ecgi

The Eco-Gender Gap in Boardrooms

Finance Working Paper N° 861/2022
September 2024

Po-Hsuan Hsu
National Tsing Hua University, National University of Singapore and ABFER

Kai Li
University of British Columbia, ABFER, CAFR, CSFN and ECGI

Yihui Pan
University of Utah

ECGI Working Paper Series in Finance

The Eco-Gender Gap in Boardrooms

Working Paper N° 861/2022
September 2024

Po-Hsuan Hsu
Kai Li
Yihui Pan

We are grateful for helpful comments from Tim Adam, Pat Akey, Najah Attig, Utpal Bhattacharya, Bo Bian, Alice Bonaime, Yingmei Cheng, Darwin Choi, Alex Corhay, Waverly Ding, Adam Exstein, Joseph Fan, Yuan Gao, David Goldreich, Bing Han, Rob Heinkel, Camille Herbert, Jun-koo Kang, Simi Kedia, Chris Lamoureux, Gen Li, Hao Liang, Stefano Lovo, Beatriz Mariano, Glades McKenzie, Sergey Mityakov, Suman Neupane-Joshi, Darius Palia, Loriana Pelizzon, Xiao Ren, Daniel Skarlicki, Kelvin Tan, Ting Xu, Jing Xu, Chelsea Yang, Liyan Yang, Irene Yi, Alminas Zaldokas, Shan Zhao, and Yuxiang Zheng, seminar participants at Central University of Finance and Economics, Columbia Women's Applied Micro Seminar, Florida State University, Goethe University, Halle Institute for Economic Research, Humboldt University, OECD, Rutgers University, University of Arizona, University of Macau, University of Queensland, University of Toronto, University of Utah, and conference participants at the NTHU Symposium on Sustainable Finance and Economics, HEC-HKUST Sustainable Finance Seminar, PRI Academic Seminar Series, Montalbano Centre for Responsible Leadership Development Research Conference, U.K. Women in Finance Conference, Canadian Sustainable Finance Network (CSFN) Conference, and the China International Conference in Finance. The paper was the recipient of the China International Conference in Finance Best Paper Award. We thank the excellent research support from McKenna Carpenter, Jianqiang Chen, Gen Li, Daniel Mack, Huayi Tang, and Chi-Yang Tsou, and Derek Hoff for copy editing. Li acknowledges financial support from the Canada Research Chair in Corporate Governance, the Social Sciences and Humanities Research Council of Canada (Grant Number: 435-2022-0285), and the Montalbano Centre for Responsible Leadership Development at UBC Sauder School of Business. All errors are our own.

Abstract

To examine what women bring to the boardroom table, we first show a significant gender gap in viewing the tradeoff between environmental and economic benefits using the Gallup Poll. We next demonstrate that such a gender gap extends into boardrooms: Having female directors is associated with more environmentally friendly business operations, but also with higher selling, general, and administrative expenses at the same time. Employing a rich set of director demographics and board characteristics, we show that none consistently supersedes the share of female directors in explaining corporate environmental performance, suggesting that female directors play a unique role in explaining firms' investment in environmental protection. Results from an analysis using a California law change that imposed a boardroom gender quota point to a potentially causal effect from female directors.

Keywords: female directors, board diversity, corporate environmental performance, pollution prevention, emissions, diversity of thought

JEL Classifications: G30; G38; G41

Po-Hsuan Hsu*
Professor
National Tsing Hua University
101, Section 2, Kuang-Fu Road
Hsinchu City , Taiwan
e-mail: pohsuan.hsu@gmail.com

Kai Li
W.M. Maurice Young Professor of Finance
University of British Columbia, Sauder School of Business
2053 Main Mall
Vancouver, BC V6T 1Z2, Canada
phone: +1 604 822 8353
e-mail: kai.li@sauder.ubc.ca

Yihui Pan
Associate Professor of Finance
University of Utah
Salt Lake City, UT 84112, USA
phone: +1-801-587-9672
e-mail: Yihui.Pan@Eccles.Utah.edu

*Corresponding Author

The Eco-Gender Gap in Boardrooms*

Po-Hsuan Hsu, Kai Li, and Yihui Pan

This version: September 2024

Abstract

To examine what women bring to the boardroom table, we first show a significant gender gap in viewing the tradeoff between environmental and economic benefits using the Gallup Poll. We next demonstrate that such a gender gap extends into boardrooms: Having female directors is associated with more environmentally friendly business operations, but also with higher selling, general, and administrative expenses at the same time. Employing a rich set of director demographics and board characteristics, we show that none consistently supersedes the share of female directors in explaining corporate environmental performance, suggesting that female directors play a unique role in explaining firms' investment in environmental protection. Results from an analysis using a California law change that imposed a boardroom gender quota point to a potentially causal effect from female directors.

Keywords: female directors; board diversity; corporate environmental performance; environmental news; pollution prevention; emissions

JEL classification: G30; G38; G41

---

* Po-Hsuan Hsu, Department of Quantitative Finance, College of Technology Management, National Tsing Hua University, Email: pohsuanhsu@mx.nthu.edu.tw. Kai Li, Sauder School of Business, University of British Columbia, Email: kai.li@sauder.ubc.ca. Yihui Pan, Department of Finance, David Eccles School of Business, University of Utah, Email: yihui.pan@eccles.utah.edu. We are grateful for helpful comments from Tim Adam, Pat Akey, Najah Attig, Utpal Bhattacharya, Bo Bian, Alice Bonaime, Yingmei Cheng, Darwin Choi, Alex Corhay, Waverly Ding, Adam Exstein, Joseph Fan, Yuan Gao, David Goldreich, Bing Han, Rob Heinkel, Camille Herbert, Jun-koo Kang, Simi Kedia, Chris Lamoureux, Gen Li, Hao Liang, Stefano Lovo, Beatriz Mariano, Glades McKenzie, Sergey Mityakov, Suman Neupane-Joshi, Darius Palia, Loriana Pelizzon, Xiao Ren, Daniel Skarlicki, Kelvin Tan, Ting Xu, Jing Xu, Chelsea Yang, Liyan Yang, Irene Yi, Alminas Zaldokas, Shan Zhao, and Yuxiang Zheng, seminar participants at Central University of Finance and Economics, Columbia Women's Applied Micro Seminar, Florida State University, Goethe University, Halle Institute for Economic Research, Humboldt University, OECD, Rutgers University, University of Arizona, University of Macau, University of Queensland, University of Toronto, University of Utah, and conference participants at the NTHU Symposium on Sustainable Finance and Economics, HEC-HKUST Sustainable Finance Seminar, PRI Academic Seminar Series, Montalbano Centre for Responsible Leadership Development Research Conference, U.K. Women in Finance Conference, Canadian Sustainable Finance Network (CSFN) Conference, and the China International Conference in Finance. The paper was the recipient of the China International Conference in Finance Best Paper Award. We thank the excellent research support from McKenna Carpenter, Jianqiang Chen, Gen Li, Daniel Mack, Huayi Tang, and Chi-Yang Tsou, and Derek Hoff for copy editing. Li acknowledges financial support from the Canada Research Chair in Corporate Governance, the Social Sciences and Humanities Research Council of Canada (Grant Number: 435-2022-0285), and the Montalbano Centre for Responsible Leadership Development at UBC Sauder School of Business. All errors are our own.

The Eco-Gender Gap in Boardrooms

Abstract

To examine what women bring to the boardroom table, we first show a significant gender gap in viewing the tradeoff between environmental and economic benefits using the Gallup Poll. We next demonstrate that such a gender gap extends into boardrooms: Having female directors is associated with more environmentally friendly business operations, but also with higher selling, general, and administrative expenses at the same time. Employing a rich set of director demographics and board characteristics, we show that none consistently supersedes the share of female directors in explaining corporate environmental performance, suggesting that female directors play a unique role in explaining firms' investment in environmental protection. Results from an analysis using a California law change that imposed a boardroom gender quota point to a potentially causal effect from female directors.

Keywords: female directors; board diversity; corporate environmental performance; environmental news; pollution prevention; emissions

JEL classification: G30; G38; G41

"This is the age of the female director. . . . there is little doubt that they will influence firm and societal outcomes. To characterize this influence we need a better understanding of what women bring to the boardroom table and how diversity affects firm outcomes."

– Renée Adams (2016, Leadership Quarterly, p. 384)

"Boards with a diverse mix of genders, ethnicities, career experiences, and ways of thinking have, as a result, a more diverse and aware mindset. They are less likely to succumb to groupthink or miss new threats to a company's business model. And they are better able to identify opportunities that promote long-term growth."

– BlackRock CEO Larry Fink's Annual Letter to CEOs, January 19, 2018

1. Introduction

New data from the Gallup Poll Social Series show that female respondents value environmental protection more than male respondents, whereas male respondents, especially those with high income, value economic growth and energy supplies significantly more. In this paper, using novel firm- and facility-level data, we first examine whether such a gender gap in viewing the tradeoff between environmental and economic benefits extends to corporate decision-making inside boardrooms. Using a rich set of director demographic variables and board qualification, diversity, and governance measures, we next explore how female directors play a role in corporate environmental performance. Our paper helps enrich our understanding of what female directors bring to the boardroom table. It also sheds new light on the interactions across corporate environmental, social, and governance (ESG) dimensions.

Investments in corporate environmental performance are characterized by a prolonged period of resource commitment that generates positive externalities to stakeholders, the community, and the natural environment, potentially reducing firms' environmentally related regulatory risk. The cost-benefit tradeoff might be firm-specific or even hard to quantify. This begs the question of what prompts modern corporations to engage in environmentally friendly business operations. Prior literature has largely examined the role of shareholders

and creditors.[1] We try to answer this question from corporate governance and social performance perspectives, with a particular focus on board gender diversity.

On the one hand, as the two opening quotations suggest, adding more female directors to typically male-dominated corporate boardrooms could broaden boards' perspectives on environmental issues, especially regarding the tradeoff between short-term economic costs and long-term environmental benefits. PwC's Annual Corporate Directors Survey (2022) provides some supporting evidence. It notes that 66% of surveyed female directors are more likely to prioritize reducing the impact of climate change, even if it impacts short-term financial performance, compared to only 45% of surveyed male directors. In addition, Malenko (2014) shows that more diverse boards communicate more effectively, leading to efficient decision-making.

On the other hand, self-selection and professional expertise might reduce, or even eliminate, gender differences in personal values and preferences inside the boardroom (Adams and Funk 2012; Lewellen 2022). Moreover, from a theoretical perspective, a diverse board could also be less effective in some settings (Baranchuk and Dybvig 2009; Garlappi, Giammarino, and Lazrak 2017), for example in a dynamic framework (Donaldson, Malenko, and Piacentino 2020). What women bring to the boardroom table and how board gender diversity shapes corporate environmental performance remain important yet unanswered empirical questions.

Using Refinitiv's environmental ratings, the U.S. Environmental Protection Agency's (EPA) source reduction practices (i.e., activities to prevent pollution), and RepRisk's negative environmental news as measures of corporate environmental performance, we first

[1] See, for example, Cao, Liang, and Zhan (2019), Krueger, Sautner, and Starks (2020), Cao, Titman, Zhan, and Zhang (2023), and Hoepner, Oikonomou, Sautner, Starks, and Zhou (2024) on the role of shareholders, as well as surveys by Matos (2020) and Gillan, Koch, and Starks (2021). The influence of creditors on firms' toxic emissions is examined by Akey and Appel (2021), Kacperczyk and Peydro (2021), Bellon (2022), and Ivanov, Kruttli, and Watugala (2022). Other important stakeholders playing a role include customers (Aghion, Bénabou, Martin, and Roulet 2023) and governments (Wu, You, Yu, and Zhou 2024).

document a positive and significant association between board gender diversity and corporate environmental performance. We include firm fixed effects to control for time-invariant general corporate attitudes towards ESG issues that might correlate with both the share of female directors and corporate environmental performance, as well as industry-year fixed effects to control for time-varying industry-level shocks. At the same time, strong environmental performance requires more investments. Consistent with that intuition, we find a positive association between the share of female directors on a firm's board and its sales, general, and administrative expenses. These results echo the survey evidence on the willingness to trade environmental actions against economic costs by the female population broadly and female directors specifically.

To examine firms' investments and actions in improving environmental performance, we employ facility-level data from the EPA's Toxic Release Inventory database, which covers both source reduction practices and the production of toxic chemicals. Our facility-level analysis suggests that an increase in the share of female directors is associated with a significant increase in the number of source reduction practices, and with a significant drop in the amount of toxic pollutants produced, both of which are consistent with our firm-level evidence. Such associations hold when we control for facility- and firm-level characteristics and for a comprehensive set of fixed effects. These findings support the notion that firms with female directors make more investments and/or take more actions to prevent toxic emissions and reduce industrial pollution, despite the associated financial costs in the short run. They also provide micro-level evidence for some real effects of female directors on corporate environmental performance.

To determine whether improved corporate environmental performance stems from female directors' demographic characteristics (for example, age), specific types of education or skills they have (for example, a science major or marketing expertise), specific facets of

board diversity (for example, ethnicity diversity) or governance they contribute to, we conduct several exploratory analyses.

Using detailed director- and board-level data from the BoardEx data set, supplemented by the Refinitiv ESG Board Member data set from 2001–2020, we first show that, in the same firm-year, compared to male directors, female directors are younger, have shorter board tenure, and are more highly educated. Moreover, female directors are more likely than male ones to have professional experience in non-business sectors such as academia, government and policy, and community, as well as to have expertise related to sustainability and risk management; they are less likely to have backgrounds or expertise traditionally valued by boards such as general management, entrepreneurship, and mergers and acquisitions (M&As) (e.g., Kim and Starks 2016; Field, Souther, and Yore 2020). These results suggest that female directors bring different perspectives into boardrooms.

We further show that the positive and significant association between the share of female directors and a firm's environmental ratings or its number of source reduction practices continues to hold when we control for a long list of director demographic characteristics and board qualification measures. Interestingly, when using the RepRisk negative environmental news variable as our measure of corporate environmental performance, we find that a number of board skill variables including science, entrepreneurship, international, manufacturing, marketing, and operations load significantly, whereas the share of female directors loses its significance, suggesting that some of those director skills with a significant gender gap could be one channel that underlies the significant association between the share of female directors and some aspects of corporate environmental performance.

Next, we turn to various board diversity measures that female directors could potentially contribute to. We find that the share of female directors is positively and

significantly associated with board diversity measures covering age, board tenure, educational background, skill, and undergraduate college. Importantly, when we run a horse race between the share of female directors and board diversity measures, the latter fails to supersede the former in explaining corporate environmental performance. The evidence suggests that director gender could be a holistic measure of some female directors' values and perspectives—even if these are hard to measure precisely due to the lack of granular data and disclosure on boardroom deliberations—which add to diversity of thought and contribute to corporate environmental performance. Our results are consistent with Schmid and Urban (2023) who suggest that unobservable differences across genders, rather than observable director characteristics, are more likely to explain the firm value loss after the death of a female director. Our results also echo the findings from PwC's Annual Corporate Directors Surveys over the last five years, which have highlighted gender diversity as the top factor (compared to race, age, tenure, socioeconomic background, etc.) in creating diversity of thought inside a boardroom.

Finally, we show that compared to male directors, female directors are more likely to sit on sustainability-related committees if these exist, and on key monitoring committees. Moreover, firms with female directors are more likely to have an ESG (executive) committee and to link executive pay to corporate ESG performance. Importantly, when we run a horse race between the share of female directors and these governance measures to explain corporate environmental performance, the governance measures sometimes load significantly but only moderately reduce the role of female directors. These results point to the governance role of female directors (Adams and Ferreira 2009; Field, Souther, and Yore 2020) as one potential channel in influencing corporate environmental performance. However, it is also clear that the role of female directors goes beyond the governance measures we examine here. Overall, none of the director demographics and board characteristics consistently

supersedes the share of female directors, suggesting that female directors play a unique role in explaining firms' investment in environmental protection.

To establish the causal effect of female directors on corporate environmental performance, we take advantage of Senate Bill (SB) 826 in 2018 in California which mandated at least one female director for public firms headquartered in the state. We employ a difference-in-differences specification, comparing changes in environmental performance between a) treated firms in California and a matched control sample outside California (both without any female directors before 2018), and b) between treated firms in California and an alternative matched control sample of firms in California with at least two female directors in 2018. We note that the vast majority (89%) of treated firms with no female director on their boards added at least one female director in the first year after SB 826 went into effect, at a significantly higher rate than those for the two control samples. Importantly, compared to control firms, treated firms experience significant increases in their environmental performance after (but not before) the Bill's passage. Overall, these two different control samples help establish the causal effect of *increasing* the female director ratio on improving corporate environmental performance.

Our paper makes three contributions. First, we highlight how directors' personal values and preferences matter in corporate environmental performance. Such a "real effect" of board gender diversity has implications for not only financial markets but also governments and policymakers with mandates to mitigate the negative externalities of economic activities. As such, our paper complements the emerging literature on how financial markets and their participants can influence firms' production technologies and resultant pollution, which largely focuses on the role of shareholders and creditors (see

footnote 1 for references). Moreover, our paper finds important positive externalities across corporate ESG dimensions, which are largely overlooked by prior studies.[2]

Second, we provide novel evidence on the important question of what women bring to the boardroom table. Combining new data from the Gallup Poll with firm- and facility-level data on corporate environmental performance, we show that when it comes to making the tradeoff between environmental and economic benefits, women in the general population and women inside boardrooms are (closely) aligned. As such, our paper contributes to the large literature on gender differences in values and preferences based on experimental and survey evidence (see, for example, Croson and Gneezy 2009; Bertrand 2011; Adams and Funk 2012) and their implications for firm outcomes (see, for example, Adams and Ferreira 2009; Huang and Kisgen 2013; Faccio, Marchica, and Mura 2016; Dyck et al. 2023; Ginglinger and Raskopf 2023; Biggerstaff, Campbell, and Goldie 2024).[3]

Finally, we identify several factors that could be potential channels for the role of female directors, such as their unique skills and governance roles. However, none of them can consistently supersede the share of female directors in explaining corporate environmental performance, suggesting that director gender is unique in explaining firms' environmental engagement, a point further bolstered by the causal effect from female

[2] There are two notable exceptions. In a cross-country study, Dyck et al. (2023) show that board renewal could be an important governance channel through which investors' preferences for sustainability are materialized into better corporate environmental performance. In contrast, Farzamfar, Foroughi, and Ng (2020) highlight a tradeoff, showing that U.S. firms invest more to address their environmental concerns at the expense of their social performance.

[3] Using France's 2011 board gender quota for identification, Ginglinger and Raskopf (2023) show that female directors increase firms' environmental and social (E&S) performance, mainly through their governance role and E&S expertise. Our paper differs from their study in the following ways. First, we focus on U.S. firms that are less subject to ESG regulations compared to their European counterparts and are used as control firms in their study. Moreover, societal views about environmental issues have become increasingly polarized in the U.S. over time (Chinn, Hart, and Sokora 2020). We employ new data from the Gallup Poll to examine whether there is any gender gap in viewing environmental issues controlling for party affiliations and other demographic factors. Second, we employ novel data sets of negative environmental news, pollution prevention activities, and toxic emissions to provide micro-level evidence on the effect of female directors on corporate environmental performance. Third, we explore how board diversity shapes corporate environmental performance using a richer set of director demographics, board qualifications, and diversity measures.

directors through the analysis of board gender quotas imposed in California.[4] As such, our paper contributes to the growing literature on board diversity by highlighting that director gender is a holistic measure of different values and perspectives that female directors bring to the table.[5]

2. Motivating Survey Evidence and Conceptual Framework

Our empirical analysis of the relation between board gender diversity and corporate environmental performance is motivated by new survey evidence from the Gallup Poll Social Series (GPSS) and PwC's Annual Corporate Directors Survey on gender differences in prioritizing environmental protection over economic growth.[6]

Introduced in 2001, GPSS is a set of public opinion surveys designed to monitor U.S. adults' views on numerous social, economic, and political topics. Gallup samples landline and cellphone numbers using random-digit-dial methods, then weights its final sample to match the U.S. population according to gender, age, race, ethnicity, education, region, population density, and phone status. The core questions in the March survey center around the environment, with about 1,000 respondents each year. We use the two questions under the "trade-offs" category. The first question asks: "With which one of these statements about

[4] For studies employing board gender quotas in Europe to study the causal effect of female directors on firm outcomes, see Ahern and Dittmar (2012), Matsa and Miller (2013), Bertrand, Black, Jensen, and Lleras-Muney (2019), Eckbo, Nygaard, and Thorburn (2022), and Ginglinger and Raskopf (2023). For studies employing Senate Bill 826 in California to study the causal effect of female directors on firm outcomes, see Greene, Intintoli, and Kahle (2020), Hwang, Shivdasani and Simintzi (2021), von Meyerinck, Niessen-Ruenzi, Schmid, and Solomon (2021), and Gertsberg, Mollerstrom, and Pagel (2022).

[5] Using a rich set of board diversity measures, Anderson, Reeb, Upadhyay, and Zhao (2011) find a positive association between their board diversity index and firm performance, whereas Adams, Akyol, and Verwijmeren (2018) find that boards with greater skill diversity do not perform better. Bernile, Bhagwat, and Yonker (2018) show that greater board diversity leads to lower firm risk and better performance. Using Korean data, Kang, Kim, and Oh (2022) show that board demographic diversity is associated with more effective monitoring and higher firm value.

[6] See the poll at: https://www.gallup.com/175307/gallup-poll-social-series-methodology.aspx. See the survey at: /https://www.pwc.com/us/en/services/governance-insights-center/assets/pwc-2022-annual-corporate-directors-survey.pdf.

the environment and the economy do you most agree—protection of the environment should be given priority, even at the risk of curbing economic growth (or) economic growth should be given priority, even if the environment suffers to some extent?" The response "protect environment" is coded as 3, "equal priority" as 2, and "economic growth priority" as 1. The second question asks: "With which one of these statements about the environment and energy production do you most agree—protection of the environment should be given priority, even at the risk of limiting the amount of energy supplies—such as oil, gas and coal—which the United States produces—(or) development of U.S. energy supplies—such as oil, gas and coal—should be given priority, even if the environment suffers to some extent?" The responses are similarly coded with higher values for protecting the environment over energy supplies.

Table 1 presents the survey results. Panel A reports the raw survey responses grouped by a respondent's gender. Using international data, Dechezleprêtre et al. (2023) find that besides gender, a respondent's age, education, and political attitudes also explain how much they worry about unabated climate change. We therefore report in Panel B the survey responses grouped by a respondent's gender, controlling for age, education, political party, year, and zip code fixed effects. We find that in both panels, female respondents on average value environmental protection more, while male respondents on average value economic growth and energy supplies more. The differences between the two groups are statistically significant. Interestingly, when focusing on high-income respondents only, male respondents exhibit an even stronger preference for economic growth (energy supplies) over environmental protection compared to female respondents, making the gender difference much larger. In contrast, female respondents in the high-income subsample exhibit a similar preference for environmental protection as female respondents in the full sample.

Figure 1 plots the temporal trend in gender differences in viewing the tradeoff between environmental and economic benefits, again controlling for respondents' age, education, and political party. We group the survey results from 2011 to 2020 into four equal time periods: 2001–2005, 2006–2010, 2011–2015, and 2016–2020, and then we plot the estimated coefficient on gender for each period, in regressions with the controls mentioned above. We note that gender differences in viewing the tradeoff appear to be stable over the 20-year survey period.

The second survey we examine is PwC's Annual Corporate Directors Survey. For over 15 years, it has taken the pulse of U.S. boardrooms by surveying directors from S&P 500 and Russel 3,000 firms on a variety of issues including ESG, crisis management, board diversity, board effectiveness, among other areas.[7] PwC's Annual Corporate Directors Survey (2022) finds that 66% of surveyed female directors are more likely to prioritize reducing the impact of climate change, even if it impacts short-term financial performance, compared to 45% of surveyed male directors. In addition, 65% of female directors agree that ESG issues are linked to company strategy, compared to 55% of male directors.

On the one hand, as the survey evidence together with the two opening quotations suggests, having more female directors in corporate boardrooms could broaden boards' perspectives on environmental issues. Moreover, Malenko (2014) shows that more diverse boards communicate more effectively, leading to efficient decision-making. As a result, it seems reasonable to expect a positive association between board gender diversity and corporate environmental performance.

On the other hand, Adams and Funk (2012) and Lewellen (2022) provide evidence suggesting that self-selection and professional expertise reduce, or even eliminate, some

[7] Recent surveys include responses from 600 to 800 public company directors.

gender differences in personal values and preferences (e.g., risk attitudes).[8] Moreover, from a theoretical perspective, it is not clear whether a diverse board is more effective in all dimensions. Baranchuk and Dybvig (2009) develop a model of board decision-making and show that directors with different information sets disagree more, suggesting that the decision-making process of more diverse boards entails more debate than more homogeneous ones, potentially affecting corporate investments in environment-friendly operations. Donaldson, Malenko, and Piacentino (2020) model board deadlock, which is the inability of a board to make decisions. Their dynamic model predicts that board diversity (with directors having heterogeneous preferences) exacerbates board deadlock, resulting in no decision-making. Garlappi, Giammarino, and Lazrak (2017) model how group disagreement leads to inefficiency in corporate investments. Ultimately, whether board gender diversity results in improved corporate environment performance remains an empirical question.

3. Data and Sample Formation

3.1. Data sources

We employ a number of data sources to measure corporate environmental performance. Our first is Refinitiv. To measure corporate environmental performance, Refinitiv develops emissions reduction, innovation, and resource use scores.[9] We use the average across these three scores to capture a firm's overall performance (*E score*) from 2002

[8] Adams and Funk (2012) find that female directors emphasize benevolence more, and that they are less power- or accomplishment-oriented. Moreover, in contrast to findings for the population, they find that female directors are less tradition- and security-oriented and more risk-embracing than male directors. Lewellen (2022) finds no evidence that gender differences in preferences for risk or altruism affect decision making of hospital CEOs.

[9] The emissions reduction score measures a company's commitment and effectiveness towards reducing environmental emissions in its production and operational processes. The resource use score measures a company's performance and capacity to reduce the use of materials, energy or water, and to find more eco-efficient solutions by improving supply chain management. The innovation score measures a company's capacity to reduce the environmental costs and burdens for its customers, thereby creating new market opportunities through new environmental technologies and processes, or through eco-designed products. This data has been used in many ESG studies, see, for example, Dai, Liang, and Ng (2021), Li, Liu, Mai, and Zhang (2021), and Dyck et al. (2023).

to 2021. Our second source is the EPA's Toxics Release Inventory (TRI) database.[10] *#Source reduction practices* is the number of a facility's source reduction practices weighted by the number of toxic chemicals to which a specific practice is applied (Akey and Appel 2021; Bellon 2022), summed across all facilities of a firm in a year. The sample period is from 2002 to 2020. Our third data source is RepRisk. *Environmental news* is the number of negative environmental news items, classified by the United Nations Global Compact (UNGC)[11] and weighted by severity and reach scores,[12] about a firm in a year. The sample period is from 2007 to 2020.

BoardEx contains information such as board composition, committee composition, and biographic and professional background (in free-form text) of directors for more than 20,000 companies since 1999. Its data coverage is more comprehensive after 2000, which explains why our sample period begins in 2001. We manually code a director's academic degree, field, and skill, following Kim and Starks (2016) and Adams, Akyol, and Verwijmeren (2018). We supplement BoardEx data with board and director data from the Refinitiv ESG Board Member data set.

We collect firms' financial data from Compustat. We obtain institutional ownership data from the Thomson Reuters Institutional Holdings (13F) data set. We extract firms' (historical) headquarters states and industry classifications (based on the Standard Industry Classification (SIC) codes) using the Augmented 10-X Header Data downloaded from Bill McDonald's website.[13]

---

[10] We provide more detailed description of the TRI database in Appendix IA1 in the Internet Appendix.
[11] We capture negative environmental news based on a firm's violation of UNGC Principle 7 (supporting a precautionary approach to environmental challenges), Principle 8 (undertaking initiatives to promote greater environmental responsibility), or Principle 9 (encouraging the development and diffusion of environmentally friendly technologies). RepRisk data collection involves systematic screening of over 100,000 sources, including traditional and online media, NGOs, government bodies, regulators, and social media. This data has been used in prior studies including Gantchev, Giannetti, and Li (2022) and Houston and Shan (2022).
[12] For example, if a firm has two events (A and B) related to the RepRisk classification in a year, and if Event A (B) is assigned of a severity score of 2 and a reach score of 2 (a severity score of 3 and a reach score of 1), then its Environmental news (RepRisk) is $2 \times 2 + 3 \times 1 = 7$ in the year.
[13] https://sraf.nd.edu/data/augmented-10-x-header-data/

As our measures of firms' real environmental performance, we employ facility-level data on *#Source reduction practices* and *Production waste*, which is the total quantity of all TRI-listed toxic chemicals produced by a facility (see, for example, Li and Zhou 2017; Hsu, Li, and Tsou 2023).[14] To control for a facility's scale and operating/financial condition, we use the National Establishment Time-Series (NETS) database (2020 version).[15] Detailed variable definitions are provided in the Appendix. Table IA1 in the Internet Appendix lists steps taken and filters applied to form firm- and facility-level samples.

3.2. Sample overview

Table 2 Panel A presents the summary statistics for the firm sample. In terms of corporate environmental performance, the average *E score* is 0.21. Over our sample period, the average share of female directors is 15%. The mean and standard deviation of *#Source reduction practices* are 2.38 and 3.35, respectively; and the mean and standard deviation of *Environmental news* are 4.89 and 16.44, respectively.

Figure 2 plots the temporal trend in the share of female directors over the period 2001–2020. Consistent with the increasing attention and scrutiny from policymakers, regulators, and institutional shareholders regarding gender diversity in boardrooms, we see a clear upward trend in the share of female directors over the sample period, from about 10% in the early 2000s to over 20% by the end of the sample period. The rise in the female director share is steeper since 2017 when the Big Three asset managers—BlackRock, Vanguard, and State Street—adopted a policy requiring at least one female director on every board of their portfolio firms (Gormley et al. 2023).

[14] In the TRI database, production waste reflects the amount of TRI chemicals produced in the production procedure. Production waste will be treated, recycled, or released to the environment (air, water, or land). We focus on production waste because it better captures how many pollutants are produced, despite some may be treated or recycled later. See https://www.epa.gov/toxics-release-inventory-tri-program/common-tri-terms.
[15] The TRI database offers the crosswalk between TRIFD and dunsnumber, which allows us to merge the two data sets. For more details about the NETS database, please refer to https://maryannfeldman.web.unc.edu/data-sources/longitudinal-databases/national-establishment-time-series-nets/.

Table 2 Panel B presents the summary statistics for the facility sample. We show that facilities in our sample on average adopt 1.05 unique pollution reduction practices and generate 1.27 million pounds of TRI pollutants.[16]

4. Female Directors and Corporate Environmental Performance

4.1. Firm-level baseline results

To examine the relation between the share of female directors on a board and corporate environmental performance, we start with the following lead-lag panel data regression specification:

$$E\ measure_{it} = \alpha_0 + \alpha_1 Female\ director\ ratio_{it-1} + \alpha_2 Governance\ characteristics_{it-1} + \alpha_3 Firm\ characteristics_{it-1} + Industry \times Year\ FE + Firm\ FE + \varepsilon_{it}, \quad (1)$$

where the dependent variables are *E score*, *#Source reduction practices,* and *Environmental news*. The control variables include an indicator variable for female CEO, a composite governance index *Board governance*, ownership by the Big Three asset managers, and firm characteristics (e.g., M/B, firm size, leverage, ROA, and cash holdings). Our variable of interest is *Female director ratio.* The choice of our control variables largely follows prior work (e.g., Dyck et al. 2019, 2023; Starks, Venkat, and Zhu 2024). We include (three-digit SIC) industry times year fixed effects to control for time-varying industry-specific shocks to both the share of female directors and corporate environmental performance. We also include firm fixed effects, which could absorb the persistent component of a firm's strategic position on ESG. Standard errors are clustered at the firm level to account for possible intertemporal dependence in a firm's environmental performance.

[16] Table IA2 in the Internet Appendix presents the correlation matrix for the firm and facility sample. Examination of the correlation matrix generally suggests that multicollinearity is unlikely an issue.

Table 3 Panel A reports the regression results. We find a positive and significant association between *Female director ratio* and *E Score* in column (1). In terms of economic significance, a one-standard-deviation increase in *Female director ratio* is associated with an increase of 0.008 (= 0.072 × 0.107) in *E score*, about 3% of its standard deviation (4% of its mean).

We then estimate Equation (1) using Poisson regressions when the dependent variables are *#Source reduction practices* and *Environmental news*.[17] Column (2) shows a positive and significant association between *Female director ratio* and the number of source reduction practices. Column (3), on the other hand, shows a negative and significant association between *Female director ratio* and the number of negative environmental news items. In terms of economic significance, a one-standard-deviation increase in *Female director ratio* is associated with an increase in *#Source reduction practices* by 9.6% (= exp(0.094 × 0.975) – 1); a one-standard-deviation increase in *Female director ratio* is associated with a drop in *Environmental news* by 6.8% (= exp(0.106 × (–0.668)) – 1). These results indicate that more female directors are associated with better environmental performance.

To address the concerns that our baseline results may be affected by time-varying local economic conditions and/or by various state-level laws and regulations, we include the following fixed effects in Equation (1) in addition to industry times year and firm fixed effects: headquarters state times year fixed effects and incorporation state times year fixed effects. The former absorbs the effects of local economic conditions related to firms' business operations (including their shares of female directors and environmental performance), and the latter absorbs the effects of various state-level laws and regulations related to social and

[17] It is worth noting that, given that we use Poisson estimations, the number of observations in these two columns is much smaller than that in column (1): Out of the 21,695 observations employed in column (1), only 9.0% and 13.2% have positive values for *#Source reduction practices* and *Environmental news*, respectively.

environmental issues. Table IA3 in the Internet Appendix presents the results. We show that our main findings remain.

The results presented in Table 3 Panel A and Table IA3 collectively support the significant role that female directors play in improving environmental performance, echoing the survey evidence from the GPSS that women (men) put more emphasis on environmental protection (economic growth), and from PwC's Annual Corporate Directors Survey (2022) that female directors are more likely to prioritize reducing the impact of climate change than male directors.

4.2. Female directors and facility-level environmental performance

In this section, we provide micro-level evidence on investments and actions taken to improve environmental performance by firms with more female directors, again motivated by female directors putting a greater emphasis on environmental outcomes compared to male directors. For this analysis, we employ facility-level data from the EPA based on regulatory reporting.

We run the following lead-lag panel data regressions:

$$\begin{aligned} Facility-level\ outcome_{jit} &= \alpha_0 + \alpha_1 Female\ director\ ratio_{it-} + \alpha_2 Facility\ characteristics_{jt-1} \\ &+ \alpha_3 Governance\ characteristics_{it-1} + \alpha_4 Firm\ characteristics_{it-1} \\ &+ \theta Facility\ FE_j + \gamma_1 Firm\ industry \times Year\ FE \\ &+ \gamma_2 Facility\ industry \times Year\ FE + \gamma_3 Firm\ HQ\ state \times Year\ FE \\ &+ \gamma_4 Facility\ state \times Year\ FE \\ &+ \varepsilon_{jit}, \end{aligned} \quad (2)$$

where $Facility-level\ outcome_{jit}$ are the following two measures of facility *j* of firm *i* in industry *s* in year *t*: *#Source reduction practices* and *Production waste* (in logarithm). Our variable of interest is $Female\ director\ ratio_{it}$. $Facility\ characteristics_{jt-1}$ include facility *j*'s sales (in logarithm), number of employees (in logarithm), and credit ratings in year *t*−1. Other control variables are similar to those included in Equation (1) for our firm-year-

level analysis. We control for facility fixed effects ($Facility\ FE_j$) that absorb facility-level, time-invariant factors. We also control for firm industry times year and facility industry times year fixed effects that absorb industry-specific time trends. We further control for firm headquarters state times year fixed effects and facility state times year fixed effects to absorb time-varying local factors (e.g., economic conditions) related to firms and facilities. We cluster standard errors at the firm level to account for firm-level treatment (i.e., the share of female directors) and for possible interdependence within a firm across its facilities in industrial pollution-related outcomes.

Table 3 Panel B presents the Poisson regression results where the dependent variable is *#Source reduction practices.* We find a positive and significant association between the share of female directors and the number of source reduction practices across different specifications. The coefficients on *Female director ratio* range between 2.134 to 2.222 across different models. In terms of economic significance, using column (4) in Panel B as an example, a one-standard-deviation increase in *Female director ratio* is associated with a 19.6% increase in facilities' source reduction practices.[18] This result indicates a real effect of female directors on environmental investments to reduce industrial pollution, consistent with Panel A column (2).

Panel C presents the OLS regression results where the dependent variable is ln (*Production waste + 1*). Here we find that the share of female directors is negatively and significantly associated with the facility-level quantity of production waste across different model specifications. The coefficients on *Female director ratio* range between -0.172 to -0.175. In terms of economic significance, using column (4) as an example, a one-standard-deviation increase in *Female director ratio* is associated with a 2.7% decrease in facilities'

[18] When a firm increases its female director ratio from 0 to 0.084 (the standard deviation of the female director ratio in the facility-level sample in Poisson regressions), its facility is associated with a 19.6% (= (exp(0.084 × 2.134) − 1)) increase in its number of pollution prevention activities.

total quantity of production waste.[19] This finding also offers evidence for the real effect of female directors on reducing environmental risk, which corroborates Panel A column (3). Using global data on the carbon disclosure project initiative (CDP), Bolton and Kacperczyk (2023) uncover a strong and positive association between a firm's share of female directors and its commitment to a carbon emissions reduction pathway. Our findings complement theirs by showing that, in addition to firm commitments, firms with more female directors are also associated with real positive environmental outcomes, including engaging in more source reduction practices and producing less pollution.

One potential concern surrounding our facility-level analysis is that firms may opportunistically relocate some of their most polluting production across facilities to help improve their environmental ratings. Including facility fixed effects in our facility-level regressions helps mitigate this concern. Moreover, our facility-level regression controls for the scale of a facility in terms of production output and employee headcount and thus helps rule out the possibility that a facility's drop in production waste results from an opportunistic cut of production scale.

In summary, our facility-level results provide micro-level evidence for some real effects of female directors on corporate environmental performance.

4.3. Female directors and costs associated with corporate environmental performance

We next look at the other side of the environment-economy tradeoff, by examining potential costs associated with corporate environmental actions. Following Di Giuli and Kostovetsky (2014) and Chen, Dong, and Lin (2020), we use the logarithm of selling, general, and administrative expenses (SG&A) as the proxy for such costs. Table 4 Panel A

[19] When a firm increases its female director ratio from 0 to 0.086 (the standard deviation of the female director ratio in the facility-level sample), its facility is associated with a drop of –0.027 (= ((1 + 1.270)/1.270) × (exp(0.086 × (–0.174)) − 1)) in total quantity of production waste produced relative to sample mean.

presents the results. We find a positive and significant association between the share of female directors and SG&A: A one-standard-deviation increase in *Female director ratio* can be translated into $12 million SG&A,[20] after all the controls and fixed effects. Of course, not all of it can be directly attributed to the effect of female directors on corporate environmental investments.

In Panel B, we document a positive and significant association between *E Score* (or #*Source reduction practices*) and SG&A, and a negative and significant association between *Environmental news* and SG&A: A one-standard-deviation increase in *E Score* (*#Source reduction practices)* can be translated into $28 ($8.4) million SG&A,[21] and a one-standard-deviation drop in *Environmental news* increases a firm's SG&A by $14.8 million.[22] Given the association between *Female Director Ratio* and environmental performance measures documented in Section 4.1, for example on *E Score*, a one-standard-deviation increase in *Female director ratio* is associated with $0.84 million (= 0.003 × $28 million) SG&A due to an improvement in *E Score* alone. Nevertheless, the above number is likely an underestimate of the total economic cost because *E Score* is just one measure for environmental performance and/or our specification only captures one channel through which female directors influence environmentally related investment.

[20] When a firm increases its female director ratio from 0 to 0.107 (the standard deviation of the female director ratio in the firm-level sample for OLS regressions), its SG&A increases by 1.06% (= (exp(0.099 × 0.107) − 1)). Given that the sample mean of SG&A is $1,130 million, such an increase approximates $12 million more in SG&A.

[21] When a firm increases its *E Scores* by one standard deviation (= 0.253 in the firm-level sample for OLS regressions), its SG&A increases by 2.45% (= (exp(0.097 × 0.253) − 1)). Given that the sample mean of SG&A is $1,130 million, such an increase is $28 million. When a firm increases its *#Source reduction practices* by one standard deviation (= 1.481 in the firm-level sample for OLS regressions), its SG&A increases by 0.74% (= (exp(0.005 × 1.481) − 1)). Given that the sample mean of SG&A is $1,130 million, such an increase is $8.4 million.

[22] When a firm increases its *Environmental news* by one standard deviation (= 6.585 in the firm-level sample for OLS regressions), its SG&A decreases by 1.31% (= (exp(-0.002 × 6.585) − 1)). Given that the sample mean of SG&A is $1,130 million, such a decrease is $14.8 million. We have more observations in columns (2) and (3) than those in column (1) because we do not require firm-year observations to have non-missing *E Score*.

In summary, consistent with the survey evidence from the GPSS and PwC showing a significant gender gap in viewing the tradeoff between environmental and economic benefits, we find that having female directors is positively and significantly associated with corporate environmental performance, as well as SGA.

5. Director Qualifications, Board Diversity, and Governance

So far, we have established that female directors are positively associated with corporate environmental performance, potentially accompanied by higher economic costs. To further address the question of "*what women bring to the boardroom table*" (Adams 2016, p. 384), motivated by the GPSS/PwC survey evidence and the literature on gender differences in educational backgrounds and work experience (see, for example, Kim and Starks 2016; Field, Souther, and Yore 2020), we posit that board gender diversity may explain corporate environmental performance through the following non-mutually-exclusive channels. First, female directors bring into boardrooms non-business backgrounds and expertise (such as in sustainability) that differ from those of male directors. Second, due to their different values and perspectives, backgrounds, and expertise, some of which are admittedly hard to measure, female directors contribute to diversity of thought in the boardroom, which may help shape environmental-friendly corporate policies and practices. Finally, female directors help improve accountability and incentive alignment, resulting in better environmental performance.

5.1. Director and board qualifications

We first examine whether and how female directors differ significantly from their male counterparts in terms of biographic characteristics and professional qualifications. For this analysis, we employ a sample of firm-director-year observations derived from the firm sample in Table 3. Table IA4 in the Internet Appendix presents the summary statistics. We

show that, at the firm-director-year level, the average probability that a director is a female is 17.9%. The average director is 62 years old, and the average director tenure is 8 years. On average, sample directors possess 3.4 skills based on our classification. It is worth noting that this statistic is similar to that reported in Adams, Akyol, and Verwijmeren (2018).

Table 5 presents the regression results using our firm-director-year panel, in which we control for firm times year fixed effects. Panel A presents the regression results comparing female and male directors in age, board tenure, and educational background, within a firm-year. We show that female directors are significantly younger and have significantly shorter board tenure compared to their male counterparts. We further show that female directors are significantly less likely to have studied business or STEM compared to their male counterparts, but more likely to have arts and medical degrees. Also, female directors are significantly more likely to have studied in more fields and be better educated (in terms of the highest degree achieved) compared to their male counterparts.

Panel B presents the regression results comparing female and male directors in skill sets, within a firm-year. We first show that female directors are more likely than their male counterparts to have skills in academic, government and policy, community, international, sustainability, legal, risk management, and technology, consistent with the findings in Kim and Starks (2016). Within the business domain, female directors are more likely to have expertise in marketing, strategic planning, and HR, but are less likely to have traditional backgrounds valued by boards, such as expertise in general management, entrepreneurship, and M&As. In general, female directors are more likely than male ones to possess environment-related expertise (e.g., sustainability and community), as well as significantly broader expertise.

We next explore the extent to which director/board qualifications account for the observed positive association between female directors and firms' environmental

performance. This positive association could be driven by director gender itself, and/or by the addition of female directors with characteristics and qualifications that correlate positively with firms' commitment to environmental performance. Our rich set of director- and board-level attributes allows us to disentangle the two possibilities. If the influence of female directors on corporate environmental performance simply reflects certain qualifications specific to female directors (as uncovered in Panels A and B), when we run a horse race by adding board-level academic fields and skills (i.e., the averages of directors' characteristics) to the baseline specification in Table 3 Panel A, we would expect those field and skill variables to load significantly and/or even to supersede the share of female directors. Panel C presents the results.

Our main findings regarding the significant role of *Female director ratio* in corporate environmental performance largely remain. The coefficients on *Female director ratio* reduce by about 6%-16% when explaining *E Score* or #*Source reduction practices*. In contrast, most female director-specific fields or expertise do not exhibit a consistent, significant association with corporate environmental performance. When explaining negative environmental news, the inclusion of director skills reduces the coefficient on *Female director ratio* by 24% and largely reduces its significance. Director skills in science and marketing are negatively associated, while those in entrepreneurship, international, manufacturing, and operations are positively associated with negative environmental news. It is also worth noting that in Panel B, we show that female directors are significantly more likely to possess skills in science and marketing than their male counterparts. Taken together, these results suggest that director qualification can be one potential channel in partially explaining female directors' influence on corporate environmental performances; nevertheless, they still point to a distinctive role of director gender beyond those individual, measurable director characteristics and qualifications.

5.2. Board diversity

Though individual, measurable director qualification does not appear to explain away the role of *Female director ratio* in corporate environmental performance, it could still be the case that a mixture of director skills underlies it. To further explore how female directors help enhance corporate environmental performance, we examine whether and how firms consider board diversity when adding female directors and whether standard board diversity measures supersede *Female director ratio* in explaining firms' environmental performance.

Table 6 Panel A explores the relations between the share of female directors and board diversity in measurable dimensions, as suggested by the opening quotations. Following Bernile, Bhagwat, and Yonker (2018), we construct various Herfindahl-Hirschman indices (HHIs) spanning age, tenure, educational background, skill, sector experience, undergraduate college, and ethnicity. We then regress those HHIs on (contemporaneous) *Female director ratio*, controlling for industry times year and firm fixed effects. We show that there are negative and significant associations between *Female director ratio* and most of the HHIs (with the exceptions of *HHI sector* and *HHI ethnicity*). In PwC's Annual Corporate Directors Survey (2019), 88% of directors say that gender diversity is important for diversity of thought in boardrooms. Our findings in Panel A are consistent with this view. Overall, our results suggest that companies indeed try to improve board diversity by adding female directors, potentially because of these directors' different backgrounds and expertise (from those of male directors).

We next examine the extent to which board diversity measures account for the observed positive association between female directors and firms' environmental performance in Panel B. We find that *Female director ratio* has a distinct and significant role rather than those HHIs in explaining all three corporate environmental performance measures. In addition, there is no significant association between any board diversity measure

and corporate environmental performance measures. In other words, they do not explain female directors' role in environmental performance. One exception is board ethnicity diversity: Greater diversity in this dimension is associated with more negative environmental news, although including this measure largely reduces the sample size due to data availability.

These results suggest that the positive association between board gender diversity and corporate environmental performance is unlikely driven by any of these specific dimensions of board diversity. Still, female directors, who are more willing to incur economic costs for environmental benefits, could contribute to diversity of thought in the boardroom and facilitate open discussions/decision-making on environmental issues, thus in turn helping to improve their firms' environmental policies and practices.

5.3. Governance

In this section, we directly examine the governance role of female directors. Flammer, Hong, and Minor (2019) show that executive compensation design is vital to improving corporate environmental performance. Adams and Ferreira (2009) and Field, Souther, and Yore (2020) point to gender differences in director monitoring. We conjecture that one way that female directors help improve corporate environmental performance is via them monitoring and/or linking executive compensation to corporate environmental performance. We obtain from the Refinitiv ESG data set, at the firm-year level, data on whether there is a ESG committee (either at the executive level or board level), and whether there is compensation policy linking ESG metrics to executive pay.[23] Table 7 presents the results.

[23] In Table IA4 Panel B in the Internet Appendix, we show that about a quarter of the firm-year observations have an ESG (executive) committee, and 28% of the firm-year observations have a compensation policy linking ESG metrics to executive pay.

Panel A presents the regression results comparing female and male directors in board leadership and committee roles, controlling for director characteristics such as education backgrounds and skills. We first show that female directors are significantly less likely than their male counterparts to serve leadership roles on boards (as Chairman of the Board or lead director), consistent with the findings in Field, Souther, and Yore (2020). We further show that female directors are significantly more likely than their male counterparts to serve on key board committees (audit, compensation, and nomination), consistent with the findings in Adams and Ferreira (2009). Importantly, we identify a positive and significant association between a director being a female and her likelihood of serving on the CSR committee.

In Panel B, we show a positive and significant (and contemporaneous) association between a firm's *Female director ratio* and its having ESG (executive) committee or ESG-linked compensation policy for executives, controlling for board-level academic fields and skill, as well as the firm-level controls and fixed effects.

In Panel C, we add the ESG-related governance variables to our baseline Equation (1). While the availability of those variables reduces the sample size quite a bit, we find that their inclusions does not eliminate the explanatory power of *Female director ratio* for *E score*: The two ESG-related governance variables are positively and significantly related to *E Score*, and reduce the coefficient on *Female director ratio* by about 20%. These results suggest that governance mechanisms such as forming an ESG committee or linking executive compensation to ESG metrics could be a channel through which female directors exert their influence to improve corporate environmental performance. They also suggest that female directors could help improve corporate environmental performance through their advising and monitoring roles beyond these two specific mechanisms.

Using an international sample, Schmid and Urban (2023) document significantly negative price reactions to female director deaths that cannot be explained by observable

director characteristics, such as age, board tenure, and education. The authors conclude that unobservable differences across genders are the more likely explanation for what makes female directors different. Our results support the importance of unobservable or unmeasurable differences across genders. Our paper extends their findings by showing that gender differences in viewing the tradeoff between environmental and economic benefits could contribute to corporate environmental performance, for example, via female directors' governance role.

6. Identification

The results so far collectively point to a distinct role of female directors, above and beyond their observable attributes, in corporate environmental performance. To establish the causal effect of female directors, we explore a plausibly exogenous shock to *Female director ratio*.

We take advantage of California's SB 826. Signed into law on September 30, 2018, this was the first female-director-quota law in U.S. history. It required public companies headquartered in California to have at least one female director by the end of 2019, and, depending on board size, some firms were required to have multiple female directors by the end of 2021.[24] To mitigate the concerns that firms with TRI-reporting facilities in California might be subject to different and potentially tighter environmental regulations than firms without, we remove those firms.

We employ a difference-in-differences (DID) specification to examine the difference of changes in both the share of female directors and corporate environmental performance

[24] In terms of enforcement, each director seat required to be filled by a female director, which is not filled by a female director, counts as a single violation. A first violation results in a $100,000 fine and subsequent violations result in $300,000 fine. Starting in March 2020, the California Secretary of State's website published an annual report on the status of compliance with the requirements of SB 826, including company name, disclosure date, and the number of female directors. The disclosure of non-compliance may create public pressure and affect a firm's image with its stakeholders.

before versus after the passage of SB 826 in 2018 between treated and control firms. We focus on *E Score* in this analysis, as data availability does not allow us to study the other environmental variables such as *#Source reduction practices* and *Environmental news*.[25] The variable of interest is *Treated* × *Post*, an interaction term between the indicator variable, *Treated*, and the indicator variable, *Post*, for the post-event window (2019 to 2021; the pre-event window is 2015 to 2017). As before, we control for firm characteristics, as well as industry times year and firm fixed effects. The treated firms are public firms without a female director in 2018 and headquartered in California. To find control firms, we first search for public firms headquartered outside California without a female director in 2018. For each treated firm, we then find a control firm in the same (three-digit SIC) industry, with the smallest total (normalized) absolute difference in total assets and *E score* in 2018 to the treated firm.[26] After the above steps, we end up with 57 treated firms and their matched control, spanning a number of industries (e.g., pharmaceutical, electronic components, real estate, and business services).

Table 8 Panel A presents the univariate DID analysis of *Female director ratio* and *E score*. We show that the treated and control firms have similar shares of female directors as well as similar environmental performance in the period before the policy change. However, these values diverge between the treated and control firms after the law's passage.

Panel B presents the DID results. In column (1), we show that the coefficient on the interaction term *Treated* × *Post* is positive and significant, suggesting that the treated firms

[25] Almost all firm-year observations in our matched treatment and control sample do not have any *#Source reduction practices* or *Environmental news*. Therefore, these two environmental performance variables cannot be used as dependent variables in Poisson regressions (as in Table 3 Panel A).

[26] To pick control firms, we proceed as follows. First, for each treated firm, we identify all potential control firms in the same size quartile and *E score* quartile with the same three-digit SIC code as the treated firm in 2018. Second, for each possible control firm, we compute the absolute size (*E score*) difference between the control and treated firms, and we normalize the difference by the standard deviation of the difference across all possible treated-control pairs. Third, we add up the two normalized differences and pick a control firm with the smallest total (normalized) difference in both size and *E score* to the treated firm.

significantly increase their shares of female directors relative to the control firms, once the law comes into effect. Figure 3 Panel A plots the results from a dynamic DID specification. We show that, before the law, both the treated and control firms have very few female directors; after passage, the gap between the two groups in *Female director ratio* grows wider over time.

Column (2) presents the DID analysis using *E score* as the dependent variable. We show that, once the law takes effect, the increase in the number of female directors stipulated by SB 826 is associated with better environmental performance of the treated firms in California compared to the control firms outside California. The dynamic DID specification in Figure 3 Panel B confirms similar levels of *E score* before the law, whereas the treated firms exhibit significantly better environmental performance, relative to the control firms, in the post-event period of 2019 to 2021.

To address the concern that our DID results in Panel B might be due to other California state-level regulations or any specific factors that only affect California firms, we repeat the DID analysis keeping the same treated firms but choosing the control firms from those headquartered in California with at least two female directors in 2018. As a result, those control firms are not required to add additional female directors.[27] We find the closest control firm for each treated firm by matching on firm size and *E score* and in the same (three-digit SIC) industry in 2018. This procedure reduces the treated firms to 43 (from 57 in Panel A). Panel C presents the results. We note that our main findings remain: Compared to peer California firms without the pressure to add female directors, the treated firms experience significant increases in *Female director ratio* and *E score* after the passage of SB

[27] We choose firms headquartered in California with at least two female directors in 2018 as the control group because some firms were required to have multiple female directors by the end of 2021 as discussed earlier. It is worth noting that our DID findings remain if we use control firms headquartered in California with at least one female director in 2018.

826. We interpret this finding as additional supporting evidence that the treatment effect is likely driven by an increase in the number of female directors mandated by SB 826, rather than by other California state-level regulations or by any specific factors that only affect California firms.

Table IA5 in the Internet Appendix conducts additional analysis using the DID setting. Panel A repeats the DID analysis using a sample of 51 compliant firms and their matching controls. Our main findings remain. Panel B repeats the DID analysis using 2016 as the pseudo-event year. As expected, we do not see any significant treatment effect, suggesting that the estimated treatment effects in Table 8 Panel B are not random, but attributable to SB 826. Panel C employs a triple difference specification, interacting an indicator variable for firms headquartered in California (regardless of their shares of female directors before SB 826) with an indicator variable for firms without any female directors before SB 826 (regardless of where they are headquartered) and an indicator variable for the post-event years. The results are consistent with Table 8 that the treatment effect from SB 826, in terms of both increased *Female director ratio* and improved *E Score*, only shows up for firms without female directors before SB 826 *and* headquartered in California (i.e., the treated firms in Table 8).

Greene, Intintoli, and Kahle (2020) and Hwang, Shivdasani, and Simintzi (2021) attribute stock market declines after the announcement of SB 826 to the limited supply of qualified female directors. von Meyerinck et al. (2021) show that part of the valuation declines resulted from investors' concerns about potential further stakeholders-friendly legislation that could hurt shareholder value. Gertsberg, Mollerstrom, and Pagel (2022) find that the stock declines were driven by sub-optimal turnovers of male directors rather than supply of qualified female directors. The findings in our paper add another possible interpretation for the negative price reaction to the enactment of SB 826: The fear of adding

female directors leading to more investments in firms' environmental performance will dampen earnings—a potential outcome that investors with short investment horizons dislike.

In summary, by exploiting a plausibly exogenous shock to female representation on boards, we identify a potential causal effect of female directors (as opposed to, for example, other director characteristics) on corporate environmental performance.

7. Conclusions

Using surveys from the Gallup Poll Social Series and PwC, we first establish that both female respondents and female directors value environmental protection more, whereas male respondents and male directors value economic growth more. Using firm- and facility-level measures of corporate environmental performance, we show a robust and positive association between a firm's share of female directors and its environmental performance, confirming that such a gender divide in prioritizing environmental protection over economy and energy supplies plays a role in corporate decision-making.

Next, we address the question of what female directors bring to the boardroom table. Using granular director- and board-level data, we show that female directors bring non-business backgrounds and expertise into the boardroom, contribute to greater boardroom diversity in educational background and skills, as well as are more likely to have ESG (executive) committees and to link executive compensation to ESG metrics. However, when running horse races between the share of female directors and these director or board characteristics in explaining corporate environmental performance, we show that the latter only has moderate power in explaining the role of female directors in some environmental outcomes. These findings suggest that director gender is likely a holistic measure of potentially unquantifiable values and perspectives that female directors bring to the table, for example their different views on environmental versus economic tradeoffs mentioned above,

which help improve corporate environmental performance. Based on an identification scheme using California's SB 826 in 2018, we find that the distinct effect of female directors on corporate environmental performances is likely to be causal. We conclude that gender diversity on boards yields long-term environmental benefits to society.

Appendix
Variable definitions

All continuous variables are winsorized at the 1st and 99th percentiles.

Variable	Definition	Source
Environmental performance measures		
E score	Average of emissions reduction score, resource use score, and innovation score.	Refinitiv ESG
#Source reduction practices (facility-level)	The total number of a facility's source reduction activities (i.e., activities a facility implements to prevents pollution) applied to each different toxic chemical in a year. For example, if a facility implements two source reduction practices W1 and W2 in a year (both W1 and W2 are applied to toxic chemicals A and B, and W2 is applied to toxic chemical Z), then its *#Source reduction practices* is 5. The value is collected from TRI File Type 2A Form (more details are provided in the Internet Appendix).	EPA Pollution Prevention (P2)
#Source reduction practices (firm-level)	The sum of #source reduction practices across all facilities of a firm in a year.	EPA Pollution Prevention (P2)
Environmental news	A firm's number of negative environmental news items violating United Nations Global Compact's (UNGC) "Principle 7: Businesses should support a precautionary approach to environmental challenges," Principle 8: undertake initiatives to promote greater environmental responsibility," or "Principle 9: encourage the development and diffusion of environmentally friendly technologies" tagged by RepRisk. This number is weighted by the severity score (that takes the value of 1, 2, or 3) and the reach score (that takes the value of 1, 2, or 3).	RepRisk
Production waste (in million pounds)	A facility's total quantity of production-related waste (i.e., toxic chemicals) (in millions of pounds) in a year.	EPA TRI
SG&A	Selling, general, and administrative expenses (in million dollars) reported by a firm in a year.	Compustat
Firm characteristics		
Female director ratio	Number of female directors scaled by board size.	BoardEx
Board governance	Sum of three indicator variables: 1) Board size indicator takes the value of one if a firm's board size is not in the top quartile of BoardEx firms in a fiscal year, and zero otherwise; 2) Board independence indicator takes the value of one if a firm's board independence ratio is in the top quartile of BoardEx firms in a fiscal year, and zero otherwise; and 3) Board busyness indicator takes the value of one if a firm's board	BoardEx

	busyness measure is not in the top quartile of BoardEx firms in a fiscal year, and zero otherwise.	
Female CEO	Indicator variable that takes the value of one if a firm has a female CEO, and zero otherwise.	BoardEx
Big3 institutions	Fraction of shares outstanding held by BlackRock, Vanguard, and State Street.	WRDS Thomson 13F
M/B	Market value of equity scaled by book value of equity.	Compustat
Firm size	Natural logarithm of total assets.	Compustat
ROA	Net income after subtracting expenses or losses, including extraordinary items scaled by total assets.	Compustat
Leverage	Sum of long-term debt and debt in current liabilities scaled by total assets.	Compustat
Cash holdings	Cash and short-term investments scaled by total assets.	Compustat
Facility characteristics		
Sales (in millions of dollars)	Estimated sales (in millions of dollars) of a facility in a year	NETS
#Employees	Reported number of employees working in a facility in a year	
Credit score	The maximum Dun & Bradstreet PayDex Score, a 100-point indexing system that captures trade experience reported to NETS, compares payment to terms of sale, and scores the overall manner of payment. The index is dollar-weighted by the amount of credit involved. A PayDex Score of 80 indicates that, on average, a business pays its bills in a "Prompt" manner.	NETS
Director and board characteristics		
Director-level		
Female	Indicator variable that takes the value of one if a director is a female, and zero otherwise.	BoardEx
Age	Director age.	BoardEx
Tenure	Director tenure.	BoardEx
Field_arts	Indicator variable that takes the value of one if a director has earned a degree in arts (e.g., BA, AB, MA, MPhil), and zero otherwise.	
Field_business	Indicator variable that takes the value of one if a director has earned a degree in economics or business (e.g., MBA, BBA, BCOM, DBA) or has professional designation as chartered accountant, or chartered financial analyst, and zero otherwise.	BoardEx

Field_STEM	Indicator variable that takes the value of one if a director has earned a degree in science (e.g., BS, BSc, Bachelor of Engineering, MSc), and zero otherwise.	BoardEx
Field_law	Indicator variable that takes the value of one if a director has earned a degree in law (e.g., JD, LLB, LLM), and zero otherwise.	BoardEx
Field_medicine	Indicator variable that takes the value of one if a director has earned a degree in medicine (e.g., MD), and zero otherwise.	BoardEx
#Fields	Sum of a director's fields of study.	BoardEx
Highest degree	Highest degree received by a director. It takes the value of 3 for PhD, 2 for MBA, JD, MD, or other master's degree, or 1 for bachelor's degree, and zero otherwise.	
Skill_academic	Indicator variable that takes the value of one if a director has worked at universities and her prior job roles contain any of the following key words—professor, lecturer, faculty, instructor, dean, director, chair, provost, chancellor, principal, or president, and zero otherwise.	BoardEx
Skill_government & policy	Indicator variable that takes the value of one if a director has worked at government agencies, or her prior job roles or descriptions contain any of the following key words—commissioner, council member, senior advisor, director, regulatory, policy, policies, government, public policy, ambassador, public sector, enforcement, or lobby, and zero otherwise.	BoardEx
Skill_risk management	Indicator variable that takes the value of one if a director has experience in risk management, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: risk, cyber, or information security.	BoardEx
Skill_scientific	Indicator variable that takes the value of one if a director has experience in scientific research or research and development, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: researcher, scientist, scientific, research & development, R&D, clinical research, research fellow, or research investigator.	BoardEx
Skill_technology	Indicator variable that takes the value of one if a director has experience in technology, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: technology, technologist, technologies, CIO, chief information officer, CTO, chief technology officer, innovation, IT, or information technology.	BoardEx
Skill_sustainability	Indicator variable that takes the value of one if a director has experience in environmental and/or sustainability issues, and zero otherwise. A director has such	BoardEx

	experience if her prior job roles or job descriptions contain any of the following key words: environment, safety, sustainability, sustainable, or ESG.	
Skill_community	Indicator variable that takes the value of one if a director has worked at charities, or her prior job roles or job descriptions contain any of the following key words—community, non-profit, nonprofit, philanthropic, philanthropy, social, CSR, feminine care, family care, PR, public relation, public affair, charity, or charities, and zero otherwise.	BoardEx
Skill_finance accounting & econ	Indicator variable that takes the value of one if a director has experience in finance, accounting, or economics, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: financ, CFO, accountant, accounting, auditing, auditor, bank, investment, securities, economist, economic, banker, private bank, equity research, private equity, equity analyst, fixed income, bond, debt, loan, capital market, account manager, account management, accounts, trader, credit analyst, security analyst, credit officer, tax, underwriter, portfolio manager, treasury, treasurer, capital market, comptroller, controller, trading, trader, real estate, wealth, corporate accounts, enterprise account, asset management, holdings, lending, mortgage, high growth markets, quantitative analyst, CFA, or CPA.	BoardEx
Skill_management	Indicator variable that takes the value of one if a director has management experience, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: executive officer, president, CEO, CFO, COO, CIO, CTO, CPO, CCO, managing, or management.	BoardEx
Skill_entrepreneurship	Indicator variable that takes the value of one if a director has experience in entrepreneurship, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: entrepreneur, evaluating business, innovative idea, start-up, startup, venture, founder, co founder, co-founder, founding, owner, or small business.	BoardEx
Skill_international	Indicator variable that takes the value of one if a director has international experience, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: global, international, multinational, worldwide, north america, latin america, europe, asia, asia pacific, americas, middle east, africa, australia, china, japan, india, canada, united kingdom, UK, great britain, france, germany, new zealand, foreign, korea, emerging markets, brazil, ireland, mexico, turkey, colombia, americas region, poland, malaysia, taiwan, italy, hong kong, or israel.	BoardEx
Skill_legal	Indicator variable that takes the value of one if a director has legal experience, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: attorney, lawyer, legal, litigation, law,	BoardEx

	intellectual property, general counsel, patent counsel, law clerk, senior counsel, or corporate counsel.	
Skill_manufacturing	Indicator variable that takes the value of one if a director has experience in manufacturing, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: industrial, manufactured, manufacturing, production, process, or quality.	BoardEx
Skill_marketing	Indicator variable that takes the value of one if a director has marketing experience, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: marketing, mktg, market, CMO, advertising, brand, sales, salesman, merchandising, merchandise, retail, product strategy, consumer, customer, channel, communication, user experience, client, media, investor relation, investor service, or analyst relation.	BoardEx
Skill_strategic planning	Indicator variable that takes the value of one if a director has experience in strategic planning, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: business planning, business planner, business-planning, business solutions, decision making, decision-making, problem solving, problem-solving, strategic, strategies, strategy, strategist, business intelligence, business development, business affairs, business analyst, corporate development, planner, corporate affairs, organization development, organizational development, alliance, or change management.	BoardEx
Skill_HR	Indicator variable that takes the value of one if a director has HR experience, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: human resource, HR, recruitment, recruiter, recruiting, talent, staffing, compensation, employee relation, labor, people operations, diversity, or DEI.	BoardEx
Skill_operations	Indicator variable that takes the value of one if a director has experience in operations, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: operations, COO, logistics, supply chain, supply-chain, business operations, supply, procurement, sourcing, buyer, commodity manager, distribution, project, quality assurance, global sourcing, product line manage, or OPS.	BoardEx
Skill_M&As	Indicator variable that takes the value of one if a director has experience in M&As, and zero otherwise. A director has such experience if her prior job roles or job descriptions contain any of the following key words: M&A, M & A, merger and acquisition, merger & acquisition, mergers and acquisitions, mergers & acquisitions, merger, or acquisition.	BoardEx

#Skills	Sum of a director's skills.	BoardEx
Chairman of the Board	Indicator variable that takes the value of one if a director is Chairman of the Board, and zero otherwise.	BoardEx
Lead director	Indicator variable that takes the value of one if a director's role contains any of the following key words—lead independent director, lead independent chairman, presiding lead independent director, lead independent corporate director, lead independent vice chairman, lead director, vice chairman (lead independent director), or lead independent outside director, and zero otherwise.	BoardEx
Audit committee	Indicator variable that takes the value of one if a director sits on audit committee in a year, and zero otherwise.	BoardEx
Compensation committee	Indicator variable that takes the value of one if a director sits on compensation committee in a year, and zero otherwise.	BoardEx
ESG committee	Indicator variable that takes the value of one if a director sits on ESG committee in a year, and zero otherwise. A board committee is responsible for ESG if its committee name contains any of the following key words: CSR, ESG, environ*, social, or sustain*.	BoardEx
Nomination committee	Indicator variable that takes the value of one if a director sits on nomination committee in a year, and zero otherwise.	BoardEx
Firm-level		
HHI age	Herfindahl-Hirschman index (HHI) of the share of directors in each age quartile of directors in BoardEx.	BoardEx
HHI tenure	HHI of the share of directors in each board tenure quartile of directors in BoardEx.	BoardEx
HHI field	HHI of the share of directors with different academic fields. The filed categories include arts, business, STEM, law, and medicine.	BoardEx
HHI skill	HHI of the share of directors with different skills due to work experience and job roles. The skill categories include academic, government, risk management, scientific, technology, sustainability, community, finance, accounting & economics, management, entrepreneurship, international, legal, manufacturing, marketing, strategic planning, HR, operations, and M&As.	BoardEx
HHI sector	HHI of the share of directors with different sector-specific experience, as defined by BoardEx.	BoardEx
HHI college	HHI of the share of directors attending different undergraduate colleges.	BoardEx

HHI ethnicity	HHI of the share of directors with different ethnicities, as defined by ISS. The ethnicity categories include Caucasian/white, Black/African American, Asian, Hispanic/Latin American, Middle-eastern/North African, Native American/Alaskan Native, Native Hawaiian/other Pacific Islander, and Other.	ISS
ESG (executive) committee	Indicator variable that takes the value of one if a firm has an ESG committee at either the board level or at the senior management level, and zero otherwise. The data item from Refinitiv is as follows: "Does the company have a CSR committee or team, e.g., board level or Senior management committee responsible for decision making on CSR strategy?"	Refinitiv
Compensation policy including ESG metric	Indicator variable that takes the value of one if a firm has an executive compensation policy that takes into account its ESG performance, and zero otherwise. The data item from Refinitiv is as follows: "Does the company have an extra-financial performance oriented compensation policy that includes remuneration for the CEO, executive directors, non-board executives, and other management bodies based on ESG or sustainability factors?"	Refinitiv

References:

Adams, Renée B., 2016. Women on boards: The superheros of tomorrow? *Leadership Quarterly* 27, 371–386.

Adams, Renée B., Ali C. Akyol, and Patrick Verwijmeren, 2018. Director skill sets, *Journal of Financial Economics* 130, 641–662.

Adams, Renée B., and Daniel Ferreira, 2009. Women in the boardroom and their impact on governance and performance, *Journal of Financial Economics* 94, 291–309.

Adams, Renée B., and Patricia Funk, 2012. Beyond the glass ceiling: Does gender matter? *Management Science* 58, 219–235.

Aghion, Philippe, Roland Bénabou, Ralf Martin, and Alexandra Roulet, 2023. Environmental preferences and technological choices: Is market competition clean or dirty? *American Economic Review: Insights* 5, 1–19.

Ahern, Kenneth R., and Amy Dittmar, 2012. The changing of the boards: The impact on firm valuation of mandated female board representation, *Quarterly Journal of Economics* 27, 137–197.

Akey, Pat, and Ian Appel, 2021. The limits of limited liability: Evidence from industrial pollution, *Journal of Finance* 76, 5–55.

Anderson, Ronald C., David M. Reeb, Arun Upadhyay, and Wanli Zhao, 2011. The economics of director heterogeneity, *Financial Management* 40, 5–38.

Baranchuk Nina, and Phillip H. Dybvig, 2009. Consensus in diverse corporate boards, *Review of Financial Studies* 22, 715–747.

Bellon, Aymeric, 2022. Fresh start or fresh water: The impact of environmental lender liability, UNC at Chapel Hill working paper.

Bernile, Gennaro, Vineet Bhagwat, and Scott Yonker, 2018. Board diversity, firm risk, and corporate policies, *Journal of Financial Economics* 127, 588–612.

Bertrand, Marianne, 2011. New perspectives on gender, in: *Handbook of Labor Economics*, 4b, eds: Orley Ashenfelter, and David Card, Elsevier: Amsterdam, 1543–1590.

Bertrand Marianne, Sandra E. Black, Sissel Jensen, and Adriana Lleras-Muney, 2019. Breaking the glass ceiling? The effect of board quotas on female labor market outcomes in Norway, *Review of Economic Studies* 86, 191–239.

Biggerstaff, Lee E., Joanna T. Campbell, and Bradley A. Goldie, 2024. Hitting the "grass ceiling": Golfing CEOs and career outcomes for female executives *Journal of Management* 50, 1502–1535.

Bolton, Patrick, and Marcin Kacperczyk, 2023. Firm commitments, Imperial College working paper.

Cao, Jie, Hao Liang, and Xintong Zhan, 2019. Peer effects of corporate social responsibility, *Management Science* 65, 5487–5503.

Cao, Jie, Sheridan Titman, Xintong Zhan, and Weiming Elaine Zhang, 2023. ESG preference, institutional trading, and stock return patterns, *Journal of Financial and Quantitative Analysis* 58, 1843–1877.

Chen, Tao, Hui Dong, and Chen Lin, 2020. Institutional shareholders and corporate social responsibility, *Journal of Financial Economics* 135, 483–504.

Chen, Jianqiang, Pei-Fang Hsieh, Po-Hsuan Hsu, and Ross Levine, 2022. Environmental liabilities, borrowing costs, and pollution prevention activities: The nationwide impact of the Apex Oil ruling, National Tsing Hua University working paper.

Chinn, Sedona, P. Sol Hart, and Stuart Soroka, 2020. Politicization and polarization in climate change news content, 1985-2017, *Science Communication* 42, 112–129.

Croson, Rachel, and Uri Gneezy, 2009. Gender differences in preferences, *Journal of Economic Literature* 47, 448–474.

Dai, Rui, Hao Liang, and Lilian Ng, 2021. Socially responsible corporate customers, *Journal of Financial Economics* 142, 598–626.

Dechezleprêtre, Antoine, Adrien Fabre, Tobias Kruse, Bluebery Planterose, Ana Sanchez Chico, and Stefanie Stantcheva, 2022. Fighting climate change: International attitudes toward climate policies, National Bureau of Economic Research working paper (No. w30265).

Di Giuli, Alberta, and Leonard Kostovetsky, 2014. Are red or blue companies more likely to go green? Politics and corporate social responsibility, *Journal of Financial Economics* 111, 158–180.

Donaldson, Jason Roderick, Nadya Malenko, and Giorgia Piacentino, 2020. Deadlock on the board, *Review of Financial Studies* 33, 4445–4488.

Dyck, Alexander, Karl V. Lins, Lukas Roth, Mitch Towner, and Hannes F. Wagner, 2023. Renewable governance: Good for the environment? *Journal of Accounting Research* 61, 279–327.

Dyck, Alexander, Karl V. Lins, Lukas Roth, and Hannes F. Wagner, 2019. Do institutional investors drive corporate social responsibility? International evidence, *Journal of Financial Economics* 131, 693–714.

Eckbo, B. Espen, Knut Nygaard, and Karin S. Thorburn, 2022. Valuation effects of Norway's board gender-quota law revisited, *Management Science* 68, 4112–4134.

Faccio, Mara, Maria-Teresa Marchica, and Roberto Mura, 2016. CEO gender, corporate risk-taking, and the efficiency of capital allocation, *Journal of Corporate Finance* 39, 193–209.

Farzamfar, Arshia, Pouyan Foroughi, and Lilian Ng. 2022. The hidden cost of going green: Evidence from firm-level violations, York University working paper.

Field, Laura Casares, Matthew E. Souther, and Adam S. Yore, 2020. At the table but cannot break through the glass ceiling: Board leadership positions elude diverse directors, *Journal of Financial Economics* 137, 787–814.

Flammer, Caroline, Bryan Hong, and Dylan Minor, 2019. Corporate governance and the rise of integrating corporate social responsibility criteria in executive compensation: Effectiveness and implications for firm outcomes, *Strategic Management Journal* 40, 1097–1122.

Gantchev, Nickolay, Mariassunta Giannetti, and Rachel Li, 2022. Does money talk? Divestitures and corporate environmental and social policies, *Review of Finance* 26, 1469–1508.

Garlappi, Lorenzo, Ron Giammarino, and Ali Lazrak, 2017. Ambiguity and the corporation: Group disagreement and underinvestment, *Journal of Financial Economics* 125, 417–433.

Gertsberg, Marina, Johanna Mollerstrom, and Michaela Pagel, 2022. Gender quotas and support for women in board elections, University of Melbourne working paper.

Gillan, Stuart L., Andrew Koch, and Laura T. Starks, 2021. Firms and social responsibility: A review of ESG and CSR research in corporate finance, *Journal of Corporate Finance* 66, 101889.

Ginglinger, Edith, and Caroline Raskopf, 2023. Women directors and E&S performance: Evidence from board gender quotas, *Journal of Corporate Finance* 83, 102496.

Gormley, Todd A., Vishal K. Gupta, David A. Matsa, Sandra Mortal, and Lukai Yang, 2023. The big three and board gender diversity: The effectiveness of shareholder voice, *Journal of Financial Economics* 149, 323–348.

Greene, Daniel, Vincent J. Intintoli, and Kathleen M. Kahle, 2020. Do board gender quotas affect firm value? Evidence from California Senate Bill No. 826, *Journal of Corporate Finance* 60, 101–121.

Hoepner, Andreas G. F., Ioannis Oikonomou, Zacharias Sautner, Laura T. Starks, and Xiaoyan Zhou, 2024. ESG shareholder engagement and downside risk, *Review of Finance* 28, 483–510.

Houston, Joel F., and Hongyu Shan, 2022. Corporate ESG profiles and banking relationships, *Review of Financial Studies* 35, 3373–3417.

Hsu, Po-Hsuan, Kai Li, and Chi-Yang Tsou, 2023. The pollution premium, *Journal of Finance* 78, 1343–1392.

Huang, Jiekun, and Darren J. Kisgen, 2013. Gender and corporate finance: Are male executives overconfident relative to female executives? *Journal of Financial Economics* 108, 822–839.

Hwang, Sunwoo, Anil Shivdasani, and Elena Simintzi, 2021. Mandating women on boards: Evidence from the United States, UNC at Chapel Hill working paper.

Ivanov, Ivan, Mathias S. Kruttli, and Sumudu W. Watugala, 2023. Banking on carbon: Corporate lending and cap-and-trade policy, Federal Reserve Bank of Chicago working paper.

Kacperczyk, Marcin, and Jose-Luis Peydro, 2022. Carbon emissions and the bank-lending channel, Imperial College working paper.

Kang, Jun-Koo, Seil Kim, and Seungjoon Oh, 2022. Does board demographic diversity enhance cognitive diversity and monitoring? *Accounting Review* 97, 385–415.

Kim, Daehyun, and Laura T. Starks, 2016. Gender diversity on corporate boards: Do women contribute unique skills? *American Economic Review: Papers & Proceedings* 106, 267–271.

Krueger, Philipp, Zacharias Sautner, and Laura T. Starks, 2020. The importance of climate risks for institutional investors, *Review of Financial Studies* 33, 1067–1111.

Lewellen, Katharina, 2022. Women in charge: Evidence from hospitals, Dartmouth College working paper.

Li, Kai, Xing Liu, Feng Mai, and Tengfei Zhang, 2021. The role of corporate culture in bad times: Evidence from the COVID-19 pandemic. *Journal of Financial and Quantitative Analysis* 56, 2545–2583.

Li, Xiaoyang, and Yue M. Zhou, 2017. Offshoring pollution while offshoring production? *Strategic Management Journal* 38, 2310–2329.

Malenko, Nadya, 2014. Communication and decision-making in corporate boards, *Review of Financial Studies* 27, 1486–1532.

Matsa, David A., and Amalia R. Miller, 2013. A female style in corporate leadership? Evidence from quotas, *American Economic Journal: Applied Economics* 5, 136–169.

Matos, Pedro, 2020. ESG and responsible institutional investing around the world: A critical review, CFA Institute Research Foundation.

PwC, 2019. PwC's Annual Corporate Directors' Survey, available at: http://www.circulodedirectores.org/wp-content/uploads/2019/12/pwc-2019-annual-corporate-directors-survey-full-report-v2.pdf (assessed on April 12, 2024)

PwC, 2022. PwC's Annual Corporate Directors' Survey, available at: https://pulse.icdm.com.my/article/pwcs-2022-annual-corporate-directors-survey-charting-the-course-through-a-changing-governance-landscape/ (assessed on April 12, 2024)

Refinitiv, 2022. Environmental, social, and governance scores from Refinitiv, available at: https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/refinitiv-esg-scores-methodology.pdf (assessed April 12, 2024)

Schmid, Thomas, and Daniel Urban, 2023. Female directors and firm value: New evidence from directors' deaths, *Management Science* 69, 2449–2473.

Starks, Laura T., Parth Venkat, and Qifei Zhu, 2024. Corporate ESG profiles and investor horizons, *Journal of Finance* forthcoming.

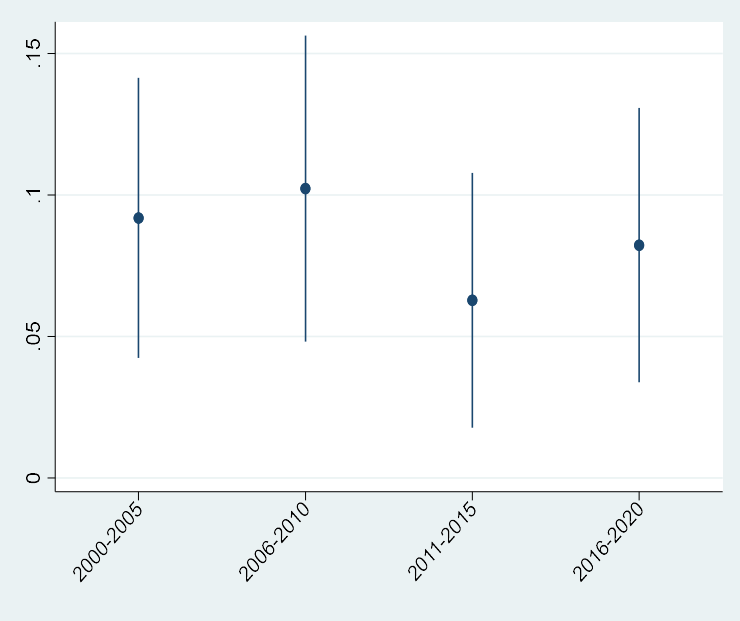
von Meyerinck, Felix, Alexandra Niessen-Ruenzi, Markus Schmid, and Steven Davidoff Solomon, 2021. As California goes, so goes the nation? Board gender quotas and shareholders' distaste of government interventions, University of Zurich working paper.

Wu, Xiting, Jiaxing You, Xiaoyun Yu, and Qing (Clara) Zhou, 2024. Leveling up your green mojo: The benefits of beneficent investment, European Corporate Governance Institute working paper (No. 985/2024).

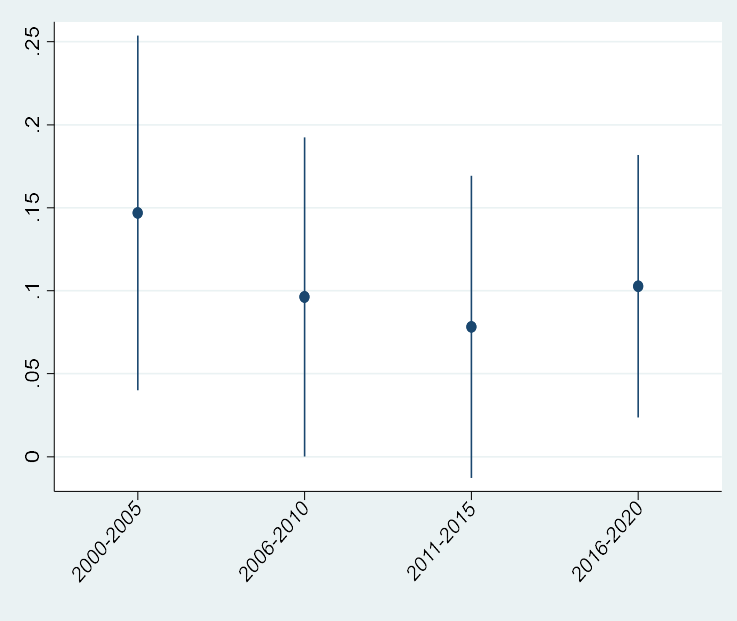
Figure 1
Gender differences in viewing the tradeoff between environmental and economic benefits

This figure plots the temporal trend in gender differences in viewing the tradeoff between environmental and economic benefits using data from the Gallup Poll Social Series (GPSS). Introduced in 2001, the core questions in the March survey each year center around the environment. We use the two questions under the "trade-offs" category. The first question asks: "With which one of these statements about the environment and the economy do you most agree—protection of the environment should be given priority, even at the risk of curbing economic growth (or) economic growth should be given priority, even if the environment suffers to some extent?" The response "protect environment" is coded as 3, "equal priority" as 2, and "economic growth priority" as 1. The second question asks: "With which one of these statements about the environment and energy production do you most agree—protection of the environment should be given priority, even at the risk of limiting the amount of energy supplies—such as oil, gas and coal—which the United States produces (or) development of U.S. energy supplies—such as oil, gas and coal—should be given priority, even if the environment suffers to some extent?" The responses are similarly coded with higher values for protecting the environment over energy supplies. Panel A plots the temporal trend in gender differences (with 95% confidence intervals) in viewing the tradeoff between environmental protection and economic growth over four five-year periods (2001–2005, 2006–2010, 2011–2015, and 2016–2020) controlling for a respondent's age, education, and political party. Panel B plots the temporal trend in gender differences (with 95% confidence intervals) in viewing the tradeoff between environmental protection and energy supplies over four five-year periods (2001–2005, 2006–2010, 2011–2015, and 2016–2020) controlling for a respondent's age, education, and political party. The left-hand-side plot uses the full sample, and the right-hand-side plot uses only the top income tercile.

Panel A: Gender differences in viewing the tradeoff between environmental protection and economic growth over time

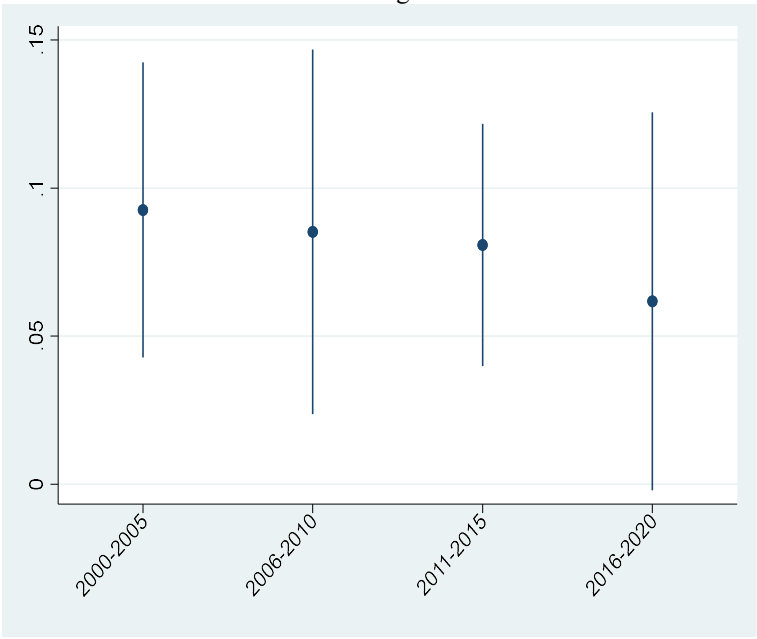


The full sample

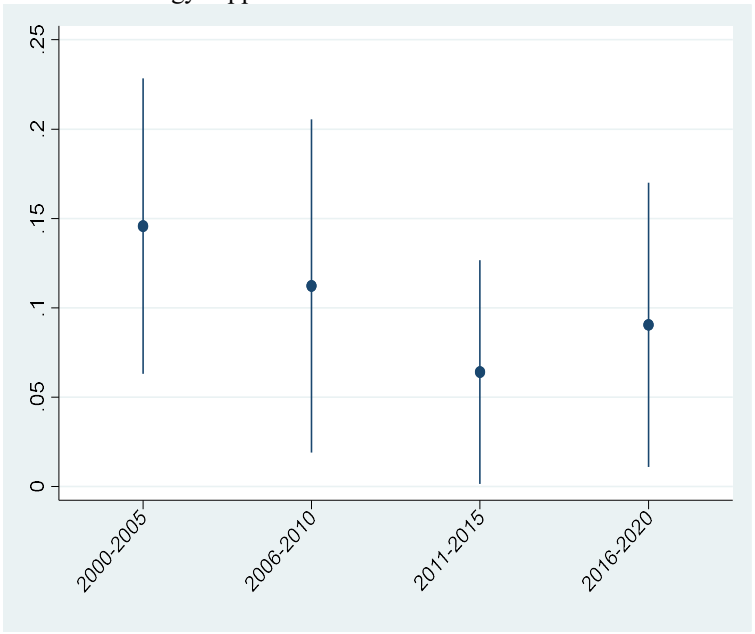


The top income tercile

Panel B: Gender differences in viewing the tradeoff between environmental protection and energy supplies over time



The full sample



The top income tercile

Figure 2
The share of female directors over time

This figure plots the temporal trend in the share of female directors over time. The horizontal axis indicates the fiscal year. The vertical axis is the average *Female director ratio* across sample firms in a fiscal year. Our sample comprises 21,695 firm-year observations representing 3,040 firms over the period 2001–2020.

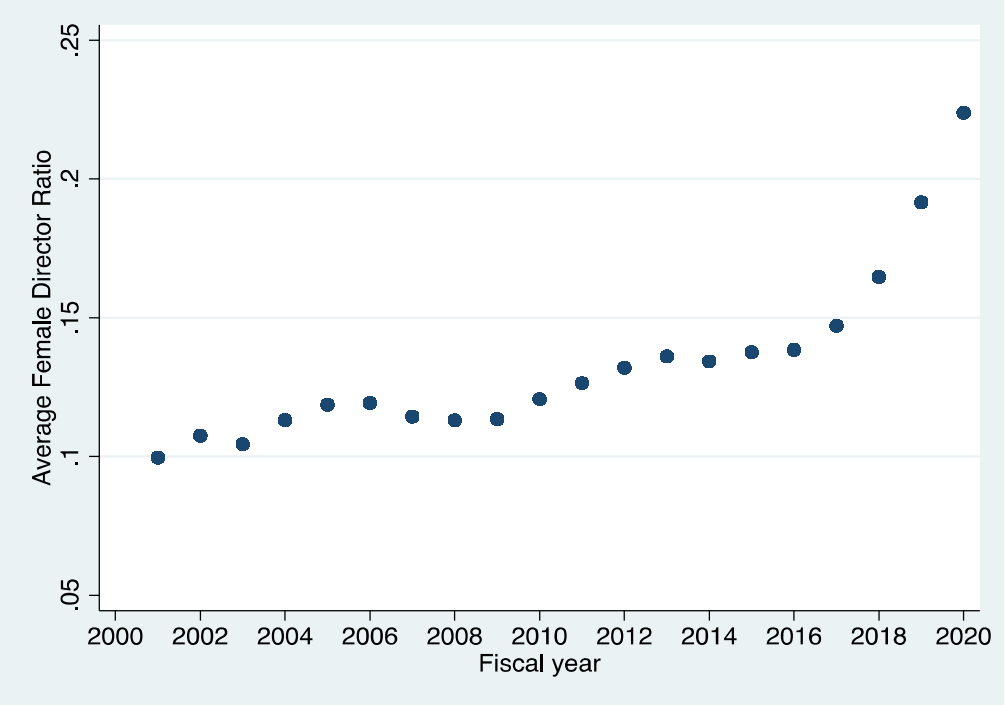
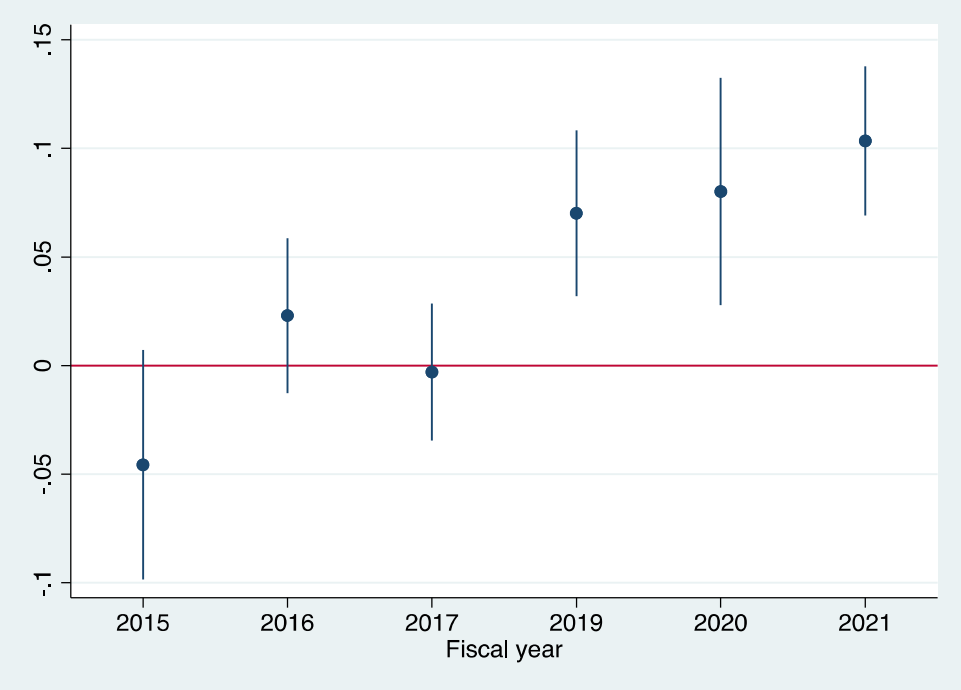


Figure 3
The treatment effect of California's SB 826 on female director ratio and E score

This figure plots the dynamic effect of California's SB 826 on *Female director ratio* and *E score*. The treated firms are public firms without a female director in 2018, headquartered (and stayed) in California, and without TRI-reporting facilities in California. We find the closest control firm for each treated firm by matching on (three-digit SIC) industry, firm size, and *E score*. Panel A shows the estimated treatment effect on *Female director ratio*. Panel B shows the estimated treatment effect on *E score*. In both panels, the red line is the benchmark (omitted) event year 2018. The horizontal axis indicates the fiscal year and the vertical axis is the estimated coefficients on interaction terms of each event year with the treatment indicator (with 95% confidence intervals).

Panel A: The dynamic effect of SB 826 on *Female director ratio*



Panel B: The dynamic effect of SB 826 on *E score*

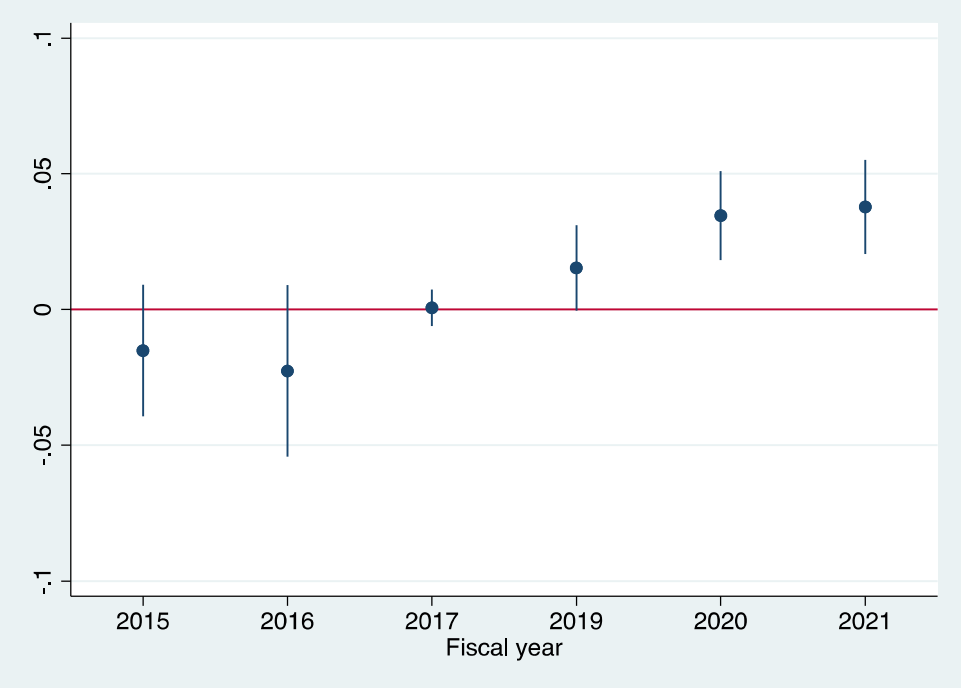


Table 1
Gender differences in viewing the tradeoff between environmental and economic benefits

This table reports gender differences in viewing the tradeoff between environmental and economic benefits using data from the Gallup Poll Social Series (GPSS). Introduced in 2001, the core questions in the March survey each year center around the environment. We use the two questions under the "trade-offs" category. The first question asks: "With which one of these statements about the environment and the economy do you most agree—protection of the environment should be given priority, even at the risk of curbing economic growth (or) economic growth should be given priority, even if the environment suffers to some extent?" The response "protect environment" is coded as 3, "equal priority" as 2, and "economic growth priority" as 1. The second question asks: "With which one of these statements about the environment and energy production do you most agree—protection of the environment should be given priority, even at the risk of limiting the amount of energy supplies—such as oil, gas and coal—which the United States produces (or) development of U.S. energy supplies—such as oil, gas and coal —should be given priority, even if the environment suffers to some extent?" The responses are similarly coded with higher values for protecting the environment over energy supplies. Panel A reports the raw survey responses grouped by a respondent's gender. Panel B reports the survey responses grouped by a respondent's gender, controlling for a respondent's age, education, political party, year, and zip code fixed effects. Columns (1) and (2) present the gender gap in agreeing that environmental protection should be given priority over economic growth. Columns (3) and (4) present the gender gap in agreeing that environmental protection should be given priority over energy supplies. Columns (1) and (3) use the full sample in the analysis, and columns (2) and (4) use only the top income tercile of the sample. ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Raw survey responses

	Environmental protection over economic growth		Environmental protection over energy supplies	
	Full sample	Top income tercile	Full sample	Top income tercile
	(1)	(2)	(3)	(4)
Female	2.149	2.152	2.130	2.149
Male	2.012	1.953	1.995	1.937
Female – Male	0.137***	0.199***	0.135***	0.211***

Panel B: Survey responses controlling for a respondent's age, education, political party, and various fixed effects

	Environmental protection over economic growth		Environmental protection over energy supplies	
	Full sample	Top income tercile	Full sample	Top income tercile
	(1)	(2)	(3)	(4)
Female	0.039	0.044	0.030	0.026
Male	-0.039	-0.077	-0.030	-0.077
Female – Male	0.078***	0.120***	0.060***	0.103***

Table 2
Summary statistics

This table provides the summary statistics for our firm and facility samples. Panel A presents the summary statistics for the firm sample. The OLS sample for *E score* comprises 21,695 firm-year observations associated with 3,040 firms over the period 2002–2021. The Poisson sample for *#Source reduction practices* comprises 6,006 firm-year observations associated with 441 firms over the period 2002-2020. The Poisson sample for *Environmental news* comprises 7,639 firm-year observations associated with 796 firms over the period 2007–2020 (the sample reduction is due to the drop of firms with all-zero dependent variables in Poisson regression). Panel B presents the summary statistics for the facility sample. The Poisson sample for *#Source reduction practices* comprises 15,103 facility-year observations associated with 1,406 facilities of 358 firms over the period 2002–2020. The OLS sample for *Production waste* comprises 48,373 facility-year observations associated with 4,662 facilities of 618 firms over the period 2002–2020. Panel B contains two subpanels that correspond to the analysis for *#Source reduction practices* and *Production waste*. Definitions of the variables are provided in the Appendix.

Panel A: Summary statistics for the firm-level sample

	Mean	SD	P5	Median	P95
	(1)	(2)	(3)	(4)	(5)
OLS sample for *E score*					
E score	0.210	0.253	0.000	0.093	0.738
Female director ratio	0.150	0.107	0.000	0.143	0.333
Board governance	1.869	0.569	1.000	2.000	3.000
Female CEO	0.038	0.191	0.000	0.000	0.000
Big3 institutions	0.145	0.081	0.021	0.145	0.284
M/B	3.453	5.700	0.506	2.229	11.952
Firm size	8.136	1.932	4.866	8.147	11.286
ROA	-0.005	0.189	-0.347	0.027	0.155
Leverage	0.269	0.221	0.000	0.239	0.689
Cash holdings	0.171	0.219	0.005	0.080	0.712
Ln(SG&A)	5.694	1.606	3.147	5.682	8.676
Poisson sample for *#Source reduction practices*					
#Source reduction practices	2.382	3.351	0.000	1.000	10.000
Female director ratio	0.114	0.094	0.000	0.111	0.286
Board governance	1.841	0.610	1.000	2.000	3.000
Female CEO	0.025	0.157	0.000	0.000	0.000
Big3 institutions	0.114	0.077	0.008	0.106	0.246
M/B	2.986	4.452	0.642	2.237	7.906
Firm size	7.849	1.783	4.977	7.804	10.822
ROA	0.042	0.094	-0.092	0.051	0.145
Leverage	0.256	0.166	0.000	0.249	0.543
Cash holdings	0.116	0.118	0.007	0.080	0.356
Poisson sample for *Environmental news*					
Environmental news	4.886	16.435	0.000	0.000	24.000
Female director ratio	0.141	0.106	0.000	0.133	0.333
Board governance	1.840	0.553	1.000	2.000	3.000
Female CEO	0.037	0.189	0.000	0.000	0.000
Big3 institutions	0.137	0.079	0.002	0.146	0.263
M/B	3.014	5.052	0.414	2.061	9.805
Firm size	8.761	1.910	5.798	8.660	11.917
ROA	0.032	0.110	-0.098	0.036	0.152

Leverage	0.290	0.192	0.004	0.281	0.621
Cash holdings	0.104	0.128	0.002	0.060	0.354

Panel B: Summary statistics for the facility-level sample

	Mean	SD	P5	Median	P95
	(1)	(2)	(3)	(4)	(5)
Poisson sample for *#Source reduction practices*					
#Source reduction practices	1.052	2.054	0.000	0.000	6.000
Female director ratio	0.127	0.084	0.000	0.125	0.273
Board governance	1.607	0.750	0.000	2.000	3.000
Female CEO	0.020	0.139	0.000	0.000	0.000
Big3 institutions	0.118	0.074	0.009	0.115	0.239
M/B	3.261	4.075	0.947	2.585	8.028
Firm size	9.041	1.957	5.928	8.970	12.602
ROA	0.056	0.066	-0.031	0.056	0.148
Leverage	0.265	0.147	0.042	0.241	0.539
Cash holdings	0.096	0.082	0.009	0.075	0.250
ln(Sales +1)	17.774	1.600	14.915	17.889	20.192
ln(#Employees +1)	5.324	1.459	2.398	5.525	7.601
Credit score	73.558	5.212	64.000	74.000	80.000
OLS sample for *Production waste*					
ln(Production waste + 1)	0.371	0.711	0.000	0.044	2.202
Production waste (in million pounds)	1.270	3.882	0.000	0.045	8.045
Female director ratio	0.136	0.086	0.000	0.133	0.286
Board governance	1.661	0.743	0.000	2.000	3.000
Female CEO	0.029	0.168	0.000	0.000	0.000
Big3 institutions	0.124	0.077	0.009	0.129	0.247
M/B	2.996	4.299	0.874	2.272	7.840
Firm size	9.132	1.925	6.200	9.009	12.801
ROA	0.047	0.066	-0.043	0.047	0.136
Leverage	0.283	0.145	0.060	0.270	0.550
Cash holdings	0.087	0.079	0.006	0.067	0.234
ln(Sales +1)	17.640	1.664	14.627	17.792	20.291
ln(#Employees +1)	5.114	1.529	2.303	5.303	7.390
Credit score	73.741	5.526	64.000	75.000	80.000

Table 3
Female directors and corporate environmental performance

This table examines the relation between the share of female directors on a board and corporate environmental performance. Panel A presents the firm-level evidence using three different environmental performance measures as the dependent variables: *E score*, *#Source reduction practices*, and *Environmental news*. Our variable of interest is *Female director ratio*, the number of female directors scaled by board size. The OLS sample for column (1) comprises 21,695 firm-year observations over the period 2002–2021. The Poisson samples for columns (2) and (3) comprise 6,006 and 7,639 firm-year observations over the period 2002–2020 and 2007–2020, respectively. We include (three-digit SIC) industry times year and firm fixed effects. Panels B and C present the facility-level evidence using two different environmental performance measures as the dependent variables: *#Source reduction practices* and *Production waste*, respectively. The Poisson sample for Panel B comprises 15,103 facility-year observations over the period 2002–2020. The OLS sample for Panel C comprises 48,373 facility-year observations over the period 2002–2020. We include a rich set of fixed effects. Definitions of the variables are provided in the Appendix. Standard errors (in parentheses) are clustered at the firm level. ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Firm-level evidence

	E score	#Source reduction practices	Environmental news
	OLS	Poisson	
	(1)	(2)	(3)
Female director ratio	0.072***	0.975**	-0.668**
	(0.022)	(0.473)	(0.342)
Board governance	0.004	0.026	-0.061
	(0.003)	(0.036)	(0.041)
Female CEO	-0.002	-0.079	0.154
	(0.015)	(0.279)	(0.106)
Big3 institutions	-0.041	-0.599	-0.528
	(0.036)	(0.794)	(0.574)
M/B	-0.000	-0.001	-0.013**
	(0.000)	(0.005)	(0.005)
Firm size	0.027***	0.153*	0.400***
	(0.005)	(0.085)	(0.063)
ROA	-0.019**	-0.126	0.040
	(0.009)	(0.251)	(0.268)
Leverage	-0.021	0.097	-0.226
	(0.013)	(0.256)	(0.267)
Cash holdings	0.030*	0.322	0.796**
	(0.018)	(0.391)	(0.390)
Industry × Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Intercept	Yes	Yes	Yes
Obs.	21,695	6,006	7,639
Adj-R^2 / Pseudo-R^2	0.844	0.509	0.831

Panel B: Facility-level evidence using *#Source reduction practices*

	#Source reduction practices			
	(1)	(2)	(3)	(4)
Female director ratio	2.222***	2.164***	2.192***	2.134***
	-0.838	-0.82	-0.839	-0.82
Board governance		-0.023		-0.022
		-0.066		-0.066
Female CEO		0.111		0.117
		-0.428		-0.429
Big3 institutions		2.105		2.071
		-1.308		-1.31
M/B		0.015*		0.015*
		-0.009		-0.009
Firm size		-0.007		-0.005

		-0.14		-0.137
ROA		0.438		0.437
		-0.489		-0.491
Leverage		0.832		0.847
		-0.536		-0.532
Cash holdings		1.145**		1.129*
		-0.575		-0.576
ln(Sales +1)			0.016	0.008
			-0.174	-0.173
ln(#Employees +1)			-0.018	-0.009
			-0.199	-0.2
Credit score			0.007	0.007
			-0.005	-0.005
Firm Industry × Year Fixed Effects	Yes	Yes	Yes	Yes
Facility Industry × Year Fixed Effects	Yes	Yes	Yes	Yes
Headquarters State × Year Fixed Effects	Yes	Yes	Yes	Yes
Facility State × Year Fixed Effects	Yes	Yes	Yes	Yes
Facility Fixed Effects	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	15,103	15,103	15,103	15,103
Pseudo-R^2	0.540	0.541	0.540	0.541

Panel C: Facility-level evidence using *Production waste*

	ln(Production waste + 1)			
	(1)	(2)	(3)	(4)
Female director ratio	-0.174***	-0.175***	-0.172***	-0.174***
	(0.063)	(0.063)	(0.062)	(0.062)
Board governance		-0.000		-0.000
		(0.004)		(0.004)
Female CEO		-0.021		-0.019
		(0.025)		(0.025)
Big3 institutions		-0.089		-0.090
		(0.103)		(0.103)
M/B		-0.000		-0.000
		(0.000)		(0.000)
Firm size		0.030***		0.030***
		(0.012)		(0.011)
ROA		0.064*		0.064*
		(0.035)		(0.035)
Leverage		-0.091**		-0.090**
		(0.039)		(0.039)
Cash holdings		-0.045		-0.046
		(0.060)		(0.060)
ln(Sales +1)			0.005	0.006
			(0.013)	(0.013)
ln(#Employees +1)			0.005	0.004
			(0.014)	(0.014)
Credit score			0.000	0.000
			(0.000)	(0.000)
Firm Industry × Year Fixed Effects	Yes	Yes	Yes	Yes
Facility Industry × Year Fixed Effects	Yes	Yes	Yes	Yes
Headquarters State × Year Fixed Effects	Yes	Yes	Yes	Yes
Facility State × Year Fixed Effects	Yes	Yes	Yes	Yes
Facility Fixed Effects	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	48,373	48,373	48,373	48,373
Adj-R^2	0.928	0.928	0.928	0.928

Table 4
Female directors and investment in corporate environmental performance

This table examines the relations between the share of female directors on a board and SG&A and between corporate environmental performance and SG&A. Panel A presents the regression results examining the relation between a firm's share of female directors on a firm's board and its SG&A. Panel B presents the regression results examining the relation between a firm's *E score*, *#Source reduction practices*, and *Environmental news* and its SG&A. Definitions of the variables are provided in the Appendix. ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Female directors and SG&A

	Ln(SG&A)
	(1)
Female director ratio	0.099*
	(0.055)
Board governance	-0.028***
	(0.006)
Female CEO	-0.007
	(0.032)
Big3 institutions	0.251**
	(0.098)
M/B	0.002***
	(0.001)
Firm size	0.524***
	(0.018)
ROA	-0.144***
	(0.039)
Leverage	-0.092**
	(0.044)
Cash holdings	-0.211***
	(0.050)
Industry × Year Fixed Effects	Yes
Firm Fixed Effects	Yes
Intercept	Yes
Obs.	17,420
Adj-R^2	0.988

Panel B: Corporate environmental performance and SG&A

	Ln(SG&A)		
	(1)	(2)	(3)
E score	0.097***		
	(0.033)		
#Source reduction practices		0.005**	
		(0.002)	
Environmental news			-0.002**
			(0.001)
M/B	0.002***	0.003***	0.003***
	(0.001)	(0.000)	(0.000)
Firm size	0.528***	0.586***	0.586***
	(0.017)	(0.009)	(0.009)
ROA	-0.141***	-0.213***	-0.213***
	(0.038)	(0.019)	(0.019)
Leverage	-0.086**	-0.113***	-0.113***
	(0.044)	(0.027)	(0.027)
Cash holdings	-0.203***	-0.222***	-0.223***
	(0.050)	(0.028)	(0.028)
Industry × Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes

Intercept	Yes	Yes	Yes
Obs.	17,628	46,560	46,560
Adj-R^2	0.988	0.985	0.985

Table 5
Director and board qualifications and corporate environmental performance

This table examines gender differences in director age, board tenure, board qualifications, and corporate environmental performance. Panel A presents the regression results comparing female and male directors in age, board tenure, and educational background. Panel B presents the regression results comparing female and male directors in skill. Panel C presents the regression results examining the relation between the share of female directors on a board, director average age, director average board tenure, board qualifications in terms of educational background and skill, and corporate environmental performance using *E score*, *#Source reduction practices*, and *Environmental news*. Definitions of the variables are provided in the Appendix. ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Gender differences in director age, tenure, and educational background

	Age	Tenure	Field_arts	Field_business	Field_STEM	Field_law	Field_medicine	# Fields	Highest degree
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	-3.358***	-2.315***	0.117***	-0.038***	-0.055***	0.008	0.009***	0.041***	0.085***
	(0.115)	(0.102)	(0.009)	(0.009)	(0.009)	(0.006)	(0.003)	(0.012)	(0.011)
Firm × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	203,439	207,045	193,912	193,912	193,912	193,912	193,912	193,912	193,918
Adj-R^2	0.137	0.229	0.049	0.028	0.047	0.026	0.123	0.031	0.074

Panel B: Gender differences in director skill

	Skill_ academic	Skill_government & policy	Skill_risk management	Skill_ scientific	Skill_ technology	Skill_ sustainability	Skill_ community	Skill_ finance accounting & econ	Skill_ management
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	0.049***	0.073***	0.013***	0.012***	0.025***	0.019***	0.071***	0.002	-0.055***
	(0.007)	(0.007)	(0.002)	(0.003)	(0.005)	(0.003)	(0.006)	(0.008)	(0.006)
Firm × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	207,045	207,045	207,045	207,045	207,045	207,045	207,045	207,045	207,045
Adj-R^2	0.034	0.064	0.015	0.134	0.051	0.015	0.016	0.030	0.028

Continued on the next page.

	Skill_ entrepreneurship	Skill_ international	Skill_legal	Skill_ manufacturing	Skill_ marketing	Skill_ strategic planning	Skill_HR	Skill_ operations	Skill_M&As	# Skills
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Female	-0.017**	0.060***	0.032***	-0.006	0.089***	0.058***	0.058***	0.006	-0.010***	0.477***
	(0.008)	(0.008)	(0.005)	(0.004)	(0.008)	(0.007)	(0.005)	(0.007)	(0.003)	(0.030)
Firm × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	207,045	207,045	207,045	207,045	207,045	207,045	207,045	207,045	207,045	207,045
Adj-R^2	0.068	0.091	0.010	0.046	0.064	0.057	0.015	0.032	0.022	0.106

Panel C: Female directors, board qualifications, and corporate environmental performance

	E score		#Source reduction practices		Environmental news	
	(1)	(2)	(3)	(4)	(5)	(6)
Female director ratio	0.068***	0.067***	0.889*	0.817*	-0.505*	-0.347
	(0.022)	(0.023)	(0.485)	(0.494)	(0.301)	(0.322)
Average age	-0.004***		-0.004		-0.008	
	(0.001)		(0.015)		(0.015)	
Average tenure	0.003*		-0.021		0.044*	
	(0.002)		(0.034)		(0.024)	
Field_arts	-0.008		0.187		-0.185	
	(0.022)		(0.317)		(0.289)	
Field_business	-0.038**		-0.328		0.034	
	(0.018)		(0.283)		(0.157)	
Field_STEM	0.006		0.028		0.243	
	(0.021)		(0.285)		(0.186)	
Field_law	0.018		0.454		-0.226	
	(0.026)		(0.472)		(0.333)	
Field_medicine	0.056		-0.976		-1.335	
	(0.051)		(0.919)		(1.356)	
Skill_academic		-0.008		-0.536		0.429
		(0.029)		(0.425)		(0.267)
Skill_government & policy		0.010		0.060		0.029
		(0.024)		(0.361)		(0.228)
Skill_risk management		0.068		-0.741		0.255
		(0.047)		(0.993)		(0.487)
Skill_scientific		0.005		-0.571		-0.666**
		(0.033)		(0.449)		(0.309)
Skill_technology		-0.004		0.245		0.306
		(0.043)		(0.519)		(0.345)
Skill_sustainability		-0.011		-0.178		-0.720
		(0.068)		(0.835)		(0.631)
Skill_community		-0.049		-0.403		-0.150
		(0.042)		(0.581)		(0.399)
Skill_finance accounting & economics		-0.003		0.319		-0.073
		(0.018)		(0.266)		(0.184)
Skill_management		0.063**		0.158		0.192
		(0.026)		(0.400)		(0.350)
Skill_entrepreneurship		0.009		-0.479		0.414*
		(0.020)		(0.348)		(0.217)
Skill_international		0.004		0.152		0.418**
		(0.022)		(0.313)		(0.191)
Skill_legal		-0.007		1.853***		-0.428
		(0.038)		(0.493)		(0.331)
Skill_manufacturing		-0.019		-0.068		1.182***
		(0.036)		(0.419)		(0.314)
Skill_marketing		-0.006		-0.453		-0.765***
		(0.023)		(0.303)		(0.229)
Skill_strategic planning		0.012		0.230		0.076
		(0.025)		(0.366)		(0.256)
Skill_HR		0.091**		1.381**		0.293
		(0.046)		(0.652)		(0.432)
Skill_operations		0.017		0.024		0.521***
		(0.023)		(0.319)		(0.190)
Skill_M&As		-0.034		-0.644		-0.355
		(0.046)		(0.911)		(0.523)
Board governance	0.003	0.004	0.017	0.020	-0.054	-0.022
	(0.003)	(0.003)	(0.035)	(0.034)	(0.038)	(0.033)
Female CEO	-0.001	-0.004	-0.093	-0.033	0.158	0.130
	(0.014)	(0.014)	(0.263)	(0.286)	(0.193)	(0.093)

Big3 institutions	-0.035	-0.048	-0.416	-0.187	-0.594	-0.437
	(0.036)	(0.036)	(0.782)	(0.757)	(0.656)	(0.544)
M/B	-0.000	-0.000	-0.001	0.000	-0.013*	-0.013**
	(0.000)	(0.000)	(0.005)	(0.004)	(0.007)	(0.005)
Firm size	0.027***	0.027***	0.150*	0.165**	0.391***	0.408***
	(0.005)	(0.005)	(0.085)	(0.084)	(0.100)	(0.065)
ROA	-0.019**	-0.020**	-0.107	-0.208	-0.002	0.022
	(0.008)	(0.009)	(0.250)	(0.242)	(0.365)	(0.268)
Leverage	-0.021	-0.021	0.049	0.074	-0.249	-0.215
	(0.013)	(0.013)	(0.254)	(0.257)	(0.298)	(0.253)
Cash holdings	0.029*	0.029	0.306	0.266	0.801	0.753**
	(0.017)	(0.018)	(0.385)	(0.374)	(0.596)	(0.372)
Industry × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	21,695	21,695	6,006	6,006	7,639	7,639
Adj-R^2 / Pseudo-R^2	0.845	0.845	0.5095	0.5128	0.823	0.823

Table 6
Board diversity and corporate environmental performance

This table examines board diversity and corporate environmental performance. Panel A presents the regression results examining the relation between the share of female directors on a board and different board diversity measures in terms of Herfindahl–Hirschman indices (HHIs) in director age, board tenure, educational background, skill, sector experience, undergraduate college, and ethnicity. Panel B presents the regression results examining the relation between the share of female directors on a board, board diversity, and corporate environmental performance using *E score*, *#Source reduction practices*, and *Environmental news*. Definitions of the variables are provided in the Appendix. ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Female directors and board diversity

	HHI age (1)	HHI tenure (2)	HHI field (3)	HHI skill (4)	HHI sector (5)	HHI college (6)	HHI ethnicity (7)
Female director ratio	-0.021***	-0.015***	-0.028***	-0.044***	-0.004	-0.033***	-0.014
	(0.004)	(0.004)	(0.008)	(0.005)	(0.006)	(0.008)	(0.038)
Board governance	0.005***	0.005***	0.002**	0.002***	0.003***	0.005***	0.008**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.004)
Female CEO	0.003**	0.002*	0.005	-0.002	-0.000	0.003	0.042*
	(0.002)	(0.001)	(0.005)	(0.002)	(0.002)	(0.003)	(0.023)
Big3 institutions	-0.007	-0.002	0.009	-0.005	0.004	-0.006	-0.044
	(0.005)	(0.005)	(0.012)	(0.006)	(0.009)	(0.011)	(0.058)
M/B	-0.000	-0.000	0.000	-0.000	-0.000	0.000	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	-0.008***	-0.008***	-0.004**	-0.003***	-0.006***	-0.008***	-0.012
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.008)
ROA	0.004	0.004*	0.003	0.004**	0.008**	0.001	-0.004
	(0.002)	(0.002)	(0.004)	(0.002)	(0.003)	(0.005)	(0.023)
Leverage	0.000	0.001	0.001	0.002	0.006	-0.001	-0.029
	(0.003)	(0.003)	(0.005)	(0.002)	(0.004)	(0.006)	(0.031)
Cash holdings	0.001	0.002	0.011*	0.000	0.006	0.005	0.043
	(0.003)	(0.003)	(0.006)	(0.003)	(0.004)	(0.006)	(0.032)
Industry × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	21,636	21,636	21,636	21,636	21,636	21,636	8,246
Adj-R^2	0.803	0.798	0.779	0.830	0.905	0.827	0.741

Panel B: Female directors, board diversity, and corporate environmental performance

	E score		#Source reduction practices		Environmental news	
	(1)	(2)	(3)	(4)	(5)	(6)
Female director ratio	0.076***	0.088*	0.880*	1.235**	-0.740**	-1.039**
	(0.022)	(0.051)	(0.483)	(0.608)	(0.335)	(0.436)
HHI age	-0.045	0.021	3.638*	3.020	2.292	2.912
	(0.106)	(0.231)	(1.872)	(2.979)	(1.736)	(2.693)
HHI tenure	0.017	-0.077	-1.313	0.702	-2.486	-3.966
	(0.111)	(0.214)	(1.898)	(2.814)	(1.641)	(2.675)
HHI field	-0.062	-0.034	-1.054**	-1.150	-0.760	0.280
	(0.041)	(0.083)	(0.492)	(0.745)	(0.463)	(0.812)
HHI skill	0.136	0.211	-1.212	1.638	-0.738	-1.355
	(0.084)	(0.178)	(1.024)	(1.395)	(0.965)	(1.930)
HHI sector	0.041	0.094	0.626	-0.131	-0.760	0.278
	(0.049)	(0.103)	(0.887)	(1.843)	(0.834)	(0.963)
HHI college	-0.010	0.136	0.478	-0.380	-0.047	-1.968
	(0.044)	(0.128)	(0.464)	(0.909)	(0.763)	(1.933)
HHI ethnicity		0.043		0.199		-0.581**
		(0.034)		(0.287)		(0.250)
Board governance	0.004	0.010**	0.017	-0.011	-0.050	0.015
	(0.003)	(0.005)	(0.036)	(0.045)	(0.039)	(0.049)
Female CEO	-0.001	-0.007	-0.042	-0.586	0.156	0.387***
	(0.015)	(0.030)	(0.285)	(0.374)	(0.105)	(0.139)
Big3 institutions	-0.041	-0.146	-0.376	0.574	-0.587	0.682
	(0.036)	(0.107)	(0.794)	(1.196)	(0.576)	(0.856)
M/B	-0.000	-0.001	-0.001	0.005	-0.013**	-0.011
	(0.000)	(0.000)	(0.005)	(0.009)	(0.006)	(0.007)
Firm size	0.027***	0.033***	0.169**	0.286**	0.391***	0.270***
	(0.005)	(0.011)	(0.082)	(0.120)	(0.062)	(0.101)
ROA	-0.020**	0.019	-0.120	0.874	0.022	-0.025
	(0.009)	(0.029)	(0.247)	(0.566)	(0.278)	(0.348)
Leverage	-0.022*	-0.007	0.127	-0.157	-0.200	-0.775*
	(0.013)	(0.035)	(0.248)	(0.421)	(0.267)	(0.397)
Cash holdings	0.030*	0.050	0.305	0.572	0.827**	1.067*
	(0.018)	(0.040)	(0.385)	(0.586)	(0.397)	(0.622)
Industry × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	21,695	7,377	6,006	2,642	7,639	2,905
Adj-R^2 / Pseudo-R^2	0.845	0.837	0.510	0.501	0.823	0.837

Table 7
Governance and corporate environmental performance

This table examines governance and corporate environmental performance. Panel A presents the regression results comparing female and male directors in board leadership and committee roles, controlling for a director's age, board tenure, educational background, and skills. Panel B presents the regression analysis examining the relation between the share of female directors on a board and a firm having ESG (executive) committee or ESG-linked compensation policy for executives, controlling for board average age, average tenure, and qualifications in terms of educational backgrounds and skills. Panel C presents the regression results examining the relation between the share of female directors on a board, a firm having ESG (executive) committee or ESG-linked compensation policy for executives, and corporate environmental performance using *E score, #Source reduction practices*, and *Environmental news*. Definitions of the variables are provided in the Appendix. ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Female directors and board leadership and committee roles

	Chairman of the Board	Lead director	Audit committee	Compensation committee	CSR committee	Nomination committee
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.082***	-0.019***	0.096***	0.031***	0.014***	0.060***
	(0.003)	(0.002)	(0.007)	(0.007)	(0.002)	(0.006)
Age	-0.003***	0.002***	0.011***	0.008***	0.000***	0.006***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure	0.012***	0.003***	-0.010***	-0.002***	-0.000**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Field_arts	-0.002	0.006**	0.003	0.038***	-0.001	0.028***
	(0.005)	(0.003)	(0.007)	(0.007)	(0.002)	(0.006)
Field_business	-0.011***	0.009***	0.104***	0.006	-0.005***	-0.003
	(0.004)	(0.003)	(0.007)	(0.006)	(0.002)	(0.005)
Field_STEM	0.011**	0.005*	0.007	0.012*	-0.002	0.009
	(0.005)	(0.003)	(0.007)	(0.006)	(0.002)	(0.006)
Field_law	0.008	0.020***	-0.022*	-0.019	0.003	0.053***
	(0.009)	(0.006)	(0.013)	(0.012)	(0.004)	(0.011)
Field_medicine	-0.025***	-0.019***	-0.101***	-0.031*	-0.002	0.028*
	(0.008)	(0.006)	(0.016)	(0.017)	(0.004)	(0.014)
Highest degree	-0.003	0.002	-0.028***	0.008*	0.003**	0.005
	(0.003)	(0.002)	(0.005)	(0.005)	(0.002)	(0.004)
Skill_academic	-0.036***	0.003	0.039***	0.001	0.003	0.038***
	(0.005)	(0.004)	(0.009)	(0.008)	(0.002)	(0.007)
Skill_government & policy	0.004	0.004	-0.043***	-0.004	0.006***	0.031***
	(0.005)	(0.003)	(0.008)	(0.007)	(0.002)	(0.006)
Skill_risk management	-0.008	-0.020***	0.070***	-0.083***	0.001	-0.053***
	(0.012)	(0.006)	(0.021)	(0.017)	(0.005)	(0.015)
Skill_scientific	-0.000	-0.020***	-0.070***	-0.073***	0.007	-0.030**
	(0.009)	(0.005)	(0.015)	(0.014)	(0.006)	(0.012)
Skill_technology	-0.012*	-0.001	0.015	-0.008	0.007**	0.001
	(0.006)	(0.004)	(0.010)	(0.009)	(0.003)	(0.008)
Skill_sustainability	0.006	-0.015**	0.009	-0.013	0.019***	0.018
	(0.012)	(0.007)	(0.021)	(0.017)	(0.007)	(0.015)
Skill_community	-0.023***	0.002	-0.013	0.010	0.007**	0.021**
	(0.006)	(0.005)	(0.012)	(0.010)	(0.003)	(0.009)
Skill_finance accounting & econ	-0.011***	0.003	0.176***	-0.052***	-0.007***	-0.030***
	(0.004)	(0.003)	(0.006)	(0.006)	(0.002)	(0.005)
Skill_management	0.069***	0.002	-0.081***	-0.011	-0.001	-0.042***
	(0.004)	(0.004)	(0.009)	(0.008)	(0.002)	(0.007)
Skill_entrepreneurship	0.016***	0.003	-0.020***	0.021***	0.001	0.015***
	(0.004)	(0.003)	(0.006)	(0.006)	(0.001)	(0.005)
Skill_international	-0.003	0.000	-0.002	0.014**	0.001	0.017***
	(0.004)	(0.003)	(0.007)	(0.007)	(0.002)	(0.005)
Skill_legal	-0.015*	-0.014**	-0.004	0.014	-0.003	0.002

	(0.009)	(0.006)	(0.014)	(0.013)	(0.003)	(0.011)
Skill_manufacturing	0.014*	-0.000	-0.023**	0.008	-0.001	0.004
	(0.007)	(0.005)	(0.011)	(0.010)	(0.003)	(0.008)
Skill_marketing	0.009**	0.000	-0.046***	0.033***	0.001	0.000
	(0.004)	(0.003)	(0.007)	(0.006)	(0.002)	(0.005)
Skill_strategic planning	-0.008*	0.003	0.016**	-0.004	0.000	0.000
	(0.005)	(0.003)	(0.007)	(0.006)	(0.002)	(0.006)
Skill_HR	-0.010	0.005	-0.077***	0.099***	0.005	0.002
	(0.008)	(0.006)	(0.013)	(0.013)	(0.004)	(0.010)
Skill_operations	0.009**	-0.001	-0.025***	-0.012*	0.001	-0.020***
	(0.005)	(0.003)	(0.007)	(0.007)	(0.002)	(0.005)
Skill_M&As	-0.027***	-0.001	-0.021	0.005	-0.005	-0.002
	(0.010)	(0.006)	(0.015)	(0.013)	(0.005)	(0.012)
Firm × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	193,722	193,722	193,722	193,722	193,722	193,722
Adj-R^2	-0.011	-0.019	0.050	0.098	0.426	0.236

Panel B: Female directors and ESG (executive) and executive compensation policy

	ESG (executive) committee		ESG reporting	
	(1)	(2)	(3)	(4)
Female director ratio	0.093*	0.094*	0.101**	0.091*
	(0.046)	(0.049)	(0.046)	(0.048)
Average age		-0.000		-0.008***
		(0.002)		(0.002)
Average tenure		0.004		0.005
		(0.003)		(0.004)
Field_arts		-0.129**		-0.095*
		(0.048)		(0.049)
Field_business		0.048		-0.065
		(0.046)		(0.047)
Field_STEM		0.098		-0.006
		(0.098)		(0.080)
Field_law		-0.076		-0.013
		(0.047)		(0.045)
Field_medicine		0.101		0.154
		(0.135)		(0.102)
Skill_academic		-0.002		0.004
		(0.072)		(0.066)
Skill_government & policy		0.053		-0.002
		(0.059)		(0.058)
Skill_risk management		0.065		0.003
		(0.129)		(0.112)
Skill_scientific		-0.069		0.115
		(0.077)		(0.069)
Skill_technology		0.056		-0.123
		(0.084)		(0.084)
Skill_sustainability		0.257		0.066
		(0.187)		(0.150)
Skill_community		0.039		-0.182*
		(0.100)		(0.094)
Skill_finance accounting & economics		-0.013		-0.040
		(0.047)		(0.041)
Skill_management		-0.039		0.014
		(0.052)		(0.049)
Skill_entrepreneurship		-0.018		0.085**
		(0.045)		(0.040)
Skill_international		0.068		0.101*
		(0.043)		(0.056)
Skill_legal		0.029		0.017

		(0.112)		(0.104)
Skill_manufacturing		0.136		0.016
		(0.090)		(0.071)
Skill_marketing		-0.058		0.032
		(0.045)		(0.043)
Skill_strategic planning		0.030		-0.026
		(0.046)		(0.050)
Skill_HR		0.097		0.181*
		(0.112)		(0.095)
Skill_operations		0.038		-0.089**
		(0.054)		(0.039)
Skill_M&As		0.064		0.001
		(0.097)		(0.097)
Board governance	0.003	0.005	0.009	0.008
	(0.006)	(0.006)	(0.010)	(0.009)
Female CEO	0.044	0.042	0.013	0.011
	(0.034)	(0.034)	(0.030)	(0.030)
Big3 institutions	0.058	0.049	-0.107	-0.095
	(0.083)	(0.081)	(0.080)	(0.078)
M/B	-0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.001)	(0.001)
Firm size	0.002	0.001	0.056***	0.056***
	(0.012)	(0.012)	(0.012)	(0.012)
ROA	0.024	0.021	-0.028	-0.031
	(0.022)	(0.022)	(0.019)	(0.019)
Leverage	0.004	0.001	-0.050	-0.053
	(0.041)	(0.041)	(0.038)	(0.036)
Cash holdings	-0.017	-0.015	0.069	0.062
	(0.034)	(0.032)	(0.051)	(0.050)
Industry × Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	19,653	19,653	19,653	19,653
Adj-R^2	0.708	0.709	0.641	0.642

Panel C: Female directors, governance, and corporate environmental performance

	E score		#Source reduction practices		Environmental news	
	(1)	(2)	(3)	(4)	(5)	(6)
Female director ratio	0.078***	0.062***	0.199	0.196	-0.757**	-0.733**
	(0.026)	(0.023)	(0.684)	(0.685)	(0.358)	(0.343)
ESG (executive) committee		0.016***		-0.001		-0.069
		(0.006)		(0.086)		(0.070)
ESG reporting		0.127***		-0.015		0.081
		(0.006)		(0.075)		(0.071)
Board governance	0.004	0.003	0.068	0.068	-0.045	-0.044
	(0.003)	(0.003)	(0.051)	(0.052)	(0.048)	(0.048)
Female CEO	-0.002	-0.005	0.443	0.444	0.227**	0.236**
	(0.018)	(0.015)	(0.520)	(0.524)	(0.104)	(0.103)
Big3 institutions	-0.046	-0.034	0.677	0.682	0.486	0.461
	(0.044)	(0.040)	(1.112)	(1.114)	(0.610)	(0.610)
M/B	-0.000	-0.000	-0.002	-0.002	-0.006*	-0.006*
	(0.000)	(0.000)	(0.006)	(0.006)	(0.003)	(0.003)
Firm size	0.034***	0.028***	0.015	0.016	0.393***	0.389***
	(0.006)	(0.005)	(0.133)	(0.134)	(0.070)	(0.069)
ROA	-0.011	-0.008	-0.048	-0.047	0.010	0.006
	(0.010)	(0.009)	(0.482)	(0.485)	(0.294)	(0.292)
Leverage	-0.017	-0.013	-0.046	-0.045	-0.144	-0.172
	(0.017)	(0.015)	(0.443)	(0.444)	(0.319)	(0.313)

Cash holdings	0.023	0.012	0.375	0.375	0.517	0.512
	(0.021)	(0.019)	(0.530)	(0.530)	(0.450)	(0.449)
Industry × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	17,033	17,033	2,429	2,429	4,737	4,737
Adj-R^2 / *Pseudo-R^2*	0.845	0.861	0.515	0.515	0.834	0.834

Table 8
Female directors and corporate environmental performance: California's SB 826

This table examines changes in both the share of female directors on a board and corporate environmental performance between the treated and control firms around the passage of California's SB 826, which since 2018 has imposed a female director quota on firms headquartered in California. The treated firms are public firms without a female director in 2018, headquartered (and stayed) in California, and without TRI-reporting facilities in California. We find the closest control firm for each treated firm by matching on (three-digit SIC) industry, firm size, and *E score*. Panel A compares the share of female directors on a board and corporate environmental performance between the treated and control firms before and after SB 826. Panel B presents the DID analysis results where the dependent variables are *Female director ratio* and *E score* using non-California firms as the control group. *Post* is an indicator variable that takes the value of one for the post-event window (2019 to 2021), and zero for the pre-event window (2015 to 2017). Panel C repeats the DID analysis using California firms with at least two female directors in 2018 as the control group. We include the same set of firm-level controls as in Table 3 Panel A. Definitions of the variables are provided in the Appendix. Standard errors (in parentheses) are clustered at the state level. ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Comparing treated and control firms in female director share and E score

	Female director ratio			E score		
	Treated	Control	Treated – Control	Treated	Control	Treated – Control
	(1)	(2)	(3)	(4)	(5)	(6)
Pre-event	0.022	0.026	-0.004	0.017	0.014	0.003
Post-event	0.210	0.126	0.084***	0.053	0.029	0.024**
Post – Pre			0.088***			0.021**

Panel B: DID analysis using non-California firms as the control group

	Female director ratio	E score
	(1)	(2)
Treated × Post	0.080***	0.030***
	(0.012)	(0.008)
Firm-level controls	Yes	Yes
Industry × Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Intercept	Yes	Yes
Obs.	530	530
Adj-R^2	0.752	0.690

Panel C: DID analysis using California firms with at least two female directors in 2018 as the control group

	Female director ratio	E score
	(1)	(2)
Treated × Post	0.122***	0.025***
	(0.032)	(0.004)
Firm-level controls	Yes	Yes
Industry × Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Intercept	Yes	Yes
Obs.	430	430
Adj-R^2	0.830	0.526

Internet Appendix for "The Eco-Gender Gap in Boardrooms"

Table IA1
Sample formation

This table lists the steps taken and filters applied to form the samples used in our analyses. Panel A reports the steps and filters applied to form our firm-level OLS sample for *E score* over the period 2002–2021, Poisson sample for *#Source reduction practices* over the period 2002–2020, and Poisson sample for *Environmental news* over the period 2007–2020. Panel B reports the steps and filters applied to form our facility-level Poisson sample for *#Source reduction practices* and OLS sample for *Production waste* over the period 2002–2020.

Panel A1: Firm-level OLS sample for *E score*

	#firm-year obs.	#firm-year obs. removed	#unique firms
WRDS Refinitiv ESG, 2002–2021	24,525		3,588
Remove observations with missing data from BoardEx	23,535	990	3,477
Remove observations with missing data form Compustat	23,343	192	3,450
Remove observations with missing data form WRDS Thomson 13F	23,279	64	3,445
Remove observations without Augmented 10-X Header Data	23,036	243	3,320
Remove observations due to fixed effects in OLS regressions	21,695	1,341	3,040
Final sample	21,695		3,040

Panel A2: Firm-level Poisson sample for *#Source reduction practices*

	#firm-year obs.	#firm-year obs. removed	#unique firms
WRDS Refinitiv ESG, 2002–2021	24,525		3,588
Remove observations with missing data from BoardEx	23,535	990	3,477
Remove observations with missing data form Compustat	23,343	192	3,450
Remove observations with missing data form WRDS Thomson 13F	23,279	64	3,445
Remove observations without Augmented 10-X Header Data	23,036	243	3,320
Remove observations due to fixed effects in Poisson regression	6,006	17,030	441
Final sample	6,006		441

Panel A3: Firm-level Poisson sample for *Environmental news*

	#firm-year obs.	#firm-year obs. removed	#unique firms
WRDS Refinitiv ESG, 2002–2021	24,525		3,588
Remove observations with missing data from BoardEx	23,535	990	3,477
Remove observations with missing data form Compustat	23,343	192	3,450
Remove observations with missing data form WRDS Thomson 13F	23,279	64	3,445
Remove observations without Augmented 10-X Header Data	23,036	243	3,320
Remove observations due to fixed effects in Poisson regression	7,639	15,397	796
Final sample	7,639		796

Panel B1: Facility-level Poisson sample for *#Source reduction practices*

	#firm-year obs.	#firm-year obs. removed	#unique firms
TRI facility-year observations matched to GVKEY (1991–2020)	166,453		14,008
Remove observations with missing information used in our firm-year obs. (BoardEx, Compustat, etc.)	90,193	76,260	8,551
Remove observations without NETS information	52,406	37,787	5,403
Remove observations due to fixed effects in Poisson regression	15,103	37,303	1,406
Final sample	15,103		1,406

Panel B2: Facility-level OLS sample for *Production waste*

	#firm-year obs.	#firm-year obs. removed	#unique firms
TRI facility-year observations matched to GVKEY (1991–2020)	166,453		14,008
Remove observations with missing information used in our firm-year obs. (BoardEx, Compustat, etc.)	90,193	76,260	8,551
Remove observations without NETS information	52,406	37,787	5,403
Remove observations due to fixed effects in OLS regressions	48,373	4,033	4,662
Final sample	48,373		4,662

Table IA2
Correlation matrices for different firm and facility samples

This table provides the correlation matrices for key variables in our firm and facility samples. Panel A1 presents the correlation matrices for key variables in the firm-level OLS sample for *E score* over the period 2002–2021. Panel A2 presents the correlation matrices for key variables in the firm-level Poisson sample for *#Source reduction practices* over the period 2002–2020. Panel A3 presents the correlation matrices for key variables in the firm-level Poisson sample for *Environmental news* over the period 2007–2020. Panel B1 presents the correlation matrices for key variables in the facility-level Poisson sample for *#Source reduction practices* over the period 2002–2020. Panel B2 presents the correlation matrices for key variables in the facility-level Poisson sample for *Production waste* over the period 2002–2020. Definitions of the variables are provided in the Appendix. ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A1: Correlation matrix of the firm-level OLS sample for *E score*

		1	2	3	4	5	6	7	8	9	10
1	E score	1.000									
2	Female director ratio	0.252***	1.000								
3	Board governance	-0.093***	0.030***	1.000							
4	Female CEO	0.033***	0.248***	0.025***	1.000						
5	Big3 institutions	0.286***	0.288***	0.142***	0.029***	1.000					
6	M/B	0.007	0.029***	0.007	0.016**	-0.009	1.000				
7	Firm size	0.506***	0.151***	-0.257***	-0.026***	0.171***	-0.127***	1.000			
8	ROA	0.201***	0.056***	-0.082***	-0.031***	0.168***	-0.044***	0.402***	1.000		
9	Leverage	0.114***	0.057***	0.056***	0.006	0.116***	-0.064***	0.124***	-0.009	1.000	
10	Cash holdings	-0.202***	-0.046***	0.081***	0.035***	-0.154***	0.217***	-0.491***	-0.468***	-0.266***	1.000

Panel A2: Correlation matrix of the firm-level Poisson sample for *#Source reduction practices*

		1	2	3	4	5	6	7	8	9	10
1	#Source reduction practices	1.000									
2	Female director ratio	0.058***	1.000								
3	Board governance	-0.155***	-0.033**	1.000							
4	Female CEO	-0.020	0.211***	-0.019	1.000						
5	Big3 institutions	-0.027**	0.373***	0.097***	0.052***	1.000					
6	M/B	0.020	0.114***	-0.040***	0.022*	0.077***	1.000				
7	Firm size	0.258***	0.371***	-0.268***	0.055***	0.377***	0.100***	1.000			
8	ROA	0.052***	0.081***	-0.047***	0.021	0.119***	0.155***	0.152***	1.000		
9	Leverage	0.042***	0.128***	0.009	-0.041***	0.083***	0.092***	0.263***	-0.162***	1.000	
10	Cash holdings	-0.094***	-0.118***	0.024*	0.025*	-0.022*	0.084***	-0.149***	0.005	-0.324***	1.000

Panel A3: Correlation matrix of the firm-level Poisson sample for *Environmental news*

		1	2	3	4	5	6	7	8	9	10
1	Environmental news	1.000									
2	Female director ratio	0.088***	1.000								
3	Board governance	-0.078***	0.001	1.000							

4	Female CEO	0.047***	0.262***	-0.003	1.000						
5	Big3 institutions	0.081***	0.370***	0.100***	0.042***	1.000					
6	M/B	-0.008	0.057***	-0.031***	0.040***	0.012	1.000				
7	Firm size	0.324***	0.314***	-0.226***	0.041***	0.306***	-0.008	1.000			
8	ROA	0.044***	0.109***	-0.067***	0.003	0.085***	0.093***	0.187***	1.000		
9	Leverage	-0.019*	0.013	0.062***	-0.012	0.019*	0.027**	-0.022*	-0.124***	1.000	
10	Cash holdings	-0.039***	0.002	-0.024**	-0.007	-0.057***	0.116***	-0.144***	-0.043***	-0.234***	1.000

Panel B1: Correlation matrix of facility-level Poisson sample for *#Source reduction practices*

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	#Source reduction practices	1.000												
2	Female director ratio	-0.044***	1.000											
3	Board governance	-0.009	-0.051***	1.000										
4	Female CEO	-0.023***	0.163***	-0.012	1.000									
5	Big3 institutions	-0.078***	0.364***	0.215***	0.047***	1.000								
6	M/B	0.001	0.131***	-0.013	0.061***	0.083***	1.000							
7	Firm size	-0.012	0.400***	-0.421***	0.068***	0.194***	0.049***	1.000						
8	ROA	0.006	0.117***	-0.037***	0.047***	0.099***	0.231***	0.121***	1.000					
9	Leverage	0.037***	0.067***	0.061***	-0.011	0.059***	0.141***	0.044***	-0.227***	1.000				
10	Cash holdings	-0.031***	-0.017**	0.000	0.049***	0.079***	0.017**	-0.002	0.131***	-0.276***	1.000			
11	ln(Sales +1)	-0.017**	0.144***	-0.110***	0.031***	0.077***	0.047***	0.277***	0.077***	-0.020**	0.062***	1.000		
12	ln(#Employees +1)	-0.045***	0.076***	-0.083***	0.014*	0.011	0.046***	0.119***	0.029***	-0.011	0.051***	0.907***	1.000	
13	Credit score	0.013	-0.043***	0.093***	-0.005	0.020**	-0.018**	-0.125***	0.008	0.025***	0.031***	-0.095***	-0.101***	1.000

Panel B2: Correlation matrix of facility-level OLS sample for *Production waste*

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	ln(Production waste + 1)	1.000												
2	Female director ratio	0.028***	1.000											
3	Board governance	0.015***	0.006	1.000										
4	Female CEO	-0.022***	0.181***	-0.002	1.000									
5	Big3 institutions	0.030***	0.402***	0.217***	0.055***	1.000								
6	M/B	-0.020***	0.087***	0.007	0.041***	0.066***	1.000							
7	Firm size	0.113***	0.375***	-0.395***	0.086***	0.163***	-0.012***	1.000						
8	ROA	-0.007	0.048***	-0.030***	0.035***	0.067***	0.177***	0.059***	1.000					
9	Leverage	0.058***	0.126***	0.051***	-0.020***	0.110***	0.109***	0.081***	-0.237***	1.000				
10	Cash holdings	-0.057***	-0.062***	-0.055***	0.016***	-0.009*	0.030***	-0.026***	0.105***	-0.279***	1.000			
11	ln(Sales +1)	0.128***	0.112***	-0.091***	0.029***	0.030***	0.033***	0.241***	0.027***	0.058**	0.022***	1.000		
12	ln(#Employees +1)	0.056***	0.025***	0.016**	-0.022***	-0.051***	0.049***	0.078***	0.002	0.044***	0.037***	0.907***	1.000	
13	Credit score	0.028***	0.008*	0.070***	0.026***	0.029***	-0.039***	-0.038***	0.032***	-0.021***	-0.007	-0.024***	-0.057***	1.000

Table IA3
Female directors and corporate environmental performance: different fixed effects

This table examines the relation between the share of female directors on a board and corporate environmental performance using the same regression analysis as in Table 3 Panel A but including different fixed effects. Definitions of the variables are provided in the Appendix. Standard errors (in parentheses) are clustered at the firm level. ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	E score	#Source reduction practices	Environmental news
	(1)	(2)	(3)
Female director ratio	0.053**	1.728***	-0.610*
	(0.025)	(0.620)	(0.372)
Board governance	0.002	-0.004	-0.027
	(0.003)	(0.040)	(0.053)
Female CEO	-0.007	0.496*	0.156
	(0.017)	(0.294)	(0.160)
Big3 institutions	-0.040	0.885	-0.569
	(0.040)	(0.944)	(0.729)
M/B	-0.000	0.001	-0.016**
	(0.000)	(0.007)	(0.007)
Firm size	0.025***	0.091	0.474***
	(0.005)	(0.116)	(0.080)
ROA	-0.010	-0.648**	-0.191
	(0.009)	(0.330)	(0.276)
Leverage	-0.019	-0.277	-0.430
	(0.014)	(0.290)	(0.338)
Cash holdings	0.024	1.023**	0.763
	(0.019)	(0.484)	(0.488)
Industry × Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Headquarters state × Year Fixed Effects	Yes	Yes	Yes
Incorporation state × Year Fixed Effects	Yes	Yes	Yes
Obs.	19,108	5,282	7,024
Adj-R^2	0.854	0.623	0.848

Table IA4
Summary statistics of director and board characteristics

This table provides the summary statistics of director and board characteristics for our director and firm samples. Panel A presents the summary statistics of director characteristics. The sample comprises 207,045 director-year observations associated with 3,040 firms over the period 2001–2020. Panel B presents the summary statistics of board characteristics. The sample comprises 21,695 firm-year observations associated with 3,040 firms over the period 2001–2020. Definitions of the variables are provided in the Appendix.

Panel A: Summary statistics for the director sample

	Mean	SD	P5	Median	P95
	(1)	(2)	(3)	(4)	(5)
Female	0.179	0.383	0.000	0.000	1.000
Age	62.249	8.744	47.000	63.000	76.000
Tenure	7.917	7.366	0.600	5.700	22.600
Field_arts	0.389	0.487	0.000	0.000	1.000
Field_business	0.533	0.499	0.000	1.000	1.000
Field_STEM	0.451	0.498	0.000	0.000	1.000
Field_law	0.136	0.343	0.000	0.000	1.000
Field_medicine	0.033	0.179	0.000	0.000	0.000
#Fields	1.542	0.686	0.000	2.000	2.000
Highest degree	1.757	0.642	1.000	2.000	3.000
Skill_academic	0.130	0.336	0.000	0.000	1.000
Skill_government & policy	0.188	0.390	0.000	0.000	1.000
Skill_risk management	0.016	0.124	0.000	0.000	0.000
Skill_scientific	0.043	0.204	0.000	0.000	0.000
Skill_technology	0.084	0.277	0.000	0.000	1.000
Skill_sustainability	0.018	0.135	0.000	0.000	0.000
Skill_community	0.069	0.254	0.000	0.000	1.000
Skill_finance accounting & economics	0.463	0.499	0.000	0.000	1.000
Skill_management	0.861	0.346	0.000	1.000	1.000
Skill_entrepreneurship	0.300	0.458	0.000	0.000	1.000
Skill_international	0.262	0.440	0.000	0.000	1.000
Skill_legal	0.095	0.293	0.000	0.000	1.000
Skill_manufacturing	0.072	0.258	0.000	0.000	1.000
Skill_marketing	0.267	0.442	0.000	0.000	1.000
Skill_strategic planning	0.179	0.383	0.000	0.000	1.000
Skill_HR	0.044	0.205	0.000	0.000	0.000
Skill_operations	0.228	0.420	0.000	0.000	1.000
Skill_M&As	0.033	0.179	0.000	0.000	0.000
#Skills	3.352	1.736	1.000	3.000	6.000
Chairman of the Board	0.101	0.302	0.000	0.000	1.000
Lead director	0.046	0.209	0.000	0.000	0.000
Audit committee	0.438	0.496	0.000	0.000	1.000
Compensation committee	0.358	0.479	0.000	0.000	1.000
CSR committee	0.033	0.180	0.000	0.000	0.000
Nomination committee	0.277	0.447	0.000	0.000	1.000

Panel B: Summary statistics for the board sample

	Mean (1)	SD (2)	P5 (3)	Median (4)	P95 (5)
HHI age	0.127	0.036	0.080	0.119	0.204
HHI tenure	0.125	0.035	0.080	0.119	0.186
HHI field	0.335	0.076	0.254	0.319	0.469
HHI skill	0.155	0.044	0.105	0.145	0.236
HHI sector	0.130	0.079	0.060	0.107	0.284
HHI college	0.150	0.077	0.083	0.136	0.265
HHI ethnicity	0.812	0.167	0.520	0.802	1.000
ESG (executive) committee	0.248	0.432	0.000	0.000	1.000
Compensation policy including ESG metric	0.275	0.446	0.000	0.000	1.000

Table IA5
Additional analysis related to California's SB 826

This table conducts additional analysis related to California's SB 826. Panel A repeats the DID analysis in Table 8 Panel B using the compliant firms as treated firms. The compliant firms are public firms that did not have a female director before September 30th, 2018 but had at least one female director the year after, headquartered (and stayed) in California, and without TRI-reporting facilities in California. We find the closest control firm for each treated firm by matching on (three-digit SIC) industry, firm size, and *E score*. Panel B repeats the DID analysis in Table 8 Panel B using 2016 as the pseudo-event year. Panel C employs the triple differences specification. *Treatment state* is an indicator variable that takes the value of one for firms headquartered in California, regardless of whether they had female directors before SB 826. *No female prior* is an indicator variable that takes the value of one for firms that had no female directors before SB 826, regardless of where they are headquartered. *Post* is an indicator variable that takes the value of one for the post-event window (2019 to 2021), and zero for the pre-event window (2015 to 2017). Definitions of the variables are provided in the Appendix. Standard errors (in parentheses) are clustered at the state level. ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: DID analysis using the compliant firms (51 treated firms)

	Female director ratio	E score
	(1)	(2)
Treated × Post	0.086***	0.033***
	(0.011)	(0.006)
Firm-level controls	Yes	Yes
Industry × Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Intercept	Yes	Yes
Obs.	455	456
Adj-R^2	0.762	0.645

Panel B: DID analysis using 2016 as the pseudo-event year

	Female director ratio	E score
	(1)	(2)
Treated × Post	0.011	0.008
	(0.010)	(0.012)
Firm-level controls	Yes	Yes
Industry × Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Intercept	Yes	Yes
Obs.	367	367
Adj-R^2	0.559	0.712

Panel C: Triple differences specification

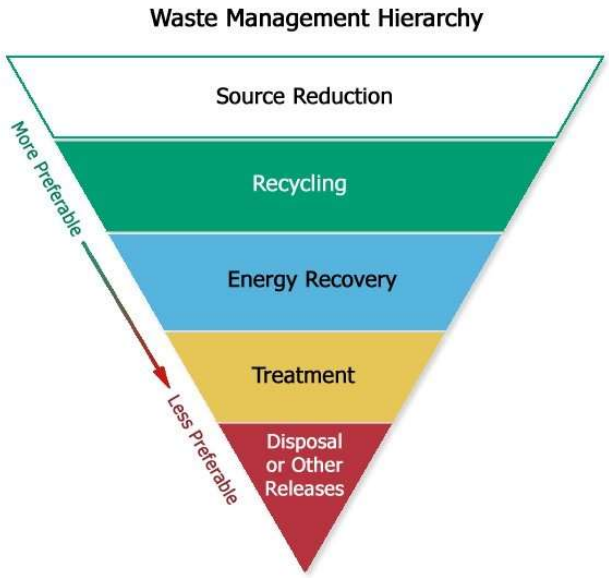
	Female director ratio	E score
	(1)	(2)
Treatment state × No female prior × Post	0.138***	0.022**
	(0.006)	(0.007)
Treatment state × Post	-0.057***	0.007
	(0.012)	(0.011)
Firm-level controls	Yes	Yes
Industry × Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Intercept	Yes	Yes
Obs.	626	626
Adj-R^2	0.811	0.666

Appendix IA1
Introduction to the EPA's TRI database

A. The Pollution Prevention (P2) database

The Pollution Prevention Act (P2 Act), approved by Congress in 1990, authorized the EPA to gather and disseminate information on pollution prevention activities (also known as source reduction activities). Such actions are compiled under the TRI database (in File Type 2A: https://www.epa.gov/toxics-release-inventory-tri-program/tri-basic-plus-data-files-calendar-years-1987-present). Facilities satisfying the following criteria are required to report to the TRI database: (1) in the mining, utility, manufacturing, publishing, hazardous waste, or federal industry; (2) manufacturing, processing, or otherwise using a TRI-listed chemical in quantities above certain threshold levels set by the EPA in a given year; and (3) having ten or more full-time equivalent employees.

Facilities are required to disclose any source reduction practices implemented at their facilities to reduce production waste in the reporting year. Source reduction practices denote the first layer of the waste management hierarchy (see the figure below): Once potential production waste is reduced, firms do not need to recycle, recover, treat, and release it.

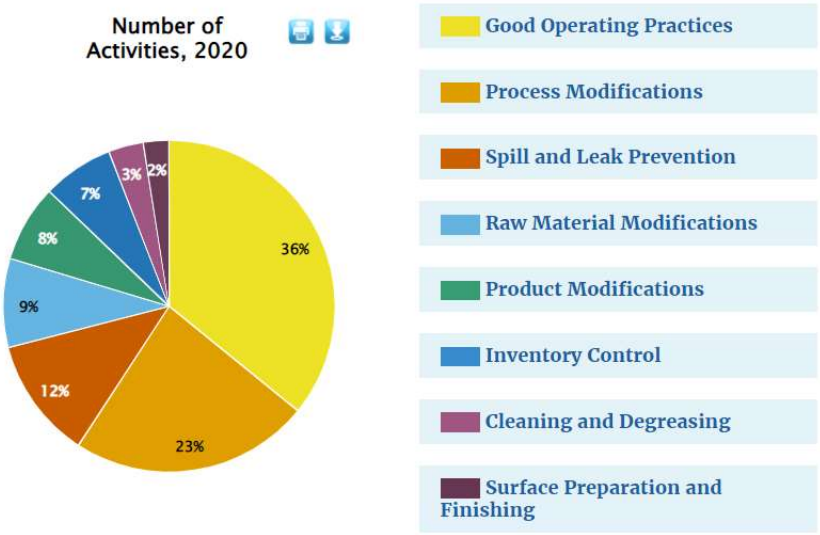


Source: https://www.epa.gov/trinationalanalysis/pollution-prevention-and-waste-management

Facilities report these newly implemented source reduction practices by selecting one or more predefined codes (W-codes) that describe specific practices within the eight categories: raw material modifications, product modifications, cleaning and degreasing, surface preparation and finishing, process modifications, spill and leak prevention, inventory control, and good operating practices (detailed definitions are provided at https://www.epa.gov/toxics-release-inventory-tri-program/pollution-prevention-p2-and-tri). Note that, since 2021, the classification of reduction practices has been changed to a system of S-codes, as seen in Appendix D of the following document: https://www.epa.gov/system/files/documents/2021-08/file_type_2a_0.pdf

The following pie chart illustrates the frequencies of eight categories of source reduction practices:

For 2020, a total of 1,188 facilities (6% of all TRI facilities) reported initiating 2,779 new source reduction activities. Good operating practices, process modifications, and spill and leak prevention were the activities reported most frequently. Click on the legend or graph to see examples of source reduction activities; reported codes are included in parentheses.



Source: https://www.epa.gov/toxics-release-inventory-tri-program/pollution-prevention-p2-and-tri

B. The Toxics Release Inventory (TRI) database

The TRI program was established by the EPA due to the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986. The TRI reporting started with the 1987 reporting year (first TRI reports due July 1st, 1988) and has continued to the present. In terms of coverage, we find more comprehensive coverage since 1991. By August 2022, the TRI toxic chemical list contains 775 individually listed chemicals and 33 chemical categories.

Each TRI-reporting facility reports the production and ultimate outlets of each chemicals (see: https://www.epa.gov/toxics-release-inventory-tri-program/common-tri-terms). "Production waste" denotes the amount of all chemicals produced along with the production process. The outlets of those waste include recycling, energy recovery, treatment, and releases (definitions are provided in the above link).
The releases include air releases, water release, and land release (also defined in the above link).

After collecting all facility-level releases data from the EPA website (https://www.epa.gov/toxics-release-inventory-tri-program), we use the link between facility id (TRIFD) and Compustat GVKEY, established by Chen, Hiseh, Hsu, and Ross (2022) based on matching facility names and parent company names.

about ECGI

The European Corporate Governance Institute has been established to improve *corporate governance through fostering independent scientific research and related activities.*

The ECGI will produce and disseminate high quality research while remaining close to the concerns and interests of corporate, financial and public policy makers. It will draw on the expertise of scholars from numerous countries and bring together a critical mass of expertise and interest to bear on this important subject.

The views expressed in this working paper are those of the authors, not those of the ECGI or its members.

ECGI Working Paper Series in Finance

www.ecgi.global/content/working-papers

Electronic Access to the Working Paper Series

The full set of ECGI working papers can be accessed through the Institute's Web-site (www.ecgi.global/content/working-papers) or SSRN:

Finance Paper Series	http://www.ssrn.com/link/ECGI-Fin.html
Law Paper Series	http://www.ssrn.com/link/ECGI-Law.html