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Exploring the Role of Board Characteristics in Shaping Corporate ESG Performance: An Empirical Analysis

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Abstract. This study examines the impact of board characteristics on ESG performance using a dataset of 4803 firm-year observations from companies listed on the STOXX Europe 600 index, utilizing data from 2010-2022. It addresses a gap in the literature by exploring the influence of specific board attributes, including gender diversity, independent board members, board size, CEO board membership, number of meetings, board-specific skills, and term duration, on ESG performance. The study's originality lies in its comprehensive analysis and the exploration of sector sensitivity as a moderating factor.

The findings reveal that board characteristics significantly impact ESG performance. Specifically, gender diversity, independent board members, and board-specific skills positively contribute to sustainability efforts, while CEO board membership and longer-term durations negatively influence ESG performance. Additionally, larger boards are associated with lower ESG performance.

Further analysis indicates that board characteristics impact ESG performance varies across sectors. In sensitive sectors characterized by heightened environ-

mental and social risks, the positive influence of independent board members is reduced. Conversely, larger boards in these sectors are better equipped to address ESG issues.

This paper's originality lies in integrating stakeholder and agency theories to explain how corporate governance can address stakeholder concerns and align management with sustainable practices. Future research should explore sector-specific governance strategies and their impact on ESG performance. Practically, companies and policymakers can use these insights to enhance corporate sustainability by optimizing governance structures. Tailored strategies that consider sector-specific dynamics are crucial for promoting effective and responsive ESG practices, leading to improved sustainability outcomes.

Keywords: Corporate Governance, Board Characteristics, Sustainability, ESG Performance

1 Introduction

The importance of Environmental, Social, and Governance (ESG) performance has surged in recent years as stakeholders increasingly demand that companies operate responsibly and sustainably. ESG considerations have become pivotal in shaping corporate strategies and policies, reflecting a broader recognition that long-term business success is intertwined with sustainable development. This trend underscores the need for robust corporate governance structures to effectively manage and enhance ESG performance. Among various governance mechanisms, board characteristics have garnered significant attention as critical determinants of corporate ESG outcomes.

Board characteristics, such as gender diversity, independence, size, CEO duality, meeting frequency, specific skills, and term duration, play a crucial role in shaping the strategic direction and oversight of a firm's sustainability practices. Prior research suggests that diverse and independent boards are better equipped to address complex ESG issues due to their varied perspectives and enhanced oversight capabilities [11, 38]. However, the impact of these board attributes on ESG performance is not uniform and can be influenced by contextual factors such as sector sensitivity. Sensitive sectors, characterized by higher environmental and social risks, may necessitate different governance approaches compared to less sensitive sectors [71].

Despite the growing body of literature on corporate governance and ESG performance, there remains a gap in understanding how specific board characteristics influence ESG outcomes across different sectors. This study, with its unique approach, aims to fill this gap by providing empirical evidence on the relationship between board characteristics and ESG performance, while also examining the moderating role of sector sensitivity. By analyzing a comprehensive dataset of 414 companies listed on the STOXX Europe 600 index over the period 2010 to 2022, this research offers valuable insights into the governance mechanisms that can enhance corporate sustainability, thereby engaging the audience with its novel findings.

The theoretical framework of this study integrates stakeholder theory and agency theory. Stakeholder theory posits that firms must address the interests of a broad range of stakeholders, including employees, customers, suppliers, and the community, to achieve long-term success [28]. This theory suggests that diverse and independent boards are better positioned to understand and respond to stakeholder concerns, thereby improving ESG performance. Agency theory, on the other hand, focuses on the relationship between principals (shareholders) and agents (executives) and highlights the importance of aligning the interests of both parties to reduce agency costs and ensure effective governance [43]. According to this theory, board members with relevant expertise and independence can effectively steer the company towards sustainable practices by mitigating conflicts of interest and ensuring that management actions align with stakeholder and shareholder interests.

This study contributes to the literature by addressing several key research questions: (1) How do board characteristics such as gender diversity, independence, size, CEO duality, meeting frequency, specific skills, and term duration impact ESG performance? (2) Does sector sensitivity moderate the relationship between board characteristics and ESG performance? By answering these questions, the research aims to provide a nuanced understanding of the governance factors that drive corporate sustainability and offer practical implications for companies, policymakers, and researchers.

In the subsequent sections, the paper delves into the empirical analysis, presenting the methodology, data collection process, and the fixed effects panel regression model employed to examine the hypotheses. The significant findings reveal insights into the role of board characteristics in shaping ESG performance and highlight the necessity of tailored governance strategies that consider sector-specific dynamics. These insights, once understood, can inform the development of effective governance frameworks that promote sustainability and enhance corporate accountability, thereby enlightening the audience on the potential for positive change.

2 Literature review and hypotheses development

2.1 ESG Performance

ESG Performance is an analytical framework used to measure an enterprise's contribution to sustainable development and its fulfillment of social responsibility [57]. This includes assessing a company's environmental impact, social contributions, and governance practices. Improved ESG performance can lead to benefits such as enhanced green technological innovation and better risk management in the capital market. Specifically, it helps companies reduce risks associated with stock price crashes and contributes positively to national competitiveness by aligning corporate practices with broader economic goals [58, 73, 83, 89].

2.2 Theoretical Frameworks Underpinning Board Characteristics and ESG Performance

The relationship between board characteristics and ESG performance is deeply rooted in theoretical frameworks such as agency theory and stakeholder theory. For instance, board independence, diversity, and expertise in sustainability issues are specific characteristics that can influence and enhance ESG outcomes. These theories provide valuable insights into how such characteristics can guide organizational strategies and governance practices, thereby improving ESG performance.

Agency Theory conceptualizes a company as a network of contracts between resource seekers (managers) and holders (shareholders) [43]. This theory underscores the implicit contractual relationships managers maintain with various stakeholders, extending beyond shareholders alone [47, 86]. Such relationships often lead to principal-agent conflicts, particularly in the allocation of company resources, due to management's self-interests and the intricate web of contracts between the company and its stakeholders [47, 55].

These conflicts, known as agency problems, are not insurmountable. They stem from the divergent interests between principals (shareholders) and agents (management), compounded by information asymmetry and power disparities [48]. However, effective corporate boards, with their strategic interventions, play a crucial role in mitigating these conflicts. They establish a well-structured internal control system that promotes transparency and accountability, setting a tone of integrity and sound governance. In doing so, they enhance societal impact and corporate transparency, demonstrating the power of their influence [49, 82].

Furthermore, boards with effective monitoring capabilities, which refer to their ability to oversee and evaluate management's actions and decisions, can reduce agency conflicts and improve environmental performance. Characteristics such as board independence and demographic diversity are vital for this role, as they enhance the board's monitoring abilities and broaden perspectives on environmental and social issues [31, 76]. Hence, effective boards significantly influence a firm's commitment to ESG activities through their governance roles.

In contrast, Stakeholder Theory posits that corporations exist to serve a broad array of stakeholders, including shareholders, employees, customers, suppliers, and the community [9, 28, 72, 80]. This theory emphasizes the interconnected nature of stakeholder relationships and the mutual benefits of ethical and socially responsible corporate conduct [16].

This perspective challenges firms to address the broader social impact of their operations and to engage in corporate social responsibility (CSR) not merely for-profit generation but for ethical and social support [84]. Stakeholder Theory stresses the importance of balancing the interests of all stakeholders. Corporate boards can facilitate this balance through various practices, such as transparent and comprehensive disclosure of information, active engagement with stakeholders, and the establishment of clear ethical guidelines [29, 67].

In the context of environmental disclosure, Stakeholder Theory provides a robust framework for understanding how corporate governance can influence sustainability

practices. By recognizing and addressing the relationships between company behaviour and stakeholder impacts, firms can navigate complex regulatory environments and build trust and engagement with their stakeholders [10]. This engagement is crucial for developing competitive advantages and fostering long-term organizational sustainability.

Empirical studies supporting these theories indicate mixed yet predominantly positive relationships between ESG performance and financial outcomes. For instance, some studies have found that companies with better ESG performance tend to have higher stock prices, lower cost of capital, and better credit ratings, while others have found no significant relationship. The meta-analyses and literature reviews further corroborate these findings, underscoring the positive impact of effective corporate governance on both ESG and financial performance. According to these theories and prior research, ESG performance is positively related to financial performance, with no single ESG component overwhelmingly contributing more than the others.

2.3 Board Gender Diversity and ESG Performance

Board gender diversity has emerged as a significant determinant of ESG performance. Studies suggest that gender-diverse boards enhance decision-making processes through a collaborative approach, incorporating diverse perspectives and improving oversight and integration of ESG principles [50]. [11] highlight that gender diversity in boards is positively correlated with higher corporate social responsibility CSR due to the board's ability to address a wide range of stakeholder concerns and ethical issues. Similarly, [39] argue that gender-diverse boards promote an inclusive corporate culture essential for sustainable business practices, leading to superior ESG outcomes.

[75] provide empirical evidence from the Australian context, demonstrating that gender diversity significantly enhances CSR reporting and transparency. This finding has practical implications, suggesting that companies can improve their ESG performance by promoting gender diversity. [63] found that recent regulatory changes in Australia requiring increased board diversity and sustainability practices have led to significant improvements. Their study on ASX-listed firms from 2010 to 2014 reveals a positive relationship between women's representation on boards and corporate sustainability. The findings, robust across various measures of gender diversity, indicate that female directors significantly enhance corporate sustainability practices. This underscores the importance of gender-diverse boards in driving sustainability.

From these findings, it is postulated that:

Hypothesis 1 (H1): There exists a relationship between board gender diversity and ESG performance of the firm.

2.4 Independent Board Members and ESG Performance

The role of independent board members in enhancing ESG performance has garnered significant attention in recent research. [33] investigated the Jordanian banking sector and found that a higher proportion of independent directors was associated with a lower level of CSR disclosure. This finding suggests that merely increasing the num-

ber of independent board members does not automatically enhance ESG performance and might indicate potential challenges in their engagement or influence, sparking curiosity about the underlying dynamics. In contrast, [34] studied East African firms and reported a positive relationship between board independence and sustainability reporting. Their findings indicate that independent directors, who are free from executive influence, can effectively advocate for comprehensive and transparent sustainability practices, thereby improving the overall quality of ESG disclosures. [26] explored the impact of board diversity, including the presence of non-executive directors, on sustainability practices in Chinese firms. They found that independent non-executive directors positively contributed to environmental sustainability expenditures, highlighting the crucial role these directors play in steering corporate strategy towards sustainable development. Similarly, [82] examined Malaysian companies and found a negative relationship between independent non-executive directors and CSR initiatives in family-controlled businesses. This suggests that the influence of independent directors can vary significantly based on the firm's ownership structure, with family businesses potentially resisting external influence on CSR practices. [1] provided additional insights by demonstrating that the presence of independent directors in Jordanian manufacturing firms was negatively associated with CSR disclosure levels. This finding underscores the complexity of the relationship between board independence and ESG performance, suggesting that other contextual factors might mediate this relationship.

From these findings, it is postulated that:

Hypothesis 2 (H2): There exists a relationship between independent board members and ESG performance of the firm.

2.5 Board Size and ESG Performance

Board size, a critical aspect of corporate governance, has a significant impact on ESG performance across various contexts. [77] highlighted that larger boards can negatively influence earnings management and insolvency risk, suggesting that enhanced oversight capabilities can lead to improved ESG outcomes. However, [79] found no significant relationship between board size and CSR disclosure in the Bangladeshi banking sector, indicating that the effect of board size may be industry-specific. In the Jordanian banking sector, [33] demonstrated a positive correlation between larger boards and higher levels of CSR disclosure, supporting the idea that increased board membership can enhance the scope of sustainability practices due to diverse perspectives. This diversity of perspectives is further emphasized by [7], who revealed that larger boards in Chinese firms promote corporate sustainability reporting, emphasizing the benefits of a comprehensive governance structure. Further, [61] found a positive influence of board size on ESG performance in Italian banks, indicating that larger boards effectively promote sustainable business practices. [27] reinforced this by showing that larger boards in the logistics and transportation sector significantly enhance social sustainability, particularly in human rights and community development. However, [34] presented a different view, finding a negative relationship between board size and sustainability reporting in East African firms. This suggests that the

effectiveness of larger boards in promoting ESG performance may depend on regional governance frameworks and industry characteristics. Despite these variations, the overall trend suggests that larger boards generally contribute to better ESG outcomes by enhancing oversight and incorporating diverse perspectives, offering a promising avenue for improving sustainability practices.

From these findings, it is postulated that:

Hypothesis 3 (H3): There exists a relationship between board size and ESG performance of the firm.

2.6 CEO Board Member and ESG Performance

The impact of CEO board membership on ESG performance has become a crucial issue in corporate governance. The phenomenon of CEO duality, where the CEO also assumes the role of the board chair, has been found to often obstruct corporate sustainability reporting [7]. This dual position can hinder transparent disclosure practices, suggesting that such concentration of power could have a detrimental effect on ESG performance. Similarly, [35] discovered no significant correlation between CEO duality and CSR disclosure, implying that this duality may not foster an environment conducive to comprehensive ESG reporting.

Further insights are provided by [1], who revealed a significant negative impact of CEO duality on CSR disclosure levels in Jordanian manufacturing companies. Their findings indicate that the combination of these roles may lead to reduced accountability and less rigorous sustainability practices, posing potential governance challenges. This underscores the importance of role separation to enhance transparency and mitigate these risks.

Furthermore, [85] identified a negative impact of CEO compensation on ESG disclosure among Thai listed companies. The association between higher CEO compensation and lower ESG transparency implies that significant financial incentives for CEOs could detract from their commitment to environmental and social governance. This finding suggests that a more balanced approach to CEO compensation could be beneficial for ESG performance.

[6] observed a significant negative relationship between CEO duality and CSR disclosure in Palestinian companies, supporting the argument that separating the roles of CEO and board chair can enhance corporate governance and lead to more robust ESG disclosures.

From these findings, it is postulated that:

Hypothesis 4 (H4): There exists a relationship between CEO board membership and ESG performance of the firm.

2.7 Number of Board Meetings and ESG Performance

Board meeting frequency, a topic of significant interest in the realm of ESG performance, has been the focus of insightful research. [2] discovered a negative correlation between the number of board meetings and CSR performance in Indian firms, a finding that challenges the conventional belief that more meetings lead to better out-

comes. This suggests that an excessive number of meetings might not effectively enhance CSR activities, potentially due to inefficient use of time and resources. Similarly, [40] observed that board meetings negatively impact CSR disclosure in Indonesian companies, underscoring the potential drawbacks of frequent meetings. This indicates that meeting frequency does not necessarily translate to improved CSR outcomes. [20] further examined board attributes in emerging markets, noting that while frequent board meetings did not directly affect overall sustainability performance, they significantly reduced ESG controversies. These controversies refer to public disputes related to a company's environmental, social, or governance practices. This finding highlights the nuanced role of board meetings in mitigating specific sustainability issues, a profound insight that suggests that frequent meetings may not boost aggregate ESG scores but can address critical governance problems in a targeted manner.

Exploring board characteristics in different regions adds a layer of complexity to the board meeting-ESG performance relationship. [7] found that frequent board meetings did not significantly impact CSR reporting in Chinese companies, a result that challenges the notion of a universal relationship between meeting frequency and CSR outcomes. This aligns with the findings of [35], who reported no significant relationship between board meeting frequency and CSR disclosure in European firms, reinforcing the notion that simply increasing the number of meetings may not enhance CSR activities. In contrast, [85] investigated Thai companies and noted a positive influence of board meetings on ESG disclosure, particularly in the governance domain. This positive impact contrasts with other findings, suggesting that the effectiveness of board meetings on ESG performance may vary across different contexts and regions, a fascinating aspect of this research.

From these findings, it is postulated that:

Hypothesis 5 (H5): There exists a relationship between the number of board meetings and ESG performance of the firm.

2.8 Board Specific Skills and ESG Performance

The relationship between board-specific skills and ESG performance has been widely studied, with a focus on how diverse expertise promotes effective corporate governance and sustainability practices. Cognitive diversity, which encompasses a range of knowledge, skills, and capabilities, is particularly significant in enhancing both the environmental and social dimensions of CSR performance [19]. This study demonstrates that cognitive diversity positively influences the quality of CSR disclosure, suggesting that boards equipped with a variety of skills are better positioned to address complex sustainability issues.

[68] examined the impact of board professionalism—a key dimension of board-specific skills—on CSR activities within Nigerian oil and gas firms. Although their findings showed an insignificant relationship between board professionalism and CSR, the study underscored the importance of expertise among board members for improving CSR participation and spending. This highlights the potential for boards with specialized skills to enhance a firm's ability to meet stakeholder needs.

Further research by [77] explored the role of board financial expertise in Iraqi banks. The study found that financial expertise on the board negatively impacted earnings management and significantly reduced insolvency risk. Additionally, CSR was shown to moderate the relationship between board financial expertise and insolvency risk, highlighting the role of skilled boards in fostering both financial stability and responsible business practices.

[34] identified board financial expertise as a positive determinant of sustainability reporting in East African firms. Their findings reinforce the idea that boards with financial knowledge are better positioned to implement and report on sustainable practices, thereby contributing to enhanced ESG performance.

From these findings, it is postulated that:

Hypothesis 6 (H6): There exists a relationship between board specific skills and ESG performance of the firm.

2.9 Board Member Term Duration and ESG Performance

Board Member Term Duration has emerged as a significant factor influencing ESG performance. In a study by [69], it was demonstrated that longer board tenures positively impact CSR strategies in non-family businesses in Thailand. This underscores the stability and deep operational understanding experienced board members bring, which enhances CSR activities. Similarly, in a study by [52], the positive effect of tenure diversity on CSR disclosure quality in Malaysian firms was highlighted. This suggests that a variety of tenure lengths among board members can lead to more comprehensive and effective CSR strategies.

Further exploring this dynamic, [70] found that tenure diversity positively affects social disclosure in multinational corporations, reinforcing the notion that a mix of short- and long-term board members balances innovative ideas with seasoned oversight. This combination of perspectives is particularly beneficial for addressing complex ESG issues, as it merges fresh viewpoints with experienced judgment, offering a promising avenue for future research and corporate governance practices.

However, the relationship between tenure diversity and CSR activities is not universally positive, revealing the nuanced nature of this topic. [24] found no significant relationship between tenure diversity and CSR activities in Pakistani firms, indicating that the impact of board member term duration may vary across different contexts and cultures. Similarly, [53] observed that tenure diversity did not significantly influence CSR disclosure quality in Pakistan's financial sector, suggesting that the benefits of varied board tenures might depend on specific national or industry characteristics.

From these findings, it is postulated that:

Hypothesis 7 (H7): There exists a relationship between board member term duration and ESG performance of the firm.

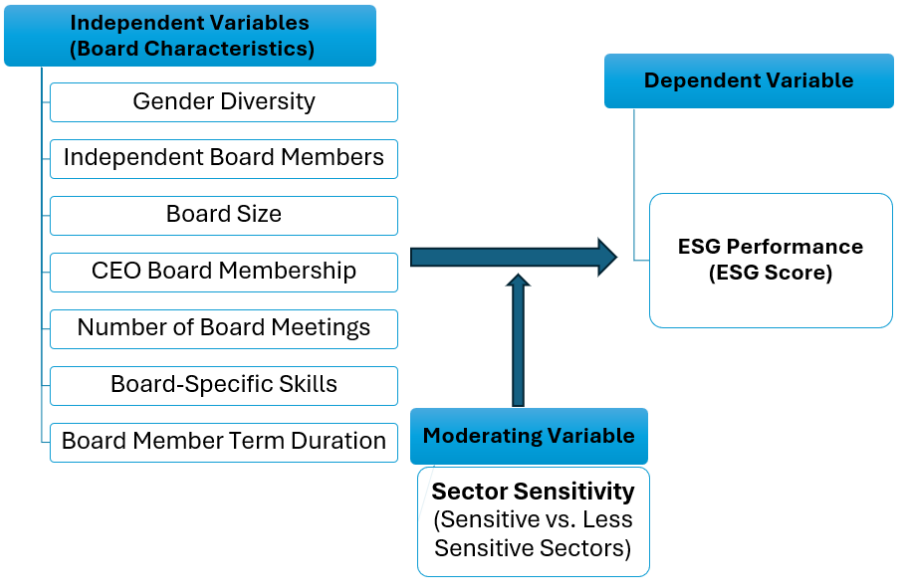


Fig. 1. Conceptual Model: Impact of Board Characteristics on ESG Performance with Sector Sensitivity as a Moderating Variable

Following the literature review and hypothesis development, Figure 1 presents the conceptual model of our study. This model illustrates the relationships between various board characteristics (gender diversity, independent board members, board size, CEO board membership, number of board meetings, board-specific skills, and board member term duration) and ESG performance, with sector sensitivity acting as a moderating variable. By incorporating sector sensitivity, defined as the differentiation between sensitive and less sensitive sectors, this model highlights the contextual factors that may influence the effectiveness of board attributes on ESG performance. This framework serves to guide the empirical analysis, which utilizes a comprehensive dataset from the STOXX Europe 600 index, aiming to provide nuanced insights into the governance mechanisms that enhance corporate sustainability practices.

3 Methodology

3.1 Data and sample

To address the research hypotheses, the study examines the impact of board characteristics and ESG performance on firm outcomes. A sample of 414 companies listed on the STOXX Europe 600 index was selected, covering the period from 2010 to 2022. This index was chosen for its diverse representation of companies across vari-

ous sectors in Europe, providing a robust framework for analyzing corporate behavior in the region. European companies were specifically chosen due to the advanced regulatory environment and the increasing emphasis on corporate governance and ESG practices in the region.

The study period from 2010 to 2022 was selected to capture a full economic cycle, encompassing recovery and growth phases following the global financial crisis, and more recent years characterized by heightened regulatory and societal focus on sustainability. Initially, all 600 companies on the STOXX Europe 600 index were considered, but 186 companies were excluded due to incomplete or unavailable data on key variables, resulting in a final sample of 414 companies.

Data on board characteristics and ESG performance were sourced from Refinitiv Eikon Datastream. The board characteristics examined include ESG Score, Board Gender Diversity, Independent Board Members, Board Size, CEO Board Member, Number of Board Meetings, Board Specific Skills, and Board Member Term Duration. Additionally, two control variables were included: Firm Size, represented by the logarithm of total assets, and leverage, represented by Total Debt as a percentage of Total Assets. Firm Size is used to account for the scale of company operations, influencing governance practices and performance outcomes [23], while leverage controls for the financial structure of the company, impacting decision-making processes and risk profiles[45].

Table I provides detailed information on the sample profile by sector.

Table 1.
Sample profile by industry

Sector	***No. of companies***	***Percentage***
Basic Materials	38	9.2%
Consumer Cyclicals	58	14.0%
Consumer Non-Cyclicals	34	8.2%
Energy	16	3.9%
Financials	83	20.0%
Healthcare	28	6.8%
Industrials	78	18.8%
Real Estate	16	3.9%
Technology	39	9.4%
Utilities	24	5.8%
Total	**414**	**100%**

The analysis employs multivariate regressions with panel data over the period from 2010 to 2022. The pooled ordinary least squares (OLS) model is utilized, supported by various diagnostic tests to ensure robustness. Specifically, the variance inflation factor (VIF) is used to verify multicollinearity, and the White test is employed to check for heteroskedasticity. Additionally, the Hausman test is conducted to determine whether fixed or random effects models are more appropriate, with the analysis ultimately performed using robust standard errors to enhance the accuracy and consistency of the estimates.

These methodological steps ensure that the analysis is both rigorous and reliable, providing a comprehensive view of the trends and changes in corporate governance and ESG performance over the specified period.

3.1. Definition of variables and model specification

In this study, we investigate the impact of board characteristics on the ESG performance of firms. The analysis utilizes a fixed effects panel regression model to account for unobserved heterogeneity across firms. The fixed effects model is specified as follows:

$$\boldsymbol{ESGScore_{it} = \alpha + \beta_1 BGD_{it} + \beta_2 IBM_{it} + \beta_3 BS_{it} + \beta_4 CBM_{it} + \beta_5 NBM_{it} + \beta_6 BSS_{it} + \beta_7 BMTD_{it} + \beta_8 FS_{it} + \beta_9 LEV_{it} + \mu_i + \epsilon_{it}}$$

Where:

$ESGScore_{it}$: ESG performance of firm *i* at time *t*
BGD_{it} : Board gender diversity of firm *i* at time *t*
IBM_{it} : Independent board members of firm *i* at time *t*
BS_{it} : Board size of firm *i* at time *t*
CBM_{it} : CEO board membership of firm *i* at time *t*
NBM_{it} : Number of board meetings of firm *i* at time *t*
BSS_{it} : Board specific skills of firm *i* at time *t*
$BMTD_{it}$: Board member term duration of firm *i* at time *t*
FS_{it} : Firm size of firm *i* at time *t*
LEV_{it} : Leverage of firm *i* at time *t*
μ_i : Unobserved individual effects
ϵ_{it} : Error term

The variables used in our regression model are defined and measured as follows:

Table 2:
Variable definitions

Variable	Abbreviation	Measurement	Source
Dependent variables:			
ESG	ESGScore	Refinitiv's ESG Score is an overall company score based on the self-reported information in the environmental, social, and corporate governance pillars	[8], [42],[15]
Independent variables:			
Board Gender Diversity	BGD	Percentage of female board members	[14], [4], [8]

Independent Board Members	IBM	Percentage of independent board members as reported by the company	[12], [8], [81]
Board Size	BS	Total number of board members at the end of the fiscal year	[12], [3], [14]
CEO Board Member	CEO_BM	1 if the CEO is a board member, otherwise 0	[12], [81], [8]
Number of Board Meetings	NBM	Number of board meetings during the year	[66], [52], [13]
Board Specific Skills	BSS	Percentage of board members with either an industry-specific background or a strong financial background	[88], [38], [4]
Board Member Term Duration	BMTD	The smallest interval of years in which the board members are subject to re-election: annual re-election for long-serving members is counted as "1" year; if one-third retire at AGM, it is 3 years	[30], [81], [46]
Control variables:			
Firm Size	FS	Logarithm of total assets	[18], [14],
Leverage	LEV	Total debt as a percentage of total assets	[32], [14],
Moderating Variable:			
Sensitive Sector	Sensitive	1 if the company belongs to a sensitive sector (Energy, Basic Materials, Utilities, Industrials), otherwise 0	[71], [17]

4 Empirical results and discussion

4.1 Descriptive statistics

A summary of the main descriptive statistics (see Table 3) and pairwise correlations for the model variables is provided. Several noteworthy observations can be drawn from these tables, which provide insights into the characteristics of the sample and the relationships between the variables under study.

The mean value of ESGScore is 65.068, with a standard deviation of 17.670, indicating moderate to high ESG performance among the sampled companies, but with substantial variability. The minimum and maximum values of 3.52 and 95.72, respectively, reflect a wide range of ESG scores, suggesting significant differences in ESG practices and disclosures across firms. The 25th percentile (p25) and 75th percentile (p75) values are 54.36 and 78.52, respectively, indicating that the middle 50% of the firms have ESG scores within this range.

Board Gender Diversity (BGD) has a mean value of 27.331%, indicating that, on average, just over a quarter of board members are female. The median value of

27.78% aligns closely with the mean, suggesting a relatively balanced distribution. However, the standard deviation of 13.482, along with the range from 0 to 75%, highlights considerable diversity in gender representation across boards. The p25 and p75 values are 17.65% and 37.5%, respectively, reflecting the interquartile range of female board representation.

The mean percentage of Independent Board Members (IBM) is 60.991%, suggesting that a majority of board members in the sample are independent. The median value is 61.54%, with a standard deviation of 22.547, indicating a significant spread. The range from 0 to 100% underscores the varied board independence structures among the firms. The p25 and p75 values for IBM are 50% and 75%, respectively.

Board Size (BS) averages 11.658 members, with a median of 11. The standard deviation of 3.820 and the range from 1 to 38 members indicate considerable variation in board sizes, reflecting differences in governance structures and possibly the scale and complexity of the firms. The p25 and p75 values are 9 and 14 members, respectively.

The binary variable for CEO Board Member (CBM) has a mean of 0.634, indicating that in approximately 63.4% of the companies, the CEO is also a board member. The binary nature of this variable (0 or 1) results in a median of 1, reflecting the commonality of CEO duality in the sample. The p25 and p75 values are 0 and 1, respectively.

Number of Board Meetings (NBM) has a mean of 9.526 meetings per year and a median of 9. This suggests that boards generally meet frequently, though the standard deviation of 4.397 and the range from 1 to 48 meetings per year indicate substantial variation in meeting frequency, which may reflect differences in board activity and engagement levels. The p25 and p75 values are 7 and 11 meetings, respectively.

Board Specific Skills (BSS) shows a mean value of 41.095%, indicating that, on average, 41.1% of board members possess specific industry or financial skills. The median is 40%, with a standard deviation of 20.634, suggesting wide variability, from boards with no such skilled members to those where all members have specific expertise. The p25 and p75 values are 26.32% and 55.56%, respectively.

Board Member Term Duration (BMTD) averages 2.4 years, reflecting typical re-election intervals. The median duration is 3 years, with a standard deviation of 1.455 and a range from 1 to 6 years. This distribution indicates variability in board member turnover policies and practices across firms. The p25 and p75 values are 1 and 4 years, respectively.

The mean value for the Sensitive sector variable is 0.377, indicating that 37.7% of the companies belong to sensitive sectors (Energy, Basic Materials, Utilities, Industrials). The binary nature of this variable results in a median of 0, consistent with its categorization. The p25 and p75 values are also 0 and 1, respectively.

Firm Size (FS), measured as the logarithm of total assets, has a mean of 7.2 with a standard deviation of 0.770, indicating a range from 4.577 to 9.425. This suggests a diverse sample in terms of company size, which is critical for understanding the generalizability of the results across different firm scales. The p25 and p75 values are 6.68 and 7.685, respectively.

Leverage (LEV) has a mean value of 24.238%, with substantial variation (standard deviation of 15.287), indicating that the leverage ratios of companies in the sample range widely from 0 to 85.61%. This diversity in financial leverage underscores the varied financial strategies and risk profiles of the firms. The p25 and p75 values are 12.9% and 34.2%, respectively.

Table 3:

Summary statistics

	Mean	Median	SD	Min	Max	p25	p75
ESGScore	65.068	68.37	17.670	3.52	95.72	54.36	78.52
BGD	27.331	27.78	13.482	0	75	17.65	37.5
IBM	60.991	61.54	22.547	0	100	50	75
BS	11.658	11	3.820	1	38	9	14
CBM	.634	1	0.482	0	1	0	1
NBM	9.526	9	4.397	1	48	7	11
BSS	41.095	40	20.634	0	100	26.32	55.56
BMTD	2.4	3	1.455	1	6	1	4
Sensitive	.377	0	0.485	0	1	0	1
FS	7.2	7.098	0.770	4.577	9.425	6.68	7.685
LEV	24.238	23.2	15.287	0	85.61	12.9	34.2

The descriptive statistics of the control variables, Firm Size and Leverage, reveal a wide diversity of financial profiles among the firms in the sample. This diversity is crucial for understanding the generalizability of the results across different company sizes and financial structures. Such variability in firm characteristics underscores the importance of controlling for these factors in the analysis to ensure robust and reliable results. The inclusion of these control variables helps isolate the specific impacts of board characteristics on ESG performance, thereby enhancing the validity of the empirical findings.

4.2 Multicollinearity test

In Table 4, the pairwise correlation matrix indicates no significant multicollinearity among the examined variables. It is widely accepted in academic literature that a correlation coefficient near or exceeding 0.80 signals multicollinearity. Such high Pearson correlation values suggest an almost perfect linear association between variables, which can compromise the interpretability of regression coefficients and potentially lead to misleading conclusions [44]. Notably, the highest correlation observed within the matrix is between Firm Size and Board Size, registering at 0.494. Although significant, this figure is well below the 0.80 threshold, suggesting that multicollinearity is not a major concern in this context. The other substantial correlations, such as between ESG Score and Board Gender Diversity (0.336), and ESG Score and Firm Size (0.422), also fall short of this benchmark.

Consequently, the variables in this study appear to offer unique informational value, enhancing confidence that the forthcoming regression analyses will yield reliable and interpretable coefficient outcomes. Table 4 illustrates the relationships between the variables according to the pairwise correlation coefficient values, supporting a robust analytical framework for further investigation. This table presents pairwise correlations between the independent and control variables included in the analysis,

demonstrating their interrelationships without substantial concerns of multicollinearity.

Table 4.
Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) ESGScore	1.000								
(2) BGD	0.336*	1.000							
	(0.000)								
(3) IBM	0.266*	0.178*	1.000						
	(0.000)	(0.000)							
(4) BS	0.242*	0.066*	-0.253*	1.000					
	(0.000)	(0.000)	(0.000)						
(5) CBM	-0.042*	-0.049*	-0.088*	0.062*	1.000				
	(0.003)	(0.000)	(0.000)	(0.000)					
(6) NBM	0.111*	0.163*	0.146*		-0.030*	1.000			
	(0.000)	(0.000)	(0.000)	(0.773)	(0.034)				
(7) BSS	-0.138*	-0.195*		-0.244*	0.314*	-0.060*	1.000		
	(0.000)	(0.000)	(0.430)	(0.000)	(0.000)	(0.000)			
(8) FS	0.422*	0.189*	0.062*	0.494*		0.237*	-0.134*	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.651)	(0.000)	(0.000)		
(9) LEV	0.139*	0.083*	0.026	0.099*	0.047*	0.158*	-0.122*	0.105*	1.000
	(0.000)	(0.000)	(0.062)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	

**** p<0.01, ** p<0.05, * p<0.1*

The pairwise correlation matrix table presents the relationships among the variables used in this study. The variables include ESG Score *(ESGScore)*, Board Gender Diversity *(BGD)*, Independent Board Members *(IBM)*, Board Size *(BS)*, CEO as Board Member *(CEO_BM)*, Number of Board Meetings *(NBM)*, Board Specific Skills *(BSS)*, Board Member Term Duration *(BMTD)*, Firm Size (FS), and Leverage *(LEV)*. Table 2 provides full definitions for each variable utilized in the analysis.

To ensure the integrity of the regression analysis and uphold the validity of the dataset, we conducted a multicollinearity assessment of the independent variables using the Variance Inflation Factor (VIF) and the tolerance coefficients. These diagnostic tools are pivotal in identifying potential multicollinearity issues that could distort the regression results.

Table 5 summarizes the results of the multicollinearity test. The VIF values, ideally below 10 to exclude concerns of high multicollinearity, ranged from 1.064 to 1.831 across the variables. The corresponding tolerance values, calculated as the inverse of VIF (1/VIF), ranged from 0.546 to 0.94. Both metrics are well within acceptable limits, indicating a healthy level of independence among the variables. Specifically, the lowest tolerance value observed was 0.546 for Board Size (BS), and the highest was 0.94 for Leverage (LEV), all of which are significantly above the critical threshold of 0.1 often cited in the literature as a marker for multicollinearity concerns [37, 56].

Furthermore, the Mean VIF across all variables stands at 1.312, affirming that the overall level of multicollinearity within this set of independent variables is minimal. This finding aligns with the guidelines set forth by Hair et al. (2019), who suggest that VIF values below 10 indicate no serious multicollinearity concerns, and by Kutner et al. (2004), who recommend a VIF threshold of 10 and a tolerance threshold of 0.1.

These results support the robustness of the forthcoming regression analyses, ensuring that the relationships and impacts identified are attributable to the variables of

interest without undue inflation from overlapping variance. This validation of the methodological approach allows for rigorous testing of the study's hypotheses, free from the interference of multicollinearity, thereby bolstering the reliability and interpretability of the empirical results.

Table 5.
Variance inflation factor

	VIF	1/VIF
BS	1.831	.546
FS	1.558	.642
BMTD	1.378	.726
BSS	1.327	.754
IBM	1.21	.826
CBM	1.172	.853
NBM	1.145	.873
BGD	1.125	.889
LEV	1.064	.94
Mean VIF	1.312	.

These results demonstrate that the dataset is free from significant multicollinearity issues, allowing for reliable and interpretable regression analyses. The moderate VIF values suggest that the variables maintain their independence, ensuring that the estimated regression coefficients are not unduly influenced by multicollinearity. This bolsters the credibility of the study's findings and supports the robustness of the methodological approach.

Hausman test results

To appropriately select between fixed and random effects models, we conducted the Hausman specification test. The Hausman test is crucial for determining the consistency of an estimator when choosing between these two models.

As presented in Table 6, the results of the Hausman test revealed a Chi-square test value of 123.55 with a p-value of 0.0. This significant result suggests a strong preference for the fixed-effects model over the random-effects model. According to Hausman (1978), a significant test result (p-value < 0.05) indicates that the fixed-effects model provides a consistent and efficient estimator compared to the random-effects model under the presence of correlated individual effects and explanatory variables.

Therefore, based on these outcomes, the fixed-effects model is deemed suitable for our analysis, particularly in testing the hypotheses concerned with the specific impacts of board characteristics on corporate ESG performance. This decision aligns with the theoretical expectations that individual entity characteristics, which do not vary over time, significantly influence the dependent variable in our model setup.

Table 6.
Hausman (1978) specification test

	Coef.
Chi-square test value	123.55
P-value	0.0

4.3 Regression analysis

Table 7 presents the regression results of our analysis, highlighting the impact of board characteristics on the ESG Performance. The results reveal several significant and relevant implications for understanding how board characteristics influence corporate ESG performance.

Table 7.
Regression results

ESGScore	*Coef.*	*St.Err.*	*t-value*	*p-value*	*[95% Conf*	*Interval]*	*Sig*
BGD	.308	.012	25.49	0	.284	.332	***
IBM	.091	.01	9.00	0	.071	.111	***
BS	-.072	.077	-0.94	.347	-.224	.079	
CBM	-1.358	.598	-2.27	.023	-2.531	-.185	**
NBM	.075	.04	1.90	.058	-.002	.153	*
BSS	.031	.008	3.91	0	.015	.046	***
BMTD	-1.047	.22	-4.76	0	-1.479	-.616	***
FS	20.523	.885	23.20	0	18.789	22.258	***
LEV	-.03	.016	-1.83	.067	-.061	.002	*
Constant	-92.959	6.228	-14.93	0	-105.17	-80.749	***

Mean dependent var	65.672	SD dependent var	17.301
R-squared	0.424	Number of obs	4803
F-test	358.440	Prob > F	0.000
Akaike crit. (AIC)	31920.528	Bayesian crit. (BIC)	31985.297

*** $p<.01$, ** $p<.05$, * $p<.1$

Firstly, the coefficient for board gender diversity (BGD) is 0.308 with a standard error of 0.012, resulting in a t-value of 25.49 ($p < 0.01$). This indicates that an increase in the proportion of female board members is positively associated with higher ESG performance. This finding is consistent with previous studies, such as those by [12][11] and [39], which emphasize the beneficial impact of gender diversity on sustainability outcomes. The positive relationship can be attributed to the diverse perspectives and values that women bring to the boardroom, which enhance decision-making processes and lead to more comprehensive sustainability strategies. Studies by [65] and [60] suggest that female directors are more likely to advocate for environmental and social issues, thereby improving the firm's ESG performance. This finding aligns with Stakeholder Theory, which posits that diverse boards are better at addressing a wide array of stakeholder concerns, leading to enhanced ESG performance [28, 72]. Gender-diverse boards represent and address the interests of various stakeholders, fostering a more inclusive governance approach [16]. Female directors often emphasize collaborative and ethical approaches, enhancing the firm's reputation and trust among stakeholders[29].

Board independence (IBM) also shows a significant positive effect on ESG performance, with a coefficient of 0.091 and a standard error of 0.01, yielding a t-value of 9.00 ($p < 0.01$). This result aligns with the literature, underscoring the importance of independent directors in fostering responsible corporate behavior and enhancing ESG performance [5, 38]. Independent directors can provide unbiased oversight and are often more vigilant in holding management accountable for sustainable practices.

They are also more likely to challenge the status quo and support initiatives that align with long-term stakeholder interests, as supported by studies like those by [19] and [64]. Agency Theory explains the importance of board independence by suggesting that independent directors can mitigate principal-agent conflicts, ensuring that management decisions align with stakeholder interests [43, 48]. Effective oversight and accountability lead to improved ESG performance, as independent directors are more likely to advocate for sustainable practices that benefit all stakeholders [86].

In contrast, the presence of the CEO as a board member (CBM) has a negative impact on ESG performance, with a coefficient of -1.358 and a standard error of 0.598, resulting in a t-value of -2.27 ($p < 0.05$). This suggests that CEO duality can compromise board independence and hinder effective governance, negatively affecting sustainability initiatives, consistent with the findings of [25] and [87]. CEO duality often leads to a concentration of power, reducing the board's ability to oversee and influence the company's ESG strategies effectively. Agency Theory explains these negative implications by highlighting that when the CEO also serves as the board chair, the concentration of power undermines the board's ability to provide effective oversight [48]. This dual role can create conflicts of interest, where the CEO may prioritize short-term financial performance over long-term sustainability goals, leading to suboptimal decisions that harm ESG performance. The lack of checks and balances in such a governance structure can result in less rigorous scrutiny of management actions, allowing practices that may not align with stakeholder interests to go unchecked [47].

Board meetings (NBM) is positively associated with ESG performance, although this relationship is only marginally significant. Specifically, the coefficient for NBM is 0.075 with a standard error of 0.04, resulting in a t-value of 1.90 ($p < 0.1$). This suggests that more frequent board meetings correlate with improved ESG outcomes, highlighting the importance of active board engagement in overseeing sustainability efforts [59, 66]. Frequent board meetings provide regular opportunities for discussing and monitoring ESG issues, thereby prioritizing sustainability within corporate governance. This finding can be contextualized within both agency theory and stakeholder theory frameworks. According to agency theory, frequent board interactions enhance monitoring and control over management, reducing information asymmetry and ensuring alignment with shareholders' interests [48]. Stakeholder Theory, on the other hand, posits that regular meetings facilitate addressing stakeholders' concerns, incorporating their interests into strategic decisions, thereby fostering trust and accountability essential for effective ESG performance [72].

Board-specific skills (BSS) significantly contribute to ESG performance, with a coefficient of 0.031 and a standard error of 0.008, yielding a t-value of 3.91 ($p < 0.01$). This finding underscores the value of having board members with industry-specific or financial expertise in integrating ESG considerations into corporate strategies [13, 90]. Directors with relevant expertise provide more effective oversight and strategic guidance, helping the company navigate complex ESG challenges and opportunities. Stakeholder Theory supports the importance of board-specific skills, suggesting that directors with relevant expertise are better equipped to understand and address the complex and evolving concerns of various stakeholders, including envi-

ronmental and social issues [16]. Their specialized knowledge enables them to provide valuable insights and strategic guidance that can enhance the firm's ESG performance. Furthermore, these directors can help the firm build competitive advantages by identifying and leveraging opportunities related to sustainability, thereby fostering long-term organizational success [9].

Interestingly, board member term duration (BMTD) exhibits a significant negative impact on ESG performance, as evidenced by a coefficient of -1.047 and a standard error of 0.22, resulting in a t-value of -4.76 ($p < 0.01$). This indicates that shorter term durations, which necessitate more frequent re-elections, enhance accountability and responsiveness to stakeholder expectations [54]. Frequent re-elections can prevent entrenchment, ensuring board members remain aligned with evolving stakeholder priorities and emerging ESG trends. From an agency theory perspective, shorter term durations can mitigate agency problems by reducing the likelihood of entrenchment and ensuring board members remain accountable to shareholders and other stakeholders [48]. Frequent re-elections offer opportunities to refresh the board with new members who bring fresh perspectives and are more attuned to current stakeholder concerns [55]. This dynamic enhances the board's responsiveness to emerging ESG issues, leading to improved performance in these areas.

Regarding financial controls, firm size (FS) has a highly significant positive coefficient of 20.523 with a standard error of 0.885, resulting in a t-value of 23.20 ($p < 0.01$). This indicates that larger firms are more likely to engage in ESG activities, supporting stakeholder theory which posits that larger firms have more resources and incentives to invest in sustainability practices [22, 26] . Larger firms often face greater public scrutiny and have more resources at their disposal to implement comprehensive ESG programs.

Conversely, leverage (LEV) has a marginally significant negative impact on ESG performance, with a coefficient of -0.03 and a standard error of 0.016, yielding a t-value of -1.83 ($p < 0.1$). This aligns with the notion that higher debt levels constrain firms' ability to allocate resources to ESG activities, prioritizing financial stability over social and environmental investments [51, 62]. High leverage can limit the financial flexibility needed to invest in long-term sustainability initiatives, as firms prioritize meeting their debt obligations.

Overall, the regression results highlight that board characteristics such as gender diversity, independent members, specific skills, and shorter-term durations positively influence ESG performance. In contrast, CEO duality and higher leverage negatively impact ESG outcomes. These findings emphasize the importance of strategically considering board composition and governance structures to enhance corporate sustainability performance. The significant F-test ($p < 0.01$) and high R-squared value (0.424) further validate the robustness of the model, indicating a strong explanatory power of the included variables in determining ESG performance.

4.4 Additional analyses

To further explore the robustness and nuances of our main findings, we conducted additional analyses incorporating interaction terms between board characteristics and

sector sensitivity. The rationale for this additional analysis is to investigate whether the impact of board characteristics on ESG performance differs between firms in sensitive sectors (Basic Materials, Energy, Industrials, and Utilities) and those in less sensitive sectors (Consumer Cyclicals, Consumer Non-Cyclicals, Financials, Healthcare, Real Estate, and Technology). This approach allows us to capture potential sector-specific dynamics that may influence the relationship between board characteristics and ESG performance.

Table 8 presents the regression results with interaction terms. Notably, the inclusion of these interaction terms provides deeper insights into the moderating role of sector sensitivity on the relationship between board characteristics and ESG performance.

Table 8.
Regression results

ESGScore	*Coef.*	*St.Err.*	*t-value*	*p-value*	*[95% Conf*	*Interval]*	*Sig*
BGD	.303	.015	20.63	0	.274	.332	***
IBM	.11	.013	8.59	0	.085	.136	***
BS	-.175	.093	-1.88	.061	-.359	.008	*
CBM	.289	.771	0.37	.708	-1.222	1.799	
NBM	.028	.048	0.59	.554	-.066	.123	
BSS	.041	.01	4.04	0	.021	.06	***
BMTD	-1.349	.265	-5.09	0	-1.868	-.83	***
FS	20.474	.884	23.15	0	18.74	22.208	***
LEV	-.026	.016	-1.60	.11	-.058	.006	
Sensitive	0	.	.	.	.	.	
BGD × Sensitive	.02	.023	0.87	.382	-.025	.064	
IBM × Sensitive	-.05	.021	-2.41	.016	-.09	-.009	**
BS × Sensitive	.332	.163	2.04	.041	.014	.651	**
CBM × Sensitive	-4.126	1.217	-3.39	.001	-6.512	-1.74	***
NBM × Sensitive	.139	.084	1.65	.099	-.026	.303	*
BSS × Sensitive	-.024	.016	-1.46	.145	-.056	.008	
BMTD × Sensitive	.978	.47	2.08	.038	.056	1.9	**
Constant	-93.402	6.225	-15.00	0	-105.607	-81.197	***

Mean dependent var	65.672	SD dependent var	17.301
R-squared	0.428	Number of obs	4803
F-test	204.586	Prob > F	0.000
Akaike crit. (AIC)	31901.405	Bayesian crit. (BIC)	32011.514

*** $p<.01$, ** $p<.05$, * $p<.1$

Board Gender Diversity (BGD): The coefficient for BGD remains positive and significant (0.303, $p<0.01$), indicating that increasing the proportion of female board members continues to be positively associated with higher ESG performance. This finding is consistent with prior studies such as [11] and [74], which highlight the beneficial impact of gender diversity on sustainability outcomes. However, the interaction term (BGD × Sensitive) is not significant, suggesting that the positive influence of board gender diversity on ESG performance does not significantly differ between sensitive and less sensitive sectors.

Independent Board Members (IBM): The main effect of IBM on ESG performance remains positive and significant (0.11, $p<0.01$). The interaction term (IBM × Sensitive) is negative and significant (-0.05, $p<0.05$), indicating that the positive impact of

independent board members on ESG performance is attenuated in sensitive sectors. This aligns with stakeholder theory, which posits that corporations exist to serve a broad array of stakeholders, including shareholders, employees, customers, suppliers, and the community. This theory emphasizes the interconnected nature of stakeholder relationships and the mutual benefits of ethical and socially responsible corporate conduct [9, 28, 72, 80]. In sensitive sectors, the complexity and heightened scrutiny might dilute the effectiveness of independent oversight as firms navigate complex regulatory environments and seek to build trust and engagement with their stakeholders [10].

Board Size (BS): The coefficient for BS is negative and marginally significant (-0.175, $p<0.1$), suggesting that larger boards may have a detrimental impact on ESG performance. Interestingly, the interaction term (BS × Sensitive) is positive and significant (0.332, $p<0.05$), implying that larger boards in sensitive sectors may be better equipped to handle ESG issues, possibly due to the increased diversity of expertise and perspectives needed to address sector-specific environmental and social challenges. This can be supported by the stakeholder theory, which argues that a broader representation within the board enhances the firm's ability to address diverse stakeholder interests [28].

CEO Board Membership (CBM): The main effect of CBM is not significant, indicating that CEO board membership alone does not significantly influence ESG performance. However, the interaction term (CBM × Sensitive) is negative and highly significant (-4.126, $p<0.01$), suggesting that in sensitive sectors, having the CEO on the board may hinder ESG performance, possibly due to potential conflicts of interest or over-concentration of power [78].

Number of Board Meetings (NBM): The main effect of NBM is not significant. The interaction term (NBM × Sensitive) is positive but only marginally significant (0.139, $p<0.1$), indicating a slight positive interaction effect in sensitive sectors. This might suggest that more frequent board meetings in sensitive sectors can marginally enhance ESG performance by ensuring more thorough oversight and deliberation of ESG issues [21, 36].

Board Specific Skills (BSS): The coefficient for BSS remains positive and significant (0.041, $p<0.01$), reinforcing the importance of board members' industry-specific or financial expertise in enhancing ESG performance. The interaction term (BSS × Sensitive) is not significant, indicating that the positive impact of board-specific skills on ESG performance does not significantly vary between sensitive and less sensitive sectors.

Board Member Term Duration (BMTD): The main effect of BMTD is negative and significant (-1.349, $p<0.01$), suggesting that longer board member term durations are associated with lower ESG performance, potentially due to stagnation or entrenchment effects. Interestingly, the interaction term (BMTD × Sensitive) is positive and significant (0.978, $p<0.05$), indicating that in sensitive sectors, longer board member terms might actually benefit ESG performance, possibly due to accumulated sector-specific knowledge and experience [52].

These additional analyses underscore the importance of considering sector-specific factors when examining the relationship between board characteristics and ESG per-

formance. The findings suggest that while certain board attributes universally enhance ESG performance, their effectiveness can be moderated by the sector in which the firm operates. This highlights the need for tailored governance strategies that account for the unique ESG challenges and opportunities presented by different sectors. Integrating the perspectives of both agency theory and stakeholder theory provides a comprehensive understanding of how board characteristics can be leveraged to improve ESG performance across various industry contexts.

5 Conclusion

This paper addresses a significant gap in the literature by empirically examining the impact of board characteristics on ESG performance. Our study, based on a robust dataset of 4,803 observations from companies listed on the STOXX Europe 600 index over the period 2010-2022, employs a rigorous methodology to ensure the validity of our findings. This research contributes to the growing body of research on corporate governance and sustainability by providing comprehensive empirical evidence on the relationship between various board characteristics—such as board gender diversity, independent board members, board size, CEO board membership, the number of board meetings, board-specific skills, and board member term duration—and ESG performance.

The findings of this study reveal that board characteristics significantly influence ESG performance. Notably, board gender diversity, independent board members, and board-specific skills have a positive impact on ESG performance, suggesting that diverse, independent, and skilled boards are better equipped to implement and oversee effective sustainability strategies. Conversely, CEO board membership and longer board member term durations are negatively associated with ESG performance, indicating that these factors may impede effective governance and sustainability initiatives. Additionally, the study identifies that larger boards and higher leverage are linked to lower ESG performance, highlighting the challenges of managing sustainability within more complex board structures and financially constrained environments.

This paper further extends the literature by investigating the moderating role of sector sensitivity on the relationship between board characteristics and ESG performance. The inclusion of interaction terms between board characteristics and sector sensitivity provides nuanced insights into how the effectiveness of board attributes varies across different sectors. For instance, the positive impact of independent board members on ESG performance is attenuated in sensitive sectors, whereas larger boards in these sectors are better positioned to address ESG issues. These findings underscore the importance of considering sector-specific dynamics in examining corporate governance and sustainability practices.

The implications of this study are manifold for companies, policymakers, and researchers. For companies, the evidence suggests that strategically enhancing board diversity, independence, and expertise can significantly improve ESG performance. Policymakers and regulatory authorities can leverage these insights to develop guide-

lines and frameworks that promote effective board governance structures, particularly in sectors where ESG challenges are more pronounced. For researchers, the findings highlight the need for further exploration of sector-specific effects of board characteristics on ESG performance and the potential integration of theories such as stakeholder theory and agency theory to provide a more comprehensive understanding of these relationships.

Despite the rigorous methodology, this study has several limitations, offering avenues for future research. The analysis focuses solely on board characteristics without considering other corporate governance mechanisms or ownership structures that may influence ESG performance. Future research could expand this scope by examining additional factors and exploring the impact of external elements such as regulatory environments and market conditions. Moreover, this study is limited to companies listed on the STOXX Europe 600 index; future research could include firms from diverse regions and industries to enhance the generalizability of the findings. Incorporating qualitative methods, such as interviews with board members and executives, could also provide deeper insights into the drivers of ESG performance and the practical challenges of implementing sustainability strategies within corporate governance frameworks.

In conclusion, this study makes a substantial contribution to understanding how board characteristics influence ESG performance, offering valuable insights for enhancing corporate sustainability practices through effective governance. The findings emphasize the need for tailored governance strategies that account for sector-specific dynamics and highlight the potential for further research to build on these results and address the identified limitations.

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