Natural disaster risk salience and the strategic appointment of directors with sustainability expertise

Bo Wang

Department of Banking and Finance, University of Southampton Business School, University of Southampton, Southampton, United Kingdom

Correspondence

Bo Wang, Department of Banking and Finance, University of Southampton Business School, University of Southampton, Southampton, United Kingdom SO17 1BJ.

Email: b.wang@soton.ac.uk

Abstract

This article examines how salient sustainability risks from near-miss natural disasters influence board composition. Using a difference-in-differences design, I find that firms located in counties neighboring disaster-affected areas significantly increase the presence of directors with sustainability expertise following the disaster. The effect is stronger for firms with greater institutional ownership and responsible investor ownership, suggesting that these governance changes are driven by investor expectations and preferences. Further analysis shows that these board changes are not short-lived, do not crowd out directors with other qualifications, and contribute to improvements in sustainability performance and firm value. Collectively, these findings highlight risk salience as a catalyst for strategic board restructuring.

JEL CLASSIFICATION G34, M14, Q54

1. INTRODUCTION

Sustainability governance has become a core component of corporate strategy, and effective board oversight is now considered necessary to fulfill fiduciary responsibility (Chowdhury et

al., 2021; Ni, 2020).[1] Boards need directors with sustainability-related expertise to strengthen firms' capacity to manage environmental uncertainty and respond to evolving stakeholder expectations. A 2024 PricewaterhouseCoopers (PwC) survey revealed that about 60% of directors consider sustainability expertise essential for board service.[2] Against this backdrop, understanding how firms adjust their boards in response to sustainability risks is increasingly important. In this article, I investigate whether salient sustainability risks—triggered by nearby but not directly damaging natural disasters—lead firms to appoint directors with sustainability expertise.

Resource dependence theory provides a useful framework for understanding how firms adjust board composition in response to the external environment. By providing essential resources, such as information, expertise, and legitimacy, the board of directors helps firms to manage environmental dependencies (Hillman et al., 2009; Pfeffer & Salancik, 1978). From this perspective, appointing directors with sustainability expertise thus reflects a strategic response to rising environmental complexity and evolving stakeholder expectations.

Yet despite both practical and theoretical recognition of its importance, many boards still lack the expertise necessary to meet emerging sustainability governance responsibilities (S.-S. Chen et al., 2020; Ilhan et al., 2023). According to the 2018 Coalition for Environmentally Responsible Economies (CERES) study of leading global firms, only 17% have board members with demonstrated sustainability-related expertise.[3] Several barriers may prevent firms from appointing such directors. First, qualified directors with sustainability

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[1] In 2019, the Business Roundtable redefined corporate purpose, emphasizing that companies should prioritize the interests of all stakeholders, including customers, employees, suppliers, and the broader community, alongside delivering value to shareholders. See details at: https://purpose.businessroundtable.org.
[2] See *2024 Annual Corporate Directors Survey: Uncertainty and transformation in the modern boardroom*, Available at: https://corpgov.law.harvard.edu/2024/10/13/2024-annual-corporate-directors-survey-uncertainty-and-transformation-in-the-modern-boardroom/ .
[3] See *Systems Rule: How Board Governance Can Drive Sustainability Performance*. Available at: https://www.ceres.org/resources/reports/systems-rule-how-board-governance-can-drive-sustainability-performance#:~:text=Integrating%20sustainability%20across%20board%20governance,goals%20will%20make%20a%20difference.

expertise are relatively scarce, creating search difficulties and higher recruitment costs. Second, adding such directors may entail trade-offs with other valuable qualifications, such as operational leadership or industry-specific knowledge. Consequently, some firms may choose lower-cost responses, such as enhancing disclosure (Huang et al., 2022), rather than board restructuring.

Beyond these practical constraints, a more fundamental barrier lies in firms' underestimation of sustainability-related risks. Many firms fail to recognize the immediacy and severity of such risks, particularly when their financial and operational consequences are uncertain or difficult to assess (Iliev & Roth, 2023). As a result, firms are less likely to recognize the strategic importance of board-level sustainability expertise and may refrain from appointing directors with the capabilities to address these challenges.

Salient events can help bridge this awareness gap by acting as an attentional mechanism that prompts individuals and organizations to adapt and respond (Tversky & Kahneman, 1973, 1974). Near-miss natural disasters that occur nearby but do not directly impact the firm can serve as vivid and salient shocks that heighten awareness of sustainability risks. These risks, such as supply chain disruptions, service interruptions, and stakeholder disengagement, carry significant operational and reputational consequences. [4] By illustrating the potential destructive impact of sustainability threats, these "wake-up calls" amplify risk perception and elevate sustainability on the corporate agenda. In recognizing the tangible consequences of environmental threats, firms may come to better appreciate the strategic value of sustainability engagement, particularly its role in strengthening resilience and maintaining operations during periods of disruption (Lins et al., 2017; Shen et al., 2023).

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[4] See *World Economic Forum*. *The Global Risks Report 2019*. Available at: https://www3.weforum.org/docs/WEF_Global_Risks_Report_2019.pdf.

Importantly, salient events reshape investor expectations around environmental threats and governance needs. As institutional investors increasingly recognize the financial materiality of sustainability risks, they have become more proactive in influencing firms' strategic and governance responses (Ilhan et al., 2023; Krueger et al., 2020). While prior studies highlight investors demand for enhanced sustainability disclosure (Huang et al., 2022), they can also exert direct pressure on firms to restructure their boards to better align with long-term sustainability objectives. Director appointments, in particular, serve as a direct channel through which investors can influence boardroom composition and sustainability governance (Dyck et al., 2023). Accordingly, salient sustainability shocks can act as a catalyst to drive the strategic appointment of directors with sustainability expertise.

To isolate the effects of heightened sustainability risk salience, I focus on firms located near, but not directly impacted by, severe natural disasters, following the empirical strategy of Dessaint and Matray (2017) and Huang et al. (2022). This approach takes advantage of the exogenous nature of natural disasters as salience shocks, providing a cleaner identification of firms' voluntary governance responses while largely mitigating potential endogeneity concerns associated with direct disaster exposure. Building on this identification strategy, I employ a difference-in-differences (DiD) framework that compares firms located in counties neighboring disaster-affected areas with a matched sample of firms in unaffected, non-adjacent counties to examine whether heightened sustainability risk salience increases the appointment of directors with sustainability expertise. To capture both operational and governance-related expertise relevant to firms' sustainability oversight (Paine, 2014), directors with sustainability expertise are defined as individuals who have prior experience in sustainability-focused roles or who have served on sustainability-related board committees, as in Burke et al. (2019) and Homroy and Slechten (2019).

Using a sample of U.S. firms from 2003 to 2021, I find that heightened salience of sustainability risks following nearby natural disasters leads to a significant increase in the appointment of directors with sustainability expertise. Specifically, firms located near disaster-affected areas are 5.8% more likely to appoint at least one director with sustainability expertise in the 3 years following the disaster, and the board share of sustainability directors increases by 17.1% relative to the sample mean. These results suggest that salient environmental shocks prompt firms to reassess their governance structures, resulting in greater board-level representation of sustainability expertise.

To ensure the validity and robustness of the findings, I conduct a series of additional analyses. These include a dynamic DiD analysis to test the parallel trends assumption, placebo tests to confirm that the results are not driven by spurious correlations, and alternative identification strategies that account for subsequent disaster overlap, local economic spillovers, and the geographic dispersion of large firms. The results also withstand a battery of robustness tests, including variations in the matching procedure, alternative measures of sustainability directors, and different definitions of natural disasters. Additional tests rule out the alternative explanation that broader trends in the appointment of female or public-sector directors drive the results (Cho et al., 2017; Rao & Tilt, 2016).

It is important to note that not all firms respond to salient sustainability risks in the same way. Because board appointments require shareholder approval, investors' philosophical resistance or preferences can play a critical role in shaping these governance adjustments. To capture both the mechanism and the heterogeneity in firm responses, I examine whether firms with different ownership structures respond differently to salient environmental risks. Prior research documents that near-miss natural disasters amplify investors' perceived salience of sustainability risks (Huang et al., 2022), and that institutional investors are increasingly paying more attention to sustainability risks and prefer to engage actively with firms to address them

(Ilhan et al., 2023; Krueger et al., 2020). Consistent with the investor-driven mechanism, I find that the post-disaster increase in directors with sustainability expertise is significantly more pronounced among firms with higher institutional ownership and greater exposure to responsible investors (e.g., United Nations Principles for Responsible Investment (UN PRI) signatories). These findings suggest that salient environmental shocks act as catalysts that amplify investors' sustainability preferences, thereby producing heterogeneous board-level adjustments across firms.

To further assess whether the observed appointments of directors with sustainability expertise are strategic and value-relevant rather than overreaction or symbolism, I conduct three additional analyses. First, I assess the persistence of sustainability director appointments over a 10-year horizon and find that these appointments remain. This pattern suggests a long-term strategic response (Huang et al., 2022), not a short-lived overreaction (Dessaint & Matray, 2017). Second, I examine whether these appointments crowd out directors with other valuable qualifications—such as operating or education-related expertise, or relational capital—and find no evidence of such trade-offs, alleviating compromised board quality concerns and suggesting that these appointments enhance overall board capacity. Finally, I show that treated firms that appoint directors with sustainability expertise subsequently exhibit stronger corporate social responsibility (CSR) performance, lower carbon emissions, more environmental spending, and higher firm value, suggesting that the appointments have tangible and strategic benefits.

This study makes several important contributions to the literature on corporate governance and sustainability. First, it contributes to research on board structure and resource dependence theory by demonstrating how firms strategically adjust their board structure in response to heightened sustainability risks. Despite the growing importance of sustainability issues, many boards lack directors with the necessary expertise to address these challenges effectively. While prior studies have examined the role of directors in providing expertise on

sustainability issues (Iliev & Roth, 2023), little is known about the factors driving such appointments. I show that sustainability risk salience is an economically meaningful factor that increases the presence of directors with sustainability expertise. This evidence underscores the evolving role of the board of directors in managing external dependencies and strengthening sustainability governance.

Second, this study adds to the literature on firm responses to salient environmental risks by identifying board restructuring as a distinct governance mechanism. While prior research has emphasized operational responses, such as increased cash holdings (Dessaint & Matray, 2017) and enhanced environmental, social, and governance (ESG) transparency (Huang et al., 2022), I show that firms also strategically reshape board composition to enhance sustainability oversight. Compared to firm-level policy changes, board adjustments represent a more substantive and strategic governance response, reflecting a fundamental shift in how investors and firms engage with governance practices, consistent with a long-term commitment to managing sustainability risks (Dyck et al., 2023). Importantly, the appointments of directors with sustainability expertise do not come at the expense of other valuable board qualifications, but rather an enhancement of board capabilities to address complex sustainability challenges. In doing so, this study extends the existing literature by identifying a novel channel—board composition changes—through which firms respond to salient sustainability risks.

Third, the article sheds light on the role of investor pressure in shaping board-level responses to salient environmental risks. Prior research shows that institutional investors increasingly engage with firms to address sustainability and climate-related challenges, often favoring active engagement—such as filing shareholder proposals and influencing governance decisions—over divestment (Ilhan et al., 2023; Krueger et al., 2020). Consistent with this literature, I show that firms with greater holdings by investors who prioritize sustainability are more likely to appoint sustainability-experienced directors following salient environmental

events. These results indicate that board restructuring is an investor-driven channel for shaping corporate sustainability oversight, and investor preferences are pivotal to the response. Therefore, my findings also offer practical insights for firms and investors navigating environmental risk and inform policy debates on board-level sustainability oversight.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Theoretical background

Much of the extant literature on board composition emphasizes agency theory, which views directors primarily as monitors of managerial behavior tasked with mitigating agency conflicts between managers and shareholders (Fama & Jensen, 1983). However, this perspective overlooks the fact that the board of directors also serves as the firm's ultimate legal authority, responsible for key strategic and organizational decisions (Adams & Ferreira, 2007). Resource dependence theory, which provides a complementary framework, emphasizes that organizations are not self-sufficient but depend on the board of directors for access to critical resources (Pfeffer & Salancik, 1978). In this view, the board of directors serves not only as a monitor but also as a resource provider, helping the firm navigate external dependencies by facilitating access to information, expertise, and legitimacy (Hillman et al., 2009).

Importantly, resource dependence theory posits that variations in board composition are purposeful responses to environmental conditions, whereby firms appoint directors who can help reduce environmental uncertainty (Hillman et al., 2000; Pfeffer, 1972). These appointments reflect not only internal governance considerations but also strategic efforts to align board capital with evolving external demands. By contributing these resources, directors enable firms to more effectively navigate uncertainty and strengthen their position within the broader institutional environment. For instance, research shows that directors with regulatory expertise can reduce regulatory uncertainty by offering valuable insights and lowering transaction costs associated with regulatory agencies (Hillman et al., 2000). Moreover,

resource-rich directors contribute to enhancing corporate reputation and credibility, strengthening a firm's position in the competitive landscape (Daily & Schwenk, 1996; Hambrick & D'Aveni, 1992).

Although not explicitly referencing resource dependence theory, studies in the finance literature demonstrate that firms often select directors whose expertise aligns with the firm's specific strategic needs and improves the firm's adaptability to external challenges. This line of research emphasizes that directors with domain-specific expertise can enhance firm decision-making and performance. For instance, directors with financial expertise contribute positively to firm financing and investment decisions (Burak Güner et al., 2008), and profitability (Apergis, 2019). Similarly, directors with prior acquisition experience improve acquisition outcomes by helping firms identify high-synergy targets (Field & Mkrtchyan, 2017). Firms also benefit from appointing directors with industry- or region-specific knowledge, especially during international expansion or sector-specific shocks (Adams, 2010; Masulis, 2012). Directors with upstream or downstream experience help anticipate industry shifts and mitigate supply chain risks (Dass et al., 2014), while China-related expertise enhances board advisory capacity and cross-border performance following trade liberalization with China (S.-S. Chen et al., 2020). These patterns highlight the critical role of board composition as a strategic mechanism for managing environmental uncertainty and securing access to vital external resources. However, the finance literature offers limited insight into the determinants of appointing directors with specific expertise.

2.2 Salient risk and directors with sustainability expertise

Individual decision-making is significantly influenced by salience-based theories, which posit that individuals disproportionately focus on vivid, recent, or emotionally impactful events, leading to heightened perceptions of their likelihood or relevance (Tversky & Kahneman, 1973, 1974). In the corporate context, such salience effects can shape managerial and investor

perceptions, leading firms to adjust their policies. For instance, since natural disasters often result in material adverse outcomes, such as property damage, reduced revenue, and lower operating income (Addoum et al., 2023; Pankratz et al., 2023), firms near, but not directly affected by, natural disasters react to perceived risks by excessively increasing cash holdings, even though their actual exposure to future disaster risk remains unchanged (Dessaint & Matray, 2017). While this illustrates the potentially distorting effects of salience risk, other studies show that salient events can also lead to constructive behavioral shifts. Huang et al. (2022), for example, find that the heightened salience of environmental risks resulting from natural disasters prompts firms to enhance the transparency of their ESG disclosures. These findings suggest that salient environmental events can interrupt default corporate norms, making sustainability issues more cognitively prominent and strategically urgent.

Institutional investors play a pivotal role in shaping firms' ESG strategies, particularly in response to environmental risks. Krueger et al. (2020) find that investors recognize the financial implications of climate risk for their portfolios and prefer proactive engagement to address these challenges. Likewise, Ilhan et al. (2023) document strong investor demand for climate-related disclosure, reflecting broader expectations of corporate accountability in managing environmental risks. These preferences are not merely normative but grounded in the strategic benefits of sustainability engagement. Prior research shows that sustainability practices yield resilience-enhancing and insurance-like value, particularly under salient sustainability threats. For instance, Lins et al. (2017) find that firms with stronger CSR performance retain higher stakeholder trust and perform better during crises. Ozkan et al. (2023) show that CSR mitigates the adverse effects of climate exposure on firm outcomes, especially in high-risk settings. Moreover, Rice and Schiller (2022) demonstrate that philanthropic responses to disasters can lower employee turnover, underscoring the organizational benefits of sustainability-aligned actions.

While prior research emphasizes that firms respond to sustainability-related pressures by adjusting financial and disclosure practices, less attention has been paid to whether, and how, investors influence board composition as a mechanism to align governance with their sustainability preferences. Emerging empirical evidence supports the benefits of appointing sustainability-experienced directors. These directors play a crucial role in overseeing sustainability policies, advising on strategic initiatives, and mitigating sustainability-related risks. For instance, Homroy and Slechten (2019) show that the presence of directors with environmental experience is associated with lower greenhouse gas emissions. Homroy et al. (2020) find that CSR-experienced directors increase compliance with mandated CSR regulations while lowering associated implementation costs. Likewise, Iliev and Roth (2023) find that sustainability-experienced board members are associated with superior ESG performance. Since the appointment of directors is a key governance mechanism through which investors influence firm behavior, investors may drive board changes to close the gap between their sustainability expectations and managerial decision-making (Dyck et al., 2023).

In summary, resource dependence theory posits that board composition can be understood as a strategic adaptation to external pressures. Directors with specialized expertise bring valuable knowledge and access to external networks that help firms manage stakeholder demands, comply with evolving regulations, and adapt to changing environmental standards. As sustainability becomes a central priority on board agendas (Chowdhury et al., 2021; Ni, 2020), directors are increasingly expected to oversee ESG strategy, manage stakeholder concerns, and navigate environmental complexity (Amin et al, 2020; Borghesi et al., 2014). Importantly, salient sustainability events, such as nearby natural disasters, can heighten investor attention to sustainability risks, making them more cognitively prominent and strategically relevant. As firms often anticipate and respond to stakeholder and investor expectations when making board-level changes (Dyck et al., 2023), such salience and external

pressure may prompt firms to reassess board composition to ensure their governance structures are equipped to address rising sustainability challenges. By appointing directors with sustainability expertise, firms strengthen their capacity for sustainability governance. These directors contribute domain-specific knowledge, enhance board credibility to stakeholders, and help firms respond more effectively to external pressures. Accordingly, when environmental risks become more salient, firms may be more likely to appoint sustainability-experienced directors. Based on this reasoning, I develop the following hypothesis:

H1: *Heightened salience of sustainability risks is associated with an increase in the presence of directors with sustainability expertise.*

3. DATA AND METHODOLOGY

3.1 Data source

I gather information on directors' employment history from BoardEx. Following the approaches used in Burke et al. (2019), Homroy and Slechten (2019), and Peters and Romi (2015), I identify directors with sustainability expertise using a keyword-based classification method. [5] A director is classified as having sustainability expertise if they held a sustainability-related position during their previous employment or served on a sustainability committee as a board member at other firms.

Information on natural disasters is obtained from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) managed by Arizona State University. The database provides detailed information on event names, dates, property damages, fatalities, and affected locations of counties and states in the U.S. I follow Cortés and Strahan (2017) to include only natural disasters in which the governor declared a "state of emergency" with a

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[5] The keywords used to identify sustainability-related job functions and committees include: best practices, charitable contributions, charitable giving, civic, community development, corporate (social) responsibility, CSR, diversity, employee development, employee health, employee responsibility, employee safety, environment, environmental, ethics, external relations, health and safety, operational safety, product quality, professional development, public affairs, public interest, public issues, public policy, public responsibility, social responsibility, stakeholder, and sustainability.

formal request for Federal Emergency Management Agency (FEMA) funds to respond to the disaster from 2003 to 2020.[6] Thus, all the disasters included in the sample are severe. However, the degree of severity varies significantly across locations. While the disaster is significant at the state level, some counties can be only marginally affected. To ensure that only severe events are included in our sample, I restrict the analysis to county-level events with total combined property and crop damages exceeding $50,000 (in 2021 dollars), as in Aretz et al. (2019). This focus on severe disasters is consistent with the salience mechanism, as only highly disruptive events are likely to generate cognitive and institutional responses.[7] Table A1 in the Appendix reports summary statistics on the number of counties affected and the total damage experienced, disaggregated by disaster type. Despite the relatively modest threshold for total damages I imposed, the average disaster-hit county in the sample incurs $47.2 million in direct total damages, underscoring the substantial economic impact of these events.

To identify the county in which each firm is headquartered, I collect historical headquarters addresses from firms' 10-K filings over the sample period. I then match each firm to a county using its full ZIP code. If a ZIP code corresponds to multiple counties, I use the full address to determine the precise county. Firm fundamental is retrieved from Compustat. I exclude financial institutions (SIC codes 6000–6999) and regulated utilities (SIC codes 4900–4999). Data on institutional ownership are from London Stock Exchange Group (LSEG) (formerly Refinitiv) Workspace Institutional (13F) Holdings. Firm-level CSR performance is extracted from the Morgan Stanley Capital International (MSCI) KLD Research & Analytics

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[6] These are presidentially declared disasters (PDD) from SHELDUS version 21. The sample period starts in 2003 because BoardEx coverage is limited before that year. While the Hazards data on natural disasters is available through 2020, I use board composition data through 2021 to capture director appointments in the year following a disaster.

[7] In addition, focus on severe disasters to preserve a sufficiently large pool of eligible control firms. Control firms are defined as those not affected by any disaster during the sample period. Including minor or less impactful events would reduce the availability of comparable untreated firms, thereby limiting the reliability of the matching process and the validity of treatment–control comparisons.

database. Firm CO2 emissions and environmental spending are from LSEG. The final sample

comprises 1,022 unique firms and 7,057 firm-year observations with complete data.

3.2 Empirical method

Following Dessaint and Matray (2017) and Huang et al. (2022), I employ a DiD design to

identify how heightened environmental risk salience from nearby, but not directly impacting,

natural disasters affects firms' board composition. This empirical strategy uses the exogenous

timing and geographic location of natural disasters as shocks to the perceived salience of

environmental risks, rather than changes in objective risk exposure or operational conditions.

To ensure that the disaster constitutes a salient and unexpected shock, a disaster shock is

defined only if the county did not experience any disasters in the preceding 3 years. By focusing

on firms in adjacent counties, this design largely mitigates endogeneity concerns that board

adjustments may reflect operational disruptions, regulatory obligations, or financial distress

directly caused by disaster impacts (Dessaint & Matray, 2017; Huang et al., 2022).[8] Thus, any

observed changes in board composition can be more credibly attributed to strategic governance

responses to heightened perceptions of environmental risk. Therefore, I implement this design

using the following model specification:

$$\begin{aligned} Sustainability\ Expertise\ Director_{i,t} = \ &\alpha + \beta_1 Treated_i \times Post\ Disaster_{i,t} + \\ &\beta_2 Post\ Disaster_{i,t} + \delta\ Controls_{\ i,t-1} + \lambda_i + \mu_{j,t} + \gamma_{s,t} + \varepsilon_{i,t}, \end{aligned} \quad (1)$$

where $Sustainability\ Expertise\ Director_{\ i,t}$ represents either $With\ Sustainability\ Director$,

a binary variable equal to 1 if the firm has at least one independent director with

sustainability expertise, or $Sustainability\ Director\ Ratio$, the proportion of independent

directors with sustainability expertise relative to the total number of independent directors on

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[8] While this approach cannot fully rule out all forms of economic exposure to disasters—particularly for firms located in areas with economic spillovers from disaster-hit counties or firms with operational facilities outside their headquarters county that may be directly affected—it substantially reduces the possibility that the observed board changes are mechanically driven by direct disaster impacts. I provide additional analyses addressing these concerns in Section 4.4.

the board.[9] To ease interpretation, I follow Homroy et al. (2020) to estimate a linear probability model on Equation (1) when the dependent variable is *With Sustainability Director* to estimate the likelihood of sustainability director appointments.

In the baseline analysis, I focus on a 6-year window encompassing 3 years before and 3 years after each disaster event. *Post Disaster* is set to 1 for the year of the disaster and the 2 subsequent years, and to 0 for the 3 years prior to the disaster. *Treated* equals 1 for firms in the treatment group and 0 for matched control firms. The treatment group is defined as firms headquartered in counties located within 50 miles of disaster-affected counties but not directly hit by the disaster themselves. The control group includes firms headquartered in counties that were neither affected by disasters nor adjacent to affected areas during the sample period.

To ensure comparability and mitigate selection bias, I apply propensity score matching (PSM), pairing each treated firm with a closest matched firm from the control group in the year immediately preceding the disaster shock. Matching is based on all firm-level covariates included in the baseline regression measured in the year prior to the natural disaster, and is restricted to firms within the same Fama-French 30 industry classification. I implement one-to-one nearest-neighbor matching with replacement, which allows a larger share of treated firms to be matched to close observable controls.[10] Table 1 reports the covariate balance for the matching variables of the treated firms and their matched control firms for the period prior to natural disaster shocks. The reported p-values from t-tests show no statistically significant

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[9] I focus specifically on independent directors for several reasons. First, the resource dependence theory emphasizes that independent directors, by virtue of their external networks and affiliations, are especially valuable in providing firms with access to critical resources, strategic information, and external legitimacy (Pfeffer & Salancik, 1978). Second, independent directors are less susceptible to internal managerial influence and are better equipped to monitor firm behavior in line with shareholder interests (Fama & Jensen, 1983). Third, evidence further suggests that independent directors carry greater signaling value for institutional investors, particularly in the context of sustainability governance, and are more likely to reflect investor-driven governance preferences (Dyck et al., 2023). Focusing on independent sustainability directors thus allows for a more precise examination of board-level governance adjustments that are strategically motivated.

[10] Item IA.1 of the Internet Appendix presents baseline regression results based on alternative PSM approaches, including matchings that additionally control for geographic-level variables, allow up to 3 matched control firms per treated firm, and employ matching without replacement. Results are qualitatively similar to the main matching method.

differences in the mean values of the matching variables between the two groups, suggesting successful covariate balance. Figure 1 depicts the geographical distribution of counties that experienced disasters and the counties where the treated firms are headquartered.

[Table 1 Around Here]

[Figure 1 Around Here]

Following previous studies, including Coles et al. (2008), Ferreira et al. (2011) and Li and Wang (2023), I control for an array of variables that are known to affect board structure, including *Ln Firm Size*, *ROA*, *Market-to-Book*, *Leverage*, *Cash Holding*, *R&D*, *Ln Firm Age*, *Tangibility*, *Ln Board Size*, *Institutional Ownership*, and *Local Director Pool*. λ_i represents firm fixed effects, which control for time-invariant heterogeneity across firms, $\mu_{j,t}$ denotes industry-by-year fixed effects, which control for shocks or trends at the industry level, and $\gamma_{s,t}$ represents state-by-year fixed effects, capturing local policy or state-level economic spillovers that may confound the treatment effect. Standard errors are clustered at the firm level. *Treated × Post Disaster* captures the causal effect of salient risks on the presence of directors with sustainability expertise. Hypothesis 1 predicts β_1 to be positive and statistically significant. Detailed variable definitions are presented in Table A2 in the Appendix.

3.3 Describe statistics

Table 2 presents descriptive statistics for the main variables used in this study. Panel A summarizes the statistics for the full sample, Panel B for treated firms, and Panel C for matched control firms. In Panel A, the mean value of *With Sustainability Director* is 0.211 for the full sample, indicating that, on average, 21.1% of firms have at least one sustainability expert director on their boards. The mean of *Sustainability Director Ratio* is 0.035, suggesting that, on average, only 3.5% of independent directors are classified as directors with sustainability expertise.

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Panels B and C show that treated firms exhibit a higher presence of directors with sustainability expertise compared to control firms throughout the sample period. The mean value of *With Sustainability Director* is 0.217 for treated firms and 0.205 for control firms, while the mean value of *Sustainability Director Ratio* is 0.036 for treated firms and 0.034 for control firms. The difference in means between the two groups is statistically significant at the 5% level for both *With Sustainability Director* and *Sustainability Director Ratio*. However, the median value for both variables is 0 across all groups, reflecting the relatively low presence of directors with sustainability expertise overall. This observation underscores that sustainability expertise has not yet become a universal feature of corporate boards, consistent with the findings of the 2018 CERES study.

[Table 2 Around Here]

4. EMPIRICAL FINDINGS

4.1 Baseline results

To test the main hypothesis, I empirically examine Equation (1) and present the results in Table 3. The dependent variable in Column (1) is *With Sustainability Director*. Despite the inclusion of comprehensive multi-dimensional fixed effects, the coefficient estimate on *Treated × Post Disaster* is 0.058 and statistically significant at the 1% level.[11] This result suggests that, on average, firms in counties neighboring those affected by natural disasters are 5.8% more likely to appoint a sustainability expert director to their board in the years following the disasters, compared to similar firms located in counties that neither experienced natural disasters nor were near disaster-affected areas. The dependent variable in Column (2) is *Sustainability*

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[11] I control for firm fixed effects in the analysis, as there is sufficient within-firm variation in board composition regarding the presence of sustainability expertise directors. Cicero et al. (2013) and Ferreira et al. (2011) argue the notion that board structure is largely time-invariant may be more myth than reality, as firms often adjust their board structure in response to evolving governance needs. Previous studies, including S.-S Chen et al. (2020), control for firm fixed effects when examining board composition for the appointment of specific types of directors. In unreported tests, I control for industry and year fixed effects, firm and year fixed effects and obtain qualitatively similar results.

Director Ratio, and *Treated × Post Disaster* also attracts a positive (0.006) and significant coefficient. The increase in the representation of directors with sustainability expertise on the board is also economically significant. For an average firm in our sample, the mean value of *Sustainability Director Ratio* is 0.035, thus, this increase suggests approximately 17.1% increase from its mean.

[Table 3 Around Here]

Since treated firms are not directly impacted but are located near disaster-hit areas, the results suggest that the heightened salience of environmental risks prompts firms to reassess their governance structures and appoint directors with sustainability expertise, thereby enhancing their capacity to respond to perceived risk salience related to sustainability challenges. These findings are consistent with previous studies, such as Huang et al. (2022), which show that heightened perceptions of risk increase firms' attention to sustainability-related issues and prompt strategic changes. Thus, proximity to natural disasters acts as a catalyst for firms to reconsider their governance structures in response to perceived sustainability risks, supporting the hypothesis that heightened sustainability risk awareness leads to a greater presence of directors with sustainability expertise on corporate boards.

4.4 Identification and empirical validation

In this section, I conduct a series of validation tests to strengthen the credibility of the causal interpretation, including tests for the parallel trends assumption, falsification tests to rule out random chance, and checks of treatment exclusivity, such as overlapping exposure across treatment groups, economic spillovers from neighboring counties, and the geographic dispersion of large firms.

4.4.1 Dynamic DiD

A key assumption for employing a dynamic DiD design is the parallel trends assumption. In this context, the parallel trends assumption requires that, in the absence of the disaster shock,

treated and control firms would have followed similar trends in the presence of sustainability expertise directors on their boards. This ensures that any observed changes in the presence of directors with sustainability expertise following the shock are driven by the treatment effect, rather than by pre-existing differences between the treated and control groups. I, therefore, perform a dynamic analysis surrounding the disaster shock to verify the parallel trend assumption. Specifically, I construct time indicators for periods before and after the disaster, following the approach of Asgharian et al. (2024). These time indicators span from 2 years before the shock (*Year -2*, *Year -1*) to 3 years after the shock (*Year 0*, *Year +1*, *Year +2*), with the year 3 prior to the disaster (*Year -3*) omitted as the benchmark to avoid collinearity. By interacting these time indicators with the *Treated* variable, I re-estimate Equation (1).

Table 4 presents the result of the dynamic DiD analysis. The coefficients on the interaction terms for the 2 years preceding the disaster shock (*Treated × Year -2*, *Treated × Year -1*) are statistically insignificant for *With Sustainability Director* and *Sustainability Director Ratio* in Columns (1) and (2), respectively. However, the coefficients on the interaction terms for the post-shock periods (*Treated × Year 0*, *Treated × Year +1*, and *Treated × Year +2*) are all positive and statistically significant. The dynamic DiD analysis shows that treated and control firms exhibit similar trends regarding the presence of directors with sustainability expertise before the shock and that differences emerge only after the disaster event, thereby supporting the validity of the parallel trends assumption and strengthening the causal interpretation of the results.

[Table 4 Around Here]

4.4.2 Placebo tests

To further rule out spurious correlations between natural disaster shocks and the increased presence of sustainability expertise directors, I perform a set of falsification tests with placebo regressions. Specifically, I randomly assign firms to the treated group and disaster years.

Pseudo Treated is set to 1 for firms that are randomly assigned to the treated group, and *Pseudo Post* equals 1 in years following randomly assigned disaster years. I perform 1,000 simulations, re-estimating Equation (1) each time for both *With Sustainability Director* and *Sustainability Director Ratio*, to reduce the influence of random chance or coincidental factors.

The distributions of the coefficients for *Pseudo Treated × Pseudo Post* are plotted in Figure 2. The mean value of pseudo coefficients on *Pseudo Treated × Pseudo Post* from the 1,000 simulations in Panel A for *With Sustainability Director* is -0.001, which is significantly different from that in Column (1) of Table 3 (0.058). And the mean value of pseudo coefficients on the interaction term in Panel B for *Sustainability Director Ratio* is close to 0, also significantly different from the actual coefficient in Column (2) of Table 3 (0.006). These tests affirm that the key finding reflects a causal relationship driven by actual natural disaster shocks in neighboring counties, as they corroborate the shock's salience and strengthen the credibility of the identification strategy.

[Figure 2 Around Here]

4.4.3 Subsequent disaster overlaps

To capture unanticipated shocks, the main identification strategy defines a disaster shock as an event occurring in a county with no disasters in the prior 3 years. However, some regions may experience recurring disasters, leading to additional shocks during the post-treatment period. These consecutive disasters can complicate the clean interpretation of the estimated effects. To address this concern, I implement two complementary strategies.

First, I construct the variable *Subsequent Disaster*, which equals 1 if the firm's associated disaster-hit county experiences any additional disaster within the 2-year period following the initial shock, to control for the potential confounding effects of overlapping exposures. Columns (1) and (2) of Panel A in Table 5 show that the coefficient on *Subsequent Disaster* is statistically insignificant, suggesting that follow-on disasters do not affect the

appointment of directors with sustainability expertise. This finding aligns with prior literature suggesting that the initial disaster shock generates the strongest psychological salience, while subsequent events are perceived as less impactful (Tversky & Kahneman, 1973, 1974). Importantly, the coefficient on the interaction terms (*Treated × Post Disaster*) remains positive and highly significant, with magnitudes nearly identical to those reported in Table 3, reinforcing the robustness of our core findings.

[Table 5 Around Here]

Second, I adopt a cleaner identification sample by requiring disaster-hit counties to be those that do not experience any other disasters within a 6-year window centered on the focal event. While this stricter criterion reduces the number of qualified treated firms and the sample size, the results reported in Columns (3) and (4) of Panel A remain consistent with the baseline estimates, as the coefficient on *Treated × Post Disaster* is positive and statistically significant. [12] Together, these robustness checks mitigate concerns that the baseline identification strategy is contaminated by overlapping or serial disaster exposures, thereby strengthening the interpretation of the disaster as a salient and exogenous shock.

4.4.4 Economic spillovers between neighboring counties

Although the treated firms are located in counties that are not directly struck by disasters, their proximity to disaster-hit counties raises the possibility of economic linkages—such as shared labor markets, supply chains, or financial networks—that could transmit spillover effects. This potential economic spillover may influence board-level decisions, complicating the clean identification of salience-driven director appointments. I, therefore, address this concern in Panel B of Table 5.

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[12] Dynamic DiD results for this cleaner identification sample, reported in Item IA.2 in the Internet Appendix, confirm parallel trends.

I first construct a variable, *Industry Linkage*, that captures the economic similarity between disaster-hit counties and the counties of treated firms and their matched firms. Specifically, I use data from the County Business Patterns (CBP) database to compute cosine similarity scores based on the distribution of employment across industries. Therefore, the similarity score captures how closely the treated firm's county industry composition (e.g., shared suppliers or labor pools) resembles that of the adjacent disaster-hit county. For matched control firms, *Industry Linkage* is calculated relative to the same disaster-hit county associated with their matched treated counterpart. This ensures that both treated and control firms are evaluated against the same disaster-hit county, allowing for a consistent control of economic similarity. Columns (1) and (2) of Panel B in Table 5 additionally control for *Industry Linkage*. The coefficient on *Industry Linkage* is statistically insignificant, and its inclusion has no impact on the estimate of *Treated × Post Disaster*, which remains positive and highly significant.

In addition, since firms in the same metropolitan statistical area (MSA) may share exposure to regional spillovers, such as commuting zones, labor markets, and supply chains, I exclude treated firms (along with their matched control firms) located in the same MSA to further mitigate the concern of shared regional exposure, thereby making the salience shock plausibly exogenous. The results, reported in Columns (3) and (4) of Panel B in Table 5, remain consistent with our main findings. Collectively, results from these two approaches support the interpretation that the observed effects are not driven by economic spillovers between disaster-hit and neighboring counties.

4.4.5 Geographic dispersion of large firms

A key identifying assumption of this study is that firms located in counties adjacent to disaster-hit areas are exposed to disaster events primarily through perceptual salience, rather than through direct operational disruptions (Dessaint and Matray, 2017; Huang et al., 2022). However, this assumption may be less valid for large, multi-establishment firms, which may

have production facilities or critical assets located in disaster-affected counties, even if their headquarters are not struck by disasters. In such cases, changes in board composition can be affected by direct economic exposure, leading to potential omitted variable bias.

To alleviate this concern, I conduct additional tests by restricting the sample to firms that are more likely to have operations outside their headquarters counties. First, I restrict the sample to firms with total assets above the annual median of the Compustat universe, as large firms are more likely to operate across multiple locations; the results are reported in Columns (1) and (2) of Panel C of Table 5.[13] Second, I limit the sample to firms with multiple operating segments, as identified in Compustat's segments database, to capture those with greater operational and potentially geographical dispersion beyond their headquarters; the results are reported in Columns (3) and (4) of Panel C. Across both specifications, the estimated coefficients on *Treated × Post Disaster* remain positive and statistically significant, consistent with the baseline results. These findings alleviate concerns that the observed board adjustments are driven by direct operational disruption and reinforce the interpretation that risk salience is the primary channel.

4.5 Robustness tests

To conserve space, I report several additional robustness tests in the Internet Appendix. Given that my primary measure of sustainability expertise is based on text-based classification, I conduct a series of alternative definitions to assess the credibility of this measure. First, following Homroy and Slechten (2019), I re-construct the sustainability expertise measure using randomly selected subsets of the keyword list and confirm that the results remain robust across multiple keyword variations. Second, I examine directors with prior employment in sustainability-related roles and directors with prior service on sustainability-related board

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[13] Unreported tests restricting the sample to firms with above-median property, plant, and equipment, and total number of employees yield similar results, which are omitted to conserve space.

committees separately. In both cases, the results continue to show a significant post-disaster increase in the appointment of directors with each type of sustainability expertise. Third, I show that the increase in directors with sustainability expertise is driven exclusively by independent directors. This lends further support to the validity of the measure and reinforces the interpretation that the observed board adjustments reflect strategic external appointments due to the strategically important role of independent directors. Next, I examine whether firms also respond to salient environmental risks by establishing board-level sustainability committees. Using both keyword-identified committees from BoardEx and committee data from LSEG, I find that treated firms are significantly more likely to form dedicated sustainability committees following disaster shocks. These results are reported and discussed in detail in Items IA.3–IA.6 of the Internet Appendix.

Furthermore, I adopt alternative disaster definitions by raising the damage thresholds to $250,000 and $1,000,000, and by following Huang et al. (2022) in restricting the sample to environmentally related natural disasters. As reported in Item IA.7 of the Internet Appendix, the results remain consistent with the baseline, suggesting that the findings are not sensitive to the definition of disaster shocks.

4.6 Alternative explanations

Prior research has shown that both female directors and directors from public sectors, such as military leaders, academics, and government officials, can positively influence a firm's sustainability initiatives, as they are more likely to advocate for socially responsible policies and are often more actively involved in sustainability-related decisions (Borghesi et al., 2014; Byron & Post, 2016; Cho et al., 2017; Dyck et al., 2023). As a result, they may be more likely to hold sustainability-related responsibilities and possess relevant experience, increasing the concern that the observed rise in directors with sustainability expertise reflects broader trends rather than the specific effects of disaster salience.

I adopt two methods to address this concern. First, I additionally control for the *Female Director Ratio*, which captures the proportion of female directors on the board, in Columns (1) and (2) of Table 6, and *Public Director Ratio*, defined as the fraction of directors with prior experience in the public sector, in Columns (3) and (4). While the presence of female directors and public-sector directors positively influences appointments of directors with sustainability expertise—as suggested by the positive coefficient on *Female Director Ratio* and *Public Director Ratio*—the coefficient on *Treated × Post Disaster* remains positive and statistically significant across all columns.

Second, I implement a stacked Difference-in-Difference-in-Differences (DDD) design to validate the differential increase in directors with sustainability expertise relative to other board diversity profiles. Specifically, I restructure the data into a stacked firm–year–director type panel, where each original firm-year observation is expanded into three separate observations, corresponding to the presence of sustainability expertise directors, female directors, and public-sector directors. This structure enables a direct comparison of post-disaster changes in board composition across director types within the same firm-year, thereby isolating whether the observed effect is uniquely concentrated among appointments of directors with sustainability expertise.

Column (5) of Table 6 presents the results from the DDD specification. The dependent variable is *Has Corresponding Director*, which equals 1 if the firm has the director of the given type (sustainability, female, or public) in the stacked firm–year–director type observation, and 0 otherwise. The key variable of interest is the triple interaction *Treated × Post × Sustainability Director*, where *Sustainability Director* is a type indicator equal to 1 for observations corresponding to the sustainability director type and 0 for the observations of female and public director types. Thus, the coefficient on the triple interaction term captures the differential post-disaster increase in directors with sustainability expertise for treated firms, relative both to

changes in control firms and to changes in the female and public director types. I find the coefficient on *Treated × Post Disaster* is positive and statistically significant, indicating that treated firms generally increase these three types of board appointments following disaster exposure. Importantly, the DDD term is positive and statistically significant (0.121, p<0.05), indicating a greater post-disaster increase in sustainability directors for treated firms relative to both controls and other director types.[14]

These results provide evidence against the alternative explanation that the main effect is simply driven by a generalized trend toward board diversity or public-sector director appointments.

5. CROSS-SECTIONAL TESTS: INVESTOR-DRIVEN MECHANISM

The results so far indicate that heightened salience of sustainability risks acts as a catalyst for significant corporate governance changes. I next conduct cross-sectional tests focused on investor characteristics and present the results in Table 7.

[Table 7 Around Here]

The cross-sectional analysis serves two purposes. First, it helps to uncover the underlying mechanism by testing whether the observed effect of salient sustainability risks on board appointments is driven by investors. Prior research shows that natural disasters significantly affect investor risk perceptions (Huang et al., 2022). Recent research finds that rather than pursuing divestment, investors are increasingly relying on active engagement, such as discussions with the management or submitting shareholder proposals, as their most common tool for managing exposure to sustainability risks (Ilhan et al., 2023; Krueger et al., 2020). Given that board appointments often require shareholder approval, such engagement channels can be a mechanism through which investors drive governance changes.

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[14] In unreported tests, the results are unchanged when absorbing director-type (cohort) effects via firm-by-cohort and year-by-cohort fixed effects, alongside state-by-year and industry-by-year fixed effects.

Second, the analysis sheds light on how variation in investor sentiments and preferences moderates firms' governance responses. While some investors may actively support sustainability governance and seek long-term sustainability integration, others may be skeptical of its financial materiality on shareholder value. These philosophical differences can create friction in governance adaptation, particularly in contexts where board restructuring requires broad shareholder support. Thus, even if firms recognize the strategic importance of sustainability, shareholders may be reluctant to act. As such, investor heterogeneity also functions as a moderating force, helping to explain variation in board responses across firms.

I begin by examining whether firms with higher levels of institutional ownership are more likely to appoint directors with sustainability expertise in response to salient risks. Prior research suggests that institutional investors exert significant influence on firms' sustainability practices (T. Chen et al., 2020; Dyck et al., 2019), and actively engage with firms to address sustainability issues (Ilhan et al., 2023; Krueger et al., 2020). To test this, I create a dummy variable, *High IO*, which equals 1 for firms with an above-median level of institutional ownership and 0 otherwise. Columns (1) and (2) report the results of the pooled regression. The coefficient on *Treated × Post Disaster × High IO* is positive and statistically significant in both columns (0.125 and 0.014), indicating that the observed increase in sustainability-related board appointments following salient environmental events is concentrated among firms with high institutional ownership. This suggests that institutional investors amplify governance responses to environmental risk salience.

Next, while institutional investors generally value sustainability, responsible investors are more committed to advocating for improved corporate sustainability practices (Dyck et al., 2019; Gibson Brandon et al., 2022). Their engagement may exert a stronger influence on the appointment of directors with sustainability expertise in response to heightened sustainability risks. I, therefore, examine whether firms with responsible investor ownership exhibit stronger

board adjustments following salient environmental shocks. Specifically, I follow Gibson Brandon et al. (2022) to classify UN PRI signatories as responsible investors. *With PRI* is a dummy variable equal to 1 for firms with shares held by responsible investors above the sample median and 0 otherwise. Columns (3) and (4) show that the coefficient on the triple interaction term (*Treated × Post Disaster × With PRI*) is positive and statistically significant, as is the coefficient *Treated × Post Disaster*. This finding suggests that the effect of salient environmental shocks on the presence of sustainability expertise directors is stronger for firms with responsible investor ownership.

These results confirm that investor influence serves as a key mechanism for shaping board composition to include directors with sustainability expertise (Dyck et al., 2019; Gibson Brandon et al., 2022), and align with the notion that sustainability-related board changes often reflect deeper shifts in investor expectations and firm-level governance strategy (Dyck et al., 2023). Furthermore, the findings reveal meaningful heterogeneity by investor preferences, indicating that investor philosophies play a moderating role in how firms adjust board composition in response to environmental shocks.

6. FURTHER ANALYSIS

6.1 Persistence of board-level adjustments

While the analysis demonstrates an immediate increase in the appointment of sustainability expertise directors following the heightened salience of natural disaster risks, it remains unclear whether this adjustment represents a lasting change or a temporary response. Prior research documents mixed evidence on the durability of salience-triggered corporate responses. On the one hand, firms may initially overreact to salient threats, responding excessively or irrationally, but later reassess and adjust their responses once the heightened perception of risk fades over time (Dessaint & Matray, 2017). On the other hand, salient events may serve as catalysts for

deeper recognition of underlying vulnerabilities, prompting firms to adopt enduring policy changes (Huang et al., 2022).

To examine the persistence of board-level adjustments, I analyze changes in the presence of directors with sustainability expertise over an extended 10-year window (-5 years to +4 years relative to the shock) and present the results in Table 8. The results show that the coefficients on the interaction terms remain positive and statistically significant. These findings align with Huang et al. (2022), who demonstrate that salient risks can drive lasting strategic changes. In our setting, disasters serve as salience shocks that elevate firms' perceived exposure to environmental risks and heighten awareness of the strategic value of directors with sustainability expertise. As a result, the appointment of such directors is not short-lived, but a strategic and sustained governance adjustment. The observed persistence is also consistent with a path-dependent response suggested by the resource dependence theory (Hillman et al., 2000), wherein a temporary shock catalyzes a lasting shift in board structure to address long-term environmental and stakeholder challenges.

[Table 8 Around Here]

6.2. Director qualification trade-off

As the presence of directors with sustainability expertise increases following disasters, a natural question to ask is, does this come at the expense of other valuable board-level competencies? In other words, firms may be substituting directors with other valuable qualifications for sustainability expertise. Yet, boards require a wide range of skills and experiences to effectively perform their monitoring and advisory functions. If such trade-offs exist, they suggest that firms face constraints in the director selection process and may sacrifice overall board quality to strengthen sustainability governance.

To answer this question, I examine whether the post-disaster presence of sustainability directors is associated with reductions in other key dimensions of director quality. I focus on

three traditional board qualifications: (i) *Director Executive Experience*, defined as the fraction of independent directors with prior senior executive roles (e.g., CEO, CFO, COO, or CIO); (ii) *Director MBA/PhD Experience*, measured as the proportion of independent directors holding an MBA or PhD degree; and (iii) *Director Network Size*, proxied by the natural logarithm of the average network size of independent directors. These measures capture various dimensions of board capital, including strategic leadership, academic expertise, and resource intermediation.

Table 9 reports the regression results. Across all columns, the triple interaction term (*Treated × Post Disaster × With Sustainability Director*) is statistically insignificant, indicating that the increase in directors with sustainability expertise following salient environmental shocks does not crowd out directors with other valuable attributes. This finding reinforces the view that firms expand board capacity in a strategic and complementary manner, rather than substituting away from traditionally valued qualifications. Thus, firms do not appear to face a zero-sum trade-off when enhancing their board sustainability governance capacity.

[Table 9 Around Here]

6.3 Sustainability outcomes and firm value

So far, the analyses have established that firms appoint more directors with sustainability expertise in response to heightened perceived environmental risks. This section examines whether these governance changes translate into tangible improvements in sustainability outcomes and firm value, thereby indicating strategic governance enhancements rather than symbolic responses to salience shocks.

In Panel A of Table 10, I examine three sustainability-related outcomes. First, I use *CSR Performance* from the KLD database to capture the firm's overall standing in corporate

social responsibility by netting CSR strengths against concerns.[15] Second, I consider *CO2 Emissions*, measured as total Scope 1 and Scope 2 emissions from LSEG scaled by total assets, to reflect emissions directly under firms' operational control and thus the effectiveness of internal environmental practices. Third, I use *Environmental Spending*, defined as total environmental-related expenditures from LSEG scaled by total assets, to capture the firm's financial commitment to sustainability initiatives.

[Table 10 Around Here]

The coefficient on *Treated × Post Disaster* in Column (1) is positive and statistically significant, consistent with prior findings (e.g., Huang et al., 2022) that salient disaster shocks lead to enhanced CSR practices. More importantly, the coefficient on the triple interaction term *Treated × Post Disaster × With Sustainability Director* is also positive and statistically significant, suggesting that firms appointing sustainability-expert directors in response to disaster shocks experience greater improvements in CSR performance relative to their peers.

Column (2) shows a negative and significant coefficient on *Treated × Post Disaster*, indicating reduced CO2 emissions following disaster shocks. Moreover, the negative and statistically significant coefficient on the triple interaction term suggests that the decline in emissions is more pronounced among firms that appoint directors with sustainability expertise. Column (3) further shows that such appointments are associated with increased environmental spending, reflecting a stronger financial commitment to sustainability initiatives. Collectively, these findings support the view that sustainability board appointments in response to salience shocks yield substantive improvements in environmental outcomes.

Panel B of Table 10 assesses the impact of sustainability board appointments on firm valuation following the disaster shock. Specifically, I examine industry-adjusted Tobin's Q

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[15] The CSR score in KLD includes ratings for environment, community, human rights, employee relations, diversity, product quality, and corporate governance dimensions. Following the prior literature, including Cronqvist and Yu (2017) and Servaes and Tamayo (2013), I exclude the corporate governance dimension from the CSR score to focus on the sustainability-related dimensions.

(*Ind-adj Tobin Q*). The coefficient on the triple interaction term is positive and statistically significant (0.363, p<0.10). This result is consistent with the argument that investors view such appointments as strengthening sustainability oversight and enhancing long-term strategic resilience.

Taken together, findings from Table 10 confirm that sustainability board appointments in response to disaster salience shocks are not merely symbolic. Rather, they represent strategic adjustments associated with substantial improvements in environmental performance and firm valuation. Thus, the appointment of directors with sustainability expertise is consistent with the resource dependence perspective (Pfeffer & Salancik, 1978; Hillman et al., 2000), which emphasizes the board's role in providing resources and legitimacy that enable firms to better manage external environmental challenges.

7. CONCLUSION

This study examines how firms restructure their board composition in response to heightened sustainability risk salience. Using exogenous shocks in perceived sustainability risk associated with natural disasters in neighboring counties, I show that firms increase the appointment of independent directors with sustainability expertise following such events. These appointments represent a strategic governance response to salience-induced pressures and are consistent with the resource dependence theory, which posits that firms adapt to environmental uncertainty by appointing directors who provide relevant expertise, legitimacy, and access to critical external resources. Further analyses show that these governance responses are particularly pronounced among firms with higher institutional ownership and with responsible investor ownership, underscoring the role of investor engagement as a mechanism shaping board-level sustainability governance.

Importantly, these governance changes are neither short-lived nor at the expense of board quality. These adjustments have meaningful implications as they lead to improved

sustainability outcomes and firm value. This shift reflects an enhanced capacity to implement sustainability initiatives effectively and provides new evidence on how board expertise translates into tangible organizational outcomes.

Overall, this study contributes to a growing literature on the role of salience and investor pressure in shaping corporate governance. It provides novel evidence that board composition is not static but adjusts in response to external sustainability risk signals. The findings highlight director appointments as a key mechanism through which investors influence sustainability governance. By linking salient environmental risk to board restructuring and subsequent performance outcomes, this article sheds light on how governance structures evolve under environmental uncertainty.

The study also offers important implications for practice and policy. For firms, the results highlight that the board-level adaptation of sustainability-experienced directors can be a strategic response to heightened sustainability risk salience. For investors, particularly those committed to ESG integration, the findings demonstrate the role of ownership in shaping board-level responses. For regulators, the evidence aligns with growing interest in ensuring that boards possess relevant sustainability expertise as part of effective environmental risk oversight.

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FIGURE 1 Geographic distribution of disaster-affected and treated firm counties.
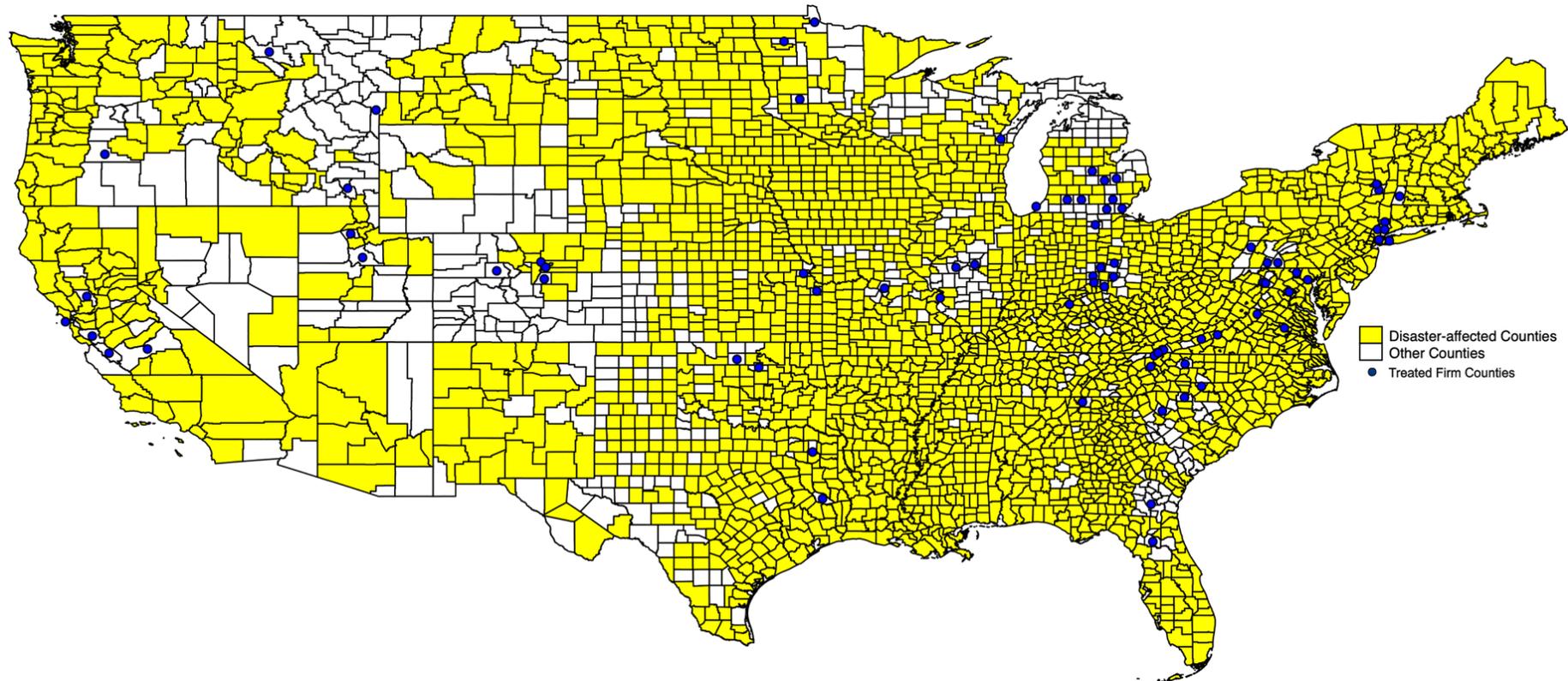
Note: This figure plots the counties directly affected by natural disasters, as well as the counties where the treated firms are headquartered. Areas highlighted in yellow represent counties that were directly impacted by natural disasters between 2003 and 2020, during which a state of emergency was declared by the Governor, a formal request for Federal Emergency Management Agency (FEMA) assistance was submitted, and total damages exceeded $50,000 (in 2021 dollars). Blue dots indicate counties where treated firms are headquartered. These counties are located within a 50-mile radius of a disaster-affected county but were not directly hit by the disaster themselves.

FIGURE 2 Coefficient distribution in placebo tests.

PANEL A: Pseudo DiD coefficients for With Sustainability Director
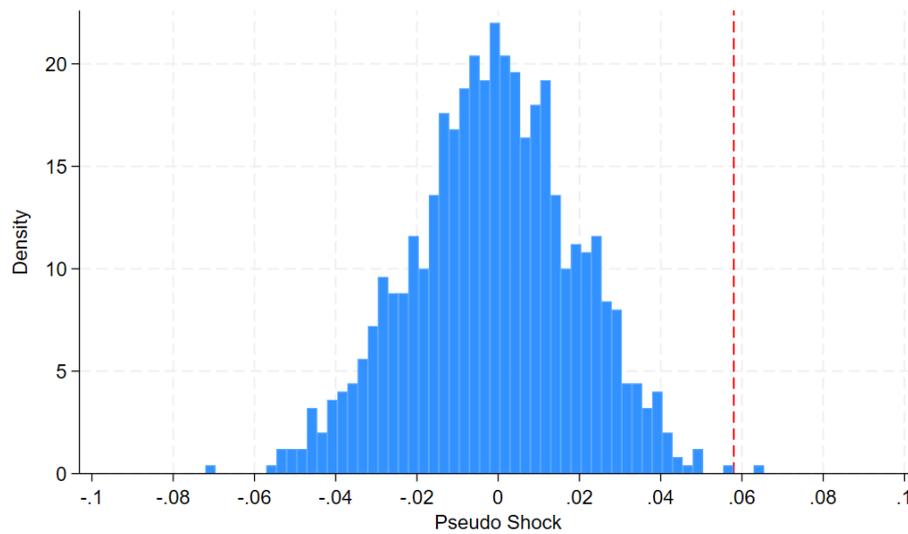
PANEL B: Pseudo DiD coefficients for Sustainability Director Ratio
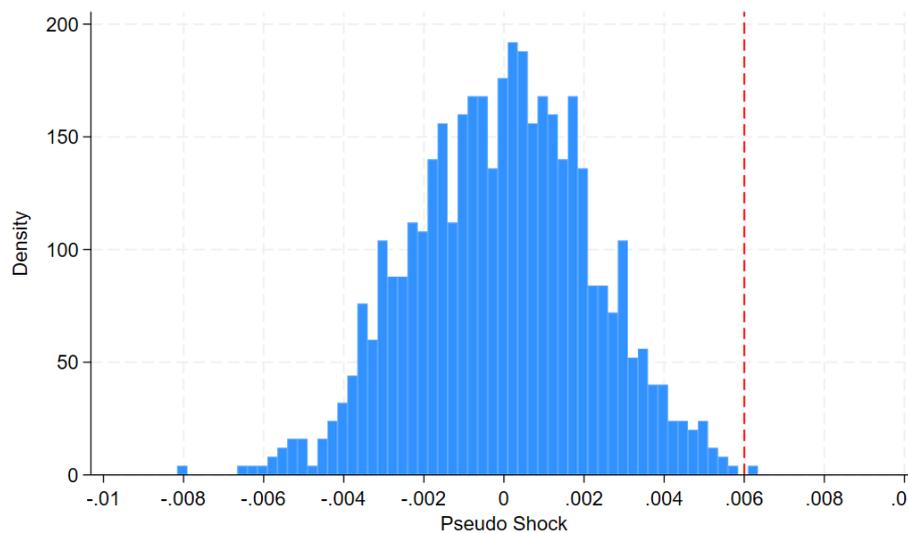
Note: This figure plots the coefficients of *Pseudo Treated × Pseudo Post* obtained from 1,000 simulated placebo tests based on Equation (1). *Pseudo Treated* is assigned a value of 1 for firms that are randomly assigned to the treated group, and *Pseudo Post* is set to 1 for years following randomly assigned disaster years. Panel A displays the placebo coefficients when the dependent variable is *With Sustainability Director*. The average value of the *Pseudo Treated × Pseudo Post* coefficients is –0.002, with a standard deviation of 0.030. The red vertical line indicates the actual coefficient of *Treated × Post Disaster* from Column (1) of Table 3. Panel B presents the coefficients when the dependent variable is *Sustainability Director Ratio*. The average value of the *Pseudo Treated × Pseudo Post* coefficients is –0.000, with a standard deviation of 0.003. The red vertical line represents the corresponding coefficient from Column (2) of Table 3.

TABLE 1 Balance test for the treatment and control sample.

	Treatment group (Obs. = 1,755)		Control group (Obs. = 1,603)		
	Mean	*Median*	*Mean*	*Median*	*P-value*
With Sustainability Director	0.203	0.000	0.209	0.000	0.691
Sustainability Director Ratio	0.033	0.000	0.033	0.000	0.934
Ln Firm Size	6.204	6.263	6.131	6.204	0.196
ROA	0.033	0.073	0.039	0.071	0.326
Market-to-Book	4.215	3.720	4.005	3.037	0.221
Leverage	0.422	0.360	0.417	0.368	0.587
Cash Holding	0.354	0.337	0.341	0.284	0.141
R&D	0.093	0.075	0.088	0.064	0.137
Ln Firm Age	2.596	2.485	2.567	2.485	0.194
Tangibility	0.218	0.116	0.225	0.136	0.370
Ln Board Size	2.312	2.303	2.302	2.303	0.287
Institutional Ownership	0.593	0.643	0.592	0.632	0.787

Note: This table presents the mean and median of the matching variables for the treatment and control groups for the period prior to the natural disaster shock. Each treated firm is matched with a similar firm based on the closest propensity score, calculated using *Firm Size*, *ROA*, *Market-to-Book*, *Leverage*, *Cash Holding*, *R&D*, *Ln Firm Age*, *Tangibility*, *Ln Board Size*, and *Institutional Ownership* in the year immediately preceding the natural disaster shock. The matched firm must also operate in the same Fama-French 30 industry as the treated firm. The matching process allows for replacement. P-values from t-tests of differences in means between the treatment and control groups across the matching variables are reported in the last column. Variable definitions can be found in Table A2 in the Appendix. All variables are winsorized at the 1st and 99th percentiles.

TABLE 2 Descriptive statistics.

PANEL A: Full sample (Obs. = 7,057)

Variables	Mean	SD	P25	Median	P75
With Sustainability Director	0.211	0.408	0.000	0.000	0.000
Sustainability Director Ratio	0.035	0.074	0.000	0.000	0.000
Ln Firm Size	6.300	1.817	5.017	6.271	7.651
ROA	0.035	0.234	0.002	0.070	0.127
Market-to-Book	2.843	3.029	1.795	2.856	4.842
Leverage	0.415	0.282	0.212	0.370	0.537
Cash Holding	0.354	0.302	0.109	0.269	0.528
R&D	0.105	0.160	0.000	0.065	0.148
Ln Firm Age	2.679	0.619	2.303	2.639	3.045
Tangibility	0.220	0.234	0.058	0.125	0.310
Ln Board Size	2.310	0.297	2.079	2.303	2.565
Institutional Ownership	0.629	0.314	0.377	0.693	0.882
Local Director Pool	4.493	1.824	3.892	5.017	5.811

PANEL B: Treated firms (Obs. = 3,639)

Variables	Mean	SD	P25	Median	P75
With Sustainability Director	0.217	0.412	0.000	0.000	0.000
Sustainability Director Ratio	0.036	0.077	0.000	0.000	0.000
Ln Firm Size	6.419	2.019	4.848	6.310	7.855
ROA	0.011	0.290	-0.023	0.065	0.128
Market-to-Book	2.863	3.566	1.778	3.217	5.445
Leverage	0.421	0.306	0.206	0.360	0.551
Cash Holding	0.391	0.337	0.104	0.292	0.607
R&D	0.124	0.199	0.000	0.068	0.170
Ln Firm Age	2.692	0.709	2.197	2.565	3.135
Tangibility	0.212	0.240	0.049	0.114	0.285
Ln Board Size	2.327	0.312	2.079	2.303	2.565
Institutional Ownership	0.625	0.308	0.386	0.686	0.876
Local Director Pool	5.157	1.548	4.543	5.746	6.295

PANEL C: Matched control firms (Obs. = 3,418)

Variables	Mean	SD	P25	Median	P75
With Sustainability Director	0.205	0.404	0.000	0.000	0.000
Sustainability Director Ratio	0.034	0.071	0.000	0.000	0.000
Ln Firm Size	6.173	1.564	5.274	6.244	7.490
ROA	0.059	0.150	0.018	0.076	0.124
Market-to-Book	2.823	2.325	1.804	2.748	4.364
Leverage	0.408	0.255	0.218	0.385	0.523
Cash Holding	0.314	0.254	0.109	0.253	0.449
R&D	0.084	0.100	0.000	0.065	0.135
Ln Firm Age	2.665	0.506	2.398	2.639	2.996
Tangibility	0.228	0.227	0.066	0.138	0.347
Ln Board Size	2.293	0.279	2.079	2.303	2.565
Institutional Ownership	0.633	0.319	0.369	0.699	0.913
Local Director Pool	3.786	1.831	3.761	4.263	5.050

Note: The table presents descriptive statistics for the main variables used in this study, including the mean (Mean), standard deviation (SD), 25th percentile (P25), median (Median), and 75th percentile (P75). Panel A reports summary statistics for the full analysis sample, comprising 7,057 firm-year observations from treated and matched control firms within the 6-year event window ([-3,+2]) over the period 2003–2021. Panel B presents statistics for the 3,639 firm-year observations of treated firms, while Panel C reports the 3,418 firm-year observations of matched control firms. The treatment group comprises firms headquartered in counties neighboring disaster-affected areas (within 50 miles of the disaster event but not in the disaster zones). The control group includes PSM-matched firms located in neither disaster-hit counties nor neighboring counties. *With Sustainability Director* is a binary variable equal to 1 if the firm has at least one independent director with sustainability expertise, and 0

otherwise. *Sustainability Director Ratio* is the proportion of independent directors with sustainability expertise relative to the total number of independent directors on the board. *Ln Firm Size* is the natural logarithm of the book value of total assets. *ROA* is earnings before interest and taxes divided by the book value of total assets. *Market-to-Book* is the market value of equity divided by the book value of common equity. *Leverage* is the sum of the book value of total long-term debt and current liabilities divided by the book value of total assets. *Cash Holding* is cash and short-term investments divided by the book value of total assets. *R&D* is the research and development expense divided by the book value of total assets; missing values are replaced with 0. *Ln Firm Age* is the natural logarithm of 1 plus the number of years the firm appears in the Compustat database. *Tangibility* is property, plant, and equipment divided by the book value of total assets. *Ln Board Size* is the natural logarithm of the number of board directors. *Institutional Ownership* is the proportion of shares held by institutions divided by the number of shares outstanding. *Local Director Pool* is the natural logarithm of 1 plus the number of non-financial firms headquartered within 60 miles of the focal firm's headquarters. Detailed variable definitions can be found in Table A2 in the Appendix. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, for the t-tests comparing the means between Panel B and Panel C. All variables are winsorized at the 1st and 99th percentiles.

Table 3. Effects of heightened risk salience on the presence of directors with sustainability expertise.

Dependent Variable:	(1) With Sustainability Director	(2) Sustainability Director Ratio
Treated × Post Disaster	0.058***	0.006***
	(0.016)	(0.002)
Post Disaster	-0.017**	-0.000
	(0.008)	(0.001)
Ln Firm Size	0.057***	0.009***
	(0.016)	(0.003)
ROA	-0.007	-0.005
	(0.035)	(0.006)
Market-to-Book	-0.000	-0.000
	(0.001)	(0.000)
Leverage	-0.008	-0.003
	(0.025)	(0.004)
Cash Holding	-0.009	-0.002
	(0.039)	(0.007)
R&D	0.025	-0.003
	(0.055)	(0.009)
Ln Firm Age	-0.097	-0.023**
	(0.062)	(0.011)
Tangibility	-0.075	-0.019*
	(0.060)	(0.011)
Ln Board Size	0.188***	0.010
	(0.057)	(0.009)
Institutional Ownership	-0.160***	-0.026***
	(0.048)	(0.008)
Local Director Pool	0.366***	0.055***
	(0.125)	(0.020)
Firm Fixed Effects	Yes	Yes
Industry-by-Year Fixed Effects	Yes	Yes
State-by-Year Fixed Effects	Yes	Yes
Constant	-1.851***	-0.210**
	(0.567)	(0.090)
Observations	7,057	7,057
Adjusted R^2	0.833	0.850

Note: This table presents the DiD estimates of the effect of heightened risk salience caused by near-miss natural disasters on the presence of directors with sustainability expertise. The sample consists of 7,057 firm-year observations from treated and matched control firms within the 6-year event window ([-3,+2]) over the period 2003–2021. *With Sustainability Director* is a binary variable equal to 1 if the firm has at least one independent director with sustainability expertise, and 0 otherwise. *Sustainability Director Ratio* is the proportion of independent directors with sustainability expertise relative to the total number of independent directors on the board. The treatment group comprises firms headquartered in counties neighboring disaster-affected areas (within 50 miles of the disaster event but not in the disaster zones). The control group includes PSM-matched firms located in neither disaster-affected counties nor neighboring counties. *Treated* is assigned a value of 1 for firms in the treatment group and 0 for matched control firms. *Post Disaster* is set to 1 for the year of the disaster and the 2 subsequent years, and 0 for the 3 years prior to the disaster. All other variables are defined in Table A2 in the Appendix. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 4 Dynamic difference-in-differences analysis.

Dependent Variable:	(1) With Sustainability Committee	(2) Sustainability Director Ratio
Treated × Year -2	0.018	0.005
	(0.013)	(0.003)
Treated × Year -1	0.029	0.005
	(0.018)	(0.003)
Treated × Year 0	0.053**	0.006**
	(0.023)	(0.003)
Treated × Year +1	0.099***	0.012***
	(0.027)	(0.003)
Treated × Year +2	0.140***	0.020***
	(0.031)	(0.004)
Year -2	-0.001	-0.002
	(0.009)	(0.002)
Year -1	-0.002	-0.002
	(0.010)	(0.002)
Year 0	-0.003	-0.000
	(0.011)	(0.002)
Year +1	-0.023*	-0.003
	(0.013)	(0.002)
Year +2	-0.040***	-0.007**
	(0.014)	(0.003)
Controls	Yes	Yes
Firm Fixed Effects	Yes	Yes
Industry-by-Year Fixed Effects	Yes	Yes
State-by-Year Fixed Effects	Yes	Yes
Constant	-1.887***	-0.218***
	(0.570)	(0.063)
Observations	7,057	7,057
Adjusted R^2	0.834	0.850

Note: This table presents the regression results for the dynamic DiD estimation examining the impact of heightened risk salience from near-miss natural disasters on the presence of directors with sustainability expertise. The sample consists of 7,057 firm-year observations from treated and matched control firms within the 6-year event window ([-3,+2]) over the period 2003–2021. *With Sustainability Director* is a binary variable equal to 1 if the firm has at least one independent director with sustainability expertise, and 0 otherwise. *Sustainability Director Ratio* is the proportion of independent directors with sustainability expertise relative to the total number of independent directors on the board. The treatment group comprises firms headquartered in counties neighboring disaster-affected areas (within 50 miles of the disaster event but not in the disaster zones). The control group includes PSM-matched firms located in neither disaster-affected counties nor neighboring counties. *Treated* is assigned a value of 1 for firms in the treatment group and 0 for matched control firms. *Year –2* is coded as one for 2 years prior to the disaster and 0 otherwise. *Year –1* is coded as 1 for the year immediately preceding the disaster and 0 otherwise. Similarly, *Year 0* corresponds to the year of the disaster, *Year +1* to the year immediately following, and *Year +2* to 2 years after the disaster. *Year –3* is omitted as the benchmark to avoid collinearity. Control variables are identical to those in Table 3. All other variables are defined in Table A2 in the Appendix. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 5 Identification validity.

PANEL A: Subsequent disaster overlap

Dependent Variable:	(1) Controlling for Subsequent Disasters With Sustainability Director	(2) Sustainability Director Ratio	(3) Excluding Subsequent-Disaster With Sustainability Director	(4) Sustainability Director Ratio
Treated × Post Disaster	0.058***	0.006***	0.057***	0.007***
	(0.016)	(0.002)	(0.018)	(0.003)
Post Disaster	-0.017**	-0.000	-0.011	-0.000
	(0.008)	(0.002)	(0.008)	(0.002)
Subsequent Disaster	0.003	0.000		
	(0.005)	(0.001)		
Controls	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Industry-by-Year Fixed Effects	Yes	Yes	Yes	Yes
State-by-Year Fixed Effects	Yes	Yes	Yes	Yes
Constant	-1.850***	-0.209***	-1.642***	-0.156**
	(0.567)	(0.060)	(0.568)	(0.067)
Observations	7,057	7,057	5,078	5,078
Adjusted R^2	0.833	0.850	0.846	0.861

PANEL B: Economic spillovers between neighboring counties

Dependent Variable:	(1)	(2)	(3)	(4)
	Controlling for Industry Linkage		Excluding Same MSA	
	With Sustainability Director	Sustainability Director Ratio	With Sustainability Director	Sustainability Director Ratio
Treated × Post Disaster	0.058***	0.006***	0.046**	0.011***
	(0.016)	(0.002)	(0.022)	(0.004)
Post Disaster	-0.017**	-0.000	-0.007	-0.001
	(0.008)	(0.002)	(0.017)	(0.003)
Industry Linkage	-0.046	-0.016		
	(0.029)	(0.010)		
Controls	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Industry-by-Year Fixed Effects	Yes	Yes	Yes	Yes
State-by-Year Fixed Effects	Yes	Yes	Yes	Yes
Constant	-1.814***	-0.197***	-0.526	-0.112
	(0.568)	(0.061)	(0.660)	(0.112)
Observations	7,057	7,057	4,213	4,213
Adjusted R^2	0.833	0.850	0.785	0.815

PANEL C: Geographic dispersion of large firms

Dependent Variable:	(1)	(2)	(3)	(4)
	Large Firms		Multi-Segment Firms	
	With Sustainability Director	Sustainability Director Ratio	With Sustainability Director	Sustainability Director Ratio
Treated × Post Disaster	0.069***	0.008***	0.050***	0.006**
	(0.018)	(0.003)	(0.015)	(0.002)
Post Disaster	-0.023**	-0.001	-0.009	-0.000
	(0.009)	(0.002)	(0.008)	(0.001)
Controls	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Industry-by-Year Fixed Effects	Yes	Yes	Yes	Yes
State-by-Year Fixed Effects	Yes	Yes	Yes	Yes
Constant	-2.441***	-0.220*	-1.942***	-0.205**
	(0.762)	(0.116)	(0.657)	(0.101)
Observations	4,697	4,697	5,033	5,033
Adjusted R^2	0.832	0.855	0.828	0.856

Note: This table presents tests evaluating the validity of the identification strategy. Panel A examines the influence of subsequent disasters. Columns (1) and (2) additionally control for *Subsequent Disaster*, an indicator equal to 1 if the disaster-hit county linked to the treated (or matched) firm is also hit by other disasters in year +1 or +2, and 0 otherwise. Columns (3) and (4) restrict the sample to disaster-hit counties that do not experience any other disasters within a 6-year window centered on the focal event. Panel B addresses the issue of economic spillovers between neighboring counties. Columns (1) and (2) additionally control for *Industry Linkage*, measured as the cosine similarity of industry-based employment shares between the firm's county and its linked disaster-hit county, using County Business Patterns data from the U.S. Census. Columns (3) and (4) exclude treated firms located in counties that share a metropolitan statistical area (MSA) with disaster-hit regions, along with their matched control firms. Panel C examines the potential geographic dispersion of large firms. Columns (1) and (2) restrict the sample to treated firms with above-median Compustat annual total assets. Columns (3) and (4) restrict the treated firms to multi-segment firms. *With Sustainability Director* is a binary variable equal to 1 if the firm has at least one independent director with sustainability expertise, and 0 otherwise. *Sustainability Director Ratio* is the proportion of independent directors with sustainability expertise relative to the total number of independent directors on the board. The treatment group comprises firms headquartered in counties neighboring disaster-affected areas (within 50 miles of the disaster event but not in the disaster zones). The control group includes PSM-matched firms located in neither disaster-affected counties nor neighboring counties. *Treated* is assigned a value of 1 for firms in the treatment group and 0 for matched control firms. *Post Disaster* is set to 1 for the year of the disaster and the 2 subsequent years, and 0 for the 3 years prior to the disaster. Control variables are identical to those in Table 3. All

other variables are defined in Table A2 in the Appendix. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 6 Disentangling sustainability director appointments from broader board diversity trends.

Dependent Variable:	(1) With Sustainability Director	(2) Sustainability Director Ratio	(3) With Sustainability Director	(4) Sustainability Director Ratio	(5) Has Corresponding Director
Treated × Post Disaster	0.056***	0.006**	0.058***	0.006***	0.046**
	(0.016)	(0.002)	(0.016)	(0.002)	(0.023)
Post Disaster	-0.016**	-0.000	-0.020***	-0.001	0.001
	(0.008)	(0.001)	(0.007)	(0.001)	(0.020)
Treated × Post Disaster × Sustainability Director					0.121**
					(0.059)
Treated × Sustainability Director					0.031
					(0.050)
Post Disaster × Sustainability Director					-0.040
					(0.056)
Sustainability Director					-0.106**
					(0.048)
Female Director Ratio	0.301***	0.083***			
	(0.112)	(0.022)			
Public Director Ratio			4.518***	0.823***	
			(0.423)	(0.066)	
Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry-by-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
State-by-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	-2.049***	-0.249***	-1.580***	-0.160**	-0.017
	(0.576)	(0.093)	(0.496)	(0.077)	(0.359)
Observations	7,057	7,057	7,057	7,057	21,171
Adjusted R^2	0.834	0.848	0.866	0.884	0.308

Note: This table presents robustness tests examining whether the observed increase in the presence of director with sustainability expertise reflects a targeted governance response rather than a broader shift in board diversity. The sample in Columns (1) to (4) consists of 7,057 firm-year observations from treated and matched control firms within the 6-year event window ([-3,+2]) over the period 2003-2021. The sample is the same as the baseline DiD estimates in Table 3, while additionally controlling for *Female Director Ratio* in Columns (1) and (2), and *Public Director Ratio* in Columns (3) and (4), defined as the proportion of independent directors who are female and who have prior experience in public sectors, respectively. Column (5) reports results from a stacked Difference-in-Difference-in-Differences (DDD) regression. Each firm-year observation is expanded into three separate rows corresponding to: (i) sustainability director, (ii) female director, and (iii) public-sector director. The dependent variable, *Has Corresponding Director*, is a binary indicator equal to 1 if the firm has the director of the observation's type (sustainability, female, or public) in a given year, and 0 otherwise. *Sustainability Director* is a type indicator equal to 1 for observations corresponding to the sustainability director type, and 0 for the observations of female and public director types. Control variables are identical to those in Table 3. All other variables are defined in Table A2 in the Appendix. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 7 Cross-sectional effects of investors' sustainability preference.

Dependent Variable:	(1) With Sustainability Director	(2) Sustainability Director Ratio	(3) With Sustainability Director	(4) Sustainability Director Ratio
Treated × Post Disaster × High IO	0.125***	0.014**		
	(0.039)	(0.007)		
Post Disaster × High IO	-0.072**	-0.009		
	(0.035)	(0.006)		
Treated × High IO	-0.019	-0.008		
	(0.049)	(0.009)		
High IO	-0.054	0.001		
	(0.040)	(0.008)		
Treated × Post Disaster × With PRI			0.115***	0.013**
			(0.037)	(0.006)
Post Disaster × With PRI			-0.115***	-0.016***
			(0.032)	(0.005)
Treated × With PRI			0.058*	0.009
			(0.034)	(0.007)
With PRI			-0.038	-0.004
			(0.030)	(0.006)
Treated × Post Disaster	0.004	0.001	0.013	0.001
	(0.023)	(0.004)	(0.018)	(0.003)
Post Disaster	0.013	0.003	0.027*	0.006**
	(0.017)	(0.003)	(0.014)	(0.002)
Controls	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Industry-by-Year Fixed Effects	Yes	Yes	Yes	Yes
State-by-Year Fixed Effects	Yes	Yes	Yes	Yes
Constant	-1.917***	-0.181**	-1.746***	-0.197**
	(0.561)	(0.090)	(0.568)	(0.089)
Observations	7,057	7,057	7,057	7,057
Adjusted R^2	0.834	0.846	0.837	0.852

Note: This table presents the DiD estimates examining the heterogeneous effect of investors' sustainability preferences on the relationship between heightened risk salience caused by near-miss natural disasters and the presence of directors with sustainability expertise. The sample consists of 7,057 firm-year observations from treated and matched control firms within the 6-year event window ([-3,+2]) over the period 2003-2021. *With Sustainability Director* is a binary variable equal to 1 if the firm has at least one independent director with sustainability expertise, and 0 otherwise. *Sustainability Director Ratio* is the proportion of independent directors with sustainability expertise relative to the total number of independent directors on the board. *High IO* is a binary variable that equals 1 if the firm's institutional ownership is above the sample median, and 0 otherwise. *With PRI* is a binary variable equal to 1 if the firm's percentage of shares held by sustainable investors exceeds the sample median, and 0 otherwise. Sustainable investors are defined as those who are UN PRI signatories. The treatment group comprises firms headquartered in counties neighboring disaster-affected areas (within 50 miles of the disaster event but not in the disaster zones). The control group includes PSM-matched firms located in neither disaster-affected counties nor neighboring counties. *Treated* is assigned a value of 1 for firms in the treatment group and 0 for matched control firms. *Post Disaster* is set to 1 for the year of the disaster and the 2 subsequent years, and 0 for the 3 years prior to the disaster. Control variables are identical to those in Table 3. All other variables are defined in Table A2 in the Appendix. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 8 Persistence of heightened risk salience on the presence of directors with sustainability expertise.

	(1)	(2)
Dependent Variable:	**With Sustainability Director**	**Sustainability Director Ratio**
Treated × Post Disaster	0.079***	0.008***
	(0.016)	(0.003)
Post Disaster	-0.016*	0.001
	(0.008)	(0.001)
Ln Firm Size	0.083***	0.012***
	(0.015)	(0.002)
ROA	-0.093***	-0.016***
	(0.035)	(0.006)
Market-to-Book	0.001	0.000
	(0.001)	(0.000)
Leverage	-0.002	0.000
	(0.026)	(0.004)
Cash Holding	0.033	0.003
	(0.038)	(0.007)
R&D	-0.042	-0.013
	(0.059)	(0.009)
Ln Firm Age	-0.142***	-0.028***
	(0.049)	(0.009)
Tangibility	-0.107*	-0.026**
	(0.058)	(0.010)
Ln Board Size	0.157***	0.010
	(0.046)	(0.008)
Institutional Ownership	-0.220***	-0.032***
	(0.041)	(0.007)
Local Director Pool	0.429***	0.051***
	(0.100)	(0.018)
Firm Fixed Effects	Yes	Yes
Industry-by-Year Fixed Effects	Yes	Yes
State-by-Year Fixed Effects	Yes	Yes
Constant	-2.050***	-0.185**
	(0.464)	(0.079)
Observations	9,699	9,699
Adjusted R^2	0.803	0.812

Note: This table presents the DiD estimates of the effect of heightened risk salience caused by near-miss natural disasters on the presence of directors with sustainability expertise over a 10-year window ([-5,+4]) over the period 2003–2021. *With Sustainability Director* is a binary variable equal to 1 if the firm has at least one independent director with sustainability expertise, and 0 otherwise. *Sustainability Director Ratio* is the proportion of independent directors with sustainability expertise relative to the total number of independent directors on the board. The treatment group comprises firms headquartered in counties neighboring disaster-affected areas (within 50 miles of the disaster event but not in the disaster zones). The control group includes PSM-matched firms located in neither disaster-affected counties nor neighboring counties. *Treated* is assigned a value of 1 for firms in the treatment group and 0 for matched control firms. *Post Disaster* is set to 1 for the year of the disaster and the 2 subsequent years, and 0 for the 3 years prior to the disaster. All other variables are defined in Table A2 in the Appendix. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 9 Effects of increased presence of directors with sustainability expertise on director quality.

	(1)	(2)	(3)
Dependent Variable:	Director Executive Experience	Director MBA/PhD Experience	Director Network Size
Treated × Post Disaster × With Sustainability Director	-0.015	-0.017	0.034
	(0.019)	(0.019)	(0.039)
Treated × Post Disaster	-0.002	-0.012	-0.019
	(0.012)	(0.013)	(0.037)
Treated × With Sustainability Director	0.063**	-0.007	-0.242***
	(0.031)	(0.030)	(0.084)
Post Disaster × With Sustainability Director	-0.003	0.008	-0.036
	(0.017)	(0.016)	(0.032)
With Sustainability Director	-0.077***	-0.003	0.240***
	(0.025)	(0.025)	(0.077)
Post Disaster	-0.003	0.008	0.015
	(0.008)	(0.007)	(0.020)
Controls	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Industry-by-Year Fixed Effects	Yes	Yes	Yes
State-by-Year Fixed Effects	Yes	Yes	Yes
Constant	0.010	2.304***	8.372***
	(0.383)	(0.507)	(1.119)
Observations	7,057	7,057	7,057
Adjusted R^2	0.892	0.889	0.923

Note: This table presents the DDD estimates examining whether the increased presence of directors with sustainability expertise due to near-miss natural disasters influences other key dimensions of director quality. I focus on three widely recognized indicators of traditional board qualifications: (i) *Director Executive Experience*, defined as the fraction of independent directors with prior senior executive roles (e.g., CEO, CFO, COO, or CIO); (ii) *Director MBA/PhD Experience*, measured as the proportion of independent directors holding an MBA or PhD degree; and (iii) *Director Network Size*, proxied by the natural logarithm of the average network size of independent directors. *With Sustainability Director* is a binary variable equal to 1 if the firm has at least one independent director with sustainability expertise, and 0 otherwise. The treatment group comprises firms headquartered in counties neighboring disaster-affected areas (within 50 miles of the disaster event but not in the disaster zones). The control group includes PSM-matched firms located in neither disaster-affected counties nor neighboring counties. *Treated* is assigned a value of 1 for firms in the treatment group and 0 for matched control firms. *Post Disaster* is set to 1 for the year of the disaster and the 2 subsequent years, and 0 for the 3 years prior to the disaster. Control variables are identical to those in Table 3. All other variables are defined in Table A2 in the Appendix. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 10 Effects of increased presence of directors with sustainability expertise on firm sustainability outcomes and value.

	PANEL A: Sustainability outcomes			PANEL B: Firm value
	(1)	(2)	(3)	(4)
	CSR Performance	**CO2 Emission**	**Environmental Spending**	**Ind-adj Tobin Q**
Treated × Post Disaster × With Sustainability Director	0.431*	-0.223*	0.152*	0.363*
	(0.231)	(0.127)	(0.090)	(0.195)
Treated × Post Disaster	0.206**	-0.185**	-0.066	-0.298***
	(0.102)	(0.093)	(0.078)	(0.099)
Treated × With Sustainability Director	-0.037	0.610	-0.167	0.498*
	(0.564)	(0.412)	(0.130)	(0.278)
Post Disaster × With Sustainability Director	0.151	-0.039	-0.036	-0.018
	(0.152)	(0.046)	(0.080)	(0.148)
With Sustainability Director	0.407	0.045	0.116	-0.410**
	(0.508)	(0.304)	(0.122)	(0.188)
Post Disaster	-0.043	-0.007	0.030	0.116*
	(0.049)	(0.007)	(0.070)	(0.063)
Controls	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Industry-by-Year Fixed Effects	Yes	Yes	Yes	Yes
State-by-Year Fixed Effects	Yes	Yes	Yes	Yes
Constant	0.616	-13.806	1.432	14.370***
	(4.378)	(9.832)	(2.127)	(3.102)
Observations	4,230	1,216	1,282	7,057
Adjusted R^2	0.815	0.728	0.993	0.771

Note: This table presents the DDD estimates examining the effect of increased presence of directors with sustainability expertise due to near-miss natural disasters on firm sustainability outcomes and firm value. Panel A presents the results for firm sustainability outcomes. *CSR Performance* is the net of CSR strength and CSR concern ratings from the KLD database. CSR strength represents the total number of strength indicators for the firm, while CSR concern reflects the total number of concern indicators. *CO2 Emissions* are measured as total Scope 1 and Scope 2 emissions from LSEG, scaled by total assets. *Environmental Spending* is defined as total environmental-related expenditures, including investments and expenses for environmental protection and prevention, reduction, eco-innovation, and control of environmental impacts and hazards, as well as costs for waste disposal, treatment, sanitation, and cleaning, from LSEG, scaled by total assets. Panel B presents the results for firm value, measured by *Ind-adj Tobin Q*, which is the difference between the firm's *Tobin Q* and the median level of firms in the same industry in a given year. The treatment group comprises firms headquartered in counties neighboring disaster-affected areas (within 50 miles of the disaster event but not in the disaster zones). The control group includes PSM-matched firms located in neither disaster-affected counties nor neighboring counties. *Treated* is assigned a value of 1 for firms in the treatment group and 0 for matched control firms. *Post Disaster* is set to 1 for the year of the disaster and the 2 subsequent years, and 0 for the 3 years prior to the disaster. Control variables are identical to those in Table 3, except that Column (5) excludes *Market-to-Book*. All other variables are defined in Table A2 in the Appendix. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

APPENDIX

TABLE A1 Disaster types and total damage.

	Number of affected counties	Total Damage (millions)					
		Mean	*SD*	*P25*	*Median*	*P75*	*Max*
Avalanche	3	0.5	0.3	0.1	0.7	0.7	0.7
Coastal	11	23.4	20.5	2.3	23.2	49.3	49.3
Drought	36	84.4	341.0	0.2	0.3	1.0	1,960.0
Earthquake	42	77.8	226.0	11.1	11.1	11.1	1,160.0
Flooding	4,473	55.0	624.0	0.3	1.1	5.8	25,900.0
Fog	4	0.1	0.1	0.1	0.1	0.2	0.3
Hail	382	2.9	21.1	0.1	0.2	0.8	359.0
Heat	3	1.6	1.2	0.3	2.0	2.5	2.5
Hurricane/Tropical Storm	1,181	164.0	791.0	0.3	2.2	24.9	14,500.0
Landslide	69	16.8	84.4	0.4	1.8	7.4	695.0
Lightning	112	0.5	2.0	0.1	0.2	0.4	20.7
Severe Storm/Thunderstorm	962	2.5	20.2	0.1	0.2	0.5	497.0
Tornado	1,342	20.3	147.0	0.2	0.7	3.8	3,520.0
Tsunami/Seiche	5	13.0	13.2	2.3	9.4	17.9	33.6
Wildfire	142	182.0	1,140.0	0.3	1.2	10.8	12,800.0
Wind	1,542	13.4	124.0	0.1	0.2	1.0	2,390.0
Winter Weather	955	8.2	28.5	0.3	1.0	5.4	408.0
All Types	11,264	47.2	494.0	0.2	0.7	3.9	25,900.0

Note: This table lists the natural disasters included in the sample. The disasters are those where the state governor declared a "state of emergency" and formally requested Federal Emergency Management Agency (FEMA) funds for disaster response between 2003 and 2020. To be included, the total combined property and crop damages from all types of disasters experienced by a county in a given year must exceed $50,000 (in 2021 dollars). The data on natural disasters is sourced from the Spatial Hazard Events and Losses Database for the United States (SHELDUS), managed by Arizona State University. All damage amounts are reported in millions of dollars.

TABLE A2 Variable definitions.

This table presents the detailed variable definitions. Compustat items are indicated in brackets.

Variables	Definition
With Sustainability Director	A binary variable that equals 1 if the firm has at least one independent director with sustainability expertise, and 0 otherwise. Sustainability expertise is identified based on their previous job functions and their roles as directors on sustainability-related committees. The keywords used to identify sustainability-related job functions and committees include: best practices, charitable contributions, charitable giving, civic, community development, corporate responsibility, CSR, diversity, employee development, employee health, employee responsibility, employee safety, environment, environmental, ethics, external relations, health and safety, nuclear, operational safety, product quality, professional development, public affairs, public interest, public issues, public policy, public responsibility, social responsibility, stakeholder, and sustainability.
Sustainability Director Ratio	Proportion of independent directors with sustainability expertise relative to the total independent directors on the board.
Treated	A binary variable that equals 1 if the firm belongs to the treatment group, and 0 if it belongs to the control group. The treatment group comprises firms headquartered in counties neighboring disaster-affected areas, defined as those within 50 miles of a disaster event but not in the disaster zones. The control group consists of PSM-matched firms located in neither disaster-hit counties nor neighboring counties.
Post Disaster	A binary variable that equals 1 for the year of the disaster and subsequent years, and 0 for the years prior to the disaster.
Ln Firm Size	Natural logarithm of the book value of total assets (at).
ROA	Earnings before interest and taxes (ebit) to book value of total assets (at).
Market-to-Book	Market value of equity (prcc_f x csho) to the book value of common equity (ceq).
Leverage	Sum of the book value of total long-term debt (dltt) and current liabilities (lct) to the book value of total assets.
Cash Holding	Cash and short-term investments (che) to the book value of total assets (at).
R&D	Research and development expense (xrd) to the book value of total assets (at), missing values are replaced with 0.
Ln Firm Age	Natural logarithm of 1 plus the number of years the firm appears in the Compustat database.
Tangibility	Property, plant, and equipment (ppent) to the book value of total assets (at).
Ln Board Size	Natural logarithm of the number of board directors.
Institutional Ownership	Proportion of shares held by institutions divided by the number of shares outstanding.
Local Director Pool	Natural logarithm of one plus the number of non-financial firms headquartered within 60 miles of the focal firm's headquarters.
Female Director	Proportion of female directors on the board.
Subsequent Disaster	A binary variable that equals 1 if the disaster-hit county linked to the treated (or matched) firm is also hit by other disasters in year +1 or +2, and 0 otherwise.
Industry Linkage	The cosine similarity of NAICS-based employment shares between the firm's county and its linked disaster-hit county, using County Business Patterns data from the U.S. Census. Specifically, for counties c and h, *Cosine similarity =*

$\dfrac{\Sigma_j S_{c,j} S_{h,j}}{\sqrt{\Sigma_j S_{c,j}^2}\sqrt{\Sigma_j S_{h,j}^2}}$, where $S_{c,j}$ is the share of employment of industry j in county c.

Public Director Ratio	A binary variable that equals 1 if the firm has at least one independent director from the public sector, including the armed forces, charities, clubs, government, sporting organizations, and universities, as defined by BoardEx, and 0 otherwise.
Has Corresponding Director	A binary variable that equals 1 if the firm has at least one director of the corresponding type (sustainability director, female director, and public-sector director) in a given stacked observation, and 0 otherwise.
High IO	A binary variable that equals 1 for firms with an above-median level of institutional ownership, and 0 otherwise
With PRI	A binary variable that equals 1 if the firm's percentage of shares held by sustainable investors exceeds the sample median, and 0 otherwise.
CSR Performance	CSR ratings from KLD database, calculated as the difference between CSR strength and CSR concern scores. CSR strength is the sum of strengths across the environment, community, product quality, diversity, human rights, and employee relations dimensions. CSR concern is the sum of concern indicators across the aforementioned dimensions.
CO2 Emission	Total Scope 1 and Scope 2 emissions from LSEG (formally Refinitiv) Workspace, scaled by total assets.
Environmental Spending	Total environmental-related expenditures, including investments and expenses for environmental protection and prevention, reduction, eco-innovation, and control of environmental impacts and hazards, as well as costs for waste disposal, treatment, sanitation, and cleaning, from LSEG (formerly Refinitiv) Workspace, scaled by total assets.
Ind-adj Tobin Q	The difference between the firm's *Tobin Q* and the median level of firms in the same industry in a given year. *Tobin Q* is computed as the market value of assets (the sum of the book value of total assets (at) and Market value of equity (prcc_f x csho)), divided by the book value of total assets (at).
Director Executive Experience	The fraction of independent directors with prior senior executive roles, including Chief Executive Officer (CEO), Chief Financial Officer (CFO), Chief Operating Officer (COO), and Chief Information Officer (CIO).
Director MBA/PhD Experience	The fraction of independent directors holding an MBA or PhD degree.
Director Network Size	The natural logarithm of the average network size of independent directors.