

Board Gender Diversity and Corporate Carbon Abatement Innovation*

Tinghua Duan, Siyue (Sarina) Guo, Oskar Kowalewski

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Abstract

This study examines the effect of increased female board representation on corporate climate innovation. Leveraging the staggered implementation of global board gender diversity reforms, we find that the presence of more female directors after the reform is associated with enhanced climate-related innovation, particularly driven by technologies focused on greenhouse gas reduction. This positive effect is predominantly attributable to female non-executive directors and is more significant among firms in carbon-intensive industries. Furthermore, the rise in a company's GHG reduction patent value following the reform leads to a reduction in corporate direct carbon emissions three years later. Our findings offer novel evidence on the role of female directors in tackling climate challenges.

Keywords: gender diversity reforms; law; climate innovation; carbon abatement innovation, carbon emissions

JEL code: G34, J16, O32, Q55

*Tinghua Duan: EDHEC Business School, Nice, France. Email: tinghua.duan@edhec.edu. Siyue (Sarina) Guo: IESEG School of Management, Univ. Lille, CNRS, UMR 9221 - LEM - Lille Economie Management, F-59000 Lille, France. Email: s.guo@ieseg.fr. Oskar Kowalewski: IESEG School of Management, Univ. Lille, CNRS, UMR 9221 - LEM - Lille Economie Management, F-59000 Lille, France. Email: o.kowalewski@ieseg.fr.

1. Introduction

In light of escalating demands from regulators and investors for verifiable advancements in climate mitigation efforts, corporations are confronting intensifying pressures to achieve quantifiable reductions in greenhouse gas emissions and identify effective mechanisms to support such outcomes. An expanding body of empirical evidence demonstrates that corporate innovations in climate-related technologies can substantially diminish carbon footprints and enhance environmental performance (Hege, Li, and Zhang, 2023; Cheng, Li, and Yang, 2024). Recent studies further suggest that board gender diversity is associated with lower corporate carbon emissions (Barroso et al., 2024), indicating that internal governance structures may play a critical role in advancing environmental goals. Building on this evidence, we examine the impact of board gender diversity on corporate climate innovation, with a specific focus on carbon-abatement technologies.

The enactment of board gender diversity reform elevates the proportion of female directors on corporate boards, thereby enriching board diversity through the integration of individuals endowed with distinctive attributes and perspectives. Existing research posits that women exhibit a longer-term temporal orientation (Silverman, 2003), which may orient firms toward a heightened emphasis on long-term performance outcomes. Given the positive medium-run abnormal stock returns documented in association with the grant of climate-related patents (Hege, Pouget, and Zhang, 2024), boards with greater female representation may evince a stronger propensity to allocate resources to the pursuit of technologies designed to mitigate climate change. In addition, women tend to assign greater importance to environmental issues (Barroso et al., 2024; Hsu, Li, and Pan, 2025), and engage more actively with climate-policy initiatives (Ben-Amar, Chang, and

McIlkenny, 2017; Liao, Luo, and Tang 2015). This heightened focus on environmental priorities among female directors fosters corporate innovation in emission reducing technologies.

To analyze the effect of female directors, we focus on worldwide board gender diversity reforms which intended to increase female representation among board directors. Following Ding et al. (2022) and Baik, Chen, and Godsell (2024), we identify board gender diversity interventions implemented across 41 countries. We obtain patent application information from Orbis Intellectual Property database, and our final sample comprises 70,491 firm-year observations of 9,972 unique listed firms in 53 countries from 2000 to 2019. To establish the causal relationship, we employ a difference-in-differences-in-differences (DiDiD) estimation approach, leveraging the staggered enactment of global board gender diversity reforms. Our findings indicate that board gender diversity reforms significantly enhance female board representation, which in turn fosters corporate carbon emission abatement innovation.

We then investigate the role of female directors by classifying the directorship into executive and non-executive positions. We find that the increase in corporate GHG reduction innovation is driven by increased female non-executive directors after the reform. Align with Adam and Ferreira (2009), our findings highlight a more pronounced monitoring effect of female directors.

Next, we explore whether increased female directors in firms with different carbon emissions level have varying impact on corporate climate innovation. In particular, we test if high-emissions firms, respond to social and regulation pressures, or low-emissions firms with established environmental priorities, exhibit greater advancements in carbon-abatement technologies. We classify firms into high and low emission groups based on the Fama-French 12-industry carbon emission levels, splitting the sample and re-estimating the baseline model. We find

that the increase in female directors following board gender diversity reforms significantly enhances GHG reduction innovation in both high- and low- emission firms, with a stronger effect in high-emission firms. Our findings are consistent with Cohen, Gurun, and Nguyen (2024), who demonstrate that energy firms invest more in green research and produce higher-quality patents.

To isolate the effect of increased female directors on climate technologies in a more relevant subsample, we further focus on innovative firms by excluding those with no patent applications during the sample period and re-examining the baseline model. Our findings reveal no statistically significant increase in corporate climate innovation with more female directors on the board following the reform. However, we observe a significant increase in carbon abatement innovation, which is consistent with our baseline results.

Finally, with existing research documenting the carbon emission mitigating effects of climate patents (Hege, Li, and Zhang, 2023), we subsequently investigate whether the increase in abatement innovation, driven by a greater proportion of female directors, yields measurable environmental benefits. We conduct a three-way interaction term to examine the combined effect of the post-reform period, the proportion of female directors, and the GHG reduction value ratio on carbon emissions across different time horizons. Our finding indicates that firms with more female directors post-reform and higher value carbon abatement patents exhibit a significant reduction in corporate scope 1 carbon emissions starting in the third year.

We conduct several tests to check the robustness of our findings, including dynamic analysis, stacked DiD regressions, controls for country-by-year and industry-by-year fixed effects, and Poisson regression with patent counts. The results hold across robustness checks, reinforcing the credibility of our empirical findings.

Our study makes several contributions to the existing literature. First, we contribute to the corporate governance literature by providing further evidence on the effectiveness of female directors in climate regulation and their contributions to addressing climate change. Prior research demonstrates that female directors are associated with less corporate carbon emissions (Barroso et al., 2024), more environmental friendly business operations (Hsu, Li, and Pan, 2022), better firms' E&S performance (Ginglinger and Raskopf, 2023), and greater responsiveness to climate disclosure initiatives (Ben-Amar, Chang, and McIlkenny, 2017; Liao, Luo, and Tang 2015). We look at the climate issue through the lens of corporate emission reduction innovation and further demonstrate the importance of board gender diversity in facilitating corporate transition to a low-carbon economy.

Second, we contribute to the growing literature on the determinants of green and climate innovation. The literature documents that higher tax-inclusive fuel prices drive firms to innovate more in clean technologies (Aghion et al., 2016), greater engagement in foreign markets increases multinational corporations' green patent filings (Kim, Pantzalis, and Zhang, 2021), new entrant firms are more likely to engage in green innovation (Bolton, Kacperczyk, and Wiedemann, 2023), companies in energy sector contribute more to green patent (Cohen, Gurun, and Nguyen, 2024), and firms with more green marks are associated with more green patents (Chiu et al., 2024). We provide new evidence to the literature from the perspective of internal corporate governance, demonstrating that an increase in female directors incentivizes companies to engage in greater emission reduction innovation activities.

More importantly, while prior research has employed various methods to identify climate patents, we delve deeper into technologies that contribute to the reduction of greenhouse gas emissions which is the primary driver of contemporary climate challenges. Following Hege, Li,

and Zhang (2023), we identify climate related patents using Cooperative Patent Classification (CPC) Y02 tag. However, we further disaggregate the category according to CPC definitions, specifically distinguishing technologies that offer potential or indirect contributions to GHG emissions mitigation. While Cohen, Gurun, and Nguyen (2024) employ Y02C 10/14 to delineate patents focused on carbon emission capture and storage, our method adopts a more targeted lens by directly emphasizing mitigation technologies that address CO₂ emissions, thereby enhancing the assessment of their tangible environmental impacts.

The paper is organized as follows. Section 2 outlines the research design. Section 3 presents and discusses the main empirical results. Section 4 concludes.

2. Research Design

2.1 Data and Sample

We first obtain the firm-level patent data from Orbis Intellectual Property, which encompasses global patent applications and corporate ownership of patents by both publicly listed and privately held corporate entities. Following Hege, Li and Zhang (2025), we identify climate patents by Cooperative Patent Classification (CPC) code Y02. Within this category, we extract patents concerning greenhouse gas (GHG) emissions abatement, specifically those assigned the CPC tags Y02B 90/00, Y02E, Y02P 90/00, Y02T 90/00, and Y02W 90/00. Patents assigned any of these codes are defined as GHG reduction patents. We focus on patent applications rather than granted patents to better capture company's innovation activities. We exclude design patents and patents without CPC code.

Second, we obtain company's carbon emissions data from the S&P Global Trucost database which classifies firms' carbon emissions into three categories. Scope 1 emissions are direct greenhouse gas emissions from sources owned or controlled by the firm. Scope 2 emissions are

greenhouse gas emissions embodied in purchased energy inputs such as principally electricity, steam, heat, or cooling used in the firm's operation. Scope 3 emissions are indirect emissions generated from sources not owned or controlled by the firm across its value chain.

Finally, we follow Ding et al. (2022) and Baik, Chen and Godsell (2024) to obtain data on the global implementation of board gender diversity reforms. Firm-level information on directors' characteristics is sourced from BoardEx, which provides extensive global coverage of corporate executives and board members. Financial data are obtained from Compustat.

To construct the final sample, we link Orbis IP firm identifier BVDID with ISIN codes and merge with BoardEx, Compustat and S&P Trucost databases. We exclude observations from the United States because board gender diversity reforms in the U.S. are implemented at the state rather than the national level. After controlling for missing values, we further exclude firm-year observations based on the following criteria: (1) negative net sales or shareholder equity, and (2) countries with fewer than 10 unique firms. Our final dataset includes 70,491 firm-year observations of 9,972 unique listed firms in 53 countries from 2000 to 2019¹.

2.2 Descriptive statistics

Table 1 presents the breakdown of the sample and total number of patent applications and the aggregate patent value by country. The United Kingdom accounts for the largest percentage of the sample (24.92%) with 2,133 unique firms, whereas Pakistan represents the least (0.03%) with 10 unique firms. Notably, Japan contributes to the greatest share of patent applications and aggregate patent value, representing 45.59% and 65.43% of the sample, respectively. Table 2 presents the summary statistics. The average *Climate Patent Value Ratio* and *Climate Patent Ratio* in the sample are 0.935% and 0.475%. The average *GHG Reduction Value Ratio* and *GHG*

¹ Given the significant drop in patent applications in 2019, we conduct a robustness test by excluding this year and re-running the baseline regression. The results are reported in Table IA2.

Reduction Patent Ratio in the sample are 0.024% and 0.287%. All variables are winsorized at the top and bottom 1%.

2.3 Models and Identification Strategy

We evaluate the causal impact of worldwide board gender diversity reform on corporate climate innovation using a staggered difference-in-difference-in-differences (DiDiD) approach. The first difference captures changes in firm's climate innovation before and after the implementation of country-level board gender diversity reforms. The second difference evaluates the heterogeneous impact of the policy across firms, distinguishing between those that are required to adjust their board composition to comply with the gender diversity mandate and those that already meet or exceed the stipulated quota. The third difference leverages cross-country variation by comparing treated firms to untreated firms across countries that adopted the reform and those that did not. This DiDiD strategy enables us to isolate the effect of board gender diversity reforms by comparing changes in corporate climate innovation over time between firms differentially affected by the policy, while controlling for common trends. We estimate the following empirical model:

*Climate innovation*_{*i,c,t*}

$$= \beta_0 + \beta_1 Post_{c,t} * Female\ directors_{i,c,t} + \beta_2 Female\ directors_{i,c,t} + \beta_3 Post_{c,t} + Controls_{i,c,t} + \lambda_i + \lambda_t + \varepsilon_{i,s,t} \quad (1)$$

Where the dependent variable *Climate innovation*_{*i,c,t*} is measured by *Patent value ratio* and *Patent ratio*. The *Patent value ratio* is defined as the share of a firm's patent value attributable to a specific type, while the *Patent ratio* represents the share of the firm's patent applications accounted for by that type. The independent variable *Post*_{*c,t*} is a dummy variable equal to one for the years following

the implementation of a boardroom gender diversity reform in country c and zero otherwise. *Female directors* $_{i,c,t}$ represents the number of female directors in a firm.

Control variables include firm-level characteristics including *Firm age*, *Ln(Sales)*, *Book leverage*, *R&D*, *Cash* and *ROA*, and board-level characteristics such as *Board size* and *NED ratio*. All model specifications include firm and year fixed effects to account for unobserved heterogeneity across firms and over time. Robust standard errors are clustered at the firm level.

3. Results and Discussion

3.1 Baseline results

We examine whether the increase in female board representation resulting from the implementation of board gender diversity reforms enhances corporate climate innovation and present the results in Table 3.

Columns (1) to (3) present estimates for firm's patent value ratio related to climate, GHG reduction, and other climate technologies, respectively. Columns (4) to (6) present analogous results for the patent ratio. We find that board gender diversity reforms are associated with increased climate technology innovation when they translate into larger female representation on boards. Firms that experienced greater increases in the number of female directors after reform show statistically significant and economically meaningful increases in both the value and the count of climate patents, with particularly strong effects for technologies aimed at greenhouse gas reduction. For other climate technologies, we find an increase in the value-weighted patent ratio but not in patent counts with increased number of female directors after the reform. This divergence suggests that increased female representation after the reform tends to enhance the quality of climate innovations rather than solely expanding their quantity.

Specifically, the coefficient on the interaction term $Post \times Female\ directors$ is positive and significant at 1% level for the *Climate Patent Value Ratio* and significant at 10% level for the *Climate Patent Ratio*. In terms of the economic magnitude, one female director increased in the corporate board after the board gender diversity reforms, on average, leads to 0.241% increase in firm's climate patent value ratio and a 0.139% increase in climate patent ratio.

Furthermore, the coefficient on $Post \times Female\ directors$ is positive and statistically significant at 1% level for both the *GHG Reduction Value Ratio* and the *GHG Reduction Patent Ratio*. The results are also important in terms of the economic magnitude. We show that one female director increased in the corporate board after board gender diversity reforms, on average, leads to 0.015% and 0.072% increase in firm's GHG reduction patent value ratio and GHG patent ratio, respectively.

3.2 Dynamic effect analysis

To alleviate the concern that the observed effect is driven by differential pre-reform trends, we conduct a dynamic effect analysis and investigate how the relationship between female board representation and climate innovation evolves over time.

We construct an event time framework centered on the year of the board gender diversity reform to capture the evolution of corporate climate innovation before and after changes in board gender composition. We replace the *Post* dummy with a series of time dummies denoting years relative to the reform year. Specifically, *Before*₋₃, *Before*₋₂ and *Before*₋₁ are indicators set to one if the firm-year observation falls one, two or three years prior to the board gender diversity reform, and zero otherwise. Current equals one if the observation occurs in the year of the reform, and zero otherwise. *After*₊₁, *After*₊₂ are indicators set to one in the first and second years following the

reform. $After_{3+}$ equals one for all firm-year observations occurring three or more years after the reform and zero otherwise.

Table 4 reports the results of dynamic effect analysis. The coefficients for the interaction term on all *Before* terms are statistically insignificant for both value and count based patent measures. This supports the assumption that in the absence of board gender diversity reform, treated and control firms would have followed similar climate innovation trajectories. In contrast, the coefficient for interactions term becomes significant and positive in the year the reform is implemented. For patent value ratio, the effect remains positive and statistics significant through all *After* term. When disaggregated by technology type, GHG reduction patents show the most consistent post-reform increases in both value and count based measures. The coefficients for interaction terms between $After_{+1}$, $After_{+2}$ and $After_{3+}$ and number of female directors are consistently positive and statistically significant for both GHG reduction value and patent ratio, indicating that the reforms led to greater female representation, which in turn contributes to an increase in corporate GHG reduction innovation activities.

3.3 Stacked regression

One concern of using staggered difference-in-differences (DiD) is that estimates may be biased when treatment timing is staggered, and treatment effects are heterogeneous. Baker, Larcker, and Wang (2022) indicates that the bias arises when early treated units are inappropriately included in the control group for units treated later. Following Cengiz et al. (2019), we implement a stacked regression approach to address the potential bias related to staggered DiD. We first remove from the sample any firms that received treatment prior to the start of our sample. Then we create an event-specific dataset for each treatment event including the treated firms and all firms that are

never treated during the sample period. We restrict the sample period to four years before and following the event. Finally, we obtain the stacked database by combining all the event-specific dataset together.

Using stacked dataset, we re-estimate the baseline regression, with the results reported in Table 5. We include cohort*firm and cohort*year fixed effects in all specifications and cluster standard errors at firm by cohort level. Across both value and count based innovation measures, we observed consistent and statistically significant positive effects on patents targeting greenhouse gas (GHG) reduction. In particular, the coefficients for $Post \times Female\ directors$ in columns (2) and (5) are positive and significant at 1% level. Regarding other climate innovation technologies, we observe a significant increase in patent quality, measured by patent value ratio. Our results mitigate the downward bias inherent in staggered DiD estimators and corroborate the positive post-reform effects on both value and the count of GHG reduction patents.

3.4 Robustness tests

We conduct several additional tests to check the robustness of the positive effect on firm's GHG reduction innovation activities. First, we re-estimate the baseline regression using more rigorous fixed effects specifications to alleviate the endogenous concern. We include industry-by-year fixed effects to control for the time-varying industry trends and include country-by-year fixed effects to control for heterogeneity in local economic conditions that may influence firm's climate innovation activities.

The results are presented in Table 6. Column (1) and (3) report estimates from specifications that include industry-by-year fixed effects, whereas columns (2) and (4) include country-by-year fixed effects. The dependent variables are *GHG Reduction Value Ratio* and *GHG*

Reduction Patent Ratio. Across all specifications, the coefficient of the interaction term between *Post* and *Female directors* is positive and significant for both value and count based GHG reduction technology measurements, which is align with the baseline results. Our findings highlight that corporate GHG reduction technologies increased significantly after the increase in female directors brought from board gender diversity reform.

We then employ a Poisson model to assess the impact of increased female board representation post-reform on corporate climate patent application counts. The results are reported in Internet Appendix Table IA1. The coefficient on $Post \times Female\ directors$ in column (2) is positive and significant at the 1% level, providing additional confirmation that the reform-induced increase in female board representation prompts firms to enhance investments in R&D for emissions-reducing technologies.

3.5 Role of Female Non-Executive directors

While board gender diversity quotas change the composition of the board as a governance body, such reforms do not necessarily produce parallel changes in the composition of the executive ranks. Non-executive directors and executive directors perform distinct functions. Non-executive directors principally provide strategic oversight and shape board-level priorities, whereas executive directors embedded in firm's day-to-day decision making and operational implementation. Prior research indicates that female directors tend to engage in stronger monitoring and on average, contribute to improved board governance (Adam and Ferreira, 2009). While existing study shows that independent directors are associated with better accounting quality, trading performance and corporate transparency (Klein, 2002; Ravina and Sapienza, 2010; Ferreira, Ferreira and Raposo, 2011), we anticipate that the non-executive female directors are better

positioned to strengthen board oversight and steer corporate strategy toward expanding R&D efforts in greenhouse gas reduction technologies.

We re-estimate the baseline model by replacing *Female directors* with *Female NED* and *Female ED*, indicating the number of female non-executive directors and the number of female executive directors respectively. The results are reported in Table 7. The coefficient on $Post \times Female\ NED$ is positive and significant at 1% level across all specifications. Consistent with the monitoring channel, our findings indicate that the positive association between increased female board representation after the reform and corporate GHG reduction innovation is driven by female non-executive directors.

3.6 Scope specific responses in Top emitter and other firms

We further investigate whether the positive effect of increased female directors after the reform on corporate greenhouse gas reduction innovation varies across firms with different levels of carbon emissions. On the one hand, firms in the most carbon intensive sectors confront stronger regulatory mandates, larger potential cost savings from abatement, and heightened public scrutiny, which might translate into higher board-level incentives to prioritize carbon reduction innovations. On the other hand, firms in low emitting industries may also exhibit increased innovation due to peer pressure, customer and investor expectations. Prior literature documents mixed evidence: while Bolton, Kacperczyk, and Wiedemann (2023) find companies with higher emissions do not tend to engage in green R&D, Cohen, Gurun and Nguyen (2024) documents that energy firms dedicate more in green research and have higher patent quality.

To empirically test this question, we conduct a subsample analysis by splitting the sample into firms in the four highest emitting industries and all other firms based on both scope 1 and

scope 2 average carbon emissions by Fama-French 12 sector, and re-estimate the baseline model. Figure 1 plots the mean carbon emissions (scopes 1-3) for each Fama-French 12 industries from 2000 to 2019. Top 4 industries with the highest scope 1 emissions are utilities, energy, manufacturing and chemicals. Top 4 industries with the highest scope 2 emissions are chemicals, energy, manufacturing and consumer durables.

The results are presented in Table 8. Panel A reports the estimates for firms' *GHG Reduction Patent Value Ratio*. Panel B reports the estimates for firm's *GHG Reduction Patent Ration*. Across all specifications, the coefficient on interaction term *Post* $\times$ *Female directors* is positive and statistically significant. Notably, the estimated coefficients are consistently larger in magnitude for firms in high emitting industries than for other firms. These findings suggest that changes in board composition appear more effective at reallocating research and development toward emissions reducing technologies for firms in carbon intensive industries, producing both more inventions and inventions of higher economic significance.

3.7 Baseline results with innovation-active firms

To further refine our analysis, we restrict the sample to firms that filed at least one patent application during the sample period. We exclude firms with no observable innovation activity as they are less likely to exhibit measurable variation in innovation outcomes in response to the reform. We then re-estimate the baseline model with innovation-active firms, with results reported in Table 9.

Columns (1) and (3) report estimates for the value- and count-based ratios of firms' climate-related innovations, while Columns (2) and (4) focus on the corresponding ratios for GHG reduction innovations. Consistent with our main findings, the coefficients on the interaction term

Post × Female directors are positive and statistically significant at the 1% level for both the value and count of GHG reduction patents, indicating that increased female board representation following the reform is associated with a greater number and higher value of emissions-reducing innovations.

3.8 Board gender diversity, innovation value, and subsequent carbon emissions

With documented positive association between increase in female board representation and corporate greenhouse gas reduction innovation, we next investigate whether this rise in abatement innovation yields measurable environmental benefits. To do so, we interact *Post × Female directors* with *GHG Reduction Value Ratio*, and we regress these terms on firms' scope 1 carbon emissions at multiple horizons. This specification tests firms that experience larger post-reform increases in female directors and generate higher-value GHG patents subsequently record declines in direct emissions. The results are presented in Table 10.

The dependent variables are natural logarithm of one plus firm Scope 1 carbon emissions in years t ($t=0,1,2,3$). The coefficients on the three-way interaction term *Post × Female directors × GHG Reduction Value Ratio* are insignificant in the current year and the subsequent two years, but become negative and significant in the third year. Our findings indicate that increases in the value of a firm's GHG reduction patents brought from greater post-reform female representation are associated with subsequent declines in corporate direct carbon emissions. However, the conversion of innovation into measurable emission reductions is not immediate, likely reflecting the temporal lag between the generation of patented technologies and their practical deployment in abatement processes.

4. Conclusion

We study the impact of increased female representation on the board on corporate climate innovation. Focusing on the implementation of board gender diversity reforms, we show that firms with larger post-reform increases in female directors experience significantly rises in climate-related patenting. The effect is particularly pronounced for greenhouse-gas (GHG) reduction technologies, where we observe significant increases in both patent value and patent counts; for other climate technologies the gains are concentrated in patent value rather than patent quantity.

We then investigate the role of female directors by distinguishing between executive and non-executive positions, and find that the increase in corporate GHG reduction innovation is primarily driven by female non-executive directors. We conduct a subsample test based on firm's industry emissions level and find that firms in the most carbon intensive sectors exhibit substantially larger increase in GHG reduction innovation relative to other firms. Finally, we investigate whether firms with higher-value carbon abatement patents achieve actual reductions in carbon emissions, and we document a significant decrease in corporate direct emissions three years later.

Overall, our findings suggest that gender diversity mandates can effectively redirect corporate research and development toward higher-impact abatement technologies, with environmental benefits emerging over a multi-year timeframe. These results offer valuable insights contemplating the inclusion of female representation on boards as a strategic approach to combating climate change.

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Figure 1 Carbon Emission by Industry

This graph depicts the average carbon emissions of three scopes by Fama-French 12 industries.

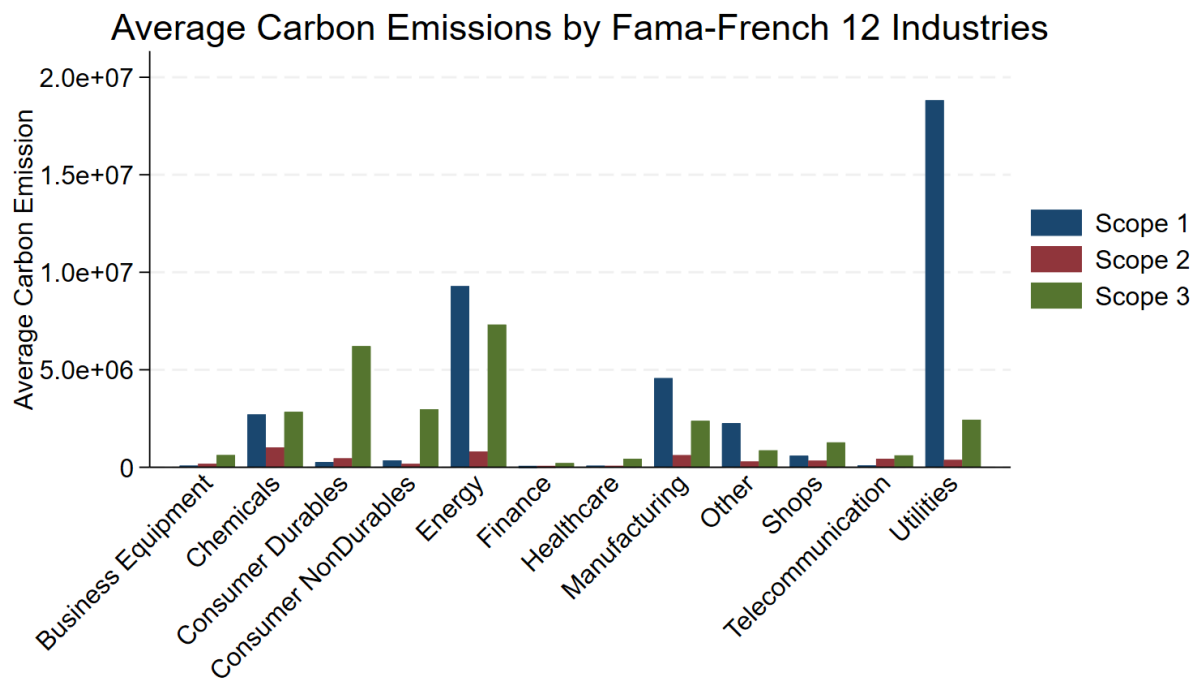


Table 1 Sample distribution by country

This table reports the sample distribution by country over the period 2000-2019.

Country	# of Firms (1)	# of Total Obs (2)	# of Patents (3)	Patent values (4)
Argentina	10	81	7	35,000
Australia	861	5,603	4,369	438,533,500
Austria	47	401	3,472	118,808,500
Belgium	94	922	16,415	824,726,000
Bermuda	265	1,796	982	133,250,000
Brazil	115	780	1,813	27,245,500
Canada	1,080	6,456	44,876	6,464,502,500
Chile	35	225	47	3,570,000
China	187	1,326	109,603	458,638,000
Colombia	10	62	124	211,500
Denmark	72	498	14,374	1,500,101,000
Egypt	10	22	0	0
Finland	113	716	52,407	1,052,314,000
France	503	4,661	190,075	4,816,665,000
Germany	423	3,444	480,910	7,979,387,000
Greece	25	241	153	44,730,500
Guernsey	26	138	0	0
Hong Kong	80	639	3,987	43,699,000
India	561	3,462	19,273	801,265,000
Indonesia	109	422	7	0
Ireland	83	726	10,650	337,298,500
Israel	105	877	9,331	1,032,847,500
Italy	158	1,146	10,492	203,175,500
Japan	470	2,792	1,670,478	185,323,551,000
Luxembourg	32	225	2,543	248,745,500
Malaysia	177	971	80	869,500
Marshall Islands	11	55	0	0
Mexico	73	462	229	14,631,000
Netherlands	144	1,269	165,304	3,995,978,000
New Zealand	79	390	2,713	822,368,000
Nigeria	18	137	0	0
Norway	135	1,201	5,279	75,855,500
Pakistan	10	18	0	0
Peru	12	45	2	0
Philippines	63	286	8	1,163,000
Poland	42	259	214	1,371,500
Portugal	34	319	12	0
Qatar	11	32	0	0
Russia	54	378	191	1,821,000
Saudi Arabia	34	102	2,043	339,466,500
Singapore	351	1,691	2,007	90,083,500

South Africa	185	1,388	155	583,000
South Korea	68	370	477,659	36,515,412,000
Spain	124	1,048	4,341	555,055,500
Sri Lanka	21	67	6	0
Sweden	277	2,151	106,521	6,185,708,500
Switzerland	167	1,472	65,805	9,143,201,500
Taiwan	137	545	121,326	11,066,779,500
Thailand	73	273	303	1,918,000
Turkey	35	207	5,456	5,723,500
United Arab Emirates	20	100	103	193,000
United Kingdom	2,133	17,567	57,994	2,551,277,000
Vietnam	10	27	16	50,000

Table 2 Descriptive statistics

This table provides the summary statistics for the sample over the period 2000-2019. Variable definitions are provided in Appendix A.

Variable	N	Mean	Std.De.	p25	p50	p75
Climate Patent Value (%)	70,491	0.935	5.425	0.000	0.000	0.000
GHG Reduction Value (%)	70,491	0.024	0.162	0.000	0.000	0.000
Other Climate Patent Value (%)	70,491	0.475	2.937	0.000	0.000	0.000
Climate Patent (%)	70,491	1.909	8.297	0.000	0.000	0.000
GHG Reduction Patent (%)	70,491	0.287	1.613	0.000	0.000	0.000
Other Climate Patent (%)	70,491	1.135	5.194	0.000	0.000	0.000
Female directors	70,491	0.994	1.195	0.000	1.000	2.000
Female NED	68,985	0.807	1.107	0.000	0.000	1.000
Female ED	68,985	0.192	0.456	0.000	0.000	0.000
Firm age	70,491	2.598	0.594	2.197	2.708	3.045
Ln(sales)	70,491	6.699	3.390	4.553	6.614	8.820
Book leverage	70,491	20.632	17.384	4.640	18.534	32.009
R&D	70,491	2.230	6.123	0.000	0.000	1.255
Cash	70,491	13.045	14.811	3.478	8.070	16.719
ROA	70,491	0.325	17.319	-0.124	3.512	7.266
Board size	70,491	2.051	0.390	1.792	2.079	2.303
NED Ratio	70,491	69.527	20.190	57.143	71.429	85.714
Ln(CO2 Scope 1)t	33,225	11.011	2.932	9.078	10.803	12.824
Ln(CO2 Scope 1)t+1	32,499	11.040	2.938	9.087	10.838	12.861
Ln(CO2 Scope 1)t+2	31,899	11.050	2.960	9.081	10.862	12.886
Ln(CO2 Scope 1)t+3	31,283	11.039	2.996	9.048	10.862	12.913

Table 3 Board gender diversity reform, female directors, and corporate climate innovation

This table reports results of the impact of board gender diversity reform on corporate climate innovation conditional on the number of female directors over the period 2000-2019. The dependent variables, *Patent Value Ratio* and *Patent Ratio*, are the value and count-based ratios of a firm's patent application for climate, carbon emission abatement and other climate technologies. *Post* is a dummy variable that equals to one in the years following a country's adoption of board gender diversity reform and zero otherwise. *Female directors* represents the number of female directors in a firm. The other variables are defined in Appendix A. All regressions include firm and year fixed effects. Numbers in parentheses are t-statistics based on standard errors clustered at the firm level. ***, **, and * correspond to statistical significance at 1%, 5%, and 10% levels, respectively.

Variables	Climate Patent Value (%) (1)	GHG Reduction Value (%) (2)	Other Climate Patent Value (%) (3)	Climate Patent (%) (4)	GHG Reduction Patent (%) (5)	Other Climate Patent (%) (6)
Post*Female directors	0.241*** (2.865)	0.015*** (5.144)	0.088** (1.973)	0.139* (1.664)	0.072*** (4.168)	0.022 (0.431)
Female directors	0.055 (0.884)	-0.002 (-1.226)	0.042 (1.224)	0.073 (0.906)	-0.006 (-0.400)	0.036 (0.733)
Post	-0.221* (-1.743)	-0.015*** (-3.848)	-0.088 (-1.276)	-0.369** (-2.433)	-0.140*** (-4.304)	-0.216** (-2.261)
Firm age	-0.606*** (-2.848)	-0.007 (-1.239)	-0.464*** (-3.824)	-0.140 (-0.604)	0.032 (0.713)	0.058 (0.419)
Ln(sales)	-0.023 (-0.539)	-0.000 (-0.152)	-0.029 (-1.188)	0.029 (0.540)	0.013 (1.358)	-0.004 (-0.141)
Book leverage	0.006*** (2.795)	0.000*** (2.877)	0.002* (1.853)	0.008** (2.289)	0.001* (1.675)	0.004** (2.138)
R&D	0.002 (0.203)	-0.000 (-0.170)	-0.001 (-0.212)	0.010 (0.754)	0.001 (0.599)	0.003 (0.411)
Cash	-0.000 (-0.178)	0.000* (1.695)	-0.001 (-0.698)	0.001 (0.239)	0.000 (0.473)	0.000 (0.151)
ROA	0.001 (1.183)	0.000 (1.199)	0.000 (0.726)	0.001 (0.507)	0.000 (0.235)	-0.000 (-0.148)
Board size	-0.227 (-1.621)	-0.006 (-1.349)	-0.111 (-1.457)	0.228 (1.155)	0.055 (1.438)	0.063 (0.552)
NED Ratio	-0.007***	-0.000***	-0.003**	0.001	-0.001	0.000

	(-2.674)	(-2.966)	(-1.994)	(0.167)	(-1.031)	(0.225)
Firm FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	70,491	70,491	70,491	70,491	70,491	70,491
Adjusted R^2	0.363	0.485	0.331	0.492	0.578	0.458

Table 4 Dynamic effect analysis

This table reports the regression results for the dynamic effects of adopting the gender diversity reform on corporate climate innovation conditional on the number of female directors over the periods 2000-2019. The dependent variables, *Patent Value Ratio* and *Patent Ratio*, are the value and count-based ratios of a firm's patent application for climate, carbon emission abatement and other climate technologies. $Before^{-t}$ is a time dummy that equals to one in the year t ($t=1,2,3$) before the implementation of the boardroom gender diversity reform and zero otherwise. $Current$ is a time dummy that equals to one in the year of the implementation of the boardroom gender diversity reform and zero otherwise. $After^{+t}$ is a time dummy that equals to one in the year t ($t=1,2$) after the implementation of the boardroom gender diversity reform and zero otherwise. $After^{3+}$ is a time dummy that equals to one if the firm-year observation is at least three years after the implementation of the boardroom gender diversity reform and zero otherwise. The independent variables are *Post* and *Female directors*. Control variables are the same as Table 3. All regressions include firm and year fixed effects. Numbers in parentheses are t-statistics based on standard errors clustered at the firm level. ***, **, and * correspond to statistical significance at 1%, 5%, and 10% levels, respectively.

Variables	Climate Patent Value (%) (1)	GHG Reduction Value (%) (2)	Other Climate Patent Value (%) (3)	Climate Patent (%) (4)	GHG Reduction Patent (%) (5)	Other Climate Patent (%) (6)
Before ⁻³ *Female directors	-0.051 (-0.782)	0.001 (0.844)	-0.027 (-0.698)	-0.043 (-0.368)	0.011 (0.538)	0.032 (0.399)
Before ⁻² *Female directors	0.070 (0.801)	0.001 (0.266)	0.059 (1.171)	0.093 (0.705)	0.022 (0.776)	0.051 (0.617)
Before ⁻¹ *Female directors	0.090 (1.017)	0.003 (1.199)	0.028 (0.595)	0.084 (0.619)	0.038 (1.328)	0.091 (1.010)
Current*Female directors	0.434*** (3.089)	0.018*** (4.317)	0.168** (2.425)	0.292** (2.215)	0.129*** (4.246)	0.105 (1.292)
After ⁺¹ *Female directors	0.324*** (2.693)	0.016*** (4.008)	0.132** (2.111)	0.412*** (2.788)	0.134*** (4.205)	0.178* (1.905)
After ⁺² *Female directors	0.373*** (3.009)	0.016*** (4.300)	0.163** (2.479)	0.235* (1.675)	0.102*** (3.473)	0.060 (0.716)
After ³⁺ *Female directors	0.233** (2.517)	0.015*** (5.243)	0.085* (1.652)	0.126 (1.164)	0.073*** (3.627)	0.034 (0.508)
Female directors	0.047 (0.685)	-0.003 (-1.471)	0.037 (0.967)	0.066 (0.667)	-0.012 (-0.766)	0.019 (0.306)
Post	-0.291**	-0.016***	-0.122*	-0.461***	-0.162***	-0.247**

	(-2.224)	(-3.951)	(-1.707)	(-2.883)	(-4.884)	(-2.487)
Controls	YES	YES	YES	YES	YES	YES
Firm FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	70,491	70,491	70,491	70,491	70,491	70,491
Adjusted R^2	0.363	0.485	0.331	0.492	0.578	0.458

Table 5 Stacked regression

This table reports the baseline results estimated using the stacked regression approach. The dependent variable, *Patent Value Ratio* and *Patent Ratio*, are the value and count-based ratios of a firm's patent application for climate, carbon emission abatement and other climate technologies. *Post* is a dummy variable that equals to one in the years following a country's adoption of board gender diversity reform and zero otherwise. *Female directors* represents the number of female directors in a firm. Control variables are the same as in Table 3. All regressions include Cohort*Firm fixed effects and Cohort*Year fixed effects. Numbers in parentheses are t-statistics based on standard errors clustered at firm by cohort level. ***, **, and * correspond to statistical significance at 1%, 5%, and 10% levels, respectively.

Variables	Climate Patent Value (%) (1)	GHG Reduction Value (%) (2)	Other Climate Patent Value (%) (3)	Climate Patent (%) (4)	GHG Reduction Patent (%) (5)	Other Climate Patent (%) (6)
Post*Female directors	0.333*** (3.437)	0.018*** (5.492)	0.148*** (3.008)	0.051 (0.571)	0.083*** (4.207)	-0.034 (-0.551)
Female directors	0.073** (2.137)	-0.001 (-0.709)	0.018 (1.030)	0.238*** (4.635)	0.006 (0.692)	0.095*** (3.071)
Post	-0.278* (-1.943)	-0.017*** (-3.877)	-0.123 (-1.595)	-0.250 (-1.444)	-0.128*** (-3.567)	-0.153 (-1.380)
Controls	YES	YES	YES	YES	YES	YES
Cohort*Firm FEs	YES	YES	YES	YES	YES	YES
Cohort*Year FEs	YES	YES	YES	YES	YES	YES
Observations	138,540	138,540	138,540	138,540	138,540	138,540
Adjusted R^2	0.446	0.525	0.419	0.518	0.600	0.481

Table 6 Alternative fixed effects

This table reports the baseline results with firm, industry-by-year and country-by-year fixed effects while the dependent variables are the value and count-based ratios of a firm's patent application for carbon emission abatement technology. The independent variable and control variables are the same as Table 3. All regressions include firm and year fixed effects. Numbers in parentheses are t-statistics based on standard errors clustered at the firm level. ***, **, and * correspond to statistical significance at 1%, 5%, and 10% levels, respectively.

Variables	GHG Reduction Value (%)		GHG Reduction Patent (%)	
	(1)	(2)	(3)	(4)
Post*Female directors	0.015*** (5.281)	0.010*** (3.553)	0.074*** (4.376)	0.032* (1.735)
Female directors	-0.003 (-1.613)	-0.000 (-0.155)	-0.010 (-0.747)	0.002 (0.126)
Post	-0.015*** (-3.820)	-0.001 (-0.293)	-0.130*** (-3.953)	-0.041* (-1.814)
Controls	YES	YES	YES	YES
Firm FEs	YES	YES	YES	YES
Industry*Year FEs	YES	NO	YES	NO
Country*Year FEs	NO	YES	NO	YES
Observations	70,383	70,491	70,383	70,491
Adjusted R^2	0.492	0.505	0.581	0.589

Table 7 Female non-executive directors

This table displays results of the impact of adopting board gender diversity reform on corporate carbon emission abatement innovation conditional on the number of female executive directors and non-executive directors over the periods 2000-2019. The dependent variables, *GHG Reduction Patent Value Ratio* and *GHG Reduction Patent Ratio*, are the proportion of corporate carbon emission abatement patent value and patent count, respectively. The independent variables are *Post*, *Female NED* and *Female ED*. *Female NED* represents the number of female non-executive directors in a firm. *Female ED* represents the number of female executive directors in a firm. Control variables are the same as in Table 3. All regressions include firm and year fixed effects. The numbers in parentheses are t-statistics based on standard errors clustered at the firm level. ***, **, and * correspond to statistical significance at 1%, 5%, and 10% levels, respectively.

Variables	GHG Reduction Value (%) (1)	GHG Reduction Patent (%) (2)
Post*Female NED	0.017*** (5.027)	0.080*** (4.170)
Post*Female ED	0.008* (1.693)	0.032 (1.185)
Female NED	-0.003 (-1.528)	-0.012 (-0.748)
Female ED	0.005 (1.364)	0.024 (1.019)
Post	-0.016*** (-4.045)	-0.141*** (-4.250)
Controls	YES	YES
Firm FEs	YES	YES
Year FEs	YES	YES
Observations	68,985	68,985
Adjusted R^2	0.487	0.578

Table 8 Higher and lower emitter

This table presents subsample tests between firms in the four highest-emitting industries and firms in other industries classified by corporate scope 1 and scope 2 carbon emissions, examining the impact of board gender diversity reform adoption and the number of female directors on firm's carbon emission abatement innovation during the period 2000-2019. Panel A reports the effect on firm's carbon emission abatement patent value ratio. Panel B reports the effect on firm's carbon emission abatement patent ration. The independent variables and control variables are the same as Table 3. All regressions include firm and year fixed effects. Numbers in parentheses are t-statistics based on standard errors clustered at the firm level. ***, **, and * correspond to statistical significance at 1%, 5%, and 10% levels, respectively.

Panel A: Carbon emission abatement patent value ratio

Variables	Scope 1 CO2		Scope 2 CO2	
	Top4 emitter firms	Other firms	Top4 emitter firms	Other firms
	GHG Reduction Value (%)			
	(1)	(2)	(3)	(4)
Post*Female directors	0.034*** (3.280)	0.014*** (2.786)	0.034*** (2.888)	0.015*** (3.207)
Female directors	-0.009 (-1.076)	-0.006* (-1.896)	-0.005 (-0.585)	-0.007*** (-2.663)
Post	-0.023 (-1.468)	-0.017** (-2.469)	-0.017 (-0.981)	-0.019*** (-2.863)
Controls	YES	YES	YES	YES
Firm FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
Observations	10,248	22,977	9,752	23,473
Adjusted R ²	0.530	0.477	0.547	0.439

Panel B: Carbon emission abatement patent ratio

Variables	Scope 1 CO2		Scope 2 CO2	
	Top4 emitter firms	Other firms	Top4 emitter firms	Other firms
	GHG Reduction Patent (%)			
	(1)	(2)	(3)	(4)
Post*Female directors	0.214*** (3.338)	0.069*** (2.589)	0.262*** (3.835)	0.060** (2.281)
Female directors	-0.110* (-1.862)	-0.004 (-0.195)	-0.117* (-1.863)	-0.005 (-0.229)
Post	-0.310** (-2.538)	-0.137** (-2.192)	-0.396*** (-3.008)	-0.102* (-1.715)
Controls	YES	YES	YES	YES
Firm FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
Observations	10,248	22,977	9,752	23,473
Adjusted R ²	0.631	0.571	0.607	0.616

Table 9 Innovative firms

This table presents subsample tests restricted to firms that filed at least one patent application during the sample period regarding the impact of board gender diversity reform adoption and the number of female directors on firms' climate innovation during the period 2000-2019. The dependent variables *Patent Value Ratio* and *Patent Ratio*, are the value and count-based ratios of a firm's patent application for climate and carbon emission abatement technologies. The independent variables and control variables are the same as Table 3. All regressions include firm and year fixed effects. Numbers in parentheses are t-statistics based on standard errors clustered at the firm level. ***, **, and * correspond to statistical significance at 1%, 5%, and 10% levels, respectively.

Variables	Climate Patent Value (%) (1)	GHG Reduction Value (%) (2)	Climate Patent (%) (3)	GHG Reduction Patent (%) (4)
Post*Female directors	0.150 (0.898)	0.023*** (4.081)	0.211 (1.172)	0.135*** (3.715)
Female directors	0.236* (1.706)	-0.002 (-0.481)	0.206 (1.102)	-0.003 (-0.098)
Post	-0.113 (-0.396)	-0.022*** (-2.590)	-0.711** (-2.009)	-0.281*** (-3.798)
Controls	YES	YES	YES	YES
Firm FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
Observations	25,561	25,561	25,561	25,561
Adjusted R^2	0.360	0.489	0.461	0.572

Table 10 Board gender diversity reform, CO2 abatement patent value ratio, and carbon emissions

This table reports the regression results of adopting board gender diversity reforms, the number of female directors and the value ratio of corporate carbon emission abatement technology on firms' carbon emissions over the period 2000-2019. The dependent variables are firm's direct carbon emissions measured as the natural logarithm of the Scope 1 carbon emissions plus one. The independent variables are *Post*, *Female directors* and *GHG Reduction Value Ratio*. *Post* is a dummy variable that equals to one in the years following a country's adoption of board gender diversity reform and zero otherwise. *Female directors* represents the number of female directors in a firm. *GHG Reduction Value Ratio* represents the proportion of corporate carbon emission abatement patent value. The control variables are the same as Table 3. All regressions include firm and year fixed effects. Numbers in parentheses are t-statistics based on standard errors clustered at the firm level. ***, **, and * correspond to statistical significance at 1%, 5%, and 10% levels, respectively.

Variables	Ln(CO2 Scope 1) _t (1)	Ln(CO2 Scope 1) _{t+1} (2)	Ln(CO2 Scope 1) _{t+2} (3)	Ln(CO2 Scope 1) _{t+3} (4)
Post*Female directors* GHG Reduction Value Ratio	0.020 (0.646)	-0.014 (-0.402)	-0.018 (-0.393)	-0.100** (-2.119)
Post*Female directors	-0.036* (-1.954)	-0.025 (-1.414)	-0.024 (-1.341)	-0.028 (-1.467)
Post* GHG Reduction Value Ratio	0.035 (0.705)	0.056 (1.171)	0.054 (1.151)	0.063 (1.241)
Female directors* GHG Reduction Value Ratio	-0.026 (-0.949)	0.007 (0.227)	0.021 (0.456)	0.129*** (2.764)
Post	0.020 (0.578)	0.007 (0.187)	0.005 (0.123)	-0.001 (-0.017)
Female directors	0.037** (2.088)	0.040** (2.221)	0.048*** (2.636)	0.048*** (2.599)
GHG Reduction Value Ratio	0.033 (0.817)	-0.014 (-0.323)	-0.021 (-0.465)	-0.124*** (-2.756)
Controls	YES	YES	YES	YES
Firm FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
Observations	33,225	32,499	31,885	31,283
Adjusted R ²	0.951	0.947	0.942	0.939

Appendix A Variable definition

This table reports the definitions of all variables.

Variables	Definition
Climate Patent Value (%)	The ratio of the total value of climate patent applications filed under CPC subclass Y02 in year t to the firm's total value of patent applications filed in that year.
GHG Reduction Patent Value (%)	The ratio of the total value of carbon emission abatement patent applications filed under the CPC code Y02B 90/00, Y02E, Y02P 90/00, Y02T 90/00, or Y02W 90/00 in year t to the firm's total patent application value that year.
Other Climate Patent Value (%)	The ratio of the total value of other climate patent applications filed in year t under CPC subclass Y02 excluding those in the carbon abatement subclasses to the firm's total patent application value that year.
Climate Patent (%)	The ratio of climate patent applications filed under CPC subclass Y02 in year t to the firm's total number of patent applications in that year.
GHG Reduction Patent (%)	The ratio of carbon emission abatement patent applications filed under the CPC code Y02B 90/00, Y02E, Y02P 90/00, Y02T 90/00, or Y02W 90/00 in year t to the firm's total number of patent applications in that year.
Other Climate Patent (%)	The ratio of other climate patent applications filed under the CPC subclass Y02 excluding the carbon emission abatement subclasses in year t to the firm's total number of patent applications in that year.
Female directors	Number of female directors.
Female NED	Number of female non-executive directors.
Female ED	Number of female executive directors.
Post	A dummy variable that equals one for years following the adoption of a board gender diversity reform by a country and zero otherwise.
Firm age	Natural log of the number of years that the firm has been covered in Compustat.
Log(sales)	Natural logarithm of sales.
Book leverage	Debt in current liabilities plus long-term debt, divided by the book value of total assets.
R&D	R&D expenses divided by the book value of total assets, with missing R&D expense data set to zero.
Cash	Cash divided by the book value of total assets.
ROA	Net income divided by the book value of total assets.
Board size	Natural log of the number of board directors.
NED Ratio	Number of non-executive directors divided by the number of board directors.
Log(CO2 Scope 1)	Natural log of Scope 1's carbon emission plus one.

Internet Appendix

Table IA1 Board gender diversity reform, female directors, and corporate climate patent number

This table reports results of the impact of board gender diversity reform on corporate climate innovation conditional on the number of female directors over the period 2000-2019. The dependent variables, *Patent number*, are the number of a firm's patent application for climate, carbon emission abatement and other climate technologies. *Post* is a dummy variable that equals to one in the years following a country's adoption of board gender diversity reform and zero otherwise. *Female directors* represents the number of female directors in a firm. The model is estimated using Poisson pseudo-maximum likelihood. All regressions include firm and year fixed effects. Numbers in parentheses are t-statistics based on standard errors clustered at the firm level. ***, **, and * correspond to statistical significance at 1%, 5%, and 10% levels, respectively.

Variables	Climate Patent Number (1)	GHG Reduction Number (2)	Other Climate Patent Number (3)
Post*Female directors	0.051 (1.470)	0.111*** (2.665)	0.023 (0.713)
Female directors	0.007 (0.184)	-0.002 (-0.033)	0.003 (0.085)
Post	-0.124* (-1.852)	-0.092 (-0.831)	-0.137** (-2.272)
Firm age	0.665*** (3.601)	1.264*** (3.206)	0.344* (1.750)
Ln(sales)	0.176 (1.047)	0.241 (1.380)	0.184 (1.158)
Book leverage	-0.005 (-1.521)	0.003 (0.534)	-0.009** (-2.276)
R&D	0.019** (2.031)	0.010 (0.848)	0.026** (2.515)
Cash	-0.007 (-1.526)	0.003 (0.586)	-0.009* (-1.748)
ROA	-0.005 (-1.337)	-0.005 (-0.937)	-0.004 (-1.131)
Board size	0.235* (1.952)	0.243* (1.771)	0.271** (2.367)
NED Ratio	-0.001 (-0.434)	-0.001 (-0.581)	-0.001 (-0.708)
Firm FEs	YES	YES	YES
Year FEs	YES	YES	YES
Observations	70,491	70,491	70,491
Pseudo R^2	0.950	0.920	0.941

Table IA2 Baseline regressions for an alternative sample

This table reports the baseline results over the period 2000-2018. The dependent variable, *Patent Value Ratio* and *Patent Ratio*, are the value and count-based ratios of a firm's patent application for climate, carbon emission abatement and other climate technologies. *Post* is a dummy variable that equals to one in the years following a country's adoption of board gender diversity reform and zero otherwise. *Female directors* represents the number of female directors in a firm. Control variables are the same as in Table 3. All regressions include firm and year fixed effects. Numbers in parentheses are t-statistics based on standard errors clustered at the firm level. ***, **, and * correspond to statistical significance at 1%, 5%, and 10% levels, respectively.

Variables	Climate Patent Value (%) (1)	GHG Reduction Value (%) (2)	Other Climate Patent Value (%) (3)	Climate Patent (%) (4)	GHG Reduction Patent (%) (5)	Other Climate Patent (%) (6)
Post*Female directors	0.269*** (2.949)	0.016*** (5.073)	0.101** (2.133)	0.153* (1.779)	0.073*** (4.079)	0.031 (0.576)
Female directors	0.049 (0.737)	-0.002 (-1.118)	0.042 (1.136)	0.054 (0.650)	-0.009 (-0.593)	0.030 (0.593)
Post	-0.232* (-1.775)	-0.016*** (-3.941)	-0.096 (-1.373)	-0.314** (-2.067)	-0.128*** (-3.933)	-0.179* (-1.886)
Controls	YES	YES	YES	YES	YES	YES
Firm FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	63,993	63,993	63,993	63,993	63,993	63,993
Adjusted R ²	0.380	0.497	0.345	0.516	0.604	0.477