interlocking boards | -0.013* | -0.016** |
| | (-1.723) | (-2.202) |
| E-Score interlock | 0.149** | 0.153*** |
| | (2.029) | (3.168) |
| Firm FE | Yes | Yes |
| Year FE | Yes | No |
| Industry-year FE | No | Yes |
| Observations | 5,291 | 5,260 |
| $R^2$ | 0.684 | 0.729 |

## Table 7. Analyses based on disaster and board characteristics

This table reports the results from analysis based on disaster and board characteristics. The dependent variable is *KLD E-Score*. All regressions include the same set of control variables as in Table 3 column (2), whose coefficients are omitted for brevity. Detailed definitions of all variables are provided in Appendix A. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | KLD E-score | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Post | -0.022 | -0.025 | -0.028 | -0.032 |
| | (-0.742) | (-0.817) | (-0.898) | (-1.025) |
| Treat × Post | 0.118** | 0.175*** | 0.139*** | 0.144** |
| | (2.223) | (3.020) | (2.600) | (2.287) |
| Treat × Post × High_damage | 0.231*** | | | |
| | (3.078) | | | |
| Treat × Post × High_fatality | | 0.141* | | |
| | | (1.726) | | |
| Treat × Post × High_interlock | | | 0.295*** | |
| | | | (3.183) | |
| Treat × Post × Senior_interlock | | | | 0.180** |
| | | | | (2.366) |
| Control variables | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes |
| Industry-year FE | Yes | Yes | Yes | Yes |
| Observations | 5,260 | 5,260 | 5,260 | 5,260 |
| $R^2$ | 0.729 | 0.727 | 0.731 | 0.728 |

## Table 8. Analyses based on firm characteristics

This table reports the results from DDD analysis based on regional environmental belief. The dependent variable is *KLD E-Score*. All regressions include the same set of control variables as in Table 3 column (2), whose coefficients are omitted for brevity. Detailed definitions of all variables are provided in Appendix A. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | KLD E-Score | |
|---|---|---|
| | (1) | (2) |
| Post | 0.014 | -0.099* |
| | (0.514) | (-1.737) |
| Treat × Post | 0.127*** | 0.116 |
| | (3.063) | (1.537) |
| Treat × Post × Environmentally sensitive | 0.242* | |
| | (1.939) | |
| Treat × Post × Financially unconstrained | | 0.185** |
| | | (2.092) |
| Treat × Subgroup | -1.975*** | 0.002 |
| | (-5.973) | (0.022) |
| Post × Subgroup | -0.097 | 0.127* |
| | (-1.443) | (1.737) |
| Control variables | Yes | Yes |
| Firm FE | Yes | Yes |
| Industry-year FE | Yes | Yes |
| Observations | 5,260 | 5,260 |
| $R^2$ | 0.728 | 0.732 |

## Table 9. Natural disaster experience and corporate risk-taking

This table reports the results from the difference-in-differences analysis on corporate financial decisions and outcomes. The dependent variables are calculated from Compustat and CRSP. All other control variables are defined in Appendix A. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | Leverage | CASH | CapEx | R&D | Ret Vol | ROA Vol |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Post | 0.005 | 0.007 | 0.002 | -0.004 | 0.000 | -0.001 |
| | (0.854) | (1.590) | (0.855) | (-1.276) | (0.072) | (-0.249) |
| Treat × Post | 0.001 | -0.009 | 0.004* | 0.006 | -0.000 | 0.002 |
| | (0.106) | (-1.499) | (1.842) | (1.604) | (-0.685) | (0.683) |
| Log (Assets) | 0.011 | -0.030*** | -0.007 | 0.009* | 0.000 | -0.014** |
| | (1.059) | (-2.991) | (-1.478) | (1.663) | (0.220) | (-1.980) |
| ROA | -0.058 | 0.074* | 0.005 | -0.048** | -0.010** | -0.020 |
| | (-1.591) | (1.924) | (0.484) | (-2.369) | (-2.441) | (-0.920) |
| Leverage | 0.221*** | -0.080** | -0.012 | -0.006 | 0.004 | 0.048*** |
| | (6.587) | (-1.994) | (-0.748) | (-0.302) | (1.212) | (3.828) |
| Market-to-book | 0.002 | -0.006 | 0.005*** | -0.002 | 0.001** | 0.001 |
| | (0.475) | (-1.474) | (6.018) | (-0.719) | (2.507) | (0.388) |
| Tangibility | 0.123** | -0.277*** | -0.079*** | -0.026 | 0.009 | -0.025 |
| | (2.467) | (-4.201) | (-3.058) | (-1.005) | (1.456) | (-0.767) |
| R&D | -0.024 | 0.150 | -0.035* | 0.056 | -0.004 | -0.003 |
| | (-0.329) | (1.591) | (-1.699) | (1.058) | (-0.413) | (-0.059) |
| Cash | -0.017 | 0.099*** | 0.018 | -0.065*** | 0.003 | 0.005 |
| | (-0.489) | (2.779) | (1.504) | (-2.905) | (0.979) | (0.344) |
| Log (Firm age) | 0.003 | -0.002 | -0.014** | -0.018** | -0.002 | -0.019*** |
| | (0.212) | (-0.118) | (-2.434) | (-2.011) | (-1.443) | (-2.847) |
| Sales growth | 0.012** | -0.004 | 0.004* | -0.011* | 0.000 | 0.009** |
| | (2.011) | (-0.844) | (1.686) | (-1.778) | (0.105) | (1.975) |
| Log (Board size) | -0.013 | -0.017 | -0.016** | -0.002 | 0.002 | -0.028** |
| | (-0.587) | (-0.788) | (-2.096) | (-0.264) | (0.584) | (-2.264) |
| Board tenure | 0.001 | 0.002 | 0.001** | 0.000 | 0.000 | -0.002** |
| | (0.322) | (1.107) | (2.529) | (0.063) | (0.646) | (-1.994) |
| Board independence | 0.042 | -0.015 | 0.003 | 0.018 | -0.001 | -0.006 |
| | (0.869) | (-0.340) | (0.151) | (1.240) | (-0.223) | (-0.233) |
| Female ratio | -0.022 | 0.052 | -0.001 | 0.018 | 0.011** | -0.018 |
| | (-0.451) | (1.168) | (-0.078) | (0.951) | (2.421) | (-0.570) |
| No. of interlocking boards | 0.001 | 0.001 | 0.000 | -0.000 | 0.000 | 0.001* |
| | (1.055) | (0.822) | (1.178) | (-0.469) | (0.475) | (1.757) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry-year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,235 | 5,240 | 5,236 | 5,240 | 5,241 | 5,240 |
| $R^2$ | 0.939 | 0.934 | 0.896 | 0.942 | 0.750 | 0.891 |

## Table 10. Analyses based on prior climate change beliefs

This table reports results from the analyses based on affected interlocking directors' political ideology. The dependent variable is *KLD E-score.* The explanatory variable of interest is *Treat × Post × Donation_Democratic*. All regressions include the same set of control variables as in Table 3 column (2). Detailed definitions of all variables are provided in Appendix A. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | KLD E-score | |
|---|---|---|
| | (1) | (2) |
| Post | -0.019 | -0.027 |
| | (-0.720) | (-0.872) |
| Treat × Post | 0.203* | 0.183*** |
| | (1.885) | (3.053) |
| Treat × Post × Donation_Democratic | 0.322** | 0.294** |
| | (2.056) | (2.318) |
| Log (Assets) | -0.030 | 0.019 |
| | (-0.518) | (0.419) |
| ROA | 0.035 | -0.034 |
| | (0.226) | (-0.264) |
| Leverage | 0.088 | 0.063 |
| | (0.496) | (0.520) |
| Market-to-book | -0.002 | 0.014 |
| | (-0.135) | (1.403) |
| Tangibility | 0.986*** | 0.094 |
| | (3.014) | (0.368) |
| R&D | -0.482* | -0.251 |
| | (-1.725) | (-1.290) |
| Cash | -0.094 | -0.093 |
| | (-0.619) | (-0.754) |
| Log (Firm age) | -0.080 | -0.094 |
| | (-0.742) | (-1.360) |
| Sales growth | 0.018 | 0.003 |
| | (0.921) | (0.209) |
| Log (Board size) | 0.072 | 0.052 |
| | (0.479) | (0.515) |
| Board tenure | 0.026* | 0.014 |
| | (1.837) | (1.389) |
| Board independence | 0.317 | 0.623** |
| | (0.764) | (2.091) |
| Female ratio | 0.177 | 0.221 |
| | (0.564) | (1.011) |
| No. of interlocking boards | -0.008 | -0.013* |
| | (-0.530) | (-1.719) |
| E-Score interlock | 0.141** | 0.153*** |
| | (2.276) | (3.168) |
| Firm FE | Yes | Yes |
| Industry-year FE | Yes | Yes |
| Observations | 3,394 | 5,260 |
| $R^2$ | 0.746 | 0.729 |

## Table 11. Analyses on firms with low climate risk exposure

This table reports the results from subsample analysis on firms with low climate risk exposure. Column 1 examines firms located in areas with low climate risk and column (2) examines firms operating in climate invulnerable industries. The dependent variable is *KLD E-score*. All other control variables are defined in Appendix A. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | KLD E-Score | |
|---|---|---|
| | (1) | (2) |
| Post | -0.053 | -0.036 |
| | (-0.875) | (-0.973) |
| Treat × Post | 0.231* | 0.262*** |
| | (1.970) | (3.538) |
| Log (Assets) | 0.147* | 0.003 |
| | (1.678) | (0.065) |
| ROA | -0.024 | -0.167 |
| | (-0.091) | (-1.151) |
| Leverage | 0.462* | 0.149 |
| | (1.790) | (1.094) |
| Market-to-book | -0.011 | 0.009 |
| | (-0.719) | (0.847) |
| Tangibility | 0.843 | -0.366 |
| | (0.994) | (-1.172) |
| R&D | 0.041 | -0.377* |
| | (0.098) | (-1.695) |
| Cash | 0.300 | -0.134 |
| | (1.531) | (-0.897) |
| Log (Firm age) | -0.223* | -0.111 |
| | (-1.803) | (-1.362) |
| Sales growth | 0.008 | 0.005 |
| | (0.574) | (0.391) |
| Log (Board size) | 0.292 | -0.054 |
| | (1.490) | (-0.439) |
| Board tenure | 0.029 | 0.019* |
| | (1.590) | (1.723) |
| Board independence | 0.581 | 0.329 |
| | (0.821) | (1.036) |
| Female ratio | -0.398 | 0.094 |
| | (-0.576) | (0.425) |
| No. of interlocking boards | -0.029 | -0.007 |
| | (-1.618) | (-0.759) |
| E-Score interlock | -0.008 | 0.174*** |
| | (-0.143) | (3.301) |
| Firm FE | Yes | Yes |
| Industry-year FE | Yes | Yes |
| Observation | 1,009 | 4,029 |
| $R^2$ | 0.830 | 0.702 |

## Table 12. Alternative measures of environmental and social performance

This table reports results from the difference-in-differences analyses using alternative measures of environmental performance. The dependent variables are *Asset4 E-Score* in column (1), *Asset4 S-Score* in column (2), and *TTR* in column (3). The key explanatory variable is *Treat × Post*. All regressions include the same set of control variables as in Table 3 column (2), whose coefficients are omitted for brevity. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | Asset4 E-Score | Asset4 S-Score | TTR |
|---|---|---|---|
| | (1) | (2) | (3) |
| Post | -1.718** | -1.378 | 0.091 |
| | (-2.076) | (-1.026) | (0.782) |
| Treat × Post | 2.392* | 0.124 | -0.278* |
| | (1.878) | (0.089) | (-1.840) |
| Control variables | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Industry-year FE | Yes | Yes | Yes |
| Observations | 727 | 727 | 519 |
| $R^2$ | 0.905 | 0.906 | 0.980 |

## Table 13. Alternative setting: disaster shock at directors' residential locations

This table reports results from the alternative setting, where disasters at directors' residential locations are used as shocks. All regressions include the same set of control variables as in Table 3 column (2), whose coefficients are omitted for brevity. In parentheses are robust t-statistics adjusted for firm-level clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | MSCI KLD E-score | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Post | -0.036 | -0.024 | |
| | (-1.252) | (-1.053) | |
| Treat × Post | 0.129*** | 0.125** | |
| | (2.802) | (2.532) | |
| Treat × Pre2 | | | -0.029 |
| | | | (-0.706) |
| Treat × Pre1 | | | 0.008 |
| | | | (0.247) |
| Treat × Post1 | | | 0.100** |
| | | | (2.238) |
| Treat × Post2 | | | 0.170** |
| | | | (2.560) |
| Pre2 | | | -0.000 |
| | | | (-0.007) |
| Pre1 | | | -0.008 |
| | | | (-0.310) |
| Post1 | | | -0.007 |
| | | | (-0.251) |
| Post2 | | | -0.056 |
| | | | (-1.397) |
| Control variables | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Year FE | Yes | No | No |
| Industry-year FE | No | Yes | Yes |
| Observations | 2,352 | 2,318 | 2,318 |
| $R^2$ | 0.807 | 0.845 | 0.845 |