INTERNATIONAL MONETARY FUND

Gender Diversity and Corporate Resilience to Climate Change

Evidence from Greenfield Investments

Ming Yan William Cheung and Bihong Huang

WP/24/157

***IMF Working Papers* describe research in progress by the author(s) and are published to elicit comments and to encourage debate.**
The views expressed in IMF Working Papers are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

2024
JUL

WORKING PAPER

© 2024 International Monetary Fund WP/24/157

IMF Working Paper
Monetary and Capital Markets Department

Gender Diversity and Corporate Resilience to Climate Change: Evidence from Greenfield Investments
Prepared by Ming Yan William Cheung and Bihong Huang

IMF Working Papers **describe research in progress by the author(s) and are published to elicit comments and to encourage debate.** The views expressed in IMF Working Papers are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

ABSTRACT: This paper examines the impact of board gender diversity on the performance of firms whose greenfield investments are struck by natural disasters. We find that corporations with more diverse boards are more likely to earn higher net income but less likely to have negative earnings in front of natural disasters. Further analyses indicate that those corporations with more diverse boards invest less in countries vulnerable to climate change but more in countries ready to adapt for climate change. They have lower exposure to environmental policy risks and are more likely to establish dedicated committees to oversee the risks.

RECOMMENDED CITATION: Ming Yan William Cheung and Bihong Huang. 2023, "Gender Diversity and Corporate Resilience to Climate Change: Evidence from Greenfield Investments." IMF Working Paper WP 24/157.

JEL Classification Numbers:	G34, Q54
Keywords:	board gender diversity; climate change; natural disaster
Author's E-Mail Address:	william.c@waseda.jp; bhuang@imf.org

WORKING PAPERS

Gender Diversity and Resilience to Climate Change

Evidence from Greenfield Investments

Prepared by Ming Yan William Cheung and Bihong Huang[1]

[1] The author(s) would like to thank Valentina Flamini, Charlotte Gardes-Landolfini, Naomi N. Griffin, Lisa Kolovich, Sujan Lamichhane, Henk Reinders, and colleagues from the IMF attending a Gender Seminar Series at which this paper was discussed for valuable comments and suggestions and assume responsibility for any remaining errors.

Contents

I. Introduction

Climate change has exacerbated the frequency and severity of extreme weather events, making corporations' production processes vulnerable to natural disasters such as hurricanes, flooding, drought, wildfires, sea-level rise, and heat waves (e.g., Auffhammer 2018; Trenberth et al. 2014; Hong 2019; Dafermos et al. 2018). Munich Re finds that climate change is taking an increasing toll and natural disasters have resulted in more than $2.25 trillion economic losses globally between 2013 and 2022.[1] According to Greenpeace's analysis, almost half of global automakers face a high level of physical risk from climate change (Greenpeace East Asia 2021). All these realities underscore the importance for the firms to take mitigation and adaptation actions that are imperative to lowering potential future losses.

Corporate strategies toward climate risks are usually developed and decided at the board level. As such, boards of directors are in a position to guide and prioritize climate change solutions. Vast evidence has shown that cognitively and demographically diverse boards benefit from a wider range of knowledge, skills, perspectives, and approaches to problem solving that improves decision making (Gompers and Kovvali 2018; Gompers and Wang 2017; Hong and Page 2004; Chang et al. 2019). Accordingly, we posit that a more diverse board can have an impact on a firm's preparedness and resilience to climate risks.

Our focus on climate risk-related outcomes stems from studies that acknowledge the positive impact of gender diversity on the quality of board and women's disposition toward the welfare of society and community. Diversity theory postulates that female directors bring a variety of abilities, perspectives, and qualities to boardroom discussions., This infuses board meetings with new dynamics, assists in the correction of informational biases during strategy development and problem solving (Dewatripont et al. 1999; Francoeur et al. 2008; Westphal and Milton 2000), and consequently improves the board's advisory function (Cumming et al. 2015; Erhardt et al. 2003). This together with women's disposition toward the welfare of society and community (Adams et al. 2011; Eagly 1987; Eagly and Wood 1991; Dawson 1997) posits that gender-diverse boards will execute their advisory role well on environmental issues. Liu (2018) finds that firms with a gender-diverse board experience relatively fewer environmental lawsuits. Liao et al. (2015) show that firms with board gender diversity not only exhibit a greater propensity to disclose their greenhouse gas emission information but also make more extensive disclosures. Further, Mavisakalyan and Yashar (2019) reveal that national parliaments with more women pass more stringent climate policies. All these findings suggest that a gender-diverse board would be more likely to contribute to mitigating climate change and strengthening the organization's resilience to natural disasters.

Based on the conceptual discussion and review of the existing literature, we assert that firms with various levels of board gender diversity tend to exhibit different levels of awareness and management of risks arising from the natural disasters amplified by climate change. In particular, we investigate how board gender diversity affects the financial performance and its working mechanisms of firms whose greenfield investments are struck by natural disasters.[2] Our focus on greenfield investments is motivated by the fact that natural disasters have increasingly affected production facilities worldwide across industries. For instance, new Greenpeace East Asia research shows that 93 percent of Toyota's global manufacturing facilities are at high risk from the

[1] Source: Munich Re NatCatService. For details, see https://www.munichre.com/en/risks/natural-disasters.html.

[2] Greenfield investment "refers to an investment that brings new and additional resources and assets to the enterprise and often leads to gross fixed capital formation (GFCF). This new investment (fresh capital) typically leads directly to increased output, employment, and improvements in productivity" (IMF 2021).

consequences of climate change (Greenpeace East Asia 2021). In particular, the increased rainfall and flooding have interrupted Toyota's manufacturing facilities in Southeast Asia.[3] About one-third of the Coca-Cola system's bottling plants are operating in water-stressed areas and drought has forced it to shut down its plants from time to time. The recent survey shows that climate-related risks are affecting the foreign direct investment (FDI) assets of four-fifths of companies and more than half of investors expect financial losses because of climate change. The escalated concerns on climate change are likely to influence the investment decisions of 77 percent of investors (Kearney 2020). Despite the increasing impact of natural disasters on firms and facilities globally, little is known about how multinational companies moderate such risks.

We use several databases to validate our hypothesis. We first construct our sample by including all the US firms covered by BoardEx, which provides comprehensive information—like education, employment history, gender, network, and so on—about board members, . We then obtain the firms' stock market data from the Center of Research in Security Prices (CRSP), balance sheet data from the Compustat Capital IQ, and compensation data of directors and corporate executives from the Compustat Execucomp. We get the greenfield investment data of each firm from fDi Markets, which provides comprehensive firm-level information on cross-border greenfield investments, covering all countries and sectors since 2003. We identify the climate-related physical risks facing each firm by using the Emergency Events Database (EM-DAT), an international disasters database. The two datasets are then combined by matching destination cities of investment projects with cities struck by climate-related natural disasters. To examine the association of board gender diversity with financial performance upon natural disasters, we match our corporate panel dataset to fDi Markets and the climate-related natural disasters recorded in EM-DAT.

Our data show that the female representation in a company board is as low as 5.1% on average. A board typically has an average of 5.58 directors, among whom only 0.228 are females. However, the panel logit regression with fixed effects reveals that a 1% increase in female board representation lowers the odds of negative earnings by 3.3% but raises the net income by 6.1% when a natural disaster strikes the location of a firm's greenfield investment. These findings corroborate that firms with more gender-diverse boards are more resilient to climate risks. Given that some unobservable or omitted variables may contaminate our estimation results, we implement the instrumental variable (IV) estimation, where the gender diversity of a board is instrumented by the percentage of uninsured women ages 19 to 64, or the gender equality index of the state where a firm is headquartered, and the results remain unchanged.

In further analysis, we explore the possible channels underlying the finding that board gender diversity enhances the firms' resilience to climate risk. An increasing body of research suggests that enhanced gender diversity within a board of directors introduces a broader spectrum of viewpoints. This diversity aids in mitigating informational biases throughout the processes of strategy formulation and problem resolution (Dewatripont 1999; Francouer et al. 2008). Moreover, the inclusion of female board members enriches corporate governance through the infusion of diverse qualities, skills, and perspectives, thereby revitalizing the dynamics of board meetings (Jamali et al. 2007). Accordingly, we propose that including female members on a board could improve a firm's awareness of climate change, moderate its exposure to environmental policy risks, and enhance its risk management strategies. Using a country's climate vulnerability and readiness indexes computed by the Global Adaptation Index (ND-GAIN), we find that firms with higher gender diversity

[3] Nikkei Asian Review. "Storm clouds loom for Asian companies unready for climate change." 2018. https://asia.nikkei.com/Spotlight/Asia-Insight/Storm-cloudsloom-for-Asian-companies-unready-for-climate-change, accessed September 2020.

tend to invest significantly less in countries vulnerable to climate change but more in countries with a stronger capacity to make use of investment to adapt to climate change, confirming the climate risk awareness channel. This is consistent with Gu and Hale (2023) who find that firms reduce their foreign investments in response to nature disasters. Further, we follow Hassan et al.'s (2019) approach to measure a firm's exposure to changes in environmental policies by its earnings calls devoted to environmental risks and find that a board with gender-diverse directors has fewer conversations on environmental policy risks in its earnings calls, validating the role of gender diversity in moderating a firm's exposure to environmental policy risks. We further use the availability of a dedicated risk committee as the proxy for risk management strategy and find a firm with more female board members is much more likely to have designated a committee responsible for primary oversight of various risks, including climate risks.

Our study is closely related to the literature studying the effects of climate risks on firms' earnings and performance, and the approaches to combating such risks. Gu and Hale (2023) reveal that attention to climate risks strengthens the impact of such risks on FDI reduction. Castro-Vincenzi (2024) finds that global carmakers reallocate production from assembly plants affected by flooding to unaffected plants within firms, which may entails productivity losses. Hambel et al. (2024) analyze impact of climate change in a global economy which consumption goods are produced by green- and carbon-intensive sectors and find that risk premia increases significantly. Addoum et al. (2019) find that extreme temperatures significantly impact earnings of over 40 percent of industries in the US. On the global scale, Pankratz et al. (2019) show that an increasing exposure to extremely high temperatures has negatively affected firms' revenues and operating income. Focusing on a panel of 55 countries, Huang et al. (2018) claim that climate risk at the country level is associated with lower corporate earnings and higher earnings volatility. Kling et al. (2021) explore the impact of climate risks on corporate performance and find that extreme weather events are associated with lower and more volatile earnings and cash flows. Using a large panel dataset consisting of more than 3.3 million nonfinancial firms from 24 developing countries over the period 1997–2019, Cevik and Miryugin (2022) discover that nonfinancial firms operating in developing countries with greater vulnerability to climate change tend to experience difficulty in accessing debt financing, even at higher interest rates, while being less productive and profitable relative to firms in countries with a lower level of vulnerability.

As more evidence confirms the susceptibility of firms' production and financial conditions to climate change, a growing number of researchers have started to explore the approaches to combating climate risks, focusing on either climate-related disclosure practices or actual emissions abatement. The literature on the former has identified several firm-specific determinants for disclosure, such as size, profitability, leverage, age, and industry (Gonzalez-Gonzalez and Ramírez 2016). Meanwhile, the literature on the latter investigates the relationship between carbon emissions and firms' value and performance (Matsumura et al. 2014). Nonetheless, firm-level studies have barely explored the approaches to strengthening a firm's resilience to climate risk. Our research attempts to address this important issue from the perspectives of corporate governance characteristics and gender diversity.

The linkage between gender and climate change has attracted increasing attention. Women experience the greatest impacts of climate change—primarily because they constitute the majority of the world's poor and are more dependent for their livelihood on natural resources that are vulnerable to climate change (UN Women 2022). However, women are also effective actors or agents of change in relation to both mitigation and adaptation. Several studies have explored the impact of companies' board gender diversity on both carbon disclosure and carbon emissions but have reached conflicting findings (Al-Shaer and Zaman 2016; Liao et al. 2015; Prado-Lorenzo and Garcia-Sanchez 2010; Ben-Amar et al. 2017; Haque 2017). Considering that managers are those that select the suitable strategy to achieve firms' environmental objectives, Altunbas et al.

(2022) explore the relationship between the percentage of women in managerial positions and CO2 emissions and find that a 1 percentage point increase in the percentage of female managers within the firm leads to a 0.5% decrease in CO2 emissions. Kyaw et al. (2022) find that the likelihood that a firm with a gender diverse board reduces environmental emission is 9% higher than its industry peers. Unlike the existing literature, our work takes a different perspective and sheds new light on the role of gender diversity in moderating the losses arising from natural disasters.

The rest of the paper is organized as follows: Section 2 describes the data sources and summary statistics; Section 3 provides details on the methodology; Section 4 shows the baseline results, regressions with instrumental variables, and various robustness tests; Section 5 tests the proposed channels; Section 6 provides further analysis and Section 7 concludes the paper with policy implications.

II. Data and Summary Statistics

In this section, we first describe our data sources, sample construction, and measures of key variables and then provide the summary statistics.

2.1 Corporate Data

We construct our sample by first including all US firms covered by the database BoardEx. Established by Euromoney Institutional Investor plc, BoardEx comprises publicly listed firms worldwide from 1999 to the present, with enhanced coverage for the corporations in the US and UK. It provides compositions of company boards and demographic information of individual board members, including gender, age, education, employment, network, and committee with the matching company profile. This comprehensive coverage across individuals allows us to identify the effect of board gender diversity on earnings while controlling effects of other individual level demographic variables. For each firm included in BoardEx, we obtain its compensation information for directors and corporate executives from the Compustat Execucomp, its balance sheet data from the Compustat Capital IQ built by S&P Global Market Intelligence, and its stock market trading data from the Center of Research in Security Prices (CRSP).

2.2 International Disasters

Our second dataset is the Emergency Events Database (EM-DAT), an international disaster data compiled by the Centre for Research on the Epidemiology of Disasters (CRED), a research unit of the Université Catholique de Louvain (UCLouvain). EM-DAT records the occurrence and effects of over 26,000 mass disasters across the world from 1900 to the present. The database is compiled from various sources, including UN agencies, nongovernmental organizations, insurance companies, research institutes and press agencies. For a disaster to be entered into this database, at least one of the following criteria must be fulfilled: 10 or more people reported killed, 100 or more people reported affected, a declaration of a state of emergency, or a call for international assistance. EM-DAT records both natural hazards and technological disasters. The natural disaster category is divided into five subgroups, which cover 15 types of disasters and more than 30 subtypes. The technological disaster category is divided into three subgroups, which cover 15 types of disasters. We use the three subgroups of natural disasters to identify the climate-related physical risk, including hydrological, meteorological, and climatological disasters. To account for different consequences of climate-related physical risks, we further classify these natural disasters into acute risks (e.g., actual natural disasters) and chronic risks (e.g., sea-level rise) according to IPCC guidance (IPCC 2021) EM-DAT provides a unique disaster event ID, location (city, province, and country), an identifier of natural or technological disaster, a description of the disaster according to a predefined classification, the date, number of deaths, missing persons, injuries, homelessness, and the value losses (estimated in US dollars). Location is the variable of interest for our identification. We match the timings and locations of all natural disasters with the cross-border investment data (see the next section for descriptions) to identify the firms whose greenfield investments were possibly struck by climate-related disasters.

2.3 Cross-Border Greenfield Investments

Our cross-border investment data come from fDi Markets, compiled by fDi Intelligence, a division of *The Financial Times*. This database, which covers all countries and industries since 2003, provides comprehensive firm-level information on cross-border greenfield investments, including the name of the country in which a firm engaging in greenfield FDI is headquartered, the name of the destination city, the year of investment, the recipient sector, the function (or nature) of the FDI project, the type of project (new or expansion), the amount of capital investment (capital expenditures), and the new employment associated with the project. There is no minimum investment size for a project to be included in the database, but the equity stake of the foreign investor cannot be lower than 10%. The database cross-references each project against multiple sources, with the focus on direct company sources. We obtain an unbalanced panel of investment data consisting of over 176,000 greenfield investment projects from 2003 to 2020. After we restrict the investing companies to the US, our investment dataset is reduced to 56,887 projects.

We merge the fDi Markets data with EM-DAT data by matching the destination cities of investment projects with those cities struck by natural disasters. Specifically, we pair names of cities, states/provinces, countries, and ISO country codes of greenfield investment with those of natural disasters. We also use Google Maps and Google Earth to mitigate inconsistencies between names of cities, states, or countries. Our dataset comprises matchings of multiple natural disasters at a single (or multiple) location(s) for one investment project and multiple investment projects at a single location of a natural disaster. We treat multiple natural disasters in the same location with nonoverlapping time periods as separate events. Finally, we match names of investment companies with the names of firms in our corporate panel dataset constructed from Compustat. We first perform an exact matching, then a fuzzy matching using a Generalized Edit Distance (GED) score (Navarro et al. 2001; Chaudhuri et al. 2003; Cohen et al. 2021). Only less than 3% of firm names require manual inspection. We have a final sample of 49,779 firm-year observations with 56,887 greenfield investment projects covering 768 locations for which 484 natural disaster events with a total damage of $4.4 trillion have been recorded.

We understand that it is not ideal to match cities only by their names across datasets. As a robustness check, we use a subsample of natural disaster locations with latitude and longitude information to match with destinations of greenfield investments through the SAS/GRAPH Map datasets. The precision of these matchings is up to 0.5 degree in latitude and longitude, which is about the size of the New York metropolitan area. Our resulting dataset has 15,812 firm-year observations with 203 greenfield investment projects and 219 natural disaster events. The main conclusions of our study remain the same with this dataset as an alternative to our main dataset.[4]

[4] For the purpose of brevity, we don’t report the estimation results, but they are available upon request.

2.4 Summary Statistics

Table 1 reports the summary statistics of our key variables, which display moderate variations. Our variable of main interest—female board percentage—is as low as 5.1% on average, with a standard deviation of 13.1% and a median value of zero. A board in our sample typically has an average of 5.58 directors and a median of five, among which only 0.228 are female directors. These statistics suggest that the female representation on a company board is indeed very low. Table 1D provides additional descriptive statistics of female board percentages by states. In our sample, 14 out of 50 states never have any females on boards. Further, the likelihood of appointing a female as a CEO is only 4.8%. The average total annual nonequity-based compensation for a director is 8.3 million and the median is 3.6 million. The average total annual equity-based compensation including stocks and options is 2 million and the median is 0.9 million. Our compensation data suggest a significantly positive skewness, i.e., some directors receive much higher compensation than others.

The amount of greenfield investment is on average $54.085 million and has a median of $19 million. Table 1C reports descriptive statistics for greenfield investments, such as number of projects, investment amounts, and number of jobs created, by types (new, expansion, multiple locations, and others) and destination countries, respectively. A natural disaster on average causes losses of $11.8 billion and a death toll of 176.4. Table 1B provides more detailed information about the scale of different types of natural disasters, such as cost of damage, number of people affected, death toll, number of people injured, and number of people losing their homes.

Among our greenfield investment- natural disaster sample, the average vulnerability index of countries is 0.441, with a standard deviation of 0.096, and the average readiness index of countries is 0.408, with a standard deviation of 0.137. Both indexes display moderate variations across countries and over time. Among our sample, 14.1 percent of firm-year observations have negative earnings per share. The average market capitalization of firms is $37 billion, with a median of 4.5 billion, suggesting that the sample contains some relatively large firms. The debt-to-total-asset ratio is about 22.4 percent, with a standard deviation of 18.1 percent. The gender equality index is 44.265 on average, with a median of 46.1.

III. Empirical Methodology

To understand the impact of gender diversity on corporate resilience to climate risks, we examine the association of female representation on the boards with earnings by firms that have production facilities in the locations struck by natural disasters. We employ a panel logit regression with fixed effects as a benchmark specification:

$$P(EPS_{it} < 0) = \alpha_0 + \alpha_1 FemaleBoard\%_{it-1} + X'_{it-1}\gamma + Z'_{it-1}\beta + \zeta_i + \nu_t + \eta_{it} \quad (1)$$

where *i* and *t* are firm and time prefixes, respectively. Our outcome variable, $P(EPS_{it} < 0)$, is the probability of negative earnings per share for firm *i* in financial year *t*. Our main variable of interest, $FemaleBoard\%$ is the percentage of female directors on the company's board in fiscal year t-1, computed as the number of female directors to the total number of directors. Z is a vector of board-specific characteristics, including stock awards, options granted, and interlocking directorship (Edmans et al. 2012; Huang and Kisgen 2013). X is a vector of firm-specific characteristics, including the gender of the CEO, the amount of greenfield investment, the log of the market value of equity, leverage, and return on assets (ROA). Estimated losses and number of deaths related to natural disasters are included in the model to reflect the cost of damage. The matching processes described in the previous two sections ensure that firm *i* must have at least one greenfield investment in year *t-1* in a location that has been struck by at least one natural disaster in year *t*. All board-specific and firm-specific variables are lagged by one period to mitigate the endogeneity concerns. We include ζ_i and ν_t as firm- and time-fixed effects, respectively, to control for unobservable firm characteristics, such as managerial efforts that may affect earnings losses over time. We include industry fixed effects in alternative specifications and cluster robust standard errors at the firm level.

To mitigate concerns of measurement error, we use a firm's net income, $NetIncome$, as an alternative outcome variable, to perform the following standard panel regression with two-way fixed effects:

$$NetIncome_{it} = \alpha_0 + \alpha_1 FemaleBoard\%_{it-1} + X'_{it-1}\gamma + Z'_{it-1}\beta + \zeta_i + \nu_t + \eta_{it-1} \qquad (2)$$

where $NetIncome$ is measured as net income to the value of book equity while other variables are defined in the same way as in equation (1).

Following the critical mass theory of female board representation (Schwartz-Ziv 2017; Torchia et al. 2011; Broome et al. 2010), we count the number of female directors as an alternative measure of female board representation. We construct an indicator variable, $1_{it-1}^{\#FemaleBoard\geq K}$(K=1 or 2), to measure whether the number of female directors is higher than the threshold K. It equals one if there are at least K female board members, and zero otherwise. We then estimate the following equations (3) and (4) by the standard panel logit regression and two-way fixed effects regression, respectively:

$$P(EPS_{it} < 0) = \alpha_0 + \alpha_1\, 1_{it-1}^{\#FemaleBoard>K} + X'_{it-1}\gamma + Z'_{it-1}\beta + \zeta_i + \nu_t + \eta_{it-1} \qquad (3)$$

$$NetIncome_{it} = \alpha_0 + \alpha_1\, 1_{it-1}^{\#FemaleBoard>K} + X'_{it-1}\gamma + Z'_{it-1}\beta + \zeta_i + \nu_t + \eta_{it-1} \qquad (4)$$

where variable definitions and model specifications are analogous to equation (1).

IV. Empirical Results

In this section we report the baseline results estimated by the panel regression models described in the previous section, the IV estimation, and the robustness tests.

4.1 Baseline Results

Table 2 presents our baseline estimates of the relation between female board representation and changes in earnings or income following natural disasters. Columns (1) to (3) report regression results on the probability of negative earnings, while columns (4) to (6) list the estimation results on the net income scaled by total assets. The female representation is proxy by female board percentage in columns (1) and (4) and by the threshold indicators in columns (2), (3), (5), and (6). In particular, $\#Female\ Board \geq 1$, is a dummy that equals one if a company has at least one female director and zero otherwise. Similarly, the dummy variable, $\#Female\ Board \geq 2$, measures whether a company has more than two female board members.

Our results indicate that firms with higher female representation are less likely to have negative earnings but tend to have higher net income after natural disasters struck the locations of their greenfield investments. This association is statistically significant at 1 percent with sizable economic magnitude. Evaluated at the sample mean values of female board and control variables, the odds of negative earnings would be 3.5 percent lower with a 1 percent increase in female board representation (column (1)), while the net income would be 4 percent higher with one standard deviation increase in female board percentage (column (4)).[5] Our findings in columns (2) and (5) suggest that firms with at least one female director are less likely to have negative earnings but more likely to have positive net income when exposed to natural disasters. In all these regressions, we control for effects of a female CEO, interlocking directorship, compensation of board members, amount of greenfield investment, losses associated with natural disasters, and firm characteristics. As shown in column (6), the association of net income with female directors becomes stronger as the number of female directors increases. Overall, our baseline results support our hypothesis that firms with gender-diverse boards are more resilient to climate risks, leading to higher net income and lower likelihood of earnings losses in the presence of natural disaster. Our finding is consistent with Lawrence (2022), who finds that greater gender diversity could lead to better investment performance.

Among our control variables, the coefficients on the proportion of options granted to total compensation (*Options Granted*) are positive and significant at the 1 percent level in columns (1) to (3), implying that the larger the proportion of executive options in total compensation, the higher the odds of negative earnings one year ahead. Related, we find that the coefficients on the proportion of stock awards to total compensation (*Stock Awards*) are negative and significant at the 1 percent level in the first three columns, indicating that the larger the proportion of executive stock awards in total compensation, the higher the likelihood of negative earnings one year ahead. These findings are consistent with Edmans et al. (2012) and Gopalan et al. (2014), who claim that long-term incentive contracts deter short-termism, making earnings less volatile. The positive and significant coefficients on *Greenfield Investment* in columns (1) to (3) reveal that firms with more investments in regions hit by natural disasters are more likely to render negative earnings. Consistent with our expectation, the severity of natural disasters, measured by economic losses and the number of deaths in cities where firms made greenfield investments, significantly raises the likelihood of negative earnings. These two findings align with the literature stating that firms reduce FDI in cities that are prone to disasters (Escaleras and Register 2011; Friedt and Toner-Rodgers 2022). The coefficients on market capitalization and ROA are both negative and significant at 1% level in columns (1) to (3), hinting that larger or better performing firms are less likely to have negative earnings (Bamber 1987; Kothari and Wasley 2019).

4.2 IV Estimation

Appointments of female directors are not random. Corporations of larger size or with higher earnings might have more resources to increase gender diversity by hiring female board directors than financially constrained firms. Moreover, the degree of board diversity could be influenced by the variations of legal requirements across states. A firm headquartered in California is subject to more stringent gender diversity requirements than other federal states, which might result in a spurious relation between corporate earnings and female board percentages. We address these endogeneity concerns by employing two exogenous variables as instruments for the female representation at the boards: (i) state-level proportion of women without health

[5] We compute the economic significance by multiplying one standard deviation of female board percentage (0.094) by the coefficient estimate (0.98) divided by the mean of net income scaled by the number of shares outstanding (2.276); thus, the economic significance equals 0.040(=0.094*0.98/2.276).

insurance (Kaiser Family Foundation 2020); and (ii) a gender equality index (Sugarman and Straus 1988).[6] With these two instruments, we are able to infer the impact of board gender diversity on corporate earnings.

The data of our first instrument are from the Kaiser Family Foundation, which estimates and publishes the health insurance coverage of women ages 19 to 64 for each state from 2008 to 2020. The estimates are based on the American Community Survey (ACS), implemented by the Census Bureau.[7] The respondents were asked about health insurance coverage at the time of the survey and sorted into one of the following types of coverage sequentially: employer, non-group, Medicaid-only, Medicare, military, or uninsured. We conjecture that states with higher health insurance coverage for women would have a higher level of gender equality in general and would be more attractive to female directors. We treat those without any of the first five types of coverage as uninsured, calculate the share in the female population for each state, and then match the ratio with each firm based on the location of a firm's headquarters. The lower percentage represents more desirable gender equality. Yet state-level health coverage for women should not directly influence a firm's future earnings performance, thus meeting the exclusion restriction requirement of an instrument. Empirically, we perform the following two-stage least squares model:

First stage: $FemaleBoard\%_{it-1} = \iota_i + \varrho_t + \lambda WomenHealth_{it-2} + \boldsymbol{X_{it}}'o + \boldsymbol{Z_{it}}'\omega + \psi_{it}$ (5)

Second stage: $Y_{it} = \alpha_0 + \alpha_1 Female\widehat{Board}\%_{\iota t-1} + \boldsymbol{X'_{it-1}}\gamma + \boldsymbol{Z'_{it-1}}\beta + \zeta_i + \nu_t + \eta_{it-1}$ (6)

Exclusion Restriction: $Y_{it} = \alpha_0 + \alpha_1 WomenHealth_{it-1} + \boldsymbol{X'_{it-1}}\gamma + \boldsymbol{Z'_{it-1}}\beta + \zeta_i + \nu_t + \eta_{it-1}$ (7)

where Y_{it} is either probability of negative earnings or net income per share; $FemaleBoard\%$ is the percentage of female directors on the firm's board; $Female\widehat{Board}\%_{\iota t-1}$ is the fitted value of female board percentage estimated from the first stage regression of (5). Z is a vector of board specific characteristics; X is a vector of firm-specific characteristics. We include firm- and year-fixed effects. In Table 3, column (1) reports the results of the first-stage regression, where the female board percentage is the dependent variable. The coefficient on our instrumental variable is significant at 5 percent, implying a critical relation between women uninsured at the state level and the female board percentage. The F-statistics is 40.5 and meets the threshold of 10, as defined by Stock and Yogo (2005), rejecting the weak instrument issues. Columns (2) and (4) report the results of exclusion restriction tests. Our instrumental variable $WomenHealth$, the proportion of women without health insurance in a state, is insignificant to explain the probability of negative earnings or net income per share, satisfying the exclusion restrictions. Consistent with the baseline results presented in Table 2, the second-stage regression results, shown in columns (3) and (5), corroborate that higher female representation at the boards reduces probability of negative earnings and increases net income per share when their greenfield investments are susceptible to natural disasters.[8]

Our second instrument is a gender equality index computed by Sugarman and Straus (1988). They estimate indicators of economic, political, and legal equality for each of the 50 US states. A higher index value for a state

[6] The health insurance data compiled by Kaiser Family Foundation is frequently employed in medical, healthcare, economics, and law research; see Garfield and Druss (2012), Keighley (2010), Liu and Sydnor (2022), and White (2013), among many others. Huang and Kisgen (2013) employ the Sugarman and Straus (1988) gender equality index as an instrument of appointments of female CEOs.

[7] We include data up to 2019, as the Census Bureau used the Current Population Survey in 2020, and its data cannot be compared to data from the ACS (https://www.kff.org/other/state-indicator/health-insurance-coverage-of-women-19-64-cps).

[8] In untabulated tests, we use the number of female board members in the two-stage least squares regressions. Results are qualitatively similar to our female board percentage estimations.

indicates women in that state have achieved a higher percentage of what is necessary for equality with men. We conjecture that firms headquartered in those states with a higher gender equality index should be more attractive to female corporate executives. Yet the gender equality index should not directly affect a firm's future earnings performance, thus satisfy the exclusion restriction of an instrument. We test and report the exclusion restriction, along with the first-stage and second-stage regression results in Table 4. The IV estimation results suggest that the female board member percentage reduces the likelihood of negative earnings and increases net income per share—but not the other way around.

4.3 Robustness Tests

In this subsection, we implement a variety of robustness tests to further validate our conclusion.
A growing number of studies disclose that the Paris sAgreement, signed into force on December 12, 2015, was ultimate impetus for firms and capital markets to incorporate climate risks into their decision making (Degryse et al. 2021; Ehlers et al. 2022; Kacperczyk and Peydro 2021; Mueller and Sfrappini 2021; Reghezza et al. 2021).We theorize that if female directors are more aware of climate change risks, the companies with more female representation should have exhibited a higher level of resilience to natural disasters even before the Paris Agreement was in place[9] To test this assumption, we construct a subsample of firm-years before 2016 and re-estimate models (1) to (4). Table 5 reports the estimation results for probability of negative earnings in columns (1) to (3) and for net income in columns (4) to (6). All our estimates are significant and comparable to our baseline estimates, reported in Table 2. Interestingly, the odds ratios of this subsample estimation are all larger than those of our baseline estimates. Our findings are consistent with the notion that female directors are more resilient to climate change risks.

Given that industry heterogeneity plays a significant role in greenfield FDI (Witte et al. 2017; Jung et al. 2021; Amendolagine et al. 2022), we re-estimate model (1) for each industry separately. The results summarized in Table A1 show negative associations between the probability of negative earnings and the female board percentage in 16 out of the 20 industries, confirming that female leadership helps moderate the negative impact of natural disasters on corporate profitability.

Further, we replace the log value of greenfield investments with the ratio of greenfield investments to capital expenditure in order to capture the differences between firms with high and low fractions of greenfield investments in their portfolios. We re-estimate model (1) and present in Table A2 the results, which are consistent with the baseline results shown in Table 2.

According to the current reporting standard, losses from catastrophic events like natural disasters are included as extraordinary items in the income statement. However, the gains and losses from extraordinary items are reported infrequently, and some firms may not even report as extraordinary items their losses from greenfield investment projects . To address this concern, we employ the earnings per share without extraordinary items as our main dependent variable and re-estimate model (1). Our regression results presented in Table A3 are qualitatively similar to the baseline results shown in Table 2.

[9] Altunbas et al. (2022) argue that the Paris Agreement is an exogenous shock to CO_2 emissions but not the percentage of female managers; a difference-in-difference framework could mitigate endogeneity concerns.

V. Proposed Channels

We propose two potential channels through which female leadership might reduce earnings losses when the locations of their firms' greenfield investments are struck by the climate-related natural disasters. The first is a risk awareness channel and the second is a risk management channel.

5.1 Risk Awareness

The first channel is the awareness of potential risks arising from investment in countries that are vulnerable to climate change but not ready to adapt to such change. Greenfield investments in regions that are more prone to natural disasters and not ready for adaptation actions may generate significant earnings losses. If a board with more female members is aware of such risk, the firm should avoid building production facilities in those regions vulnerable to climate changes. We examine this risk awareness channel by employing the Global Adaptation Index (ND-GAIN) to gauge a country's vulnerability to and readiness for climate change. The ND-GAIN index consists of two subindexes, a vulnerability index and a readiness index. The vulnerability index consists of 36 indicators covering six life-supporting sectors, including food, water, health, ecosystem, human habitat, and infrastructure. It ranges from 0 to 1, with a higher value indicating greater vulnerability to climate change.

The readiness index measures a country's readiness to make effective use of investments in adaptation actions. It comprises nine contributing indicators, reflecting economic readiness, governance readiness, and social readiness. The readiness index also ranges from 0 to 1, and the higher value, the more capable a country is of leveraging investments in adaptive actions to climate change. If a board with more female members takes climate risk into considerations when making greenfield investment decisions, the company should invest less in the countries with a higher vulnerability index but more in regions with a higher readiness index, all else being equal.

To evaluate the risk awareness channel, we first classify all countries into either a high vulnerability group or low vulnerability group by the annual median value of climate vulnerability index. We then compute each firm's greenfield investment in countries with high vulnerability $(VI\%)$ and low vulnerability $(1 - VI\%)$ respectively. We regress the logarithm of the ratio of investment in high- to low-vulnerability countries against female board percentages while controlling for other corporate covariates by using a log-transformed panel regression model with MacKinnon-White (1985) standard deviation as follows:

$$log\left(\frac{VI\%}{1 - VI\%}\right) = \alpha_0 + \alpha_1 FemaleBoard\%_{it-1} + X'_{it-1}\gamma + Z'_{it-1}\beta + \zeta_i + \nu_t + \eta_{it} \qquad (8)$$

where $FemaleBoard\%$ is the percentage of female directors on a company's board in fiscal year t-1, defined as the number of female directors divided by the total number of directors. The definitions of other variables are the same as in model (1). Our panel regression results reported in Table 6 suggest that female board percentage is negatively associated with investment in regions that are vulnerable to climate change.

We further assess the climate risk awareness channel with the climate readiness index of countries. Our procedure is similar to the country's vulnerability we just described. We split all countries into two groups, high readiness and low readiness, by the annual median value of the climate readiness index. We then compute each firm's greenfield investment in regions with high readiness $(RD\%)$ and low readiness $(1 - RD\%)$. We regress the logarithm of the ratio of investment in high to low climate readiness against female board percentages while controlling for other economic covariates by using a log-transformed panel regression model with the MacKinnon-White (1985) standard deviation as follows:

$$log\left(\frac{RD\%}{1 - RD\%}\right) = \alpha_0 + \alpha_1 FemaleBoard\%_{it-1} + X'_{it-1}\gamma + Z'_{it-1}\beta + \zeta_i + \nu_t + \eta_{it} \qquad (9)$$

where $FemaleBoard\%_{it-1}$ is the percentage of female directors on company i's board in fiscal year t-1. Other variables are defined similarly as in model (1). Our panel regression results presented in Table 7 indicate that the female board percentage is positively and significantly associated with investment in countries with a high climate readiness index. Our findings imply that firms with higher gender diversity tend to invest significantly more in countries capable of leveraging investments and convert them to adaptation actions.

Taken together, our findings support the conjecture that the firms could benefit from the awareness of female board members on climate change risks and consequently invest more in countries that are of higher climate change readiness and are less vulnerable to climate change.

5.2 Risk Management

We propose risk management as the second channel through which female leadership could reinforce corporate resilience to climate risks. We construct two proxies for risk management efficiency: exposure to changes in environmental policy and dedicated risk committees.

The first proxy is a firm's exposure to changes in policies regarding environmental standards (Hassan et al. 2019). Previous studies have shown that women are more sensitive to environmental issues (Davidson and Freudenburg 1996; Zelezny et al. 2000; McCright and Xiao 2014). A board with more female members should be more efficient in managing a firm's exposure to changes in environmental policy standards. While we cannot directly observe the process of risk management for a firm, we could measure its exposure to changes in environmental policy standards through its communications to investors in its quarterly earnings conference calls (Hassan et al. 2019).[10] The idea of the measure is to count the number of occurrences of two-word combinations, bigrams, indicating discussion of a given environmental topic within the set of 10 words surrounding a synonym of *risk* or *uncertainty* on either side, scaled by the total number of bigrams in the transcript. For our analysis. we multiply the resulting measure by 100,000.[11] The higher the share of a firm's earnings calls devoted to environmental risks, the higher its risk exposure to changes in policies on environmental standards.

A more efficient management of environmental policy risks would reduce this risk exposure. As such, we expect a board with more female directors would have fewer conversations on environmental policy risks in its earnings calls. We use the following model to verify this risk management channel:

[10] We acknowledge the data provided by Tarek Hassan at https://sites.google.com/view/firmrisk/risk#h.p_afs8XoBs3Gl6.
[11] See Hassan et al. (2019) for more detailed discussion of the measure.

$$Risk_{it}^{Env} = \alpha_0 + \alpha_1 FemaleBoard\%_{it-1} + X'_{it-1}\gamma + Z'_{it-1}\beta + \zeta_i + \nu_t + \eta_{it} \quad (10)$$

where $FemaleBoard\%_{it-1}$ is the percentage of female directors on the company's board in fiscal year t-1. The definitions of other control variables are the same as in (1).

Table 9 reports our regression results estimated by the standard Fama-MacBeth model, panel fixed effects model, and Ordinary Least Squares (OLS) model with clustered standard errors, respectively. In all three model specifications, female board percentage is negatively associated with environmental policy risks with 1 percent significance. Our findings also suggest that the economic impact is significant. Using the Fama-MacBeth estimates ($\widehat{\alpha_1} = -0.336$) as an example, one standard deviation increase in female board percentage reduces environmental policy risks by 4.4 percent. Our findings support the risk management channel that boards with more female members are more efficient in managing risks that are environmental in nature.

The second proxy for risk management is the availability of a dedicated risk committee. The Dodd-Frank Wall Street Reform and Consumer Protection Act (DFA 2010) requires financial institutions with more than $10 billion of assets must have a dedicated risk committee within the board. For nonfinancial firms, the New York Stock Exchange requires the audit committee to oversee risk assessments, and hence, most boards delegate oversight of risk management to the audit committee (Lipton et al. 2012).) Having a dedicated risk committee allows a large firm to understand and assess the risk appetite, tolerance, and limits (Johnson 2011; Lipton et al. 2012) and is valuable to shareholders (Stulz et al. 2021). Moreover, a growing number of risk committees are required to oversee climate-related risks. Following this strand of recent literature, we posit that a firm with more female members on the board are more likely to have a dedicated risk committee. We identify a dedicated risk committee by manually searching names of committees for strings of "risk" or "risk committee" or "risk subcommittee." The search identifies 91 distinct committee names. We define an indicator variable RC_{it} which equals one if there is a committee name containing "risk" or "risk committee" or "risk subcommittee" for firm i in year t, and zero otherwise. We then run the following logistic regression of risk committee availability on female board percentage

$$RC_{it} = \alpha_0 + \alpha_1 FemaleBoard\%_{it-1} + X'_{it-1}\gamma + Z'_{it-1}\beta + \zeta_i + \nu_t + \eta_{it} \quad (11)$$

where $FemaleBoard\%_{it-1}$ is the percentage of female directors on the company's board at fiscal year t-1. The definitions of other control variables are the same as in (1). The regression results reported in Table 8 indicate that female board representation is positively associated with the availability of a risk committee, at a 1 percent level of significance. Our findings support the risk management channel that boards with more female members are more likely to have dedicated risk committees.

VI. Further Analysis

6.1 Geographical Diversification of Greenfield Investments

Given the complexity of firms' earnings, one may argue that geographically bound natural disasters would less likely affect bottom-line earnings of firms that are highly diversified geographically. Yet female board percentage could be correlated with this firm-level geographical diversity. For example, large firms are more likely to diversify their investments geographically and have more resources to recruit female board members. To tackle this potential concern, we follow the geographical diversification measure of Morgan and Samolyk

(2003) and Meslier et al. (2016) to construct a new variable, $geodiv_{t,j}$, measuring the degree of geographical diversification of a portfolio of greenfield investments of a firm:

$$geodiv_{t,j} = \frac{1 - \sum_i (\frac{gf_{i,t,j}}{gf_{t,j}})^2}{\sum_i (\frac{gf_{i,t,j}}{gf_{t,j}})^2}$$

where $gf_{i,t,j}$ is the amount of greenfield investments of firm j in country i in year t and $gf_{t,j}$ is the total greenfield investment of the firm j in year t. Consistent with our baseline regression, we regress the probability of negative earnings against an interaction variable between female board percentage and geographical diversity. We expect the probability of negative earnings to be negatively associated with geographical diversity for firms with a higher female board percentage. Results are reported in Table 10. We find that the probability of negative earnings is significantly and negatively associated with the interaction term between female board percentage and geographical diversity, with the estimated coefficient equaling -2.07, at a 1 percent significant level. The geographical diversity itself is positive and significant. Collectively, our results suggest that not all diversifications are equal in terms of reducing the likelihood of losses. Firms with more female board members seem to choose investment locations more strategically for diversifying geographically against climate disasters, resulting in a lower likelihood of earnings loss.

6.2 Acute versus Chronic Disasters

Literature on climate-related physical risks broadly separates acute short-term events (e.g., hurricanes) from chronic long-term changes in climate (e.g., drought). These two types of events have starkly different risk characteristics. If a gender diversified board cares more about long-term firm value, we expect the impact of board gender diversity to be stronger when facing chronic natural disasters. As such, board gender diversity may be more critical for chronic than acute natural disasters. To evaluate this assumption, we classify natural disasters (with earthquakes and volcanic activities excluded) into acute and chronic risks according to IPCC guidance (IPCC 2021, p.13). We construct a chronic disaster indicator variable with its value equaling one for a chronic disaster and zero for an acute disaster. We regress the probability of negative earnings against an interaction variable between female board percentage and chronic disaster indicator. If gender diversified boards focus more on long-term firm values, the probability of negative earnings should be negatively associated with chronic disasters for firms with a higher female board percentage. Results are reported in column (3) of Table 10. We find that the probability of negative earnings is indeed significantly and negatively associated with the interaction term between female board percentage and the chronic disaster indicator, with the estimated coefficient equaling -16.585 at a 1 percent significance level. The chronic disaster indicator itself is positive and significant, suggesting that the probability of losses is higher for chronic than acute disasters. Consistent with the previous long-term value creation, our results suggest that a gender diversified board reduces the likelihood of losses due to chronic disasters more than acute natural disasters.

VII. Conclusion

This paper studies how a firm's organizational structure, in particular, the board gender diversity, affects its preparedness and resilience to climate risks. We construct our corporate panel dataset by using several databases, including BoardEx, CRSP, Compustat Capital IQ, and Compustat Execucomp. To examine the association of board gender diversity with earnings loss upon natural disasters, we match our corporate panel dataset with the Emergency Events Database (EM-DAT), an international disasters database, and fDi Markets, a global greenfield investment database, both of which are novel to finance research. The baseline panel logit regression with fixed effects reveals that a 1 percent increase in female board percentage lowers the odds of negative earnings by 3.5 percent and raises the net income by 6.1 percent. These findings corroborate that firms with gender-diverse boards are more resilient against climate risks.

Further, we investigate the possible channels underlying the finding that board gender diversity enhances firms' resilience against climate risks. Using a country's vulnerability and readiness computed by the Global Adaptation Index (ND-GAIN), we find that firms with a higher female board percentage invest significantly less in countries vulnerable to climate change but more in countries with stronger capacity to adapt to climate change, confirming the investment awareness channel. We follow Hassan et al.'s (2019) approach to measuring a firm's exposure to changes in environmental policies by a firm's earnings calls devoted to environmental risks and assume that more efficient management of environmental policy risks would reduce such risk exposure. The empirical evidence shows that a board with more female directors has fewer conversations on environmental policy risks in its earnings calls, confirming the risk management channel.

Our results have important implications for both corporate leadership and policymakers. Firms should foster the inclusion of females on the board to enhance resilience against climate change. According to McKinsey (2023), the lack of women on boards and in senior management is attributed to gender gaps in promotion rates rather than in hiring. Collecting data and disclosing gender disparities in promotions are hence pivotal to understanding the underlying factors and implementing targeted interventions for achieving gender balance in leadership. The establishment of a board diversity policy and commitments by a company's CEO and Chair are essential for ensuring representation and inclusion of women on boards. Given that a disproportionately high share of board members comes from recommendations within a network,[12] all corporate board assignments should be merit-based, considering candidates' track record and achievements. This approach would enhance the diversity of the board pool and reduce bias in board appointments. Investors should remain vigilant in establishing gender diversity expectations for the companies in which they invest. Two-thirds of US and UK institutional investors have a voting policy with a gender diversity target (Deloitte 2024), which may already be making an impact. The appointment rate for women on the boards of the UK's FTSE100 Index increased from 30 percent in 2017 to 47 percent in 2023,[13] while across the Russell 3000 Index in the US, 38 percent of newly appointed board members were women in 2023.[14]

Governments can play a significant role in empowering women in leadership and management roles in the private sector. Countries that have implemented policies like boardroom quotas, voluntary targets, disclosures requirements, and private initiatives have witnessed improved gender parity on boards (OECD 2020). Additionally, corporate governance codes have emerged as effective tools for enhancing gender equality on boards in Organisation for Economic Co-operation and Development (OECD) countries. To further support women in leadership, governments could explore initiatives such as childcare support, enshrining flexible working practices into law, and fostering a more friendly and inclusive work environment for women leaders.

[12] For details, see Women On Boards: How To Close The Gap (forbes.com).
[13] For details, see FTSE Women Leaders.
[14] For details, see Reports - 50/50 Women on Boards (5050wob.com).

This research focuses on US firms, which predominantly operate under a monistic, or one-tier, board structure. However, the influence of board gender diversity on a company's climate-related performance may vary according to the board's structure—whether it is monistic or dualistic (two-tier) (Hopt and Leyens 2023). This opens avenues for future research to examine how gender diversity within these differing board structures can affect a firm’s resilience to climate change. Additionally, the extent to which a diverse board can shape corporate strategy may also hinge on the nature, frequency, and severity of both acute and chronic physical effects of climate change. Future research could investigate how varying degrees of climate change entail different results.

In addition, our paper primarily examines the corporate resilience to physical risks of climate change. Nonetheless, the significance of transition-related risks within the manufacturing sector is well documented and cannot be overlooked. The impact of gender diversity on corporate strategy, especially in the context of devising and executing strategies for low-carbon transitions, is profound. Investigating how diverse board compositions influence companies' shift towards low-carbon operations could yield invaluable insights.

References

Adams, R.B., and D. Ferreira. 2009. “Women in the boardroom and their impact on governance and performance.” *Journal of Financial Economics* 94 (2), 291–309.

Addoum, J., D. Ng, and A. Ortiz-Bobea. 2023. “Temperature shocks and industry earnings news.” *Journal of Financial Economics,* forthcoming.

Altunbas, Y., L. Gambacorta, A. Reghezza, and G. Velliscig. 2022. ”Does gender diversity in the workplace mitigate climate change?” European Central Band Working Paper Series No. 2650.

Amendolagine, V., Crescenzi, R. and Rabellotti, R., 2022. The geography of acquisitions and greenfield investments: firm heterogeneity and regional institutional conditions. London School of Economics Geography and Environment Discussion Paper Series No. 33.

Bamber, L.S., 1987. Unexpected earnings, firm size, and trading volume around quarterly earnings announcements. *Accounting Review:* 510–32.

Bansal, R., M. Ochoa, and D. Kiku. 2016. “Climate change and growth risks.” National Bureau of Economic Research Working Paper 23009.

Barber, B.M., and T. Odean. 2001. “Boys will be boys: gender, overconfidence, and common stock investment.” *Quarterly Journal of Economics,* 116: 261–92.

Beck, T., P. Behr, and A. Guettler. 2013. “Gender and banking: are women better loan officers?” *Review of Finance,* 17, 1279–1321.

Ben-Amar, W., M. Chang, and P. McIlkenny. 2017. “Board gender diversity and corporate response to sustainability initiatives: evidence from the carbon disclosure project.” *Journal of Business Ethics,* 142: 369–83. *Economic Perspectives,* Vol. 32 (Fall): 33–52

Castro-Vincenzi, J., 2024, Climate hazards and resilience in global car industry. Working paper, Princeton University.

Chang, E.H., K.L. Milkman, D.M. Gromet,, R.W. Rebele, C. Massey, A.L. Duckworth, and A.M. Grant. 2019. “The mixed effects of online diversity training.” In Proceedings of the National Academy of Sciences 116: 7778–83.

Chaudhuri, S., K. Ganjam, V. Ganti, and R. Motwani. 2003. “Robust and efficient fuzzy match for online data cleaning.” In Proceedings of the 2003 ACM SIGMOD International Conference on Management of Data: 313–24. June.

Cumming, D., T.Y. Leung, and O. Rui. 2015. “Gender diversity and securities fraud.” *Academy of Management Journal,* 58: 1572–93.

Dafermos, Y., M. Nikolaidi, and G. Galanis. 2018. “Climate change, financial stability and monetary policy.” *Ecological Economics,*152: 219–34.

Davidson, D.J., and W.R. Freudenburg. 1996. “Gender and environmental risk concern: a review and analysis of available research.” *Environment and Behavior,* 28: 302–39.

Dawson, L.M. 1997. “Ethical differences between men and women in the sales profession.” *Journal of Business Ethics,* 16: 1143–52.

Dewatripont, M., I. Jewitt, and J. Tirole. 1999. “The economics of career concerns, Part I: Comparing information structures. *Review of Economic Studies,* 66(1): 183–98.

Deloitte. 2024. *Key trends in investor voting policies from the 2022 (AGM) season.* https://www.deloitte.com/global/en/services/risk-advisory/analysis/investor-behavior-in-the-2022-agm-season.html.

Dewatripont, M., I. Jewitt, and J. Tirole. 1999. “The economics of career concerns, Part I: Comparing information structures.” *Review of Economic Studies,* 66(1): 183–98.

Dietz, T., L. Kalof, and P.C. Stern. 2002. “Gender, values, and environmentalism.” *Social Science Quarterly,* 83, 353–64.

Eagly, A.H., 1987. *Sex differences in social behavior: A social-role interpretation*. New Jersey: Hillsdale.

Eagly, A.H., and W. Wood. 1991. “Explaining sex differences in social behavior: a meta-analytic perspective.” *Personality and Social Psychology Bulletin,* 17(3): 306–15.

Edmans, A., X. Gabaix, T. Sadzik, and Y. Sannikov. 2012. “Dynamic CEO compensation.” *The Journal of Finance,* 67(5): 1603–47.

Erhardt, N.L., J.D. Werbel, and C.B. Shrader. 2003. “Board of director diversity and firm financial performance.” *Corporate Governance,* 11(2): 102–11.

Escaleras, M., and C.A. Register. 2011. “Natural disasters and foreign direct investment.” *Land Economics.* 87(2), 346–63.

Faccio, M., M.T. Marchica, and R. Mura. 2016. “CEO gender, corporate risk-taking, and the efficiency of capital allocation.” *Journal of Corporate Finance,* 39: 193–209.

Francoeur, C., R. Labelle, and B. Sinclair-Desgagné. 2008. “Gender diversity in corporate governance and top management.” *Journal of Business Ethics,* 81(1): 83–95.

Friedt, F.L., and A. Toner-Rodgers. 2022. “Natural disasters, intra-national FDI spillovers, and economic divergence: Evidence from India.” *Journal of Development Economics,* 157: 102872.

Garfield, R.L., and B.G. Druss. 2012. “Health reform, health insurance, and mental health care.” *American Journal of Psychiatry*, 169(7): 675–77.

Greenpeace East Asia. 2021. *Auto Environmental Guide 2021*. https://www.greenpeace.org/static/planet4-eastasia-stateless/2021/11/47de8bb4-gpea_auto_environmental_guide_2021.pdf.

Gompers, P., and S. Kovvali. 2018. “The Other Diversity dividend.” *Harvard Business Review*: 96 (4): 72–7.

Gompers, P.A., and S.Q. Wang 2017. “Diversity in innovation.” *National Bureau of Economic Research Working Paper 23082*.

Gonzalez-Gonzalez, J.M., and C.Z. Ramírez. 2016. “Voluntary carbon disclosure by Spanish companies: an empirical analysis.” *International Journal of Climate Change Strategies and Management,* 8: 57–79.

Gopalan, R., T. Milbourn, F. Song, and A.V. Thakor. 2014. “Duration of executive compensation.” *The Journal of Finance,* 69(6): 2777–817.

Gu, G.W. and Hale, G., 2023. Climate risks and FDI. *Journal of International Economics*, *146*, p.103731.

Hambel, C., Kraft, H. and van der Ploeg, F., 2024. Asset diversification versus climate action. *International Economic Review, forthcoming*.

Haque, F. 2017. “The effects of board characteristics and sustainable compensation policy on carbon performance of UK firms.” *British Accounting Review,* 49: 347–64.

Hassan, T.A., Hollander, S., Van Lent, L. and Tahoun, A., 2019. Firm-level political risk: Measurement and effects. The Quarterly Journal of Economics, 134(4), 2135-2202.

Huang, J., and D.J. Kisgen. 2013. “Gender and corporate finance: are male executives over-confident relative to female executives?” *Journal of Financial Economics,* 108, 822–39.

Huang, H., J. Kerstein, and C. Wang. 2018. “The impact of climate risk on firm performance and financing choices: an international comparison.” *Journal of International Business Studies,* 49: 633–56.

Hong, H., F.W. Li, and J. Xu. 2019. “Climate risks and market efficiency.” *Journal of Econometrics,* 208(1): 265–281.

Hong, L., and S.E. Page. 2004. “Groups of diverse problem solvers can outperform groups of high-ability problem solvers.” In Proceedings of the National Academy of Sciences 101: 16385–89.

Hopt, K.J., and P.C. Leyens. 2023. “The Structure of the Board of Directors: Boards and Governance Strategies in the US, the UK and Germany.” European Corporate Governance Institute Law Working Paper No. 567/2021.

Intergovernmental Panel on Climate Change. 2021. “The concept of risk in the IPCC Sixth Assessment Report: a summary of cross-Working Group discussions.” Risk-guidance-FINAL_15Feb2021.pdf (ipcc.ch).

International Monetary Fund. 2021. “Greenfield Investment and Extension of Capacity." http://www.intranet.imf.org/departments/STA/methodology/STA_ISS/DITT/Draft%20Guidance%20Notes/D.1%20Greenfield%20Investment%20and%20Extension%20of%20Capital.pdflnk.

Jamali, D., A. Safieddine, and M. Daouk. 2007. “Corporate governance and women: An empirical study of top and middle women managers in the Lebanese banking sector.” *Corporate Governance: The International Journal of Business in Society,* 7(5), 574–85. https://doi.org/10.1108/14720700710827167.

Johnson, K.N., 2011. “Addressing gaps in the Dodd-Frank act: directors' risk management oversight obligations.” *University of Michigan Journal of Law Reform,* 45 (1), 55-112.

Jung, Y.S., E. Owen, and G.S. Shim. 2021. “Heterogeneity in how investors respond to disputes: greenfield foreign direct investment and coindustrial disputes.” *The Journal of Politics,* 83(4): 1260–74.

Kyaw, K., S. Treepongkaruna, and P. Jiraporn. 2022. “Board gender diversity and environmental emissions.” *Business Strategy and the Environment,* 31: 2871–81.

Kearney. 2020. *Entering the storm: anticipating risk in an uncertain world: the 2020 FDI confidence index.* https://www.kearney.com/foreign-directinvestment-confidence-index/2020-full-report (2020).

Keighley, J., 2010. “Health care reform and reproductive rights: sex equality in arguments for abortion coverage in a national plan.” *Harvard Journal Law & Gender,* 33: 357–402.

Kling, G., U. Volz, V. Murinde, and S. Ayas. 2021 “The impact of climate vulnerability on firms’ cost of capital and access to finance.” *World Development,* 137: 105–31.

Kothari, S.P., and C. Wasley. 2019. "Commemorating the 50-year anniversary of Ball and Brown (1968): the evolution of capital market research over the past 50 years." *Journal of Accounting Research*, *57*(5): 1117–59.

Lawrence, S. 2022. "Diversity Matters: The Role of Gender Diversity on US Active Equity Fund Performance (March 23, 2022)." SSRN: https://ssrn.com/abstract=4081494 or http://dx.doi.org/10.2139/ssrn.4081494.

Levi, M., K. Li, and F. Zhang. 2014. "Director gender and mergers and acquisitions." *Journal of Corporate Finance,* 28: 185–200.

Liao, L., L. Luo, and Q. Tang. 2015. "Gender diversity, board independence, environmental committee and greenhouse gas disclosure." *The British Accounting Review,* 47: 409–24.

Lipton, M., D.A. Neff, A.R. Brownstein, S.A. Rosenblum, A.O. Emmerich, and S. Fain. 2011. "Risk management and the board of directors." *Bank and Corporate Governance Law Reporter,* 45(6): 793–99.

Liu, C., 2018. "Are women greener? Corporate gender diversity and environmental violations." *Journal of Corporate Finance,* 52: 118–42.

Liu, C. and J. Sydnor. 2022. "Dominated options in health insurance plans." *American Economic Journal: Economic Policy,* 14(1): 277–300.

Matsumura, E.M., R. Prakash, and S.C. Vera-Munoz. 2014. "Firm-value effects of carbon emissions and carbon disclosures." *The Accounting Review,* 89, 695–724.

Mavisakalyan, A., and Y. Tarverdi. 2019. "Gender and climate change: do female parliamentarians make difference?" *European Journal of Political Economy,* 56(C)" 151–64.

McKinsey. 2023. *Women in the workplace: Breaking up to break through.* https://www.mckinsey.com/featured-insights/diversity-and-inclusion/women-in-the-workplace.

Meslier, C., D.P. Morgan, K. Samolyk, and A. Tarazi. 2016. "The benefits and costs of geographic diversification in banking." *Journal of International Money and Finance,* 69: 287–317.

Mohai, P. 1992. "Men, women, and the environment: An examination of the gender gap in environmental concern and activism." *Society and Natural Resources,* 5: 1–19.

Munich RE. 2018. Risks posed by natural disasters. https://www.munichre.com/en/risks/natural-disasters-losses-are-trending-upwards.html.

Navarro, G., R. Baeza-Yates, E. Sutinen, and J. Tarhio. 2001. "Indexing methods for approximate string matching." *IEEE Data Engineering Bulletin,* 24(4):19–27.

Organisation for Economic Co-operation and Development (OECD). 2020. *Policies and Practices to Promote Women in Leadership Roles in the Private Sector*. https://www.oecd.org/corporate/OECD-G20-EMPOWER-Women-Leadership.pdf.

Pankratz, N., R. Bauer, and J. Derwall. 2019. "Climate change, firm performance, and investor surprises." SSRN: https://ssrn.com/abstract=3443146.

Prado-Lorenzo, J.M., and I.M. Garcia-Sanchez. 2010. "The Role of the Board of Directors in Disseminating Relevant Information on Greenhouse Gases." *Journal of Business Ethics,* 97: 391–424.

Schwartz-Ziv, M. 2017. "Gender and board activeness: the role of a critical mass." *Journal of Financial and Quantitative Analysis,* 52(2): 751–780.

Torchia, M., A. Calabrò, and M. Huse. 2011. "Women directors on corporate boards: from tokenism to critical mass." *Journal of Business Ethics,* 102(2), 299–317.

Trenberth, K.E., A. Dai, G. Van Der Schrier, P.D. Jones, J. Barichivich K.R. Briffa, and J. Sheffield. 2014. "Global warming and changes in drought." *Nature Climate Change,* 4 (1): 17–22.

UN Women. 2022. "How gender inequality and climate change are interconnected." https://www.unwomen.org/en/news-stories/explainer/2022/02/explainer-how-gender-inequality-and-climate-change-are-interconnected.

Westphal, J.D., and L.P. Milton. 2000. "How experience and network ties affect the influence of demographic minorities on corporate boards." *Administrative Science Quarterly,* 45(2): 366–98.

White, J. 2013. "The 2010 US health care reform: approaching and avoiding how other countries finance health care." *Health Economics, Policy and Law,* 8(3): 289–315.

Witte, C.T., M.J. Burger, E.I. Ianchovichina,and E. Pennings. 2017. "Dodging bullets: The heterogeneous effect of political violence on greenfield FDI." *Journal of International Business Studies,* 48(7): 862–92.

Xiao, C., and A.M. McCright. 2007. "Environmental concern and sociodemographic variables: a study of statistical models." *The Journal of Environmental Education,* 38: 3–14.

Table 1A. Descriptive Statistics

This panel reports the descriptive statistics of key variables in our analysis. Probability of negative earnings *P(EPS<0)* is the dependent variable of Models (1) to (3), which are estimated using panel logit regression with year and industry fixed effects. *Net income*, scaled by number of shares outstanding, is the dependent variable of Models (4) to (6) which are estimated using panel two-way fixed effects. Probability of negative earnings takes a value of one if the earnings per share is negative in each firm-year. *Female board %* is the percentage of female members represented on the board of directors. *# Female Board* ≥ 1 is an indicator for at least one female director. *Female CEO* equals one if a CEO is a female, zero otherwise. *Interlocking Directorship* equals one if an executive officer of one firm (i) serves on the board committee that makes his or her compensation decisions; (ii) serves on the board (and possibly compensation committee) of another company that has an executive officer serving on the compensation committee of the indicated officer's company; or (iii) serves on the compensation committee of another company that has an executive officer serving on the board (and possibly compensation committee) of the indicated officer's company. *Total Annual Compensation* is the total compensation, including salary, bonus, long-term incentive payouts, and other annual payouts. *Options Granted* is the total Black-Scholes (1973) value of equity options granted to all executives in a fiscal year using Standard & Poor's methodology. *Stock Awards* is the total value of stock awards to all executives during the firm-year under FAS 123R. *Greenfield investment is the log of total amount of greenfield* investment in each firm-year. *Estimated losses* represent the value losses due to disasters. *Total deaths* is the number of deaths associated with natural disasters. *Vulnerability index* is the vulnerability component of the ND-GAIN index, which measures a country's vulnerability to the negative impacts of climate change. *Readiness index* is the readiness component of the ND-GAIN index, which measures a country's readiness to make effective use of investments for adaptation to climate change. *Net income* is the income after expenses and losses have been subtracted from all revenues and gains for the fiscal period, including extraordinary items and discontinued operations. *Share outstanding* is the net number of all common shares outstanding at the fiscal year-end, excluding treasury shares and scrip. *Market capitalization* is the product of fiscal year-end closing price and shares outstanding. *Leverage* is computed as the long-term debt scaled by total asset. Long-term debt is the debt obligations due more than one year from the company's balance sheet date. *Total assets* represents the total value of assets reported on a firm's balance sheet. *Gender equality index* (Sugarman and Straus 1988) is the indicators of economic, political, and legal equality for each state in the US.

	N	Mean	Standard Deviation	1st Percentile	Median	99th Percentile
Probability of negative earnings P(EPS<0)	49779	0.141	0.348	0	0	1
Female Board	49779	0.051	0.131	0	0	0.571
Number of Female Directors	49779	0.228	0.534	0	0	2
Number of Board Members	49779	5.58	1.075	3.0	5.0	9.0
Female CEO	49779	0.048	0.213	0	0	1.0
Interlocking Directorship	49779	0.011	0.102	0	0	1.0
Total Annual Compensation (in millions USD)	49198	4.744	5.398	0.313	3.066	23.205
Options Granted (in millions USD)	49779	1.130	1.516	0	0.629.88	7.181

Stock Awards	39338	1.868	3.000	0	1.061	13.293
Greenfield Investment (in millions USD)	48725	54.085	141.293	0.400	19.000	410.300
Estimated Losses (in billions USD)	37987	11.798	62.801	0.0002	0.554	224.0
Total Deaths	37987	176.4	1257.5	10	18	1388
ND-GAIN Vulnerability Index	4550	0.441	0.096	0.269	0.429	0.676
ND-GAIN Readiness Index	4800	0.408	0.137	0.183	0.377	0.767
Net Income (in millions USD)	49666	1525.65	5551.23	-2687	219.83	17410
Shares Outstanding (in millions USD)	49765	689.580	1800.3	8.943	139.026	10536.9
Market Capitalization (in millions USD)	49765	37312.11	101754.7	58.53	4545.23	737467.3
Debt to Total Asset	49713	0.224	0.181	0	0.203	0.669
Gender Equality Index	48128	44.265	8.154	24	46.1	56.1

Table 1B. Descriptive Statistics

This panel reports descriptive statistics of natural disasters by type.

Type	**Number of natural disasters**	**Average damage in USD (M)**	**Average number of people affected**	**Average deaths**	**Average injured**	**Average of homelessness**
Drought	113	1716.672	1423333.33	.	.	.
Extreme temperature	163	7041.146	448310.4	254.05	1674.16	.
Flood	473	1269.595	154821.2	44.62	236.40	14093.66
Landslide	42	9.000	1051.441397	23.62	194.34	55
Storm	447	2879.85	127291.6	28.77	364.38	166654.95
Wildfire	46	617.08	789.33	5.35	273.50	790.3
Acute vs. chronic disasters						
Acute	649	3342.47	675488.31	149.33	955.282	14093.66
Chronic	635	1168.65	43044.12	19.24	277.41	55833.42

Table 1C. Descriptive Statistics

This panel reports descriptive statistics of greenfield investments by type and location.

Project type	Number of greenfield investments	Total investment in USD (M)	Total jobs created
New	1728	132841.81	366270
Expansion	348	28611.27	119278
Multiple locations	20	2175.74	1351
Others	28	703.82	6643
Destination country	**Number of greenfield investments**	**Total investment in USD (M)**	**Total jobs created**
Albania	9	27.90	180
Angola	24	553.00	3552
Argentina	28	1428.80	4260
Bangladesh	13	452.40	832
Belgium	2	12.18	56
Brazil	262	31601.86	55872
Bulgaria	106	6205.99	56844
Canada	42	1946.71	3486
Chile	21	963.60	791
Colombia	24	308.63	7044
Costa Rica	13	483.20	6432
Croatia	1	23.80	38
Cuba	2	716.80	238
Czech Republic	15	534.20	5349
Ecuador	44	1320.00	264
El Salvador	2	30.60	22
Greece	38	1924.70	7600
Guatemala	5	233.50	1090
Honduras	3	43.70	665
Hungary	12	386.70	4062
India	268	11191.80	85052

Indonesia	58	3829.50	36246
Iran	13	1490.40	2646
Ireland	91	4946.99	11563
Israel	24	449.34	1270
Italy	41	2838.24	2611
Jordan	9	433.90	1536
Kenya	11	118.50	373
Lebanon	1	15.10	16
Luxembourg	4	185.00	133
Malaysia	57	2558.90	8474
Mexico	204	7719.19	20978
Montenegro	16	1658.60	3475
Morocco	9	242.03	3396
Mozambique	1	11.00	18
Myanmar	9	1464.30	1692
New Zealand	7	215.10	361
Nicaragua	21	483.10	3272
Oman	3	221.80	262
Pakistan	49	12161.40	6248
Paraguay	5	3000.00	605
Peru	25	14470.70	5318
Philippines	53	5460.40	23862
Poland	50	3672.53	18197
Portugal	3	37.50	125
Romania	4	13.84	92
Senegal	4	171.00	371
Serbia	51	13395.10	46205
Slovakia	17	651.90	3044
Spain	100	2614.73	9422
Sri Lanka	27	805.90	1222
Thailand	32	5852.80	8416

Tunisia	5	264.40	1370
Türkiye	10	655.5	1593
Uganda	3	45.9008	30
United Kingdom	91	2496.30	5651
United States	58	5266.60	4071
Uruguay	9	2009.80	2102
Venezuela	14	1215.20	12376
Yemen	1	800.00	1171

Table 1D. Descriptive Statistics

This panel reports descriptive statistics of female board percentages by state of company headquarters.

States of headquarters	Number of firm-years	Average female board	Standard deviation of female board	Median female board
Arizona	52	0.17	0	0.17
Arkansas	91	0	0	0
California	1872	0.07	0.13	0
Colorado	25	0	0	0
Connecticut	1102	0.003	0.02	0
Florida	171	0.03	0.08	0
Georgia	1334	0.03	0.06	0
Illinois	381	0.02	0.05	0
Indiana	16	0.2	0	0.2
Iowa	18	0	0	0
Kentucky	8	0.33	0	0.33
Louisiana	983	0.02	0.07	0
Maryland	163	0	0	0
Massachusetts	490	0.01	0.04	0
Michigan	576	0.04	0.07	0
Minnesota	310	0.06	0.11	0
Missouri	154	0	0	0
New Hampshire	28	0	0	0
New Jersey	410	0.05	0.08	0
New York	1400	0.03	0.07	0
North Carolina	256	0.13	0.16	0
Ohio	304	0	0	0
Oregon	54	0	0	0
Pennsylvania	606	0.01	0.05	0
South Carolina	60	0	0	0
Tennessee	26	0	0	0
Texas	489	0.04	0.08	0

Virginia	58	0	0	0
Washington	674	0	0	0
Washington, DC	21	0	0	0
Wisconsin	267	0.03	0.09	0

Table 2. Earnings Losses upon Natural Disasters and Female Board Percentages

This table reports results of regressing probability of earnings losses and net income upon natural disasters on female board percentages and actual number of female board members. Probability of negative earnings *P(EPS<0)* is the dependent variable of Models (1) to (3), which are estimated using panel logit regression with year and industry fixed effects. *Net income*, scaled by number of shares outstanding, is the dependent variable of Models (4) to (6), which are estimated using panel two-way fixed effects. Probability of negative earnings takes a value of one if the earnings per share is negative in each firm-year. *Female board %* is the percentage of female member presented in the board of directors. *# Female Board* ≥ 1 is an indicator for at least one female director. Control variables include an indicator of a *Female CEO*, and *Interlocking directorship*. *Options Granted* is the total value of equity options granted to all executives during the firm-year using Standard & Poor's Black-Scholes methodology, scaled by total compensation. *Stock Awards* is the total value of stock awards to all executives during the firm-year under FAS 123R, scaled by total compensation. *Greenfield investment* is the log of total amount of greenfield investments in each firm-year. *Estimated losses* represent the value losses due to natural disasters. *Total deaths* is the number of deaths associated with natural disasters. *Vulnerability index* is the vulnerability component of the ND-GAIN index that measures a country's vulnerability to negative impact of climate change. *Readiness index* is the readiness component of the ND-GAIN index that measures a country's readiness to make effective use of investments for adaptation to climate change. *Net income* is the income after expenses and losses have been subtracted from all revenues and gains for the fiscal period, including extraordinary items and discontinued operations. *Share outstanding* is the net number of all common shares outstanding at the fiscal year-end, excluding treasury shares and scrip. *Market capitalization* is the product of fiscal year-end closing price and shares outstanding. *Leverage* is computed as the long-term debt scaled by total asset. *Long-term debt* is the debt obligations due more than one year from the company's balance sheet date. *Total assets* represents the total value of assets reported on a firm's balance sheet. Standard errors in parentheses are heteroscedastic-consistent and cluster-adjusted. Odds ratio for variables in Models (1) to (3) are reported in square brackets. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

	(1) P(EPS<0)	(2) P(EPS<0)	(3) P(EPS<0)	(4) Net Income	(5) Net Income	(6) Net Income
Female Board %	-6.803***			0.983***		
	(0.367)			(0.245)		
	[0.035]					
# Female Board ≥ 1		-1.543***			0.400***	
		(0.088)			(0.057)	
		[0.214]				
# Female Board ≥ 2			-1.178***			0.466***
			(0.0185)			(0.054)
			[0.308]			
Options Granted	2.409***	2.493*	2.533**	-0.443***	-0.479***	-0.442***
	(0.215)	(0.212)	(0.214)	(0.163)	(0.163)	(0.163)
	[11.124]	[12.092]	[12.594]			
Stock Awards	-0.352***	-0.330***	-0.290***	0.099**	0.105**	0.095**
	(0.095)	(0.095)	(0.095)	(0.044)	(0.044)	(0.044)
	[0.704]	[0.719]	[0.748]			

Female CEO	-1.144***	-1.015***	-0.0887***	0.005	-0.033	0.043
	(0.051)	(0.050)	(0.048)	(0.034)	(0.032)	(0.031)
	[3.138]	[2.758]	[2.427]			
Interlocking	0.001	0.001	0.001	-0.001	-0.001*	-0.001*
Directorship	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[1.000]	[0.000]	[0.000]			
Greenfield Investment	0.056***	0.048**	0.048***	0.118***	0.120***	0.119***
	(0.016)	(0.016)	(0.016)	(0.011)	(0.012)	(0.011)
	[1.057]	[1.049]	[1.049]			
Economic Losses of	0.020***	0.022***	0.021***	-0.007**	-0.007**	-0.007***
Natural Disasters	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
	[1.020]	[1.022]	[1.021]			
Number of Deaths	0.066***	0.056***	0.058**	0.019*	0.019**	0.020***
	(0.013)	(0.013)	(0.013)	(0.010)	(0.010)	(0.010)
	[1.069]	[1.057]	[1.060]			
Leverage	1.575***	1.549***	1.542***	-1.168***	-1.168***	-1.588***
	(0.1288)	(0.130)	(0.130)	(0.094)	(0.104)	(0.094)
	[2.449]	[2.498]	[2.833]			
Market	-0.072***	-0.050***	-0.059**	0.732***	0.729***	0.599***
Capitalization (log)	(0.023)	(0.023)	(0.023)	(0.011)	(0.011)	(0.009)
	[0.931]	[0.951]	[0.943]			
Returns of Assets	-1.212***	-1.206***	-1.387***	0.208***	0.208***	0.128***
	(0.021)	(0.020)	(0.023)	(0.002)	(0.002)	(0.002)
	[0.298]	[0.299]	[0.250]			
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
N	49698	49698	49698	49585	49585	49585

Table 3. Instrumental Variable Analysis of the Impact of Female Board Members on Earnings Losses upon Natural Disasters

This table reports the results of a two-stage least squares model of impact of female board percentage on earnings losses and net income. In the first stage, state-level proportion of women without health insurance (*WomenHealth*) is used as an instrumental variable of female board percentage. The first column reports the first stage of the two-stage least squares regression: regress female board percentage *FemaleBoard%* against the proportion of women without health insurance (relevance condition). The second column reports exclusion restriction of the instrumental variable proportions of uninsured women: regress probability of earnings losses against the proportion of women without health insurance. The instrumented female board percentage is used in the second stage in explaining earnings losses. The third column reports the results of the second-stage estimation of the two-stage least squares regression: regress earnings losses and net income against the instrumented female board percentage. Control variables include female CEO, executive compensation, interlocking directorship, greenfield investment, economics losses from natural disasters, total deaths, the log of market capitalization, leverage, and returns on assets. Year and industry fixed effects are included. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

	(1) Female Board % (First Stage)	(2) P(EPS<0) (Exclusion Restriction)	(3) P(EPS<0) (Second Stage)	(4) Net Income (Exclusion Restriction)	(5) Net Income (Second Stage)
WomenHealth	-0.049**	-1.453		0.541	
	(0.012)	(0.485)		(0.371)	
Instrumented Female Board Percentage			-2.905***		8.066***
			(0.681)		0.484
Control Variables	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES
N	24769	24769	24769	24769	24769

Table 4. Instrumental Variable Analysis of the Impact of Female Board Members on Earnings Losses upon Natural Disasters

This table report the results of a two-stage least squares model of the impact of female board percentage on earnings losses and net income. In the first stage, the state-level gender equality index is used as an instrumental variable of female board percentage. The first column reports the first stage of the two-stage least squares regression: regress female board percentage against a gender equality index (relevance condition). The second column reports the exclusion restriction of the instrumental variable against a gender equality index: regress probability of earnings losses against a gender equality index. The instrumented female board percentage is used in the second stage in explaining earnings losses. The third column reports the results of the second-stage estimation of the two-stage least squares regression: regress earnings losses and net income against the instrumented female board percentage. Control variables include female CEO, executive compensation, interlocking directorship, greenfield investment, economics losses from natural disasters, total deaths, the log of market capitalization, leverage, and returns on assets. Year and industry fixed effects are included. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

	(1) Female Board % (First Stage)	(2) P(EPS<0) (Exclusion Restriction)	(3) P(EPS<0) (Second Stage)	(4) Net Income (Exclusion Restriction)	(5) Net Income (Second Stage)
Gender Equality Index	0.002***	-3.016		0.001	
	(0.000)	(3.211)		(0.003)	
Instrumented Female Board %			-8.519***		6.156***
			(2.035)		(1.308)
Control Variables	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES
N	24769	24769	24769	24927	25762

Table 5. 2016 Paris Agreement on the Impact of Board Gender Diversity on Earnings Losses upon Natural Disasters

This table reports results of regressing probability of earnings losses and net income upon natural disasters on female board percentages and actual number of female board members restricted to a subsample of firm-years before the 2016 Paris Agreement, signed into force on December 12, 2015. Probability of negative earnings *P(EPS<0)* is the dependent variable of Models (1) to (3), which are estimated using panel logit regression with year and industry fixed effects. *Net income*, scaled by number of shares outstanding, is the dependent variable of Models (4) to (6), which are estimated using panel two-way fixed effects. Probability of negative earnings takes a value of one if the earnings per share is negative in each firm-year. *Female board %* is the percentage of female member presented in the board of directors. *# Female Board* ≥ 1 is an indicator for at least one female director. Control variables include female CEO, executive compensation, interlocking directorship, greenfield investment, economics losses from natural disasters, total deaths, the log of market capitalization, leverage, and returns on assets. Standard errors in parentheses are heteroscedastic-consistent and cluster-adjusted. Odds ratio for variables in Models (1) to (3) are reported in square brackets. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

	(1) P(EPS<0)	(2) P(EPS<0)	(3) P(EPS<0)	(4) Net Income	(5) Net Income	(6) Net Income
Female Board %	-2.854***			1.857***		
	(0.406)			(0.256)		
	[0.058]					
# Female Board ≥ 1		-1.715***			1.486***	
		(0.096)			(0.110)	
		[0.493]				
# Female Board ≥ 2			-0.764***			1.547***
			(0.115)			(0.110)
			[0.466]			
Control Variables	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
N	25120	25120	25120	25051	25051	25051

Table 6. Greenfield Investments in Countries Vulnerable to Climate Change

This table reports the results of regression greenfield investments in countries vulnerable to climate change on female board percentage with log-transformed logistic regressions and a truncated regression. The dependent variable for logistic regressions is the logarithm of the ratio of investment in high- to low-vulnerability countries. The dependent variable for a truncated regression is the percentage of greenfield investment in highly vulnerable countries. Vulnerability is defined by the ND-GAIN vulnerability index. Each year, countries are divided into high or low vulnerability by median. Control variables include female CEO, executive compensation, interlocking directorship, greenfield investment, economics losses from natural disasters, total deaths, the log of market capitalization, leverage, and returns on assets. Year and industry fixed effects are included. MacKinnon-White (1985) standard errors are reported in parentheses in columns (1) to (3). ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

	Logarithm of the ratio of greenfield investment in high- to –low-vulnerability countries			
	(1) Log-transformed MacKinnon-White (1985) SD	(2) Log-transformed MacKinnon-White (1985) SD	(3) Log-transformed MacKinnon-White (1985) SD	(4) Truncated Regression
Female Board %	-12.926*** (1.304)			-3.878** (1.690)
# Female Board ≥ 1		-3.211*** (0.526)		
# Female Board ≥ 2			-3.897*** (0.279)	
Control Variables	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
N	20005	20005	20005	20005

Table 7. Greenfield Investments in Countries with Readiness to Adapt to Climate Change

This table reports the results of regression greenfield Investments in countries ready to make effective use of investments for adaptation of climate change on female board percentage with log-transformed logistic regressions and a truncated regression. The dependent variable for logistic regressions is the logarithm of the ratio of investment in countries with high to low readiness. The dependent variable for a truncated regression is the percentage of greenfield investment in countries with high climate readiness. Readiness is defined by the ND-GAIN readiness index. Each year, countries are divided into high or low readiness by median. Control variables include female CEO, executive compensation, interlocking directorship, greenfield investment, economics losses from natural disasters, total deaths, the log of market capitalization, leverage, and returns on assets. Year and industry fixed effects are included. MacKinnon-White (1985) standard errors are reported in parentheses in columns (1) to (3). ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

	Log-transformed MacKinnon-White (1985) SD	Log-transformed MacKinnon-White (1985) SD	Log-transformed MacKinnon-White (1985) SD	Truncated Regression
Female Board %	5.393*** (1.143)			5.623** (0.679)
# Female Board ≥ 1		1.138*** (0.379)		
# Female Board ≥ 2			1.784*** (0.391)	
Control Variables	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
N	20005	20005	20005	20005

Table 8. Gender Diversity on Environmental Policy Risk

This table reports the regression results of female board percentage on a firm's risk exposure to changes in policies regarding environmental standards. The dependent variable, $Risk_{it}^{Env}$, is the share of a firm's quarterly earnings conference calls devoted to environmental policy risks following Hassan et al. (2019). Control variables include female CEO, executive compensation, interlocking directorship, greenfield investment, economics losses from natural disasters, total deaths, the log of market capitalization, leverage, and returns on assets. Year and industry fixed effects are included. Column (1) reports Fama-MacBeth regression results; column (2) reports panel regression results; and column (3) reports OLS with clustered standard errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

	(1) Environmental Policy Risk (Fama-MacBeth)	(2) Environmental Policy Risk (Panel Regression)	(3) Environmental Policy Risk (OLS clustered SD)
Female Board %	-0.336*** (0.074)	-0.371*** (0.074)	-0.389*** (0.087)
Control Variables	YES	YES	YES
Year FE		YES	YES
Industry FE	YES	YES	YES
N	24927	25738	25762

Table 9. Gender Diversity on Risk Management Committee

This table reports the regression results of female board percentage on the establishment of a firm's risk management committee. The dependent variable, RM_{it}, is the likelihood of the establishment of a firm's risk management committee. Control variables include female CEO, executive compensation, interlocking directorship, greenfield investment, economics losses from natural disasters, total deaths, the log of market capitalization, leverage, and returns on assets. Year and industry fixed effects are included. Column (1) reports Fama-MacBeth regression results; column (2) reports panel regression results; and column (3) reports OLS with clustered standard errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

	Likelihood of the Establishment of a Firm's Risk Management Committee			
	(1) Log-transformed MacKinnon-White (1985) SD	(2) Log-transformed MacKinnon-White (1985) SD	(3) Log-transformed MacKinnon-White (1985) SD	(4) Truncated Regression
Female Board %	0.674*** (0.219)			2.889*** (0.118)
# Female Board ≥ 1		0.340*** (0.051)		
# Female Board ≥ 2			0.624*** (0.059)	
Control Variables	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
N	41736	41736	41736	41736

Table 10. Gender Diversity, Geographical Diversification, and Type of Natural Disasters

	(1) P(EPS<0)	(2) P(EPS<0)	(3) P(EPS<0)
Female board percentage	-1.184** (0.518)	-2.677*** (0.387)	-1.480*** (0.471)
Geographical diversity	0.077*** (0.028)	0.044* (0.026)	
Female board percentage* geographical diversity	-2.070*** (0.514)		
Female board percentage * Chronic disaster indicator			-16.585*** (2.864)
Chronic disaster indicator			1.104*** (0.110)
Controls	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes
N	34041	34041	29961

Appendix

Table A1. Industry Distributions

Industry	Firm-year observations	Baseline coefficient	Industry	Firm-year observations	Baseline coefficient
Automotive	1200	-230.914	Coal, Oil and Natural	3415	-16.594
Education	241	-135.854	Financial Services	14309	-12.293
Biotechnology and Pharmaceuticals	4319	-104.716	Transportation	4420	-10.183
Medical Devices	966	-78.873	Business Services	4490	-3.294
Semiconductors	350	-70.94	Food, Tobacco and Beverages	3914	-2.905
Communications	1432	-55.926	Software and IT service	6094	-1.251
Metals	301	-41.93	Alternative/Renewable	1274	4.991
Hotels & Tourism	2845	-25.73	Aerospace/Space & Defense	1535	16.286
IT Hardware, Electronic & Electrical Equip	4738	-21.816	Chemicals	2186	26.074
Construction	1240	-18.857	Real Estate	3864	44.202

Table A2. Greenfield Investment Scaled by Capital Expenditure

	Probability of Negative Earnings			
	(1) Log-transformed MacKinnon-White (1985) SD	(2) Log-transformed MacKinnon-White (1985) SD	(3) Log-transformed MacKinnon-White (1985) SD	(4) Truncated Regression
Female Board %	-6.811*** (0.544)			-1.570*** (0.053)
# Female Board ≥ 1		-1.801*** (0.134)		
# Female Board ≥ 2			-1.693*** (0.145)	
Control Variables	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
N	23265	23265	23265	23265

Table A3. Earnings per Share without Extraordinary Items

	Probability of negative earnings per share without extraordinary items			
	(1) Log-transformed MacKinnon-White (1985) SD	(2) Log-transformed MacKinnon-White (1985) SD	(3) Log-transformed MacKinnon-White (1985) SD	(4) Truncated Regression
Female Board %	-1.130*** (0.409)			-1.457*** (0.080)
# Female Board ≥ 1		-0.092 (0.097)		
# Female Board ≥ 2			-0.058 (0.112)	
Control Variables	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
N	25120	25120	25120	25120

Table A4. Earnings per Share Conditioned on Number of Female Directors

	Earnings per share (EPS)	
	N	Average EPS
Female Board = 0	40347	-0.0854
Female Board = 1	6826	-0.0448
Female Board = 2	1707	0.0527
Female Board = 3	328	0.0605

PUBLICATIONS