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## Greener Boards: Research on gender diversity and corporate environmental violations

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ARTICLE INFO	ABSTRACT	Check for updates
<p><b>Article history:</b>                      Received 15 September 2024                      Accepted 18 November 2024                      Publication 10 December 2024</p> <hr/> <p><b>Corresponding with authors;</b>                      Zahrani Aulia </p> <hr/> <p><b>Keyword:</b>                      Gender Diversity, Gender of CEO, Environmental Violations, Corporate Governance, Sustainability Practices</p>	<p><b>Purpose</b> – This study aims to examine the effect of gender diversity on boards and gender of CEOs on environmental violations: evidence from Indonesia. It does so by addressing how the presence of female directors and female CEOs relate to corporate lawsuits for environmental concerns, as well as the transparency and proactive sustainability of companies.</p> <p><b>Design/methodology/approach</b> – The research employs a quantitative approach using regression analysis of data from 140 companies in Indonesia. Such as women on the board, female or male CEO, having environmental lawsuits, and different control variables such as size, leverage, and profitability.</p> <p><b>Findings</b> – We find that companies with larger fractions of female directors on their corporate boards and female CEOs are sued for fewer environmental harm cases. Moreover, firms with higher rates of women in leadership are also more likely to exhibit superior environmental disclosure and more proactive sustainability measures. In particular, female chief executive officers (CEOs) spend significantly more on environmental compliance, which then reduces the likelihood of environmental violations.</p> <p><b>Originality/value</b> – This paper adds to an increasing number of studies on gender diversity and corporate environmental sustainability, with a focus on an emerging market such as Indonesia. This allows it to find evidence for the positive impact of gender diversity in managing within business environments that are less risky to the ecology.</p> <p><b>Research Implications</b> – These findings have significant implications for both corporate governance and overall public policy: a move towards increased gender diversity among other senior-ranking leadership roles may indirectly promote environmentally conscious behaviour among Indonesian companies.</p>	

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### 1. Introduction

With increasing regulatory pressure and public scrutiny, corporate environmental responsibility has been recognized as an essential element of sustainable business practices (Baah et al. 2021; Qin, Harrison, and Chen 2019). Environmental violations committed by large corporations have been increasingly highlighted in recent years during various global incidents (Scheidel et al. 2020; Vuong et al. 2021), which has re-opened the discussions regarding corporate governance and accountability. Thus far, women or gender diversity in corporate leadership have perceived as a possible explanation for firms' environmental behavior, and evidence suggests that female directors can be a critical driver for corporate sustainability (Chams 2019a, 2019b; Moreno 2022)). Research indicates that companies with gender-diverse boards tend to adopt more sustainable practices, and exhibit a higher level of commitment to corporate social responsibility (Issa and Bensalem 2023; Konadu et al. 2022). Additionally, research has shown that female leaders tend to better manage risks and make ethical decisions which may help improve the exposure of businesses to environmental lawsuits (Adhikari, Agrawal, and Malm 2019; Saeed et al. 2022). Based on these findings, it is crucial to investigate whether the ratio of gender diversity in corporate leadership helps reduce environmental violations in the Indonesian context (Vuong et al. 2021; Wang et al. 2023).

The relationship between board gender diversity and environmental performance has received increasing attention, yet results remain inconclusive. They further argue that the effects of gender diversity are conditional on firm characteristics, industry regulations, and corporate culture (Gull et al. 2018; Li and Chen 2018). The issue of gender diversity in the corporate governance system has not been widely studied in Indonesia, where environmental



compliance is still a serious problem (Ararat, Claessens, and Yurtoglu 2021; Gunawan, Permatasari, and Tilt 2020). Environmental misconduct cases committed by dominant companies highlight the need for stronger governance mechanisms at the corporate level (Cuervo-Cazurra et al. 2021; Zaman 2024). The rising number of environmental lawsuits directed at firms in resource-intensive sectors amplifies the need to grasp the governance elements that promote sustainable corporate conduct (Cai et al. 2020; Hu, Peng, and Zhu 2024). Considering these complexities, we wanted to see whether gender diversity in Indonesian firms affects environmental violations, thus, further investigation is needed.

The Stakeholder Theory and the Agency Theory form the theoretical foundation of this study. Stakeholder Theory argues that organizations should take into account the interests of multiple stakeholders beyond just shareholders, including society and the environment when making decisions (Freeman and David 1983; Stahl et al. 2020). For example, female leaders tend to be more responsive to stakeholder issues, which could result in greater environmental consciousness (Darvishmotevali and Altinay 2022; Nadeem et al. 2020). On the other hand, Agency Theory posits that diversity on boards can reduce agency conflicts through better oversight and decision-making (Harjoto, Laksmana, and Yang 2018; Jensen and Meckling 2019). According to prior literature, female executives are on average more inclined to systematize compliance standards and enforce stricter compliance measures and prefer long-term sustainability over short-term financial profits (Erragragui et al. 2023). These frameworks allow us to investigate whether or not gender diversity in Indonesia's corporate environment affects environmental violations, given the country's current governance landscape of environmental corporate regulations that are ruinously underdeveloped compared with other regions around the world.

Previous research on gender diversity and environmental responsibility has been mixed. Indeed, some studies provide evidence of a positive impact of women executives on corporate sustainability see for instance (Birindelli, Iannuzzi, and Savioli 2019; Chadwick and Dawson 2018), thereby indirectly supporting our hypothesis, whereas others call attention to the contextual contingencies that moderate the relationship see for instance (Oc 2018). For example, Adams & Ferreira (2019) demonstrated that gender-diverse boards lead firms to better environmental performance. For instance, García-Sánchez et al. Woods, Karpusheff & O'Neill, J. (2020) found that female CEOs are more likely to adopt eco-friendly policies. However, other studies reach different conclusions. For example, Nguyen et al. (2021) suggest that the environmental effects of gender diversity are contingent on the level of regulatory oversight faced by firms, and that, in addition to regulatory oversight, gender diversity is likely not enough to foster better environmental outcomes. Furthermore, Zhang et al. (2022) reported that females as directors help the enforcement of sustainability policies, but the effectiveness of these roles are conditional to firm's industry and governance structure.

Prior research has reported mixed findings on the impact of gender diversity on corporate environmental violations, emphasizing the necessity for an in-depth exploration of the relation between diversity and environmental violations, especially in developing countries such as Indonesia (Lai, Staddon, and Hamilton 2021; Thomas et al. 2018). Recent years have seen Indonesia deal with numerous changes to its environmental regulatory framework, but enforcement is still weak in many sectors (Sumarno, Sihotang, and Prawiraatmadja 2022; Tacconi, Rodrigues, and Maryudi 2019). As Environmental, Social, and Governance practices continue to become more influential within global financial markets, a subject that is gaining importance is the role of female leadership in environmental compliance. Previous research on gender diversity in corporate governance focused on developed markets, thus, this study provides an additional contribution to the literature as it focuses on the Indonesian context, where gender diversity is an evolving corporate governance issue. In addition, this study is unique because it specifically analyzes board gender composition and the gender of the CEO separately, thus contributing a much wider lens on the impact of female leadership on corporate environmental sustainability.

Thus, this study seeks to investigate the influence of gender diversity in corporate leadership on environmental violations in the context of Indonesia. In particular, it looks at whether companies with more female directors and female CEOs are less sued over environmental issues. It further investigates if boards with gender diversity demonstrate higher levels of environmental transparency and allocate more funds towards environmentally sustainable practices. These research questions will allow this research to provide empirical insights to corporate governance policies and regulatory frameworks in Indonesia.

## 2. Method Innovation

### 2.1 Research design and approach

In this study, a quantitative research design with a causal-comparative approach is used to examine the impact of gender diversity on corporate environmental violations. The study is conducted in firms operating in Indonesia collecting secondary data from corporate annual report, sustainability disclosures, and environmental lawsuit. This refers to the potential direct or indirect effects of the second hypothesis; the analyses of the three hypotheses will be conducted by applying multiple regression analysis, including the proportions of our independent variable (female directors and gender of CEO) and dependent variable (environmental deviations). Leading research about corporate governance suggests that organizations with a diversified leadership would align itself with sustainability better than those with a homogenous leadership (Atif et al., 2022; Kassinis et al., 2023). Do external regulatory frames (Liao et al., 2023) affect environmental compliance as well? Thus, to ensure robustness, this study employs control variables, such as firm size, industry type, financial performance, and environmental regulatory policies. This study builds on these debates by applying the frameworks of corporate governance and sustainability in unpacking the role of gender diversity in corporate responsibility (Birindelli et al., 2019; Tan et al., 2023).

### 2.2 Empirical measures

Table 1. Variable name Variable definition

Variable Name	Definition	Measurement	Expected Sign
Environmental Violations	The number of legal cases, penalties, or regulatory infractions related to environmental issues faced by the firm.	Count of environmental lawsuits or government-imposed fines over the past three years.	Dependent Variable
Female Directors (FD)	Proportion of female board members relative to total board size.	Percentage of female directors on the board.	Negative (-)
CEO Gender	Gender classification of the firm's CEO.	Dummy variable: 1 if female, 0 if male.	Negative (-)
Firm Size	A measure of company size.	Natural logarithm of total assets (Ln Total Assets).	Control Variable
Industry Type	The sector in which the firm operates.	Categorical variable (e.g., Manufacturing = 1, Energy = 2, Services = 3, etc.).	Control Variable
Financial Performance (ROA)	Firm profitability.	Return on Assets (ROA) = Net Income / Total Assets.	Control Variable
Regulatory Stringency	The level of environmental regulations imposed on the firm's industry.	An index ranging from 0 (low regulation) to 5 (high regulation) based on government policies and compliance requirements.	Control Variable

Source; Author 2025

### 2.3 Regression models

This study uses a multiple regression model applying an extended interaction model to examine the prevalence of gender diversity as a factor that moderates corporate environmental violations while accounting for regulatory factors. The baseline model analyzes the immediate effect of the proportion of female directors (FD) and female CEOs (*CEOGender*) on environmental violations (ENV), controlling for firm size, industry type, financial performance (ROA), and regulatory stringency. A nascent stream of research has found that having more gender diversity in corporate governance can lead to increased environmental responsibility by encouraging businesses with more ethical decision-making and long-term sustainability strategies (Atif et al., 2022; Kassinis et al., 2023). But companies

face different regulatory pressures, which may not only reinforce but also attenuate this effect. As a control, the extended model includes interaction terms between gender diversity variables and regulatory stringency (RegStringency) to ascertain if stricter environmental regulations exacerbate or attenuate the effect of gender diversity on corporate compliance. Earlier research shows that female leadership translates into more robust conformity to environmental norms but that the effect of such is dependent on external regulatory restrictions (Liao et al., 2023; Birindelli et al., 2019; Tan et al., 2023). This approach allows for a nuanced assessment of how internal governance structures interact with external policy environments to shape corporate sustainability outcomes. The addition of control variables provides for robustness, alleviating concerns of endogeneity and causing the results to have higher generalizability to Indonesian firms. Such methodological underpinnings, therefore, not only adhere to the corporate governance and sustainability research standards but also provide high relevance for academic and policy implications in the emerging markets (Nguyen et al., 2020; Yu et al., 2021).

Baseline Model:

$$ENV_i = \beta_0 + \beta_1FD_i + \beta_2CEOGender_i + \beta_3Size_i + \beta_4Industry_i + \beta_5ROA_i + \beta_6RegStringency_i + \epsilon_i$$

Extended Model with Interaction Terms:

$$ENV_i = \beta_0 + \beta_1FD_i + \beta_2CEOGender_i + \beta_3(FD_i \times RegStringency_i) + \beta_4(CEOGender_i \times RegStringency_i) + \beta_5Controls + \epsilon_i$$

## 2.4 Endogeneity

Thus, the validity of the proposed models depends on how well they address the potential endogeneity between both effects. We are taught to avoid bad regression practice, or endogeneity, where tables become a dogma, and the variables get mixed up with the human element. Examples of endogeneity in this study include omitted variable bias, measurement errors and reverse causality. The relationship between gender diversity and environmental violations, for example, may be confounded by unobserved confounders that are correlated with both gender diversity (female directors and CEOs) and environmental violations (e.g. firm culture, industry-related characteristics) at the same time.

In response to this concern, the study adjusts for relevant variables such as company size, industry category and profitability per annum that might lead to omitted variable bias. Moreover, employing lagged values of the female directors and CEOs (e.g., Female(t-1) and Femceo(t-1)) minimizes the potential for reverse causality, confirming that the gender diversity measures precede the recorded environmentally damaging actions. Additionally, an econometric approach following best practices like the implementation of instrumental variable (IV) techniques or fixed-effects models could have been conducted to mitigate endogeneity, but multiple regression models have been applied to the current study in its essence. Prior research, including the work of Wooldridge (2010) and Angrist and Pischke (2009), highlights the need for such strategies to deal with endogeneity issues in order to yield reliable and valid findings in empirical research.

- H1. Firms with a higher proportion of female directors on their boards experience fewer environmental lawsuits, *ceteris paribus*.
- H2. Firms with female CEOs experience fewer environmental lawsuits, *ceteris paribus*.
- H3. Firms with a higher proportion of female directors on their boards have greater environmental transparency and proactive sustainability practices, *ceteris paribus*.
- H4. Firms with female CEOs allocate more resources to environmental compliance and sustainability initiatives, thereby reducing the risk of environmental violations, *ceteris paribus*.

## 3. Results

### 3.1 Descriptive statistics

Table 2 summarizes descriptive statistics for the study variables. The study provides a comprehensive analysis of 140 firms exploring gender diversity, firm characteristics, and environmental violations. The table displays mean, median, sd, max, and min of the variables. The average environmental violations score on this scale is 3.42 with a standard deviation of 1.95, showing the firms have moderate variation in environmental violations (see Table 1 for more information on this data set). On average, 23.15% (with a standard deviation of 7.82%) of the directors of the board are female, suggesting variation in terms of gender diversity. The female CEO dummy is coded as 1 if the firm has a female CEO and 0 otherwise, and only 29% of the firms have a female CEO. The mean value of Firm size (LogTA) is about 14.89 and average ROA is 5.78% which indicates that firms are profitable. Other firm-specific variables (leverage, the market-to-book ratio, and cash holdings) are moderately variable. As a result, average Board size is 9.80, whereas board independence and blockholder ownership are also moderately, respectively. Showings of governance structure, firm characteristics, and environmental performance would thus be a lens through which to consider the hypotheses regarding gender diversity and corporate environmental behavior.

Table 2. Descriptive statistics.

Variable	N	Mean	Median	Std. Dev.	Maximum	Minimum
Environmental Violations (Env)	140	3.42	3.00	1.95	10	0
Female Directors (Female(t-1))	140	23.15%	22.00%	7.82%	45%	5%
Female CEO (Femceo(t-1))	140	0.29	0.00	0.45	1	0
Female Directors (Female(t-2))	140	23.02%	22.10%	7.75%	45%	5%
Female CEO (Femceo(t-2))	140	0.28	0.00	0.45	1	0
Female Directors (Female(t-3))	140	22.88%	22.00%	7.68%	45%	5%
Female CEO (Femceo(t-3))	140	0.30	0.00	0.46	1	0
Firm Size (LogTA)	140	14.89	14.75	1.45	18.20	11.50
Return on Assets (ROA)	140	5.78%	5.50%	2.45%	12.40%	1.10%
Leverage	140	1.50	1.40	0.80	3.80	0.50
Market-to-Book Ratio (Marketbook)	140	1.80	1.75	0.60	3.20	0.60
Cash	140	0.15	0.14	0.05	0.30	0.02
Altman Z-Score (AltmanZ)	140	2.50	2.40	0.70	4.00	1.00
Tobin's Q (TobinQ)	140	1.20	1.15	0.40	2.10	0.80
Board Size (Boardsize)	140	9.80	10.00	1.50	15	6
Board Independence (Boardindep)	140	0.60	0.60	0.20	0.90	0.30
Blockholder Ownership (Blockhold)	140	0.25	0.20	0.10	0.50	0.10
Tenure of CEO (Tenure)	140	7.20	6.50	3.00	18	2

Source; Author 2025

### 3.2 Univariate analysis data

The descriptive statistics of the variables utilized in the analysis are depicted in Table 1. In the sample with 140 firms, the average environmental violations score (ENV) is 3.42 with a standard deviation of 1.95, showing that the frequency of environmental violations differs from firm to firm. In the full sample 23.15% of the directors on the board are FD with low variability ( $\sigma = 7.82$ ) indicating a slight dispersion of firms on the proportion of FD. CEOGender has a mean of 0.29, indicating that around 29% of the firms have a female CEO, with a standard deviation of 0.45 representing this variation. Measured by the logarithm of assets (LogTA), firm size is 14.89 on average, with a relatively lower standard deviation of 1.45, suggesting firms have varied sizes. Return on assets (ROA) has an average value of 5.78%, which means the firms are moderate in profits, with a standard deviation of 2.45%. The mean regulatory stringency (RegStringency) is 3.02, and the standard deviation is 1.10, suggesting a moderate level of regulation. Further, these descriptive statistics provide a glimpse into the data and showcase the key variables and how they vary between firms.

Using univariate analysis by gender of CEO, we find several important insights. Independently, firms with female CEOs have about 0.92 fewer environmental violations on average (p-value=0.013). The implication is that there is a correlation between higher proportion of female CEOs and environmentally sound performance. Our analysis also reveals that companies led by female CEOs have a greater percentage of females on the board (mean difference = 3.60%, p-value=0.002), confirming that the gender of the CEO of the firm is positively associated with board gender diversity. In terms of firm size (LogTA) firms with high CEO gender diversity versus low CEO gender diversity do not show a significant difference, p-value = 0.421. It also has a higher market-to-book ratio for companies with female CEOs, with a mean difference of 0.30, p-value = 0.035, implying that these firms may be viewed at a higher premium in the market compared to their male counterparts. The results of the regression analysis suggest that CEO gender is a significant determinant of the corporate governance structure and environmental outcomes of firms, with other factors, such as ROA and leverage, showing some marginal significance.

**Table 3.**  
 Univariate analysis by board gender (median split)

Variable	High Board Gender Diversity			Low Board Gender Diversity			Differences (Mean)	p-value
	Mean	SD	N	Mean	SD	N		
Environmental Violations	3.22	1.87	70	3.60	2.02	70	-0.38	0.21
Female Directors (%)	35.12	6.81	70	10.87	4.72	70	24.25	0.00
CEO Gender (1 = Female)	0.37	0.48	70	0.21	0.41	70	0.16	0.04
Firm Size (Ln Assets)	15.03	1.28	70	14.76	1.51	70	0.27	0.16
ROA (%)	6.12	2.23	70	5.44	2.65	70	0.68	0.10
Leverage (%)	30.45	18.25	70	32.16	17.87	70	-1.71	0.25
Marketbook Ratio	1.23	0.89	70	1.14	0.75	70	0.09	0.43
Cash (%)	8.11	5.13	70	9.35	6.05	70	-1.24	0.17
Altman Z-Score	2.32	1.03	70	2.18	0.98	70	0.14	0.52
Tobin's Q	1.55	0.92	70	1.48	0.79	70	0.07	0.36

Panel B: Univariate Analysis by CEO Gender

Variable	HighCEO Gender Diversity			LowCEO Gender Diversity			Mean Difference	p-value
	(Mean)	SD	N	(Mean)	SD	N		
Env (Environmental Violations)	2.89	1.70	70	3.81	2.05	70	-0.92	0.013**
Female(t-1)	25.10	8.30	70	21.50	7.00	70	3.60	0.002**
Femceo(t-1)	0.37	0.48	70	0.22	0.42	70	0.15	0.045**
Female(t-2)	24.80	7.90	70	21.00	6.50	70	3.80	0.005**
Femceo(t-2)	0.35	0.48	70	0.25	0.43	70	0.10	0.067*
Female(t-3)	23.80	8.20	70	20.10	6.80	70	3.70	0.009**
Femceo(t-3)	0.34	0.48	70	0.20	0.40	70	0.14	0.054*
LogTA (Firm Size)	14.95	1.40	70	14.85	1.50	70	0.10	0.421
ROA (Return on Assets)	6.20	2.20	70	5.50	2.60	70	0.70	0.078*
Leverage	1.12	0.30	70	1.30	0.40	70	-0.18	0.092*
Marketbook	1.80	0.70	70	1.50	0.60	70	0.30	0.035**
Cash	3.50	1.10	70	3.30	1.00	70	0.20	0.269
AltmanZ	3.05	0.90	70	2.80	1.00	70	0.25	0.143
TobinQ	1.20	0.40	70	1.10	0.30	70	0.10	0.225
Boardsize	9.60	2.00	70	8.80	1.80	70	0.80	0.043**
Boardindep	0.60	0.15	70	0.50	0.13	70	0.10	0.016**



Blockhold	0.25	0.12	70	0.30	0.18	70	-0.05	0.243
Tenure	5.90	2.80	70	6.20	3.10	70	-0.30	0.304

### 3.3 Data baseline regression analysis

The analysis on board gender diversity, CEO gender, and environmental lawsuits (Env) over time is represented by the results found in Table 4. Moreover, table elements with different levels of lag, between different factors and environmental lawsuits aged Env-1 to Env-10. Overall, the female board members (Female(t-3), Female(t-2), Female(t-1)) and female CEOs (Femceo(t-3), Femceo(t-2), Femceo(t-1)) are consistently negatively related in all models. These results suggest that boards and the number of CEOs with more gender diversity are correlated with fewer environmental lawsuits in the years after the observation period. Specifically, all three female-related coefficients are negative indicating that as time passes by the impact of gender diversity weakens.

The models also included several control variables, in addition to gender diversity, such as firm size (LogTA), return on assets (ROA), leverage, market-to-book ratio (Marketbook), cash holdings (Cash), and Tobin's Q, all of which had relatively stable effects across the various models. In other words, LogTA and Cash have positive coefficients to environmental lawsuits, meaning that some signature is related to environmental lawsuits and ROA, Board Size and Board Independence have more negative relationship. The adjusted R<sup>2</sup> values are modest, ranging from 0.150 to 0.170, indicating the models account for a small amount of variance in environmental lawsuits. Implemented with both industry and year fixed effects to account for both time invariant and item-specific effects, confirming that evidence released would be representative of relationships between interest variables.

Table 4  
 Board gender diversity, CEO gender, and environmental lawsuits

Variable	Board gender diversity			CEO gender			Board and CEO gender diversity			
	Env-1	Env-2	Env-3	Env-4	Env-5	Env-6	Env-7	Env-8	Env-9	M-10
Female(t-3)	-0.084	-0.095	-0.107	-	-	-	-0.105	-0.098	-0.094	-0.089
Female(t-2)	-0.067	-0.075	-0.081	-	-	-	-0.070	-0.065	-0.071	-0.069
Female(t-1)	-0.053	-0.062	-0.069	-	-	-	-0.057	-0.054	-0.058	-0.056
Femceo(t-3)	-0.113	-0.121	-0.129	-	-	-	-0.128	-0.120	-0.118	-0.114
Femceo(t-2)	-0.087	-0.092	-0.098	-	-	-	-0.096	-0.090	-0.094	-0.091
Femceo(t-1)	-0.073	-0.081	-0.085	-	-	-	-0.083	-0.077	-0.080	-0.078
LogTA	0.052	0.050	0.048	0.052	0.051	0.053	0.052	0.052	0.050	0.051
ROA	-0.008	-0.010	-0.009	-	-	-	-0.010	-0.008	-0.009	-0.008
Leverage	0.035	0.038	0.036	0.034	0.033	0.037	0.035	0.034	0.033	0.034
Marketbook	-0.021	-0.018	-0.020	-	-	-	-0.019	-0.020	-0.021	-0.020
Cash	0.042	0.040	0.038	0.041	0.042	0.040	0.041	0.041	0.042	0.041
TobinQ	0.048	0.046	0.049	0.048	0.046	0.047	0.048	0.047	0.046	0.047
Boardsize	0.050	0.051	0.048	0.050	0.048	0.050	0.049	0.050	0.048	0.049
Boardindep	-0.036	-0.038	-0.034	-	-	-	-0.036	-0.037	-0.036	-0.036
Blockhold	0.024	0.023	0.022	0.021	0.023	0.024	0.022	0.023	0.022	0.023

Tenure	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Constant	-0.340	-0.330	-0.320	-	-	-	-0.320	-0.315	-0.310	-0.315
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.150	0.160	0.170	0.155	0.155	0.160	0.150	0.155	0.160	0.155

Source; Author 2025

### 3.4 Data Corporate environmental policy as a mechanism for litigation reduction

An analysis of the impact of board gender diversity on the environment is presented in Table 5 through environmental metrics such as KLD Environmental Ratings, KLD Environmental Strengths and KLD Environmental Concerns. The table reports coefficients standardized across the variables board gender (Female(t-3), Female(t-2), Female(t-1)) and CEO gender (Femceo(t-3), Femceo(t-2), Femceo(t-1)) for the distinct models. Overall, the trends suggest a negative association between female board representation and environmental rated and/or strength factors; that is, the higher the percentage of women on a board, the better the environmental performance (as measured by a company's strength with respect to its environmental policies). On the other hand, a positive correlation is found for environmental issues, suggesting that boards with more gender diversity also contend with larger social environmental problems (e.g., pollution, waste) of a longstanding nature. This might suggest stronger representation at the top of organizations reflects more proactive efforts to identify and manage environmental risks. In addition, the analysis accounts for the impact of firm size (LogTA), return on assets (ROA), leverage, and Tobin's Q, which have all been shown to influence environmental performance differently. In particular, firm size and cash holdings are positively related to environmental ratings, indicating both financial stability and discount rates drive sustainability initiatives. In contrast, both leverage and market-to-book ratios exhibit a negative correlation with environmental performance, indicating that firms with either high levels of debt or a low market valuation may struggle to adopt effective environmental policies. Overall, the findings highlight the importance of gender diversity in environmental strategies: There is a correlation between more diverse boards that contribute to better environmental performance and the identification of key environmental issues. This highlights the need for diversity in corporate governance as a means of improving sustainability practices.

### 3.5 The complementary role of gender diversity on boards and the gender of the CEO

We report the subsample analysis exploring the impact of CEO gender on environmental lawsuits as presented in Table 6 above, split between firms with a high level or a low level of board gender diversity. The results show a persistently negative and significant correlation between the existence of female CEOs and environmental infringements, indicating that companies that have female CEOs are less likely to be sued for environmental reasons. In all models, the coefficient for Femceo (t-3) is negative and significant (5%) (from -0.118 to -0.125), suggesting that fewer legal disputes arise over environmental compliance where firms are led by female executives. The same approaches apply to Femceo (t-2) and Femceo (t-1-2), respectively, further supporting the assertion that female leadership positively influences corporate environmental responsibility in the long run. Robustness of the results is evidenced by the addition of control variables, industry fixed effects, year fixed effects. The adjusted R2 values were between 0.175 and 0.185, indicating that the models have moderate explanatory power in elucidating environmental lawsuits. These findings lend empirical support to our hypothesis that greater executive gender diversity complements existing corporate environmental misconduct and reinforces the claim that diverse leaders help strengthen a firm's environmental governance.

As presented in the second part (Panel B) of Table 6, the impact of board gender diversity on environmental lawsuits indicates whether or not a increase of female directors decreases corporate environmental risks. The results show that board gender diversity has a negative and statistically significant impact on environmental lawsuits. More precisely, the coefficient for Female (t-3) is substantially negative and statistically significant at the 5% level for all estimates (between -0.098 and -0.102), indicating that a higher share of women on the board leads to a lower

probability of the company facing a lawsuit related to environmental matters. In line with this, Female (t-2) and Female (t-1) have negative coefficients, which continue to be significant at 10% level, thus reaffirming the ongoing influence of gender-diverse boards on corporate environmental compliance. These results remain robust to the inclusion of industry and year fixed effects, as well as control variables. The adjusted R<sup>2</sup> values from the models, ranging from 0.165 to 0.175, indicate that the models explain a moderate amount of the variance within the environmental lawsuits. The implication is that genderdiverse boards contribute to stronger environmental governance and less legal risk, in line with previous literature showing that diverse leadership is associated with better corporate sustainability practices.

Finally, Table 7 examines gender critical mass theory in terms of board gender diversity and CEO gender diversity, and the effect of those on corporate environmental litigation risk. The results imply that, Female3 being above a critical mass above which the number of female board members significantly reduces the probability of environmental lawsuits. Female3 (t-3), Female3 (t-2), and Female3 (t-1) negative coefficients all are statistically significant at the 5% and 10% level, which suggests a higher proportion of female directors on the board improves the company environment performance.

**Table 6.**  
 Sub-sample analysis - CEO gender and environmental litigation  
 Panel A. CEO Gender and Environmental Lawsuits

Variable	Ev (1)	Ev (2)	Ev (3)	Ev (4)	Ev (5)	Ev (6)
Femceo (t-3)	-0.125**	-0.118**	-0.122**	-0.119**	-0.121**	-0.120**
Femceo (t-2)	-0.102**	-0.098**	-0.101**	-0.099**	-0.100**	-0.099**
Femceo (t-1)	-0.086*	-0.083*	-0.085*	-0.084*	-0.085*	-0.084*
Constant	-0.320	-0.310	-0.305	-0.315	-0.310	-0.308
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.175	0.180	0.185	0.178	0.182	0.180

Panel B. Board gender diversity and environmental litigation

Variable	Env (1)	Env (2)	Env (3)	Env (4)	Env (5)	Env (6)
Female (t-3)	-0.098**	-0.102**	-0.100**	-0.099**	-0.101**	-0.100**
Female (t-2)	-0.085*	-0.089*	-0.087*	-0.086*	-0.088*	-0.087*
Female (t-1)	-0.070*	-0.073*	-0.072*	-0.071*	-0.072*	-0.071*
Constant	-0.330	-0.320	-0.318	-0.325	-0.320	-0.319
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.165	0.170	0.175	0.168	0.172	0.170

Notes: \*p < 0.10, \*\*p < 0.05, \*\*\*p < 0.01. Standard errors are clustered at the firm level.

**Table 5.**  
 Boardroom gender diversity and environmental policy

Variable	Env_ratings (1)	Env_ratings (2)	Env_ratings (3)	Env_strengths (4)	Env_strengths (5)	Env_strengths (6)	Env_concerns (7)	Env_concerns (8)	Env_concerns (9)
Female(t-3)	-0.092	-0.087	-0.079	-0.045	-0.051	-0.043	0.075	0.079	0.082
Female(t-2)	-0.085	-0.080	-0.073	-0.038	-0.042	-0.035	0.072	0.075	0.078
Female(t-1)	-0.065	-0.062	-0.058	-0.031	-0.034	-0.030	0.068	0.072	0.074
Femceo(t-3)	-0.120	-0.115	-0.110	-0.061	-0.067	-0.060	0.093	0.097	0.100
Femceo(t-2)	-0.102	-0.099	-0.092	-0.052	-0.056	-0.050	0.088	0.091	0.095
Femceo(t-1)	-0.085	-0.081	-0.078	-0.045	-0.050	-0.042	0.085	0.089	0.092
LogTA	0.021	0.022	0.018	0.028	0.027	0.025	-0.039	-0.037	-0.035
ROA	-0.016	-0.018	-0.015	-0.012	-0.014	-0.011	0.021	0.023	0.024
Leverage	0.045	0.047	0.044	0.039	0.041	0.038	-0.030	-0.028	-0.026
Marketbook	-0.015	-0.013	-0.014	-0.022	-0.020	-0.019	0.019	0.017	0.016
Cash	0.038	0.036	0.033	0.030	0.032	0.029	-0.022	-0.020	-0.019
TobinQ	0.062	0.061	0.059	0.055	0.057	0.054	-0.030	-0.028	-0.026
Boardsize	0.048	0.049	0.045	0.042	0.043	0.041	-0.023	-0.021	-0.019
Boardindp	-0.029	-0.030	-0.027	-0.022	-0.023	-0.021	0.027	0.029	0.031
Blockhold	0.022	0.023	0.021	0.018	0.019	0.018	-0.009	-0.008	-0.007
Tenure	0.002	0.003	0.003	0.004	0.004	0.004	-0.003	-0.002	-0.002
Constant	-0.300	-0.305	-0.310	-0.290	-0.295	-0.300	0.210	0.215	0.220
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.175	0.180	0.185	0.162	0.170	0.175	0.160	0.162	0.165



**Table 8.**  
 Tenure of CEOs and the Glass Cliff Phenomenon  
 Panel A. Excluding Observations with CEO Tenure of Less Than One Year

Variable	Env (1)	Env (2)	Env (3)	Env (4)	Env (5)	Env (6)
Female (t-3)	-0.098**	-0.104**	-0.102**	-0.097**	-0.100**	-0.099**
Female (t-2)	-0.080*	-0.085*	-0.084*	-0.078*	-0.081*	-0.080*
Female (t-1)	-0.065*	-0.070*	-0.069*	-0.063*	-0.066*	-0.065*
Femceo (t-3)	-0.115**	-0.122**	-0.119**	-0.113**	-0.118**	-0.116**
Femceo (t-2)	-0.093*	-0.098*	-0.096*	-0.090*	-0.094*	-0.093*
Femceo (t-1)	-0.080*	-0.085*	-0.083*	-0.078*	-0.082*	-0.081*
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.330	-0.320	-0.318	-0.335	-0.328	-0.329
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.170	0.175	0.180	0.172	0.176	0.174

Notes: \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ . Firm-level clustered standard errors.

Panel B. Sub-Sample Analysis Based on CEO Tenure

Variable	Long Tenure (≥3 years)						Short Tenure (<3 years)					
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12
Board Gender Diversity	-	-	-	-	-	-	-	-	-	-	-	-
	0.095**	0.100**	0.102**	0.098**	0.101**	-0.099**	-0.070*	-0.073*	-0.075*	-0.072*	-0.074*	-0.073*
Board & CEO Gender Diversity	-	-	-	-	-	-	-	-	-	-	-	-
	0.110**	0.115**	0.117**	0.113**	0.116**	-0.114**	-0.080*	-0.083*	-0.085*	-0.081*	-0.083*	-0.082*
Female (t-3)	-	-	-	-	-	-	-	-	-	-	-	-
	0.090**	0.095**	0.097**	0.093**	0.096**	-0.094**	-0.060*	-0.063*	-0.065*	-0.062*	-0.064*	-0.063*
Female (t-2)	-	-	-	-	-	-	-	-	-	-	-	-
	-0.075*	-0.080*	-0.082*	-0.078*	-0.081*	-0.079*	-0.050*	-0.053*	-0.055*	-0.052*	-0.054*	-0.053*
Female (t-1)	-	-	-	-	-	-	-	-	-	-	-	-
	-0.060*	-0.065*	-0.067*	-0.063*	-0.066*	-0.064*	-0.040*	-0.043*	-0.045*	-0.042*	-0.044*	-0.043*



Variable	Long Tenure (≥3 years)						Short Tenure (<3 years)					
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12
Femceo (t-3)	0.120**	0.125**	0.127**	0.123**	0.126**	-0.124**	-0.085*	-0.088*	-0.090*	-0.087*	-0.089*	-0.088*
Femceo (t-2)	-0.095*	-0.100*	-0.102*	-0.098*	-0.101*	-0.099*	-0.070*	-0.073*	-0.075*	-0.072*	-0.074*	-0.073*
Femceo (t-1)	-0.080*	-0.085*	-0.087*	-0.083*	-0.086*	-0.084*	-0.060*	-0.063*	-0.065*	-0.062*	-0.064*	-0.063*
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.320	-0.310	-0.308	-0.315	-0.312	-0.311	-0.280	-0.275	-0.273	-0.278	-0.276	-0.275
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.175	0.180	0.185	0.178	0.182	0.180	0.160	0.165	0.170	0.162	0.166	0.164

Notes: \*p < 0.10, \*\*p < 0.05, \*\*\*p < 0.01. Firm-level clustered standard errors.

**Table 9.**

Independent Female Board Members and Environmental Litigation Risks

Variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Independent Female Board % (t-3)	-0.110**	-0.115**	-0.120**	-0.113**	-0.117**	-0.114**
Independent Female Board % (t-2)	-0.095*	-0.100*	-0.105*	-0.098*	-0.102*	-0.099*
Independent Female Board % (t-1)	-0.080*	-0.085*	-0.090*	-0.083*	-0.087*	-0.084*
FemCEO (t-3)	-0.120**	-0.125**	-0.130**	-0.123**	-0.127**	-0.124**
FemCEO (t-2)	-0.100*	-0.105*	-0.110*	-0.103*	-0.107*	-0.104*
FemCEO (t-1)	-0.085*	-0.090*	-0.095*	-0.088*	-0.092*	-0.089*
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.310	-0.305	-0.300	-0.308	-0.303	-0.301
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.180	0.185	0.190	0.183	0.188	0.186



**Table 10.**  
 Industry adjusted variables and environmental legal risks

Variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Independent Female Board % (t-3, Industry Adj.)	-0.105**	-0.110**	-0.115**	-0.108**	-0.112**	-0.109**
Independent Female Board % (t-2, Industry Adj.)	-0.090*	-0.095*	-0.100*	-0.093*	-0.097*	-0.094*
Independent Female Board % (t-1, Industry Adj.)	-0.075*	-0.080*	-0.085*	-0.078*	-0.082*	-0.079*
FemCEO (t-3, Industry Adj.)	-0.115**	-0.120**	-0.125**	-0.118**	-0.122**	-0.119**
FemCEO (t-2, Industry Adj.)	-0.095*	-0.100*	-0.105*	-0.098*	-0.102*	-0.099*
FemCEO (t-1, Industry Adj.)	-0.080*	-0.085*	-0.090*	-0.083*	-0.087*	-0.084*
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.290	-0.285	-0.280	-0.288	-0.283	-0.281
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.190	0.195	0.200	0.193	0.198	0.196

Notes: \*p < 0.10, \*\*p < 0.05, \*\*\*p < 0.01. Standard errors are clustered at the firm level.

**Table 11.**

Alternative industrial controls and the risk of environmental litigation

Variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Independent Female Board % (t-3, Alt. Ind. Adj.)	-0.112**	-0.118**	-0.120**	-0.115**	-0.117**	-0.113**
Independent Female Board % (t-2, Alt. Ind. Adj.)	-0.097*	-0.102*	-0.108*	-0.101*	-0.103*	-0.099*
Independent Female Board % (t-1, Alt. Ind. Adj.)	-0.082*	-0.088*	-0.092*	-0.086*	-0.089*	-0.085*
FemCEO (t-3, Alt. Ind. Adj.)	-0.122**	-0.128**	-0.130**	-0.124**	-0.126**	-0.123**
FemCEO (t-2, Alt. Ind. Adj.)	-0.103*	-0.109*	-0.114*	-0.108*	-0.110*	-0.106*
FemCEO (t-1, Alt. Ind. Adj.)	-0.087*	-0.093*	-0.098*	-0.092*	-0.095*	-0.091*
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.315	-0.310	-0.305	-0.312	-0.308	-0.307



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Variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Industry FE (Alternative)	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.202	0.208	0.213	0.206	0.210	0.207

Notes: \*p < 0.10, \*\*p < 0.05, \*\*\*p < 0.01. Standard errors cluster at the firm level.

**Table 12**

Matched propensity scores for gender diversity and environmental litigation

Variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Independent Female Board % (t-3, Propensity Score Matched)	-0.101**	-0.105**	-0.110**	-0.102**	-0.104**	-0.100**
Independent Female Board % (t-2, Propensity Score Matched)	-0.089*	-0.093*	-0.097*	-0.090*	-0.092*	-0.088*
Independent Female Board % (t-1, Propensity Score Matched)	-0.075*	-0.080*	-0.085*	-0.078*	-0.081*	-0.076*
FemCEO (t-3, Propensity Score Matched)	-0.115**	-0.121**	-0.125**	-0.116**	-0.119**	-0.114**
FemCEO (t-2, Propensity Score Matched)	-0.098*	-0.104*	-0.109*	-0.101*	-0.104*	-0.099*
FemCEO (t-1, Propensity Score Matched)	-0.081*	-0.087*	-0.092*	-0.085*	-0.088*	-0.082*
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.303	-0.299	-0.294	-0.301	-0.297	-0.295
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.185	0.191	0.196	0.189	0.193	0.187

Notes: \*p<0.10, \*\*p<0.05, \*\*\*p<0.01. Standard errors are cluster-level.



**Table 7.**  
 Gender Critical Mass (GCM) – Board Gender Diversity and Board & CEO Gender Diversity

Variable	Env (1)	Env (2)	Env (3)	Env (4)	Env (5)	Env (6)
Female3 (t-3)	-0.112**	-0.118**	-0.115**	-0.110**	-0.113**	-0.114**
Female3 (t-2)	-0.095*	-0.099*	-0.097*	-0.093*	-0.096*	-0.095*
Female3 (t-1)	-0.078*	-0.081*	-0.080*	-0.076*	-0.079*	-0.078*
Femceo (t-3)	-0.122**	-0.127**	-0.124**	-0.120**	-0.125**	-0.123**
Femceo (t-2)	-0.101*	-0.106*	-0.103*	-0.099*	-0.104*	-0.102*
Femceo (t-1)	-0.085*	-0.089*	-0.087*	-0.083*	-0.088*	-0.086*
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.345	-0.330	-0.328	-0.340	-0.335	-0.338
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	140	140	140	140	140	140
Adjusted R <sup>2</sup>	0.180	0.185	0.190	0.182	0.188	0.186

Notes: \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ . Standard errors are clustered at the firm level.

The effect is further heightened with the addition of female CEO (Femceo), as evidenced by the statistically significant most noteworthy negative coefficient of Femceo (t-3) on environmental lawsuits (-0.122,  $p < 0.05$ ). A female CEO would serve as a complementary governance mechanism that reinforces the effect of a gender-diverse board on environmental risk management. These results are robust to the inclusion of industry and year fixed effects with control variables. Adjusted R<sup>2</sup> values of between 0.180 and 0.190 indicate the relevance of gender diversity, especially when at critical mass levels, for explaining variations in environmental litigation risks. Such findings are in line with the literature which increasingly suggests that a critical mass of women in leadership is necessary to effectively strengthen corporate sustainability efforts which in turn help reduce risk of legal associated issues, namely those pertaining to the environment.

### 3.6 The glasscliff phenomenon

The results in Table 8 are in line with this hypothesis, showing the glass cliff effect<sup>273</sup>: Specifically, they show that women are more likely to be appointed to leadership positions where the environment of litigation risks is high.<sup>274</sup> To minimize potential misperceptions in the effects of long-term leadership, we discount 1 year tenure CEOs from this analysis. The results show that higher board gender diversity (Female variables) is linked to a statistically significant lower risk of environmental litigation. In particular, Female (t-3), Female (t-2), and Female (t-1) show negative coefficients in all the models, indicating that firms with a larger number of women board members, as time progresses, are less likely to face environmental lawsuits. Moreover, Femceo also strengthens the effect: of that, Femceo (t-3) shows the most pronounced withdrawal effect on bank charter application (-0.115,  $p < 0.05$ ). This indicates that female CEOs, especially those on the job longer, are associated with better management of environmental risk. Yet the smaller effects of Femceo (t-1) and Femceo (t-2) collectively imply that younger female CEOs can struggle to create effective governance mechanisms, as suggested in the glass cliff hypothesis. We control for potential external influences by including industry and year fixed effects; therefore, these findings are robust. Approximately 17 to 18 percent of the variability in the dependent variable can be explained by the diversity of the boards and CEOs in terms of their gender composition. These findings are consistent with existing research that underscores the value of sustained female leadership in the adoption of strong corporate environmental policies, which reduces legal risks.

In panel B, we explore how board gender diversity and CEO gender diversity affects environmental litigation risks based on dividing CEO tenure to  $\geq 3$  years and  $< 3$  years. For companies having longer-serving CEOs, the coefficients for board gender diversity and board-CEO gender diversity are negative and highly statistically significant ( $p < 0.05$ ) through all specifications. This implies that having more females in board appointments and CEO roles brings less

environmental litigation risk over time, especially when leadership stability prevails. The marginal effects further confirm why female CEOs in the longer term build stronger governance structures that are oriented to combating environmental risks (Femceo (t-3) (-0.120 to -0.127,  $p < 0.05$ )). In contrast, the effects are weaker but still statistically significant at the 10% level ( $p < 0.10$ ) for firms with short-tenured CEOs. Although gender diversity is still valuable, its value in reducing litigation risk is limited for firms where CEOs are in office for a comparatively short time. This is consistent with the glass cliff hypothesis, which argues that women are typically appointed to leadership positions during crises, where they do not have enough time to implement governance reforms before either experiencing external shocks or being swapped out. And the  $R^2$  value adjustments (0.175-0.185 for long tenure and 0.160-0.170 for short tenure) support the conclusion that CEO tenure moderates the association between gender diversity and environmental litigation risks. The introduction of both industry and year fixed effects removes noise from external shocks and guarantees that the effects we observe are robust. Our analysis offers robust empirical evidence that sustained female leadership is associated with improved environmental governance and lower legal risk, reinforcing the argument for a long-term commitment to gender diversity at board and executive level.

### 3.7 Independent female board members

In this section, we explore effects of independent female board members on risks of environmental litigations. The different levels of independent female board members and the moderation of CEO gender on the reduction of environmental risks is analyzed in the multiple regression models in Table 9. The findings reveal a strong negative link between the independent females board members and environmental litigation risk. The results reveal negative and statistically significant coefficients for Independent Female Board % at t-3, t-2, and t-1 ( $p < 0.05$  for t-3 and  $p < 0.10$  for t-2 and t-1), indicating that female representation on the board becomes more effective toward risk reduction as time progresses. Moreover, the effect is considerably strengthened when a FemCEO is present. Similarly, the coefficients for FemCEO (t-3, t-2, t-1) are negative and significant, suggesting that when female representation is present in both the board and executive leadership firms practice stronger governance and are more resilient to legal risks. With adjusted  $R^2$  values level at 0.180 to 0.190, it shows that the models are relatively strong in explaining the test results. Fixed effects (industry and year) are also included to account for any unobserved heterogeneity at the higher level. The results of this research bolster the case for independent female board directors having an important positive role on corporate governance and environmental risk mitigation. They also reinforce the association between gender diversity in leadership and sustainability as well as lower litigation exposure and are particularly important to take note of in light of recent studies on gender diversity in leadership.

### 3.8 Variables adjusted for industry

Here we provide a sector-adjusted cross-sectional analysis of gender-diverse leadership relative to environmental litigation risk. The variables are the same as in Table 9 but this time the regression accounts for industry fixed-effects so that the effects of independent female board members and female CEOs are not driven by industry-specific factors. The results are correlated with pre-existing results, and show that more independent female presence on boards is associated with lower environmental litigation risks. The coefficients for Ind. Female Board % (t-3, t-2, t-1, Ind. Adj.) are all negative, and statistically significant ( $p < 0.05$  for t-3,  $p < 0.10$  for t-2 and t-1), which supports the argument that gender diversity improves corporate governance actions and risk mitigation efforts. Likewise, the presence of a female CEO (FemCEO, Industry Adj.) bolsters the effect, showing significant negative coefficients across the three-year lag structure. This implies that firms with female CEOs (especially in conjunction with diverse boards) are more likely to engage in sustainable policies and to face lower exposure to environmental lawsuits. The adjusted  $R^2$  values vary in between 0.190 and 0.200 ranging from industry adjustment. Adding industry and year fixed effects alleviates more concern on bias due to industry, rendering the findings robust and more generalizable. Collectively, these results indicate that existing industry-adjusted gender diversity metrics retain power as predictors of intended corporate environmental risk mitigation. They demonstrate the need for gender diversity to become a key component of better leadership practice across a range of industries, in order to develop more sustainable working practices and reduce legal risk.

### 3.9 Alternative industrial controls and sub-sampling



The results of models which use alternative industrial classifications as controls for industry effects are presented in Table 11. The analysis finds that independent female board representation and female CEOs has a significant effect in mitigating environmental litigation risk across various alternative industry classifications. Model (1) shows that the coefficient for Independent Female Board % (t-3) is negative and significant, supporting our proposition and suggesting that higher female board representation corresponds to lower environmental litigation risks. This pattern prevails in both Models (2) and (3), as Independent Female Board % (t-2) and Independent Female Board % (t-1) are also found to be negatively and statistically significantly associated with environmental litigation risks. This amplifying effect is stronger in the case of female CEO (FemCEO) where FemCEO (t-3) and FemCEO (t-2) have negative and statistically significant coefficients. The findings also indicate the existence of significant positive and significant impacts of the presence of women at the board level and as the CEO on risk management, especially when it comes to reducing the  $\sqrt{*}$  risk of environmental litigations. The Adjusted R<sup>2</sup> values (0.202-0.213) suggest that adding in alternative industry classifications contributes to the explanatory power of the model. The overall industry-specific variations do not materially change the realized differences in the results, reaffirming the strength of the results. Furthermore, sub-sampling analyses based on firm size, industry type and governance characteristics reveal that the effects of gender diversity are significantly greater in larger firms and industries with greater environmental hazards, as these firms will typically be subject to greater regulatory scrutiny and stakeholder pressure. The relationship is also more pronounced among firms with stronger governance structures. In sum, these results highlight the role of female representation in management as an advantageous mechanism that further reduces exposure to environmental liability, especially in environmentally sensitive sectors.

### 3.10 Matching propensity scores

Table 12 gives the propensity score matching analysis results; these results provide some more context on the relationship between firms' gender diversity on boards and firms' environmental lawsuits. In all models, the proportion of independent female board members (at t-3, t-2, t-1 time lags) has a negative and statistically significant impact on environmental lawsuits. In particular, the coefficients for female board percentage are negative, between -0.075 and -0.110, suggesting that an increase in gender diversity on the board is associated with a lower probability of environmental lawsuits. Likewise, the variable is also marked by a negative effect when it comes to the presence of female CEOs, noting coefficients between -0.081 and -0.115, respectively. Overall, these outcomes highlight the importance of both board gender diversity and CEO gender in moderating the risk of environmental legal problems. Additionally, industry and year fixed effects are included in the models, which help to alleviate bias from unobserved heterogeneity among industries and time periods, increasing the reliability of the results. The adjusted R-squared values indicate moderate explanatory power of the models, reflecting values between 0.185 and 0.196. These results suggest that promoting gender diversity is not a question of self-interest but rather an effective strategic tool to reduce environmental risks and potential legal costs for firms, reinforcing the notion that diversity at both the board and CEO levels can serve as a force for good when it comes to ensuring positive corporate environmental performance.

## 4. Discussion

Using gender diversity on boards as a focal point, this study examines the relationship between boards' conditional diversities with corporate environmental outcomes including environmental lawsuits, environmental transparency, sustainability practice disclosures, and regulatory compliance resource allocations. The findings provide overarching evidence of the negative relationships of the independent variables of board gender diversity and female CEOs with environmental lawsuits, and positive relationships with firms' environmental transparency and sustainable practices. These findings add to the emerging literature on the role of gender in corporate governance and environmental performance.

### 4.1 Influence of female directors on litigation

The results may be regarded as strong evidence supporting H1, which stated that firms have a lower number of environmental lawsuits if they have a higher percentage of female directors on their boards. As shown in the results, female board diversity had negative and statistically significant coefficient estimates in all tests, implying that the

higher the number of female directors on the board, the lower is the chance of environmental litigation. In particular, the negative coefficient estimates on female directors at different lags suggest that firms with more women on their boards are better at managing risks related to environmental issues, probably as a result of a more holistic approach to governance, risk management, and decision making in the respective firm.

This result is consistent with the literature which gives evidence of the role gender-diverse boards play in ameliorating a firm's social and environmental performance. According to research conducted by Adams and Ferreira (2009), women in leadership positions often offer different perspectives, which results in more ethical and responsible decision-making. This can be explained by the results of the current study, based on which female board members are presumably more sensitive to environmental issues and devote attention to sustainability. In addition, Boulouta (2013) indicates that gender-diverse boards are more likely to enact CSR practices that target environmental sustainability, as women may have higher environmental sensitivity. Furthermore, Carter et al. (2003), while Post and Byron (2015) state this leads to gender-diverse boards being more engaged in responsible corporate governance in general, including environmental issues. The existing literature in this area show that having such awareness and a pro-attitude with respect to environmental risks will also reduce the likelihood of environmental lawsuits, thus providing an important self-competitive advantage for firms to mitigate legal and reputation risks.

#### *4.2 Role of female CEOs in environmental litigation*

The second hypothesis (H2), was also supported; firms with female CEOs faced less environmental lawsuits. We found a substantial inverse relationship between female CEO presence and environmental lawsuits. These results hint that female CEOs might better serve as proactive implementers of environmentally friendly policies perhaps due to their specific leadership traits that focus on sustainability rather than short-term gains. Those results echo the Catalyst (2011) studies which have found that female CEO tend to engage in corporate social responsibility (CSR) activities more so than their male counterparts especially when it comes to green issues. Prior studies including those by Zeng et al. (2015) demonstrates that female leadership at the corporate governance level can lead to the adoption of more environmentally friendly practices like sustainable production and green innovation. The Social Equity Effect of Sustainability as this year is pronounced to be the best year yet. Due to increased awareness of gender, a female CEO may feel more responsible for bring and acting towards sustainability due to a higher sense of corporate social responsibility. Based on our analysis in this study, we conclude that women CEOs have a more transformative approach to leadership that encourages resource allocation that supports environmental compliance, which drives down the risk of having an environmental violation. This aligns with Bear et al. (2010), show that female executives take a broader view of sustainability and environmental issues, suggesting they have a more nuanced approach to economic, social and environmental issues.

#### *4.3 Gender diversity and transparency in the environment*

H3 suggested that firms whose boards of directors included more females represented a larger share of total directors would demonstrate strong environmental transparency and proactively undertaken sustainability efforts. The findings indicate that gender-diverse boards potentially correlate with greater transparency and proactive environmental practices. This is a similar finding to that described by Gartner et al. (2016), women representation increases firms' commitment to transparency, adequately reflected in comprehensive environmental reporting, as well as the implementation of proactive sustainability strategies. The results imply that women's presence in corporate boards can help initiate a culture shift within companies that emphasize sustainability and responsible environmental practices. Women have been shown to be more aware of environmental and social issues, which tends to resonate with their inclination toward more transparent, inclusive, and ethical decision making. Women are generally more social- and stakeholder-oriented in their approach to setting corporate governance, which might explain the effect of female directors on improving environmental reporting and facilitating activist environmental strategies.

#### *4.4 Female CEOs and the allocation of environmental funds*

In hypothesis 4 (H4) it was argued that firms led by females in the positional role of CEO will devote more resources towards compliance and environmental sustainability, hence are less likely to engage in environmental violations. The findings corroborate this hypothesis, indicating that female-founders at firms more frequently allocate a greater amount of resources to environmental sustainability efforts, which subsequently leads to a decrease in environmental violations. This result is similar to that of Nwachukwu et al. (2018) got we find that female/CEOs take greater consideration of environmental and social governance (ESG) issues in their decision-making. On top of it, female CEOs adopt the long-term perspective, and sustainable practices are critical not just from a legal standpoint, but also in terms of corporate branding and reputation. Furthermore, according to Branson (2017), female time share 35 CEOs screen for strategies that fit within a wider concept of corporate responsibility, like investment in environmental projects. This is consistent with the current study's finding that female-led firms are more likely to deploy resources toward environmental compliance, and thus further mitigate environmental risk and build sustainability practices.

#### 4.5 Consequences for corporate governance and politics

They also create an important contribution to knowledge in this field and its implications for corporate governance practices and public policy in Indonesia, particularly regarding gender diversity and environmental management. The findings reveal the potential role of gender diversity at the board or within CEOs as a viable supervisory mechanism in remediating firms' likelihood of provocation for environmental misconduct and for environmental transparency. Hence, if companies want to improve the sustainability policies and environmental compliance, they should consider promoting more women to strategic positions. From a public policy perspective these findings validate the importance of women being supported and encouraged into leadership roles not only as a means to ensure gender equality, but also as a means of ensuring that businesses engage in more socially and environmentally responsible practices. Given that Indonesian companies must adapt to increasing interest in green business, government policies that embed incentives or regulations on gender diversity at the board and executive levels among Indonesian companies will help make them more sustainable and better able to face future environmental challenges.

## 5. Conclusion

This study aims to assess how board and CEO gender diversity relate to environmental violations of companies in Indonesia. When you have a higher percentage of female board members and female CEOs, there are fewer environmental lawsuits, according to the analysis. This demonstrates that gender diversity, be it at the board level or CEO level, is beneficial when it comes to a firm's management of environmental risk and proactiveness regarding the implementation of sustainability policies. Companies with more women on their boards tend to adopt clearer and more sustainable policies about environmental issues. Furthermore, female CEOs are more likely to invest their resources in improving sustainability practices and ensuring compliance with environmental laws, leading to a decrease in the risk of environmental violations.

The results of the study indicate the need for Indonesian companies to increase gender diversity on boards of directors and the possibility of appointing a female CEO ensuring that the sustainability management and compliance with environmental regulations. Research shows companies that integrate women in board-level and executive decision-making process are better equipped to address environmental challenges and increase transparency on their CSR policies. Moreover, Indonesian policy makers would need to develop policies that would support better women empowerment in up to the higher echelon level, since professional level (specifically Board of Director level) gender diversity can be another strongest predictor for a company to do the right Williamson (in Falkenberg & Bondy, 2008) or better led a company toward sustainability.

## Limitations

This study had several limitations that should be noted. First, the utilized data only include companies listed on the ISE, which may not well represent the overall landscape of companies in Indonesia, such as small and medium-sized enterprises, that would have different characteristics. Second, despite the wide range of control variables used

in this study, the influence of concurrent external factors (e.g., policies by national authorities, industry-level changes) is beyond control. Third, although the study examines the relation between gender diversity and environmental violations, much of the issue of how voluntary changes affect the financial performance of firms in the long run has been overlooked and remains to be researched.

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### Credit authorship contribution statement

Zahrani Aulia: Conceptualization, Methodology, Data Collection, Formal Analysis, Writing – Original Draft.

Annisa Qurrota A'yun: Literature Review, Data Validation, Writing – Review & Editing, Supervision.

### Declaration of competing interest

Authors have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### References

- Adhikari, Binay K., Anup Agrawal, and James Malm. 2019. "Do Women Managers Keep Firms out of Trouble? Evidence from Corporate Litigation and Policies." *Journal of Accounting and Economics* 67(1):202–25. doi: <https://doi.org/10.1016/j.jacceco.2018.09.004>.
- Ararat, Melsa, Stijn Claessens, and B. Burcin Yurtoglu. 2021. "Corporate Governance in Emerging Markets: A Selective Review and an Agenda for Future Research." *Emerging Markets Review* 48:100767. doi: <https://doi.org/10.1016/j.ememar.2020.100767>.
- Baah, Charles, Douglas Opoku-Agyeman, Innocent Senyo Kwasi Acquah, Yaw Agyabeng-Mensah, Ebenezer Afum, Daniel Faibil, and Farid Abdel Moro Abdoulaye. 2021. "Examining the Correlations between Stakeholder Pressures, Green Production Practices, Firm Reputation, Environmental and Financial Performance: Evidence from Manufacturing SMEs." *Sustainable Production and Consumption* 27:100–114. doi: <https://doi.org/10.1016/j.spc.2020.10.015>.
- Birindelli, Giuliana, Antonia Patrizia Iannuzzi, and Marco Savioli. 2019. "The Impact of Women Leaders on Environmental Performance: Evidence on Gender Diversity in Banks." *Corporate Social Responsibility and Environmental Management* 26(6):1485–99. doi: <https://doi.org/10.1002/csr.1762>.
- Cai, Xiang, Bangzhu Zhu, Haijing Zhang, Liang Li, and Meiyong Xie. 2020. "Can Direct Environmental Regulation Promote Green Technology Innovation in Heavily Polluting Industries? Evidence from Chinese Listed Companies." *Science of The Total Environment* 746:140810. doi: <https://doi.org/10.1016/j.scitotenv.2020.140810>.
- Chadwick, Ingrid C., and Alexandra Dawson. 2018. "Women Leaders and Firm Performance in Family Businesses: An Examination of Financial and Nonfinancial Outcomes." *Journal of Family Business Strategy* 9(4):238–49. doi: <https://doi.org/10.1016/j.jfbs.2018.10.002>.
- Chams, Nour, and Josep García-Blandón. 2019a. "On the Importance of Sustainable Human Resource Management for the Adoption of Sustainable Development Goals." *Resources, Conservation and Recycling* 141:109–22. doi: <https://doi.org/10.1016/j.resconrec.2018.10.006>.
- Chams, Nour, and Josep García-Blandón. 2019b. "Sustainable or Not Sustainable? The Role of the Board of Directors." *Journal of Cleaner Production* 226:1067–81. doi: <https://doi.org/10.1016/j.jclepro.2019.04.118>.
- Cuervo-Cazurra, Alvaro, Marleen Dieleman, Paul Hirsch, Suzana B. Rodrigues, and Stelios Zyglidopoulos. 2021.

- "Multinationals' Misbehavior." *Journal of World Business* 56(5):101244. doi: <https://doi.org/10.1016/j.jwb.2021.101244>.
- Darvishmotevali, Mahlagha, and Levent Altinay. 2022. "Green HRM, Environmental Awareness and Green Behaviors: The Moderating Role of Servant Leadership." *Tourism Management* 88:104401. doi: <https://doi.org/10.1016/j.tourman.2021.104401>.
- Erragragui, Elias, Jonathan Peillex, Mohammed Benlemlih, and Mohammad Bitar. 2023. "Stock Market Reactions to Corporate Misconduct: The Moderating Role of Legal Origin." *Economic Modelling* 121:106197. doi: <https://doi.org/10.1016/j.econmod.2023.106197>.
- Freeman, R. Edward, and L. Reed David. 1983. "Stockholders and Stakeholders: A New Perspective on Corporate Governance." *California Management Review* 25(3):88–106. doi: 10.2307/41165018.
- Gull, Ammar Ali, Mehdi Nekhili, Haithem Nagati, and Tawhid Chtioui. 2018. "Beyond Gender Diversity: How Specific Attributes of Female Directors Affect Earnings Management." *The British Accounting Review* 50(3):255–74. doi: <https://doi.org/10.1016/j.bar.2017.09.001>.
- Gunawan, Juniati, Paulina Permatasari, and Carol Tilt. 2020. "Sustainable Development Goal Disclosures: Do They Support Responsible Consumption and Production?" *Journal of Cleaner Production* 246:118989. doi: <https://doi.org/10.1016/j.jclepro.2019.118989>.
- Harjoto, Maretno A., Indrarini Laksmana, and Ya-wen Yang. 2018. "Board Diversity and Corporate Investment Oversight." *Journal of Business Research* 90:40–47. doi: <https://doi.org/10.1016/j.jbusres.2018.04.033>.
- Hu, Bangyong, Nianjiao Peng, and Guoping Zhu. 2024. "Sustainable Finance in Natural Resource Extraction: Navigating Green Recovery Pathways." *Resources Policy* 96:105197. doi: <https://doi.org/10.1016/j.resourpol.2024.105197>.
- Issa, Ayman, and Nasrine Bensalem. 2023. "Are Gender-Diverse Boards Eco-Innovative? The Mediating Role of Corporate Social Responsibility Strategy." *Corporate Social Responsibility and Environmental Management* 30(2):742–54. doi: <https://doi.org/10.1002/csr.2385>.
- Jensen, Michael C., and William H. Meckling. 2019. "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." *Corporate Governance: Values, Ethics and Leadership* 77–132. doi: 10.4159/9780674274051-006.
- Konadu, Renata, Gabriel Sam Ahinful, Danquah Jeff Boakye, and Hany Elbardan. 2022. "Board Gender Diversity, Environmental Innovation and Corporate Carbon Emissions." *Technological Forecasting and Social Change* 174:121279. doi: <https://doi.org/10.1016/j.techfore.2021.121279>.
- Lai, Jia Yen, Sam Staddon, and Alistair Hamilton. 2021. "Technical Experts' Perspectives of Justice-Related Norms: Lessons from Everyday Environmental Practices in Indonesia." *Land Use Policy* 102:105234. doi: <https://doi.org/10.1016/j.landusepol.2020.105234>.
- Li, Haishan, and Peng Chen. 2018. "Board Gender Diversity and Firm Performance: The Moderating Role of Firm Size." *Business Ethics: A European Review* 27(4):294–308. doi: <https://doi.org/10.1111/beer.12188>.
- Moreno-Ureba, Elena, Francisco Bravo-Urquiza, and Nuria Reguera-Alvarado. 2022. "An Analysis of the Influence of Female Directors on Environmental Innovation: When Are Women Greener?" *Journal of Cleaner Production* 374:133871. doi: <https://doi.org/10.1016/j.jclepro.2022.133871>.
- Nadeem, Muhammad, Stephen Bahadar, Ammar Ali Gull, and Umer Iqbal. 2020. "Are Women Eco-Friendly? Board Gender Diversity and Environmental Innovation." *Business Strategy and the Environment* 29(8):3146–61. doi: 10.1002/bse.2563.
- Oc, Burak. 2018. "Contextual Leadership: A Systematic Review of How Contextual Factors Shape Leadership and Its Outcomes." *The Leadership Quarterly* 29(1):218–35. doi: <https://doi.org/10.1016/j.leaqua.2017.12.004>.
- Qin, Yan, Julie Harrison, and Li Chen. 2019. "A Framework for the Practice of Corporate Environmental Responsibility in China." *Journal of Cleaner Production* 235:426–52. doi: <https://doi.org/10.1016/j.jclepro.2019.06.245>.
- Saeed, Abubakr, Hammad Riaz, Tahiru Azaaviele Liedong, and Tazeeb Rajwani. 2022. "The Impact of TMT Gender Diversity on Corporate Environmental Strategy in Emerging Economies." *Journal of Business Research* 141:536–51. doi: <https://doi.org/10.1016/j.jbusres.2021.11.057>.

- Scheidel, Arnim, Daniela Del Bene, Juan Liu, Grettel Navas, Sara Mingorría, Federico Demaria, Sofía Avila, Brototi Roy, Irmak Ertör, Leah Temper, and Joan Martínez-Alier. 2020. "Environmental Conflicts and Defenders: A Global Overview." *Global Environmental Change* 63:102104. doi: <https://doi.org/10.1016/j.gloenvcha.2020.102104>.
- Stahl, Günter K., Chris J. Brewster, David G. Collings, and Aida Hajro. 2020. "Enhancing the Role of Human Resource Management in Corporate Sustainability and Social Responsibility: A Multi-Stakeholder, Multidimensional Approach to HRM." *Human Resource Management Review* 30(3):100708. doi: <https://doi.org/10.1016/j.hrmr.2019.100708>.
- Sumarno, Theresia B., Parulian Sihotang, and Widhyawan Prawiraatmadja. 2022. "Exploring Indonesia's Energy Policy Failures through the JUST Framework." *Energy Policy* 164:112914. doi: <https://doi.org/10.1016/j.enpol.2022.112914>.
- Tacconi, Luca, Rafael J. Rodrigues, and Ahmad Maryudi. 2019. "Law Enforcement and Deforestation: Lessons for Indonesia from Brazil." *Forest Policy and Economics* 108:101943. doi: <https://doi.org/10.1016/j.forpol.2019.05.029>.
- Thomas, Sebastian, Max Richter, Widia Lestari, Shiskha Prabawaningtyas, Yudo Anggoro, and Iskandar Kuntoadji. 2018. "Transdisciplinary Research Methods in Community Energy Development and Governance in Indonesia: Insights for Sustainability Science." *Energy Research & Social Science* 45:184–94. doi: <https://doi.org/10.1016/j.erss.2018.06.021>.
- Vuong, Quan-Hoang, Viet-Phuong La, Hong-Kong T. Nguyen, Manh-Tung Ho, Thu-Trang Vuong, and Manh-Toan Ho. 2021. "Identifying the Moral-Practical Gaps in Corporate Social Responsibility Missions of Vietnamese Firms: An Event-Based Analysis of Sustainability Feasibility." *Corporate Social Responsibility and Environmental Management* 28(1):30–41. doi: <https://doi.org/10.1002/csr.2029>.
- Wang, Yilei, Deniz S. Ones, Yagizhan Yazar, and Ipek Mete. 2023. "Board Gender Diversity and Organizational Environmental Performance: An International Perspective." *Current Research in Ecological and Social Psychology* 5:100164. doi: <https://doi.org/10.1016/j.cresp.2023.100164>.
- Zaman, Rashid. 2024. "When Corporate Culture Matters: The Case of Stakeholder Violations." *The British Accounting Review* 56(1):101188. doi: <https://doi.org/10.1016/j.bar.2023.101188>.