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THE GREEN BOARD PARADOX: ENVIRONMENTAL PERFORMANCE AS A MEDIATOR BETWEEN GOVERNANCE AND EARNINGS

Adriana-Sofia DUMITRESCU

Accounting and Audit Department, Faculty of Accounting and Management Information Systems, Bucharest University of Economic Studies, Bucharest, Romania

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Abstract. This study challenges the "win-win" narrative in corporate sustainability by identifying a key trade-off between environmental performance and short-term profitability. Using a global panel of the 1,000 largest companies across 23 developed markets, we employ a two-way fixed-effects estimation to test 24 potential mediation pathways linking board governance to financial outcomes via ESG performance. Our results reveal what we term the "Green Board Paradox." We find that board independence and gender diversity are robustly associated with improved environmental scores, confirming their role in advancing corporate sustainability. However, this environmental performance acts as a significant mediator that is, in turn, associated with lower Earnings Per Share (EPS). This finding highlights a central tension: the very governance mechanisms that promote environmental responsibility simultaneously create a drag on short-term profits. Furthermore, we find that board independence and diversity act as substitutes, suggesting firms can achieve similar environmental outcomes through alternative governance configurations. Ultimately, our study provides critical evidence on the governance-sustainability-performance nexus, offering a nuanced framework for navigating the trade-offs between corporate ESG ambitions and financial realities.

Keywords: ESG, corporate governance, board independence, gender diversity (women on boards), environmental performance, mediation analysis, two-way fixed effects models.

JEL Classification: G34, M14, Q56, C33.

Corresponding author. E-mail: ***sofia.dumitrescu@cig.ase.ro***

1. Introduction

The relationship between corporate governance and firm financial performance is a foundational theme in academic literature (Shleifer & Vishny, 1997; Ali et al., 2020; Said, 2025), frequently framed by the enduring tension between shareholder wealth maximization (Agency Theory) and the interests of a wider range of constituents (Stakeholder Theory). Within this debate, two board characteristics have emerged as critical determinants of corporate strategy and outcomes: board independence (BI) and gender diversity (WOB). A substantial body of work investigates whether independent directors improve monitoring, reduce agency costs, and enhance shareholder value (Duchin et al., 2010; Bird et al., 2017; Pucheta-Martínez & Gallego-Álvarez, 2020). Likewise, studies on board gender diversity emphasize the potential benefits of diverse perspectives, enhanced stakeholder legitimacy, improved governance,

better control over decisions and a greater focus on the long-term investment strategy of the company (Isidro & Sobral, 2015; Gharios et al., 2024). Despite this extensive literature, empirical evidence on the financial implications of BI and WOB remains mixed, with some studies reporting positive effects, others negative, and many finding no significant impact (Zubeltzu-Jaka et al., 2019).

In parallel, the rise of environmental, social, and governance (ESG) considerations has reshaped both academic inquiry and corporate practice. ESG is increasingly recognized not only as a matter of corporate responsibility but also as a determinant of long-term firm value (Fang & Guo, 2025). Treating ESG as an aggregate index may obscure important differences across its environmental, social, and governance pillars, and scholars have called for more granular analyses (Ehlers et al., 2024; Billio et al., 2021; Martiny et al., 2024). Given the evolving frameworks, regulatory pressures, and investor demand for sustainable practices, it is critical to disentangle which ESG dimensions are most relevant in shaping the governance–performance nexus.

While numerous studies have explored the direct impact of these attributes on firm value, often with mixed or context-dependent results, the underlying mechanisms through which this influence is exerted remain mostly underexplored.

This study addresses that critical gap. We move beyond the question of if good governance creates value, to ask a more nuanced question: how? We posit that the firm's commitment to ESG principles is the crucial, yet often overlooked, mediating channel in this relationship. With the evolution of ESG frameworks and growing stakeholder demands for sustainability, it is increasingly crucial to understand how boards convert governance structures into concrete ESG outcomes and how these outcomes affect financial performance.

To investigate these dynamics, we first establish the critical link between board structure and non-financial performance. Our analysis confirms a strong and robust positive relationship between our governance metrics (BI and WOB) and the firm's ESG performance across all pillars. This initial finding validates that board structure is a critical antecedent of a firm's commitment to sustainability. Building on this, we employ a comprehensive mediation analysis to test our central hypotheses.

The primary contribution of this paper is twofold. First, we explicitly model the mediating role of ESG and its three pillars, thereby unpacking the pathways through which board governance may shape financial performance. Second, we move beyond single-country or sector-specific analyses by employing a large global sample of 1,000 large-cap firms across 23 developed markets during 2016–2023. Prior studies have examined the governance–performance nexus extensively, particularly in developed markets such as the U.S. (Yermack, 1996; Adams & Ferreira, 2009) and Western Europe countries (Carnini Pulino et al., 2022; Menicucci & Paolucci, 2024) or in emerging countries (Sarkar & Selarka, 2015; Siueia et al., 2019; Abdullah et al., 2024). However, much of this research has focused on direct effects, often within single-country settings, while systematic cross-country evidence on the mediating role of ESG remains scarce (Pham & Ho, 2024). Using a large global panel of blue-chip firms, this study reveals how governance diversity shapes sustainability practices and financial outcomes across institutional contexts where investor scrutiny and governance standards are most advanced.

Methodologically, we combine a two-way (firm and year) fixed-effects estimation with bootstrap mediation analysis, testing 24 potential mediation paths requiring a total of 72 regression estimations and validating results with robust inference procedures.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature on BI, WOB, ESG and firm performance and develops our hypotheses. Section 3 describes

our data and methodology. Section 4 presents empirical results, including our main mediation findings and robustness checks. Section 5 discusses the implications of our findings, limitations and avenues for future research.

2. Literature review and hypothesis development

2.1. Theoretical framing and conceptual framework

The relationship between corporate governance and firm performance is complex, often framed by the tension between agency theory and stakeholder theory. Agency theory views boards primarily as monitors that protect shareholder value by reducing agency costs (Jensen & Meckling, 1976; Fama & Jensen, 1983), while stakeholder theory positions them as mediators of broader social and environmental responsibilities (Freeman, 1984; Donaldson & Preston, 1995).

Our study operationalizes this tension by examining two key governance features. Board independence (BI) reflects the agency logic of oversight, while gender diversity (WOB) often embodies the stakeholder logic by bringing plural perspectives to sustainability issues (Terjesen et al., 2009).

To test how boards navigate these competing pressures, we propose a mediation model where the effect of board governance on financial performance is transmitted through the firm's environmental (ESG) actions. This framework, illustrated in Figure 1, allows us to analyze both the direct and indirect effects, building on the mediation framework of Baron and Kenny (1986).

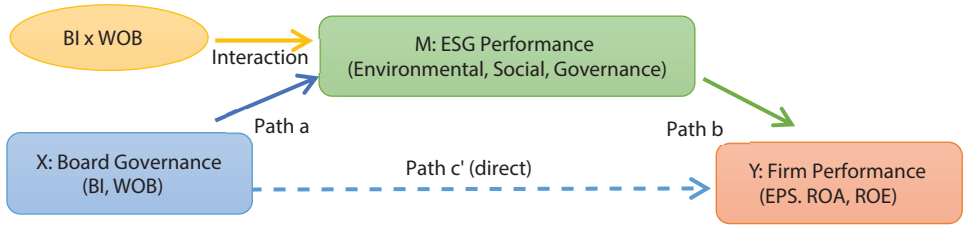

Figure 1. Mediation conceptual framework: board governance, ESG pillars, and firm financial performance (source: author's creation)

The following sections will now review the literature for each component of this framework to develop our testable hypotheses.

2.2. The ambiguous link between board governance and financial performance (Path c: X → Y)

Empirical research frequently associates board independence (BI) and women on boards (WOB) with firm financial outcomes, although the evidence remains mixed and highly context-dependent. Several studies report positive effects of independent and gender-diverse boards on profitability, governance quality, and market valuation, particularly in developed economies and firms operating in complex environments (Terjesen et al., 2016; Gharios et al., 2024; Souther, 2021). Prior research also suggests that these governance mechanisms may enhance firm performance indirectly by improving monitoring quality, strategic decision-making, and access to intangible resources (Carter et al., 2003; Ali & Butt, 2025).

However, the relationship is not uniformly positive. Adams and Ferreira (2009) show that stronger board monitoring associated with female directors may reduce firm value in already well-governed firms, while evidence from emerging markets often reports weak, insignificant, or even negative effects of BI and WOB on performance (Abdullah et al., 2024; Absy & Hasan, 2023; Ali et al., 2020). These mixed findings suggest that the effectiveness of governance structures depends heavily on institutional, ownership, and firm-specific conditions.

2.3. Board governance as a driver of ESG strategy (Path a: X → M)

Boards play a pivotal role in setting the sustainability agenda of the firm. Prior research generally associates independent and gender-diverse boards with stronger ESG engagement, environmental responsibility, and stakeholder-oriented governance (Jo & Harjoto, 2011; Liao et al., 2015; Menicucci & Paolucci, 2024). Independent directors are often linked to stronger monitoring and sustainability oversight, while female directors tend to promote ethical standards and broader stakeholder engagement.

Despite these positive associations, the effectiveness of these governance mechanisms depends heavily on institutional context. In some emerging economies, governance reforms may result in symbolic compliance, where ESG disclosure functions more as a regulatory formality than as a genuine transparency mechanism (Dumitrescu, 2025). For example, in the Romanian context, firms often treat governance disclosure as a formal requirement rather than a meaningful communication tool, creating what Dobroteanu et al. (2010) describe as an "ignorance gap." These patterns suggest that governance structures alone may be insufficient to ensure substantive ESG engagement in weaker institutional environments.

2.4. The ESG-financial performance trade-off (Path b: M → Y)

The relationship between ESG and financial performance remains one of the most contested issues in the literature: does "being green" create value or impose costs? Three dominant perspectives emerge.

The stakeholder view argues that ESG investments enhance firm value by reducing risk exposure, strengthening stakeholder relations, and fostering long-term resilience. Evidence from European firms indicates that more extensive ESG disclosure is associated with stronger earnings and improved profitability (Carnini Pulino et al., 2022). Horobet et al. (2024) find that in the oil and gas sector, both ESG scores and the intensity of sustainability-related discourse are positively associated with stock market returns, suggesting that transparent communication of environmental and technological initiatives reinforces investor confidence.

The trade-off perspective highlights that ESG initiatives require significant resources and may undermine short-term financial performance (Duque-Grisales & Aguilera-Caracuel, 2021). Horobet et al. (2025) show that environmental innovation increases valuation for certain industrial firms but has limited or even adverse effects in other cases, while IT companies remain predominantly driven by profitability. These findings indicate that ESG initiatives do not uniformly translate into financial gains and can entail costs that challenge short-term profitability.

The neutral view maintains that ESG–performance links are highly context-dependent and often inconsistent, varying across industries, regions, and time horizons (Pham et al., 2022; Iazzolino et al., 2023; Aslan et al., 2021).

In summary, while the literature presents conflicting perspectives, the aggregate evidence suggests a predominantly positive link between ESG and financial performance (Friede et al.,

2015; Whelan et al., 2021). This general finding, however, underscores the critical need to disaggregate the ESG construct, as the costly, short-term investments required by the environmental pillar may create trade-offs with immediate financial performance.

2.5. Assembling the puzzle – research gap and developing hypotheses

Existing research separately documents the links between board governance, ESG performance, and firm financial outcomes. However, these relationships have rarely been examined jointly, and the mechanisms through which governance characteristics translate into financial performance remain underexplored. Prior studies have largely focused on direct effects, while evidence on the mediating role of ESG remains limited and often relies on narrow or context-specific samples (Pham & Ho, 2024; Asiedu & Mensah, 2023).

This "black box" of how board governance translates into financial outcomes calls for systematic testing. We address this gap by adopting a mediation framework that incorporates ESG performance and its three pillars as potential channels linking BI and WOB to financial performance. Drawing on a large global panel of blue-chip firms across 23 developed markets, we move beyond the question of whether governance creates value to investigate how it does so, testing which ESG dimensions consistently transmit governance effects to firm performance.

Building upon these premises, we propose the following hypotheses:

- H1 (Path c, X → Y): Board governance characteristics (BI and WOB) are significantly associated with firm financial performance;
- H2 (Path a, X → M): Board governance characteristics (BI and WOB) are positively associated with a firm's ESG performance and each of its three pillars;
- H3 (Path b, M → Y): A firm's ESG performance significantly influences its financial performance;
- H4 (Path c' – Mediation, X → M → Y): ESG performance and its pillars mediate the relationship between board governance characteristics and firm financial performance;
- H5 (Interaction, BI x WOB): Board independence and gender diversity act as substitutes in shaping a firm's environmental performance.

3. Research methodology

3.1. Data and sample selection

The sample for this study was constructed to provide a comprehensive, high-impact, and globally representative view of the relationship between corporate governance, ESG and financial performance. To ensure transparency and replicability, the sample was generated using a rules-based, bottom-up approach within the LSEG Workspace Screener tool. The process began with the global universe of publicly traded companies available in the LSEG Workspace database (formerly Refinitiv), which was then refined by applying a sequential set of filters: (1) headquarters country, (2) market capitalization exceeding $10 billion USD, and (3) exclusion of firms classified in the GICS Financials sector. Thus, we first applied a geographic filter to include only firms headquartered in 23 developed markets (see Appendix), corresponding to MSCI World Index country constituents. Our research is deliberately constructed with a broad, cross-national scope to test the generalizability of the relationships beyond the influence of a single nation's institutional framework. By drawing our sample from 23 devel-

oped markets, we are able to analyze the effects of BI and WOB across a large and diverse set of firms operating within relatively mature and comparable regulatory environments. This cross-jurisdictional methodology provides a more robust and globally relevant test of our hypotheses, offering insights that are not confined to the idiosyncratic characteristics of one specific market.

Second, a size filter was implemented to retain only large-cap corporations with a market capitalization greater than $10 billion USD. In these sophisticated settings, where governance practices and investor pressures are arguably most advanced, we can analyze the dynamics with greater clarity.

Third, to enhance the comparability of financial ratios and focus the analysis on non-financial corporations, all companies classified within the GICS "Financials" sector were excluded. After the data cleaning process, our final unbalanced panel consists of 1,074 firms over the 2016–2023 period, yielding a total of 8,167 firm-year observations for the analysis. For readability, we refer to this group as the "1,000 largest listed firms" throughout the paper. Finally, the timeframe was strategically chosen to align with the modern era of ESG reporting that commenced after the 2015 Paris Agreement, while excluding the less consistent data from 2015 itself. The sample period concludes in 2023 to mitigate biases from the inherent reporting lag of non-financial data, ensuring that the unavailability of complete 2024 ESG scores does not compromise the balance and integrity of the panel dataset.

To understand the composition of our final sample, we first examine its distribution. Figure 2 illustrates the geographical breakdown of the sample across 23 developed markets. The sample is heavily weighted towards firms headquartered in the United States, which account for 50.37% of the unique companies, representing nearly half of the entire dataset.

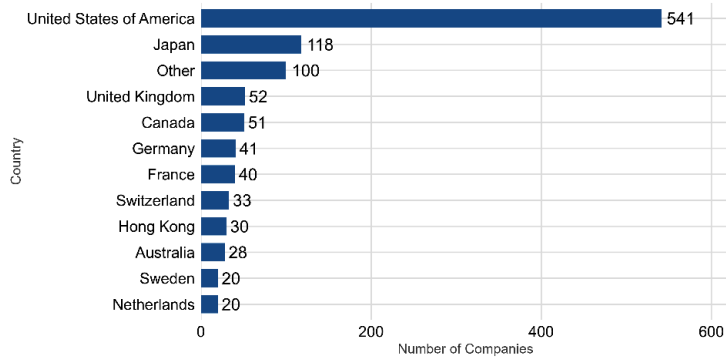

Figure 2. Geographic distribution of the final sample by country of headquarters (top 10 and other) (source: author's computation using R)

In addition to its geographic distribution, it is crucial to understand the sample's industrial composition. Figure 3 displays the breakdown of firms across the 11 primary GICS Sectors. The distribution reveals a significant concentration in the Industrials (23.5%), Information Technology (13.7%), Consumer Discretionary (12%), and Health Care (11.5%) sectors, which collectively represent over 60% of the companies in our analysis. This concentration reflects the structure of the modern developed economy, though it suggests that caution should be exercised when generalizing findings to capital-intensive sectors like Utilities or Energy.

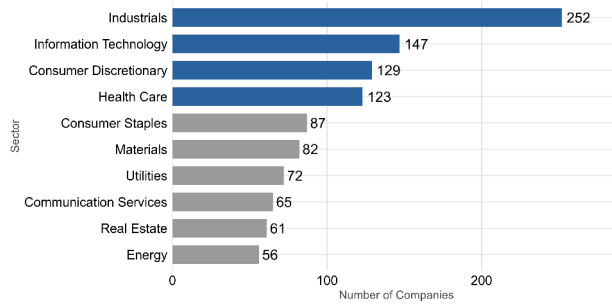

Figure 3. Industrial composition of the final sample by GICS sector (source: author's computation using R)

3.2. Variable definitions and measurement

The empirical analysis in this study relies on a set of key variables representing board governance characteristics (BI and WOB), ESG performance pillars, and firm financial performance, alongside a set of standard control variables. In line with prior research on the determinants of financial performance, we control for firm size, firm age, market-to-book ratio, and board size (Pham & Ho, 2024; Hasan et al., 2018; Fatma & Chouaibi, 2021; Naim & Aziz, 2022; Assenga et al., 2018; Siueia et al., 2019).

Table 1 presents the detailed operationalization of these constructs, including their definitions. The data for all variables were sourced from the LSEG database.

Table 1. Operationalization of variables

Variables	Symbol / measure	Description
Independent key variable		
Board Independence	BI (%)	Percentage of independent directors on the board.
Women on Board	WOB (%)	Percentage of female directors on the board.
Dependent variables		
Return on Assets	ROA (%)	Net Income divided by Total Assets, measuring operational efficiency and profitability.
Return on Equity	ROE (%)	Net Income divided by Shareholders' Equity, measuring return to shareholders.
Earnings per Share	EPS (value)	Net Income divided by the number of outstanding shares, measuring profitability per share.
Mediating variable		
ESG Score (aggregate)	ESG (points)	Overall ESG score capturing environmental, social and governance practices.
Environmental pillar	env (points)	ESG sub-score: environmental dimension.
Social pillar	soc (points)	ESG sub-score: social dimension.
Governance pillar	gov (points)	ESG sub-score: governance dimension.

End of Table 1

Variables	Symbol / measure	Description
Control variables		
Firm Size	Size (value)	Natural logarithm of total assets.
Firm Age	firm_age (years)	Number of years since the company's listing, controlling for market maturity and experience.
Board Size	BS (count)	Number of directors on the board.
Market-to-Book Ratio	MTB (ratio)	Market Value of Equity divided by Book Value of Equity, included as control for growth opportunities.

To address significant outliers in key financial variables (ROA, ROE, EPS), all continuous variables used in our analysis were winsorized at the 1st and 99th percentiles. This standard procedure ensures that our findings are robust to the influence of extreme values.

Table 2 presents the descriptive statistics for all variables. The summary statistics portray a sample of large, well-established corporations with a mean age of approximately 32 years. The average firm in our sample has a board of 11 members, of which roughly 26% are women and 60% are independent. On average, the firms exhibit positive financial performance and strong ESG scores, with a mean aggregate ESG score of 62.16. The variation in the number of observations (Obs) across variables reflects the unbalanced nature of our panel dataset and the presence of missing values for certain indicators in some firm-year observations.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Median	Min	Max
BI	7938	59.48	27.60	60.68	2.88	98.97
WOB	7939	25.93	12.87	27.27	0.00	100.00
ROA	8129	5.63	8.83	5.32	-34.65	30.57
ROE	7856	16.16	30.56	12.86	-94.68	184.40
EPS	8157	23.15	71.76	3.03	-7.48	491.05
ESG	7939	62.16	18.39	65.67	14.26	91.45
env	7939	58.40	26.17	65.06	0.00	96.37
soc	7939	65.42	20.60	69.05	11.62	96.49
gov	7939	59.97	21.23	62.98	9.01	94.83
MTB	7852	5.80	9.47	2.96	0.47	70.81
size	8154	24.07	2.14	23.78	19.57	30.00
firm_age	8167	32.02	25.38	25.00	0.00	118.00
BS	7939	10.95	3.39	11.00	1.00	138.00

Figure 4 presents the Pearson correlation matrix, confirming that multicollinearity is not a concern for our analysis as all correlation coefficients among the predictor variables fall well below the conventional 0.7 threshold.

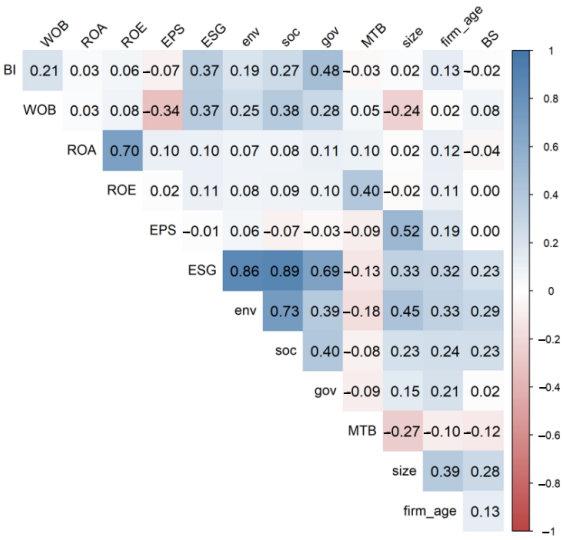

Figure 4. Correlation matrix

The matrix provides preliminary evidence regarding our hypotheses. We observe positive and statistically significant correlations between board governance characteristics (BI, WOB) and the ESG pillars, offering initial support for the first stage of our proposed mediation model (H2). Interestingly, the simple correlation between the environmental pillar (env) and EPS is weakly positive (+0.06). This contrasts with the negative relationship uncovered in our more sophisticated fixed-effects models, a finding that underscores the critical importance of controlling for confounding factors and unobserved heterogeneity to isolate the true underlying effect.

3.3. Econometric model and estimation strategy

To test our hypotheses, we employ a mediation analysis framework within a panel data setting. Our primary estimation strategy utilizes a Two-Way Fixed Effects (TWFE) model, the choice of which was confirmed by a series of Hausman tests ($p < 0.01$ in all cases). This approach is particularly well-suited for our analysis as it effectively controls for all time-invariant, unobserved firm-specific heterogeneity, such as corporate culture or persistent management quality, which could otherwise bias the estimated coefficients. The year fixed effects were included to account for macroeconomic shocks or trends that are common to all firms in a given year. The mediation logic follows the classic four-step approach proposed by Baron and Kenny (1986): (1) Path c, the total effect; (2) Path a, the effect on the mediator; (3) Path b, the effect of the mediator on the dependent variable; and (4) Path c', the direct effect while controlling for the mediator, as previously illustrated in Figure 1.

Before proceeding with the main analysis, we performed a diagnostic check for multicollinearity among the predictor variables. The results confirmed that all Variance Inflation Factor (VIF) scores were well below the conservative threshold of 5, with the highest score being 1.40. This indicates that multicollinearity is not a concern for our analysis, ensuring the stability and reliability of the estimated coefficients.

The mediation analysis (H1–H4) involves the estimation of the following three core panel regression equations:

$$Y_{it} = \beta_c X_{it} + \gamma Controls_{it} + \alpha_i + \delta_t + \epsilon_{it}; \quad (1)$$

$$M_{it} = \beta_a X_{it} + \gamma Controls_{it} + \alpha_i + \delta_t + \epsilon_{it}; \quad (2)$$

$$Y_{it} = \beta_{c'} X_{it} + \beta_b M_{it} + \gamma Controls_{it} + \alpha_i + \delta_t + \epsilon_{it}. \quad (3)$$

In these equations, i indexes the firm and t indexes the year. Y_{it} represents the financial performance metrics (ROA, ROE, EPS); X_{it} represents the governance variables (BI, WOB); and M_{it} represents the ESG mediators (ESG, env, soc, gov).

To test for the interaction effect (H5), we estimate an additional model where the dependent variable is environmental performance (env). This model includes both BI and WOB as main effects, along with their interaction term:

$$env_{it} = \beta_1 BI_{it} + \beta_2 WOB_{it} + \beta_3 (BI_{it} \times WOB_{it}) + \gamma Controls_{it} + \alpha_i + \delta_t + \epsilon_{it}. \quad (4)$$

A statistically significant and negative coefficient on the interaction term (β_3) would support our hypothesis that board independence and gender diversity act as substitutes.

In all equations, $Controls_{it}$ is a vector of control variables (size, firm age, board size, MTB), α_i and δ_t are the firm and year fixed effects, and ϵ_{it} is the error term.

All models were estimated using the *R* software environment, with standard errors clustered at the firm level to account for potential heteroscedasticity and serial correlation.

4. Results

This section presents the findings from our two-way (firm and year) fixed-effects panel regression analysis. Our analysis is structured in two parts. First, we test the mediation hypotheses (H1–H4) to understand the channels through which governance affects performance. Second, we test the interaction hypothesis (H5) to examine whether board independence and gender diversity act as substitutes or complements.

4.1. Mediation analysis

We systematically tested 24 potential mediation pathways within a framework comprising 72 regression models. Two pathways emerged as statistically significant, revealing a consistent and specific mechanism through which board characteristics influence firm outcomes.

Our analysis reveals that a firm's environmental performance (env) appears to mediate the relationship between board governance characteristics (both BI and WOB) and EPS. The results consistently point towards a strategic trade-off, where effective governance mechanisms that promote environmental responsibility do so at a measurable short-term cost to shareholder earnings.

Table 3 presents the results for the mediation analysis of BI on EPS through the environmental pillar.

Model (1) estimates the total effect of Board Independence on EPS. The result indicates a negative and marginally significant relationship (Path c; $\beta = -0.047$, $p < 0.05$), suggesting that, overall, greater BI is associated with slightly lower EPS.

Table 3. Mediation analysis of the effect of BI on EPS via environmental performance

Dependent Variable:	(1) Total Effect	(2) Mediator Model	(3) Outcome Model
	EPS	env	EPS
Board Independence (BI)	–0.047** (0.021)	0.160** (0.08)	–0.045** (0.021)
Environmental Score (env)			–0.093** (0.037)
Control Variables			
Size (log)	3.719** (1.425)	8.380*** (0.476)	4.502*** (1.457)
Firm Age	1.729*** (0.225)	1.344*** (0.075)	1.855*** (0.230)
Market-to-Book (MTB)	0.070 (0.067)	0.026 (0.022)	0.073 (0.067)
Board Size (BS)	–0.435*** (0.160)	0.051 (0.054)	–0.431*** (0.160)
Model Diagnostics			
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	7,654	7,654	7,654
R^2	0.029	0.286	0.030
F Statistic	17.910*** (df = 11; 6597)	240.690*** (df = 11; 6597)	16.967*** (df = 12; 6596)

Notes: Two-way fixed-effects models are reported. Robust SE are in parentheses. *p < 0.1; **p < 0.05; ***p < 0.01.

Model (2) tests the first stage of mediation and shows that BI has a positive and statistically significant effect on env (Path a; $\beta = 0.16$, $p < 0.05$). This supports hypothesis H2 and indicates that a 10-percentage-point increase in board independence is associated with a 1.6-point increase in the firm's environmental score.

Model (3) reveals the final steps of the analysis. The coefficient for the environmental score on EPS is negative and significant (Path b; $\beta = –0.093$, $p < 0.05$), providing strong support for H3. This result suggests that higher environmental performance is associated with lower short-term EPS. In economic terms, while environmental actions do not dominate traditional financial drivers, this association remains economically meaningful. Specifically, a 10-point improvement in the firm's environmental score translates to an EPS reduction of approximately 0.93, which represents a 4.02% decrease relative to the sample mean EPS. To put this into perspective against standard financial controls, this economic friction offsets roughly half of the typical annual earnings increase associated with firm maturity (Firm Age $\beta = 1.855$), highlighting that governance-driven environmental improvements can generate tangible short-term earnings trade-offs.

Furthermore, the analysis reveals a dynamic of partial mediation, as a significant direct negative relationship between board independence and EPS still remains after controlling for the mediator (Path c'; $\beta = –0.045$, $p < 0.05$). The robust significance of both Path a and b, corroborated by the attenuation of the coefficient from the total to the direct effect, provides strong support for our core mediation hypothesis (H4) and reveals a dynamic of partial mediation. This result confirms that while environmental performance is a key channel, it is

not the only mechanism through which BI influences EPS, underscoring the complex and multifaceted nature of the "Green Board Paradox."

A remarkably consistent pattern is observed when examining the role of WOB, as shown in Table 4.

Table 4. Mediation analysis of WOB on EPS through environmental performance

Dependent Variable:	(1) Total Effect	(2) Mediator Model	(3) Outcome Model
	EPS	env	EPS
Women on Board (WOB)	–0.140** (0.062)	0.133*** (0.021)	–0.128** (0.062)
Environmental Score (env)			–0.089** (0.037)
Control Variables			
Size (log)	4.000*** (1.430)	8.112*** (0.477)	4.722*** (1.461)
Firm Age	1.931*** (0.247)	1.134*** (0.082)	2.032*** (0.250)
Market-to-Book (MTB)	0.077 (0.067)	0.020 (0.022)	0.079 (0.067)
Board Size (BS)	–0.430*** (0.160)	0.051 (0.053)	–0.425*** (0.160)
Model Diagnostics			
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	7,654	7,654	7,654
R^2	0.029	0.290	0.030
F Statistic	18.053*** (df = 11; 6597)	245.477*** (df = 11; 6597)	17.045*** (df = 12; 6596)

Notes: Two-way fixed-effects models are reported. Robust SE are in parentheses. *p < 0.1; **p < 0.05; ***p < 0.01.

Model (1) estimates the total effect of WOB on EPS. The result indicates a negative and statistically significant relationship (Path c; $\beta = -0.140$, $p < 0.05$), suggesting that, overall, a greater proportion of women on the board is associated with lower short-term EPS.

Model (2) tests the first stage of mediation, showing that WOB has a strong, positive effect on environmental performance (Path a; $\beta = 0.133$, $p < 0.01$), again supporting H2. Specifically, a 10-percentage-point increase in female board representation is associated with a 1.33-point increase in the environmental score.

Model (3) reveals the final steps of the analysis. The coefficient for the environmental score on EPS is negative and significant (Path b; $\beta = -0.089$, $p < 0.05$), providing strong support for H3. This result suggests that higher environmental performance is associated with lower short-term EPS. Specifically, a 10-point improvement in the firm's environmental score translates to an EPS reduction of approximately 0.89, which represents a 3.84% decrease relative to the sample mean EPS. Consistent with the board independence model, this result suggests that the association between environmental improvements and short-term earnings remains economically meaningful and is consistent with a short-term financial performance trade-off.

The significance of both Path a and Path b, coupled with the observed reduction in the coefficient's magnitude from the total effect (Path c) to the direct effect (Path c') validates our core mediation hypothesis (H4).

Furthermore, the analysis reveals a dynamic of partial mediation, as a significant direct negative relationship between WOB and EPS still remains after controlling for the mediator (Path c'; $\beta = -0.128$, $p < 0.05$). This reinforces the narrative that stronger board governance—whether through independence or gender diversity—leads to improved environmental actions that create a direct, negative pressure on short-term earnings.

We tested the remaining 22 mediation pathways, including those with ROA and ROE as financial outcomes and the aggregate ESG, social, and governance pillars as mediators. For transparency, the full set of results for these additional specifications is reported in Appendix Table A1, which summarizes the estimated coefficients for Path a, Path b, and Path c'. In these models, while the first stage of mediation (Path a—the effect of BI and WOB on the mediator) was consistently statistically significant, the second stage (Path b—the effect of the mediator on financial performance) was generally non-significant. Consequently, we find no robust evidence of mediation in these additional pathways.

The divergence in statistical significance between EPS and the broader financial performance metrics (ROA and ROE) likely reflects differences in their accounting construction and sensitivity to sustainability-related costs. EPS directly captures short-term fluctuations in net income and is therefore more responsive to operational expenditures associated with environmental initiatives. In contrast, ROA and ROE scale profitability by large balance-sheet bases—total assets and shareholders' equity—which tend to dampen the observable impact of short-term earnings fluctuations. As a result, the financial friction associated with environmental investments may be diluted in these broader financial performance ratios, making the effect visible primarily in EPS.

Robustness to endogeneity: lagged mediator specification

To address concerns regarding endogeneity and reverse causality—specifically the "slack resources" premise that highly profitable firms might inherently achieve better environment scores due to resource availability—we conduct a dynamic robustness check. Following the logic of temporal precedence, we re-estimate the final stage of our mediation framework by substituting the contemporaneous environmental score with its one-year lagged value (env_{t-1}) for both the board independence and gender diversity models. The results, detailed in Appendix Table A2, are structurally consistent with our main findings. The lagged environmental score maintains a significant and negative association with current-year EPS across both specifications ($\beta = -0.116$, $p < 0.05$ for the BI model; $\beta = -0.114$, $p < 0.05$ for the WOB model). Notably, when introducing the lagged mediator, the direct effects of both governance mechanisms on EPS become statistically insignificant, consistent with a mediating role. This temporal sequence is consistent with the interpretation that the cost burden of past environmental policies may be associated with lower subsequent short-term earnings, which helps to alleviate concerns regarding reverse causality.

Robustness to mediation methodology: bootstrapped indirect effects

While the Baron and Kenny (1986) framework provides a clear stepwise approach for assessing mediation through the sequential significance of Path a and Path b, recent methodological literature highlights several limitations of this approach. In particular, the Baron and Kenny procedure in its original formulation does not directly test the statistical significance of the

indirect effect and implicitly relies on the assumption that the product of coefficients (a × b) follows a normal distribution—an assumption that is rarely satisfied in empirical applications (Hayes, 2022).

To address this limitation and strengthen the robustness of our findings, we also estimate the indirect effect using a non-parametric bootstrap procedure with 1,000 replications. Bootstrapping generates empirical confidence intervals for the indirect effect without relying on distributional assumptions and is therefore widely recommended in contemporary mediation analysis.

The results of this procedure are presented in Table 5. Consistent with the Baron and Kenny analysis, the bootstrapped indirect effects confirm the environmental mediation pathway for both board independence and gender diversity. The convergence of these two approaches provides additional support for the proposed green board mediation framework.

Table 5. Bootstrapped indirect effects for the environmental mediation pathway

Path	Indirect Effect (ACME)	Direct Effect (ADE)	Total Effect	Proportion mediated
BI → env → EPS	–0.078***	–0.168***	–0.246***	31.7%
WOB → env → EPS	–0.239***	–1.119***	–1.357***	17.6%

Note: Unstandardized coefficients are reported. Indirect effects are estimated using a non-parametric bootstrap procedure with 1,000 resamples. *** p < .001.

4.2. Interaction effect analysis

To test hypothesis H5, we examined the interaction effect between Board Independence (BI) and Women on Board (WOB) on the firm's environmental performance (env). The results, presented in Table 6, provide strong support for our hypothesis.

Table 6. Interaction effect of BI and WOB on environmental (env) performance

Variable	Coefficient	Robust SE
Main Variables		
Board Independence (BI)	0.060***	0.023
Women on Board (WOB)	0.250***	0.055
BI x WOB Interaction	–0.002***	0.001
Control Variables		
Size (log)	7.923***	0.892
Firm Age	1.153***	0.125
Market-to-Book (MTB)	0.017	0.038
Board Size (BS)	0.056	0.054
Model Diagnostics		
Firm Fixed Effects	Yes	
Year Fixed Effects	Yes	
Observations	7,654	
R^2	0.293	
F Statistic	209.866*** (df = 13; 6595)	

Notes: The dependent variable is the Environmental Score (env). *p < 0.1; **p < 0.05; ***p < 0.01.

The model reveals that both BI and WOB have significant, positive main effects on the environmental score. Holding other factors constant, a 10-percentage-point increase in board independence (BI) is associated with a 0.6-point increase in the firm's environmental score ($\beta = 0.060$, $p < 0.01$). Similarly, a 10-percentage-point increase in female board representation (WOB) is associated with a 2.5-point increase in the environmental score ($\beta = 0.250$, $p < 0.01$).

Crucially, the interaction term (BI x WOB) is negative and statistically significant ($\beta = -0.002$, $p < 0.01$). This negative coefficient indicates a substitution effect, where the positive impact of one governance mechanism is diminished as the level of the other increases. For example, for a board with 30% female representation, the positive effect of board independence on environmental performance is effectively neutralized ($0.060 + 30 * -0.002 = 0$). This suggests that while both are effective governance tools for promoting environmental responsibility, they are, to some extent, alternative rather than complementary pathways to achieving that goal, strongly supporting H5.

This substitution dynamic is visualized in Figure 5. The plot clearly illustrates that the positive marginal effect of BI is strong and significant only when gender diversity is low. This effect is completely attenuated, even becoming negative, as the proportion of WOB increases.

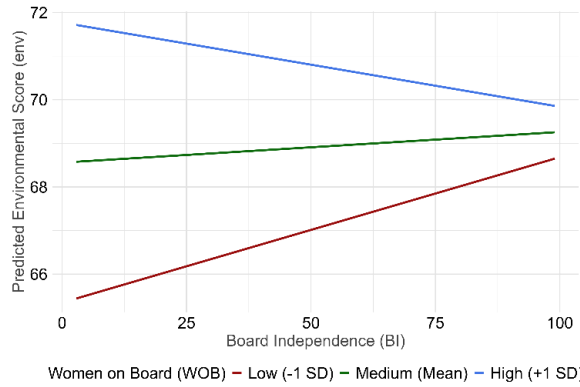

Figure 5. Interaction effect of BI and WOB on environmental score

5. Discussion

5.1. Theoretical contributions

The central finding of our study is the identification of what we term the "Green Board Paradox." This paradox directly challenges and refines Agency Theory by demonstrating that key governance mechanisms, such as board independence and diversity, do not have a monolithic effect on shareholder value. Our results unfold in two distinct stages: first, both BI and WOB are positively and significantly associated with stronger environmental performance, corroborating existing research. The primary contribution, however, lies in the second stage, where we demonstrate that this improved environmental performance acts as a significant mediator that is associated with lower short-term EPS. This finding is consistent with recent studies where the environmental pillar acts as a costly mediator in the governance-performance relationship (Pham & Ho, 2024). Consequently, our work introduces a strategic trade-off, challenging the traditional assumption that good governance always maximizes short-term profits. Furthermore, the paradox contributes directly to Stakeholder Theory.

The symmetrical nature of our finding—that two distinct "good governance" attributes operate through the same environmental cost channel—provides robust evidence that satisfying the interests of one stakeholder group (society) can create a direct and measurable conflict with the short-term interests of another (shareholders). This challenges the persistent "win-win" narrative in the corporate sustainability literature.

Finally, our interaction analysis adds another critical layer of strategic insight. We demonstrate that BI and WOB act as substitutes, rather than complements, in driving environmental performance. The positive impact of WOB is strongest when BI is low, and vice-versa. One plausible explanation lies in the partially overlapping governance roles associated with these board characteristics. Both independent and female directors are typically associated with stronger monitoring and heightened attention to stakeholder concerns, which can encourage firms to adopt more responsible environmental practices (Adams & Ferreira, 2009). When a board is already highly independent, the additional oversight introduced through gender diversity may therefore generate diminishing marginal governance effects, consistent with the substitution logic between governance mechanisms documented in prior research (Rediker & Seth, 1995). At the same time, increasing multiple dimensions of board heterogeneity may introduce coordination challenges and slower consensus formation when boards evaluate complex strategic initiatives such as environmental investments (Goodstein et al., 1994). Consistent with these mechanisms, our findings suggest that firms can achieve similar environmental outcomes through alternative governance configurations, adding an important nuance to the prescriptive literature on optimal board structure.

5.2. Practical implications

Beyond its academic contribution, this study offers significant practical implications for a broader range of stakeholders.

For investors, our findings provide a clearer lens through which to assess corporate sustainability strategies, enabling them to distinguish between genuine environmental investments, which may temporarily depress earnings, and mere "greenwashing" (Parguel et al., 2011). Recent evidence further suggests that investors increasingly differentiate between formal ESG compliance and effective environmental policies (Dumitrescu et al., 2025). Therefore, investors and analysts should recognize that governance reforms that lead to real environmental action may depress quarterly earnings but can enhance risk management and resilience over longer horizons.

For policymakers and regulators, our findings offer two key insights. First, the discovery that board independence and gender diversity act as substitutes suggests that a rigid, "one-size-fits-all" approach to governance reform may be inefficient.

More importantly, our study clarifies the fundamental need for environmental regulation. By showing that sustainability initiatives come at a direct short-term cost to earnings, we identify a classic market failure: purely profit-driven firms lack a natural incentive to prioritize the environment. This confirms that regulatory pressure—through mandatory reporting and environmental standards—remains a critical tool for aligning corporate behavior with societal goals, as short-term profit rewards for environmental action may be absent.

Finally, our findings suggest that improved corporate governance can translate into tangible environmental actions by firms, but often at a measurable short-term cost. This highlights the broader trade-offs associated with corporate sustainability and suggests that the financial burden of achieving environmental objectives cannot rest solely on individual firms and shareholders.

5.3. Limitations

We acknowledge certain limitations in our study. First, while the use of Two-Way Fixed-Effects panel models controls for time-invariant omitted variables, we cannot entirely rule out the possibility of endogeneity from time-varying factors. Second, our data is sourced from a single provider (LSEG), and ESG scores can vary across different rating agencies and may be subject to bias. This introduces potential measurement heterogeneity, meaning that the magnitude of our mediation effects may vary depending on the provider's methodology, which may in turn affect the broader generalizability of our results. Third, our study relies on accounting-based measures of financial performance. These metrics are historical in nature and may not fully capture market expectations of future value. Future research could explore whether these findings hold when using market-based indicators, such as Tobin's Q or stock returns. Fourth, our analysis focuses on contemporaneous effects; delayed benefits of ESG may not be observable.

The results may also depend on the sample period and industry structure, so the generalization of our findings to other markets or periods should be made with caution. Finally, our sample focuses on large-cap firms located in developed markets. While this design improves comparability across firms and institutional environments, the findings may not fully generalize to smaller firms or to companies operating in emerging economies, where governance structures, regulatory frameworks, and ESG pressures may differ substantially.

5.4. Future research

Our results open several avenues for future research. A natural extension would be to investigate whether the short-term costs reflected in EPS translate into long-term benefits (e.g., higher market valuation or a lower cost of capital) through lagged models. It would also be interesting to explore other potential mediators, such as innovation expenditures (R&D) or organizational culture. Future research can also disaggregate environmental scores into sub-dimensions (emissions, energy efficiency, biodiversity) for mechanism testing or examine industry heterogeneity, especially between high-impact (energy, manufacturing) and low-impact sectors.

Finally, replicating this study in different institutional contexts, such as emerging markets, could provide valuable insights into the role of context in shaping the relationship between governance, ESG, and performance.

6. Conclusions

The main contribution of this study is the identification and validation of a consistent mechanism through which two key corporate governance attributes—board independence and gender diversity—influence financial performance. We have demonstrated that both mechanisms operate through a common "environmental policy cost channel," leading to a measurable, negative short-term impact on Earnings Per Share (EPS).

This creates what we term the "green board paradox": the very governance structures that are most effective at advancing environmental responsibility simultaneously are correlated with lower short-term financial performance. This finding highlights a fundamental strategic trade-off between sustainability objectives and immediate shareholder returns.

Furthermore, we demonstrate that BI and gender diversity act as substitutes, rather than complements. The positive impact of having more WOB on environmental performance is

strongest when the board is not very independent. Conversely, in a company that already has a very high level of BI, the additional benefit of adding more women to the board is smaller. This finding adds a critical layer of strategic insight, suggesting that firms can achieve similar environmental outcomes through alternative governance configurations.

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Disclosure statement

The author declares no competing interests.

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APPENDIX

The 23 developed markets correspond to the MSCI World Index country constituents as of September 2025 and include: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

Table A1. Comprehensive summary of mediation pathways (all indicators)

Indep. Var.	Mediator	Dep. Var.	Total Effect (c)	Path a	Path b	Direct Effect (c')	Mediation Type
BI	ESG	ROA	0.005	0.095***	0.016	0.004	No Mediation
BI	ESG	ROE	0.006	0.095***	0.009	0.006	No Mediation
BI	ESG	EPS	–0.047**	0.095***	–0.011	–0.045**	No Mediation
BI	env	ROA	0.005	0.16**	0.006	0.005	No Mediation
BI	env	ROE	0.006	0.16**	–0.009	0.007	No Mediation
BI	env	EPS	–0.047**	0.16**	–0.093**	–0.045**	Partial Mediation
BI	soc	ROA	0.005	0.024***	0.017	0.005	No Mediation
BI	soc	ROE	0.006	0.024***	0.028	0.006	No Mediation
BI	soc	EPS	–0.047**	0.024***	0.001	–0.047**	No Mediation
BI	gov	ROA	0.005	0.262***	0.002	0.005	No Mediation
BI	gov	ROE	0.006	0.262***	–0.007	0.008	No Mediation
BI	gov	EPS	–0.047**	0.262***	0.051	–0.06**	No Mediation
WOB	ESG	ROA	0.011	0.19***	0.017	0.007	No Mediation
WOB	ESG	ROE	0.036	0.19***	0.007	0.035	No Mediation
WOB	ESG	EPS	–0.14**	0.19***	–0.012	–0.138**	No Mediation
WOB	env	ROA	0.011	0.133***	0.005	0.01	No Mediation
WOB	env	ROE	0.036	0.133***	–0.011	0.037	No Mediation
WOB	env	EPS	–0.14**	0.133***	–0.089**	–0.128**	Partial Mediation

End of Table A1

Indep. Var.	Mediator	Dep. Var.	Total Effect (c)	Path a	Path b	Direct Effect (c')	Mediation Type
WOB	soc	ROA	0.011	0.07***	0.017	0.009	No Mediation
WOB	soc	ROE	0.036	0.07***	0.027	0.034	No Mediation
WOB	soc	EPS	–0.14**	0.07***	0.002	–0.14**	No Mediation
WOB	gov	ROA	0.011	0.399***	0.003	0.009	No Mediation
WOB	gov	ROE	0.036	0.399***	–0.008	0.039	No Mediation
WOB	gov	EPS	–0.14**	0.399***	0.041	–0.156**	No Mediation

Notes: Unstandardized coefficients are reported. Mediation pathways are evaluated following the stepwise framework of Baron and Kenny (1986), while mediation types follow the classification proposed by Zhao et al. (2010). *p < 0.1, **p < 0.05, ***p < 0.01.

Table A2. Robustness check: lagged environmental performance on EPS

	Model 1: BI	Model 2: WOB
Board Independence	–0.037 (0.053)	
Women on Board		–0.097 (0.082)
Lagged Environmental Performance	–0.116** (0.051)	–0.114** (0.051)
Controls Included	Yes	Yes
Firm Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Observations	6,628	6,628
R^2	0.028	0.028
Adjusted R^2	–0.154	–0.154

Notes: Two-way fixed effects regressions are reported. Robust standard errors clustered at the firm level are in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles. *p < 0.10, **p < 0.05, ***p < 0.01.