

How sustainability committees moderate the link between ESG performance and environmental innovation in European firms?

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Received 7 June 2024
Revised 12 September 2024
5 November 2024
16 December 2024
Accepted 17 December 2024

Abstract

Purpose – This paper investigates the moderating role of sustainability committees in the relationship between environmental, social and governance (ESG) performance and environmental innovation within European nonfinancial firms.

Design/methodology/approach – The study analyzes data from 691 nonfinancial sector firms operating within EU states from 2013 to 2022. It employs regression analysis to examine the correlation between ESG performance and environmental innovation, considering the moderating effect of sustainability committees.

Findings – The research reveals a significant and positive correlation between ESG performance and environmental innovation. Moreover, it demonstrates that sustainability committees play a positive moderating role in this relationship, indicating their importance in fostering environmental innovation within organizations.

Research limitations/implications – The study is limited to European nonfinancial companies, potentially limiting the generalizability of findings. Additionally, the research focuses on the moderating role of sustainability committees, leaving room for further exploration of other governance mechanisms.

Practical implications – The findings suggest that implementing an ESG performance framework and establishing dedicated sustainability oversight mechanisms, such as sustainability committees, can enhance environmental innovation within organizations. This insight is valuable for strategic decision-making aimed at advancing both sustainability and innovation agendas.

Originality/value – This study addresses a gap in the literature by exploring the moderating effect of sustainability committees on the link between ESG performance and environmental innovation from various theoretical viewpoints. It contributes to the understanding of mechanisms that enhance environmental innovation within companies and provides practical implications for corporate reporting accuracy and sustainability initiatives.

Keywords Sustainability committees, ESG performance, Environmental innovation, European firms, Moderation analysis

Paper type Research paper

1. Introduction

Integrating corporate governance and sustainability has become a central focus for scholars, communities, policymakers, and corporations. In the last ten years, firms have gradually made substantial attempts to incorporate sustainability indicators that specifically target ESG factors. Corporate governance practices have been implemented in response to increasing calls to mitigate adverse impacts on the sustainability agenda and advance policies that are crucial for enhancing corporate sustainability performance and addressing stakeholders' concerns to achieve a more favorable market reputation (Baselga-Pascual *et al.*, 2018; Abdullah *et al.*, 2024). Recent



Business Process Management Journal
Vol. 31 No. 7, 2025
pp. 2709-2731
© Emerald Publishing Limited
e-ISSN: 1758-4116
p-ISSN: 1463-7154
DOI 10.1108/BPMJ-05-2024-0360

The authors acknowledge the support from the Program of the National Social Science Foundation of China (22CGL063).

discussions on corporate governance have increasingly focused on contemporary ESG issues to understand better how firms are managed and to identify corporate governance strategies that can positively influence ESG performance and drive environmental innovation (Hussain *et al.*, 2018). One result of these discussions has been a growing prevalence of sustainability committees within firms (López-Arceiz *et al.*, 2022; Thun and Zülch, 2023).

ESG performance plays an important role not only in ensuring regulatory compliance and effective risk management but also in fostering sustainable, profitable, and resilient business practices (Alodat and Hao, 2024). As the business landscape continues to evolve, firms that prioritize ESG performance are likely to gain a competitive edge, attract investment, and contribute positively to society and the environment (Daugaard and Ding, 2022). In addition, research has been conducted to resolve theoretical arguments concerning the effect of ESG performance on environmental innovation (Tan and Zhu, 2022; Chen *et al.*, 2023; Saydam *et al.*, 2024). Nevertheless, the results of prior research are inconclusive (Doni and Fiameni, 2024), prompting the need for further investigation.

Previous studies investigating the effects of sustainability committees on environmental innovation have been provided, and limited inconclusive results (Rodrigue *et al.*, 2013; Biswas *et al.*, 2018; Abdullah *et al.*, 2024). For instance, the studies conducted by Rodrigue *et al.* (2013) and Berrone and Gomez-Mejia (2009) do not find any correlation between sustainability projects and environmental performance. Biswas *et al.* (2018). However, there is evidence that establishing specialized sustainability committees enhances sustainability performance. Most of these studies have focused on examining the direct impact of sustainability committees on environmental innovation. According to Abdullah *et al.* (2024), there is a need to examine the mechanisms through which corporate governance may positively influence environmental innovation. Hence, this study aims to investigate the moderating effect of sustainability committees on the relationship between ESG performance and environmental innovation.

To face challenges, firms must strive to follow environmental innovation practices. This approach preserves the natural environment and enhances its reputation and performance (Hizarci-Payne *et al.*, 2021). Our research is intricately aligned with the United Nations Sustainable Development Goals. We mainly focus on Sustainable Development Goal 9, emphasizing innovation's role in sustainable development (Denoncourt, 2020). Sustainable Development Goal 7 emphasizes the shift towards cleaner and readily available energy sources to tackle environmental and societal issues (Villavicencio Calzadilla and Mauger, 2018). Sustainable Development Goal 12 focuses on promoting sustainable consumption and production patterns, which are essential for maintaining the well-being of current and future generations (Al-ahdal *et al.*, 2024).

The concept of environmental innovation, coined in the late 20th century, has gained traction. Initially defined as creating products, processes, or services offering value while reducing environmental impact, its scope has since broadened (Watson *et al.*, 2018). In addition, they have expanded this definition to encompass innovations minimizing environmental risks and resource consumption throughout their lifecycle (Garcés-Ayerbe *et al.*, 2019). Despite varying interpretations, this study adopts the definition proposed (Rennings, 2000), we are emphasizing innovation focused on environmental enhancement within organizational contexts. Terminology including “green,” “eco,” “environmental,” and “sustainable” innovation has been employed. The Brundtland report introduced “sustainable innovation” as meeting present needs without compromising future generations’ abilities (Burton, 1987). Noted a shift towards “green” and “eco-innovation” since 2005 (Schiederig *et al.*, 2012) Emphasizing economic and ecological aspects, while “sustainable innovation” integrates social elements (Díaz-García *et al.*, 2015). Defining eco-innovation based on environmental performance rather than intention is deemed more pertinent, highlighting its positive environmental effects. Although past studies have predominantly focused on environmentally motivated innovation, it's noted that many innovations offer environmental

benefits, emphasizing the necessity of assessing whether their use results in less environmental harm compared to alternatives (Renning, 2000).

A limited body of research investigates the correlation between ESG performance and environmental innovation (Wang *et al.*, 2023; Saydam *et al.*, 2024; Li and Li, 2024) and this relationship remains insufficiently understood. Furthermore, the sustainability committee is an essential governing entity that guides a firm toward a more sustainable future, reconciling profitability with social responsibility and environmental stewardship (Orazalin *et al.*, 2024a, b). Based on prior literature that has employed the sustainability committee as a moderate variable (Orazalin *et al.*, 2024a, b; Alodat and Hao, 2024; Nguyen *et al.*, 2024). We propose that the sustainability committee may be pivotal in influencing the relationship between ESG performance and environmental innovation. The sustainability committee provides insights and policies on the impact of governance on environmental innovation (Li *et al.*, 2023). It helps understand how companies can better leverage internal governance to drive sustainability-related innovations. This research supports strategic decision-making and enhances corporate contributions to sustainable development goals.

The characteristics of sustainability committees and boards are vital in promoting environmental innovation and ensuring corporate sustainability in European countries (Farza *et al.*, 2022). Its strategic supervision, risk management, and resource allocation responsibilities, together with its influence on fostering innovation and improving compliance, establish the committee as a predominant entity in navigating the intricacies of sustainability in the contemporary corporate environment (Annesi *et al.*, 2024). By aligning with European sustainability objectives, the committee contributes to the firm's success and the achievement of the United Nations Sustainable Development Goals (Zampone *et al.*, 2024).

The study of the relationship between ESG performance and environmental innovation within the context of sustainability committees in European countries is motivated by several key factors. First, there is an increasing worldwide focus on business sustainability, environmental innovation, and responsible governance in line with the United Nations Sustainable Development Goals. Managers, investors, and policymakers need to understand the impact of ESG performance on environmental innovation to align their objectives with sustainable practices. Second, it is essential to analyze the moderating effects of the sustainability committee to comprehend that it shapes the efficacy and results of ESG strategies. This study contributes to the European business landscape by bridging the gap in ESG Performance, environmental innovation, and sustainability literature.

The role of sustainability committees has emerged as a critical and highly relevant topic in today's landscape, attracting significant interest from researchers and scholars alike (Orazalin *et al.*, 2024a, b). Advocates claim that forming a sustainability committee improves decision-making, cultivates a heightened sense of social responsibility, and propels advancements in a firm's environmental innovation (Valle *et al.*, 2019; Orazalin, 2020). Furthermore, recent studies have investigated the relationship between ESG performance, environmental innovation, and sustainability committees. Multiple studies have aimed to consolidate the literature on ESG disclosures, sustainability committees, and environmental innovation, emphasizing the interrelation of these factors (Yang *et al.*, 2024; Wu *et al.*, 2024; Abdullah *et al.*, 2024). Most of the prior research has ignored the moderating role of sustainability committees. This study seeks to address a critical gap in the literature by examining the moderating influence of sustainability committees on the connection between ESG performance and environmental innovation in European firms. Although current research has explored numerous aspects affecting ESG performance, there has been insufficient focus on the possible moderating role of governance mechanisms, such as sustainability committees, in the relationship between ESG practices and innovation results. This study uniquely contributes to the area by offering empirical evidence that enhances the knowledge of how governance structures might improve the efficacy of ESG-driven environmental innovation. Consequently, this study aims to investigate the moderating effect of sustainability committees on the association

between ESG performance and environmental innovation in the context of European non-financial firms listed in European countries from 2013 to 2020. This study seeks to address the existing research gap concerning environmental innovation and sustainability within community firms, which holds significant implications for regulators and stakeholders across European nations.

This study contributes to the literature on innovation and sustainability within diverse contexts. First, this study investigates the moderating effect of a sustainability committee on the relationship between ESG factors and environmental innovation. Firms rely on the sustainability committee as an essential resource to execute their duties and meet their responsibilities; thus, examining sustainability committees as a moderating will explain the indirect relation between ESG performance and environmental innovation. The study conducted by [Alodat and Hao \(2024\)](#) is one of the limited number of scholarly investigations that specifically examine the role of sustainability committees as a moderating factor inside the European Union. Although [Alodat and Hao \(2024\)](#) provide evidence on the moderating role of the sustainability committee, the study did not specifically examine environmental innovation. Therefore, this study aims to address the existing gap in the ESG performance literature by offering a more detailed analysis of mechanisms. It seeks to enhance practical implications for ensuring the integrity and accuracy of corporate reporting and fostering environmental innovation.

Moreover, to the best of our knowledge, prior research has not extensively examined the moderating role of sustainability committees in the relationship between ESG performance and environmental innovation through the lens of stakeholder theory. Stakeholder theory, as articulated by [Freeman \(1984\)](#), underscores the importance of creating value for shareholders and a diverse array of stakeholders, including employees, customers, communities, and the environment. This perspective is particularly relevant in escalating environmental challenges, where stakeholders increasingly demand that organizations prioritize sustainability initiatives. By addressing these concerns, firms can align their ESG activities with stakeholder expectations, fostering environmental innovation. This study contributes to the growing literature by exploring this relationship and offering practical insights into how organizations can leverage stakeholder engagement to drive sustainable outcomes.

Our study has significant practical implications for policymakers, investors, organizations, and stakeholders. Our findings thoroughly examine the function of sustainability committees in European firms and boost the comprehension of ESG performance frameworks to promote environmental innovation. Thus, our findings offer significant insights for organizations, their boards, and sustainability committees in developing and implementing effective strategies to advance environmental innovation and boost sustainability outcomes. Organizations prioritizing stakeholder requests and expectations can proactively implement alignment mechanisms to improve environmental innovation. Sustainability committees play a mediating role in the relationship between ESG performance and environmental innovation. Moreover, sustainability committees within the board exhibit heightened responsiveness to stakeholder demands by incorporating alignment and monitoring mechanisms, directly and indirectly impacting performance. Policymakers may promote the formation of influential sustainability committees within enterprises, thereby improving ESG performance and stimulating environmental innovation.

The subsequent sections of this paper are organized as follows: [Section 2](#) provides a comprehensive review of the literature and establishes hypotheses. [Section 3](#) outlines the data collection process and methodology employed in this study. [Section 4](#) presents the empirical findings and offers a detailed discussion. [Section 5](#) delves into the regression results, while [Section 6](#) addresses potential endogeneity concerns. Finally, [Section 7](#) offers concluding remarks and avenues for future research.

2. Literature review and hypotheses development

2.1 ESG performance

ESG is the acronym for the words (E) Environment, (S) social responsibility, and (G) Governance. The Environmental aspect centers on a firm's environmental footprint, advocating for advancements such as sustainable materials and renewable energy; this incentivizes firms to investigate environmentally friendly technologies (Wu *et al.*, 2024). The Social dimension analyses the impact of a firm's interactions with communities, employees, and consumers on its ability to innovate. Firms that establish robust social performance are likely to cultivate a conducive atmosphere for innovation, resulting in the development of goods that effectively tackle societal demands (Solesvik *et al.*, 2022). Governance, the third pillar, encompasses the principles of high-quality management and ethical business practices, which guarantee that firms make decisions are in line with sustainability objectives (Wu *et al.*, 2024).

2.2 Environmental innovation

The concept of environmental innovation, first introduced in the late 20th century, has evolved significantly. Rennings (2000) defined it as including innovations that reduce environmental risks and resource consumption throughout their life cycles (Garcés-Ayerbe *et al.*, 2019). This study adopts Kemp and Pearson (2007) definition, which focuses on innovations aimed at improving environmental conditions within organizational settings. The literature has used various terms, such as “green,” “eco,” “environmental,” and “sustainable” innovation. The Brundtland report introduced “sustainable innovation” as addressing current needs without jeopardizing future generations' capabilities. Schiederig *et al.* (2012) observed a growing preference for “green” and “eco-innovation” post-2005, highlighting both economic and ecological considerations, whereas “sustainable innovation” incorporates social dimensions (Díaz-García *et al.*, 2015). The definition of eco-innovation is more relevant when based on actual environmental performance rather than mere intent, as it underscores tangible positive environmental impacts. While much research has focused on innovations driven by environmental motivations, it is crucial to evaluate whether these innovations result in less environmental damage compared to available alternatives (Kemp and Pearson, 2007).

2.3 Sustainability committees

The sustainability committee, a subcommittee of the board of directors, oversees the firm's sustainability strategies and practices. Its mandate includes auditing, monitoring, and advocating for comprehensive practices related to ESG performance (Burke *et al.*, 2019). Additionally, the committee aims to mitigate the impact of negative performance while ensuring the effective implementation and monitoring of sustainability practices across the firm and all stakeholders (Valle *et al.*, 2019). The sustainability committee increases transparency and corporate responsibility, and working on sustainability practices improves the relationship between stakeholders and the board of directors (Abdullah *et al.*, 2024), the sustainability committee oversees the firm's communication strategies and internal control processes to enhance ESG performance (Burke *et al.*, 2019). Firms investing highly in ESG performance tend to create sustainability committees (Burke *et al.*, 2019; Abdullah *et al.*, 2024).

2.4 Stakeholder theory

An integrated theoretical framework grounded in stakeholder theory is developed to examine the moderating influence of the sustainability committee. This framework emphasizes the firm's responsibility to address the interests of all stakeholders (Freeman and Dmytriiev, 2017). According to Freeman (1984), a firm's success depends on its ability to create value for a broad range of stakeholders, including investors, employees, local communities, suppliers,

and customers. Recognizing these stakeholders' pivotal roles ensures the firm's long-term viability and sustained success (Freeman, 1984). Consequently, fostering enduring relationships with stakeholders and effectively addressing their concerns is imperative for achieving organizational objectives.

2.5 ESG performance and environmental innovation

Research highlights the role of a positive relationship between ESG performance and driving environmental innovation (Chen *et al.*, 2006; Li *et al.*, 2018a, b; Chouaibi *et al.*, 2022a, b). Although various inherent industry and firm-specific characteristics complicate typical environmental innovation models, firms that emphasize ESG practice insights to maximize resource utilization and improve competitive advantage (Chouaibi *et al.*, 2022a, b). The effect of ESG performance on environmental innovation is shaped by national settings and acknowledged by third-party rating organizations, demonstrating business dedication to sustainable development (Limkriangkrai *et al.*, 2017; Aouadi and Marsat, 2018). This increasing emphasis corresponds with green development objectives, bolstered by financial resources and managerial priorities, as companies progressively utilize environmental innovation to gain competitive advantages in the market (Tan and Zhu, 2022; Mansour *et al.*, 2024a).

Several studies have explored the impact of ESG performance on environmental innovation, noting a positive link between ESG initiatives and green advancements. Yuan and Cao (2022) found that ESG initiatives, informed by resource-based views and stakeholder theories, promote environmental innovation and the development of green products, primarily through stakeholder impact. Mukhtar *et al.* (2023) emphasized that firms strategically integrate ESG to encourage adoption of environmental innovation. Moreover, Zhang *et al.* (2022) research demonstrates that ESG performance enhances green patent applications and grant approvals, hence promoting environmental innovation. Padilla-Lozano and Collazzo (2021) emphasized that corporate social responsibility initiatives can improve competitive advantage, mitigate risks, and promote sustainable practices inside organizations. Wu *et al.* (2024) examined firms listed on the Shenzhen and Shanghai Stock Exchanges from 2014 to 2021, discovering that ESG performance significantly impacts green innovation. In addition, Xu *et al.* (2021) found that more robust ESG performance positively correlates with increased green invention patents. In contrast, Marietza and Nadia (2021) noted a negative effect of limited corporate social responsibility on green innovation in some contexts.

Previous studies suggest a strong link between ESG performance and enhanced environmental innovation, as firms engaged in ESG practices promote innovation-centric processes that drive social value and financial performance (Doni and Fiameni, 2024; Hull and Rothenberg, 2008). Research shows that firms adopting corporate social responsibility practices tend to innovate across operations (Bocquet *et al.*, 2013), with empirical evidence from Spanish firms confirming corporate social responsibility positively impacts performance and innovation capabilities (Reverte *et al.*, 2016). Ueki *et al.* (2016) further validate the positive influence of corporate social responsibility on environmental innovation. Benkraiem *et al.* (2023) demonstrate how reductions in greenhouse gas emissions and green innovation enhance financial performance independently and synergistically. Guided by stakeholder theory, firms focus on the interests of all stakeholders to foster responsible practices. They leverage internal and external collaboration to improve knowledge integration and innovation (Donaldson and Preston, 1995; Jiang *et al.*, 2020; Choi and Wang, 2009).

Integrating ESG performance is a strategic driver of environmental innovation in emerging economies (Mo *et al.*, 2022). ESG is critical in promoting such innovation (Hong *et al.*, 2020). Emphasizing ESG fosters sustainable environmental practices, encouraging investments in eco-friendly technologies and processes that reduce waste and energy consumption (Shahzad *et al.*, 2020). Drawing from prior literature and stakeholder theory, a positive relationship between ESG performance and environmental innovation is evident (Liu and Lyu, 2022; Fu *et al.*, 2023; Saydam *et al.*, 2024). Accordingly, this study proposes the following hypothesis.

- H1. There is a significant positive relationship between ESG performance and environmental innovation.

2.6 The moderating role of the sustainability committee

The role of ESG performance in fostering environmental innovation has become a focal point of research and practice within contemporary organizational strategy. Amid growing concerns about climate change, resource depletion, and societal impact, businesses are increasingly adopting ESG frameworks to enhance their sustainability practices (Alodat and Hao, 2024). However, the effectiveness of these ESG initiatives in driving environmental innovation can vary significantly (Chen *et al.*, 2023). One potential moderating factor in this relationship is the presence and influence of a dedicated sustainability committee. This committee typically composed of members with diverse expertise in environmental issues, corporate governance, and stakeholder engagement, could be crucial in guiding and enhancing the organization's ESG efforts (Bifulco *et al.*, 2023).

Sustainability committees are pivotal in enhancing ESG performance by integrating environmental, social, and governance elements into a firm's strategy and operations, promoting sustainable growth, and facilitating long-term value generation (Alodat and Hao, 2024; Velte, 2024). They advocate investments in sustainable technology, manage the design and execution of environmental innovation programs, and improve board efficacy regarding sustainability matters (Eccles *et al.*, 2014; Liao *et al.*, 2015; Biswas *et al.*, 2018). Sustainability committees provide resources, oversee environmental and social initiatives, and synchronize governance processes with stakeholder expectations (Donaldson and Preston, 1995; Dalziel *et al.*, 2011; Farza *et al.*, 2022). Some research indicates a good correlation between sustainability committees and outcomes like GHG emissions reduction (Liao *et al.*, 2015) and social performance (Biswas *et al.*, 2018), while others demonstrate a limited association with environmental performance (Berrone and Gomez-Mejia, 2009). Ultimately, these committees support the development and execution of sustainability strategies, promoting environmental innovation and aligning firm practices with stakeholder needs (Bifulco *et al.*, 2023).

Environmental innovation provides sustainable growth prospects via internal shareholder governance systems (Chen *et al.*, 2023) and is intricately associated with ESG performance (Fatemi *et al.*, 2018; Li *et al.*, 2018a, b). Implementing ESG practices improves organizational learning (Duque-Grisales and Aguilera-Caracuel, 2021) and strengthens corporate governance (Khan, 2022), promoting environmental innovation (Chen *et al.*, 2023; Zhang *et al.*, 2023a, b; Mohy-ud-Din, 2024). The sustainability committee facilitates ESG initiatives, oversees management (Bifulco *et al.*, 2023), and enhances environmental innovation (Baraibar-Diez and Odriozola, 2019). Prior research highlights the committee's positive impact on practices and disclosures (Liao *et al.*, 2015), human rights (Mallin and Michelon, 2011), pollution control (Homroy and Slechten, 2019), and overall ESG outcomes (Flammer, 2015; Burke *et al.*, 2019; Elmaghrabi, 2021). Based on the studies above, the sustainability committee is anticipated to enhance the connection between ESG performance and environmental innovation, owing to its significant role within the board, decision-making processes, and influence. Consequently, the hypotheses are articulated as follows.

- H2. Sustainability committee positively moderates the relationship between the ESG performance and environmental innovation.

3. Methodology, data, and model specification

3.1 Data and sample selection

The paper empirically tests the predicted model by analyzing data from 691 non-financial sector enterprises operating in European Union countries. A quantitative design was employed to investigate the influence of ESG Performance (ESG) on environmental innovation (ENV)

and the moderating effect of the sustainability committee (SC). Moderation analyses are standard in social science and management research (Aguinis *et al.*, 2017). These analytical methods are essential for comprehending the mechanisms by examining the conditions or contingencies of an effect (moderation) (Aguinis, 2004; Aguinis *et al.*, 2017).

The study period from 2013 to 2022 for non-financial sector companies operating within European Union countries is chosen to analyze the impact of significant regulatory changes, economic shifts, and evolving ESG performance on corporate governance and performance during a decade of transformation. Data on the variables used in the study were obtained from the EIKON database. The information outlines the sample selection process and the corresponding number of observations per country. The specific numbers are as follows: Spain (227), Ireland (198), Italy (268), Luxembourg (56), Netherlands (234), Poland (96), Portugal (35), Greece (65), Hungary (22), Finland (229), France (471), Denmark (197), Germany (636), Austria (121), Belgium (138), Cyprus (20), and Sweden (585). The cumulative observations count is 3,598, encompassing 17 European Union countries. Financial firms were excluded from the sample due to variations in their governance structures and regulatory obligations (Alodat and Hao, 2024). Moreover, we eliminated firms that did not meet the data criteria for corporate governance, ESG performance, and financial variables and outliers, as shown in Table 1, Distribution of Sample Selection by Country.

3.2 Definition of variables

3.2.1 Dependent variable. For environmental innovation in our modeling process, we utilized metrics sourced from the Eikon platform, a product of Thomson Reuters. These metrics are meticulously curated by analysts who verify data to construct the variables like the Thomson Reuters platform. The dataset undergoes biweekly updates to incorporate fresh information from various reputable sources, including annual reports, sustainability reports, websites of non-governmental organizations and firms, news outlets, and stock exchange filings on the Thomson Reuters platform. Consequently, all environmental innovation factors integrated into the model were derived from a singular source, Thomson Reuters.

3.2.2 Independent variable

ESG performance assessment involves the utilization of ESG scores, which are formulated based on data extracted from annual reports, corporate social responsibility reports, sustainability reports, and corporate websites. These scores, furnished by EIKON, range from 0.63 for entities offering minimal ESG data disclosure to 94.5 for those demonstrating comprehensive data disclosure across all ESG categories as compiled by EIKON.

3.2.3 Moderating variable. The sustainability committee is a binary variable equivalent to 1 if there is a sustainability committee on the firm's board of directors and 0 otherwise (Khan *et al.*, 2024). Table 2 provides a comprehensive overview of the measurements employed for the various variables investigated within the scope of this study.

3.3 Study model

In this study, we considered environmental innovation the dependent variable and ESG performance the independent variable and used the sustainability committee as the moderating variable. In addition to the control variables, we considered leverage, firm age, firm size, board size, and CEO duality. Figure 1 illustrates the theoretical framework we present.

The study developed an interaction variable (ESG performance* sustainability committee), which was included as an independent variable, to investigate the moderating impact of the sustainability committee on the link between the performance of the ESG and environmental innovation. Consequently, the regression model employed in this study is articulated as follows:

Table 1. Distribution of sample selection by country

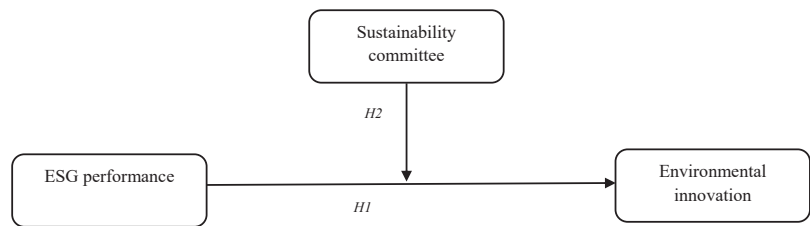
Sample	No. of observations
The initial sample consists of 27 EU member states	7,570
Non-financial sector firms	(2,630)
Excluded firms that did not match the prescribed data criteria for environmental innovation, corporate governance, and financial characteristics	(1,210)
Excluded countries have insufficient observations to mitigate biases arising from threats peculiar to each country	
Outliers are excluded	(132)
<i>A total final sample of firm observations</i>	<i>3,598</i>

Country name	No. of observations	%
France	471	13.09
Germany	636	17.67
Sweden	585	16.25
Netherlands	234	6.50
Finland	229	6.36
Italy	268	7.44
Spain	227	6.30
Ireland	198	5.50
Denmark	197	5.47
Austria	121	3.36
Belgium	138	3.83
Greece	65	1.80
Poland	96	2.66
Luxembourg	56	1.55
Cyprus	20	0.55
Hungary	22	0.611
Portugal	35	0.97
Total	3,598	100

Source(s): Authors' own work**Table 2.** Measurement of variables

Variable	Acronym	Measurements
Environmental innovation	ENV	EIKON Environmental Innovation Score signifies the firm's ability to decrease environmental expenses for consumers, thereby creating new environmental opportunities through new and innovative technologies
<i>Independent variables</i>		
ESG performance	ESG	EIKON Reuter's score for ESG performance
<i>Moderating variable</i>		
Sustainability committee	SC	Equals 1 if the firm has a sustainability committee, 0 otherwise
<i>Control variables</i>		
Firm size	FSIZE	Natural logarithm of total assets
Firm age	FAGE	Number of years since establishment
Leverage	LEV	As the total liabilities divided by total assets
Board Size	BSize	The total number of directors on the board
CEO Duality	CEO	Equals 1 if the chairman was ex-CEO, 0 otherwise

Source(s): Authors' own work



Source(s): Authors' own work

Figure 1. Theoretical framework

$$ENV = \beta_0 + \beta_1 ESG_{it} + \beta_2 FSIZE_{it} + \beta_3 FAGE_{it} + \beta_4 LEV_{it} + \beta_5 BSize_{it} + \beta_6 CEO_{it} + u_{it}$$

Where; ENV = Environmental innovation, ESG = Environmental, social, and governance performance, FSIZE = Firm size, FAGE = Firm age, LEV = Leverage, BSize = Board Size, CEO = CEO Duality.

3.3.1 Hierarchical regression results (moderating effect). The analysis integrates hierarchical features to examine moderating variables, aiming to uncover interactions and influences among various levels within the dataset. Utilizing a hierarchical approach facilitates a nuanced understanding of variable relationships and the identification of potential moderating factors affecting observed outcomes. This comprehensive method enhances the depth and accuracy of findings, enabling more informed decision-making processes (Alodat and Hao, 2024).

To identify moderator effects, it is necessary to generate interaction terms between predictor and moderator variables (Alodat and Hao, 2024). However, the creation of these interaction terms may introduce multicollinearity issues with their constituent variables. To mitigate this concern, two approaches are available: unstandardized and standardized solutions. The unstandardized solution utilizes mean values for predictor and moderator variables, while the standardized solution employs z-scores. In this investigation, the unstandardized solution was adopted to address multicollinearity concerns. The examination of moderating effects involved conducting hierarchical multiple regression analysis using STATA software, following the sequential four-step process delineated by Baron and Kenny (1986), Frazier *et al.* (2004). These steps entail initially introducing control variables, followed by independent variables, moderating variables, and ultimately, interaction terms. The evaluation of moderation significance was based on changes in R-squared values.

Step 1:

$$ENV = \beta_0 + \beta_1 FSIZE_{it} + \beta_2 FAGE_{it} + \beta_3 LEV_{it} + \beta_5 BSize_{it} + \beta_6 CEO_{it} + u_{it}$$

Step 2:

$$ENV = \beta_0 + \beta_1 ESG_{it} + \beta_2 FSIZE_{it} + \beta_3 FAGE_{it} + \beta_4 LEV_{it} + \beta_5 BSize_{it} + \beta_6 CEO_{it} + u_{it}$$

Step 3:

$$ENV = \beta_0 + \beta_1 ESG_{it} + \beta_2 SC_{it} + \beta_3 FSIZE_{it} + \beta_4 FAGE_{it} + \beta_5 LEV_{it} + \beta_6 BSize_{it} + \beta_7 CEO_{it} + u_{it}$$

Step 4:

$$\begin{aligned} \text{ENV} = & \beta_0 + \beta_1 \text{ESG}_{it} + \beta_2 \text{SC}_{it} + \beta_3 \text{FSIZE}_{it} + \beta_4 \text{FAGE}_{it} + \beta_5 \text{LEV}_{it} + \beta_6 \text{BSize}_{it} \\ & + \beta_7 \text{CEO}_{it} + \beta_8 \text{SC} * \text{ESG}_{it} \end{aligned}$$

where; ENV = Environmental innovation, ESG = Environmental, social, and governance performance, SC = Sustainability committee, FSIZE = Firm size, FAGE = Firm age, LEV = Leverage, BSize = Board Size, CEO = CEO Duality.

2719

4. Result and discussion

4.1 Descriptive analysis

Table 3 shows descriptive statistics for the study variables, including the minimum, maximum, standard deviations, and Mean. Descriptive analysis will reveal more details, allowing for an easier and more accurate interpretation and understanding of the data (Mishra *et al.*, 2019). Table 3 presents the descriptive statistics of the dependent variable, where for the overall environmental innovation, the mean value was 42.87, with a maximum of 99.89 and a minimum of 0. Meanwhile, the mean value of ESG is 57.804, with a maximum of 94.57 and a minimum of 0.63. The SC variable, where the mean value is 0.674 with a maximum of 1 and a minimum of 0.

4.2 Diagnostic examinations

This section outlines the diagnostic procedures employed during the data analysis phase of the study. We examine the data on which the multiple regression analysis is based to obtain accurate results. To accomplish the aim, thorough tests of diagnostic tests, including outliers, normality, linearity, multicollinearity, autocorrelation, and heteroscedasticity, were conducted (Knief and Forstmeier, 2021). According to the findings outlined in Table 3, the univariate approach for identifying outliers and assessing kurtosis and skewness to evaluate normality consistently affirms the absence of any concerns.

4.2.1 Correlation matrix. The findings from the correlation matrix indicate that none of the variables examined in this study exhibited correlations exceeding 0.80. This observation confirms that multicollinearity was not present within the dataset (Ben Barka and Legendre, 2017; Mansour *et al.*, 2023). The variance inflation factor (VIF) was employed to identify multicollinearity. According to Gokmen *et al.* (2022), a VIF value of >10 indicates significant multicollinearity. Table 4 presents the correlation matrix results, indicating no evidence of multicollinearity issues based on the VIF analysis.

Table 3. Descriptive statistics

Variable	Obs	Mean	Std. Dev	Min	Max	Skewness	Kurtosis
env	3,598	42.87	32.941	0	99.89	0.126	1.714
esg	3,598	57.804	19.764	0.63	94.57	-0.455	2.53
sc	3,598	0.674	0.469	0	1	-0.744	1.553
lev	3,598	0.114	0.201	-1.71	1.24	-0.981	2.134
age	3,598	53.919	44.585	-6	180	0.647	1.973
fsize	3,598	9.634	0.8	6.682	11.783	-0.277	3.383
bsize	3,598	10.732	4.097	2	28	0.658	3.361
ceo	3,598	0.258	0.438	0	1	1.107	2.224

Source(s): Authors' own work

Table 4. Correlation matrix and variance inflation factor (VIF) results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	VIF
(1) env	1.000								
(2) esg	0.575* (0.000)	1.000							2.10
(3) sc	0.320* (0.000)	0.579* (0.000)	1.000						1.54
(4) lev	0.096* (0.000)	0.148* (0.000)	0.129* (0.000)	1.000					1.10
(5) age	0.028 (0.086)	0.106* (0.000)	0.032 (0.055)	0.035* (0.034)	1.000				1.02
(6) fsize	0.434* (0.000)	0.637* (0.000)	0.446* (0.000)	0.298* (0.000)	0.033* (0.044)	1.000			2.50
(7) bsize	0.262* (0.000)	0.382* (0.000)	0.318* (0.000)	0.165* (0.000)	0.069* (0.000)	0.617* (0.000)	1.000		1.64
(8) ceo	0.040* (0.015)	0.085* (0.000)	0.101* (0.000)	0.056* (0.001)	−0.004 (0.788)	0.158* (0.000)	0.160* (0.000)	1.000	1.03

Note(s): *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source(s): Authors' own work

Testing was conducted regarding heteroscedasticity and autocorrelation. This degree of clustering would result in an estimator that is resilient to variations in cross-sectional data dispersion and correlations within panels (Saleh and Mansour, 2024; Mansour *et al.*, 2024b). This guarantees the production of reliable statistical inferences regarding the coefficient, as indicated in Table 4.

5. Regression results

Table 5 shows the Model 1 Base models showing the Breusch-Pagan (LM) test obtained a value of <0.05 (significant), while the Hausman test result is significant. Moreover, Table 5 shows the relationship between ESG performance and environmental innovation. The model was statistically significant and deemed fit. The R^2 result within the model is 22.9%, which is statistically valid. Thus, the study proved a positive and significant relationship between the performance of ESG and environmental innovation. Hence, H1 was supported.

Table 5. Fixed effect regression results for ESG performance and environmental innovation (Base models)

Variables	Coefficients	t-stat
ESG	0.732	9.72***
lev	5.821	1.45
age	−0.21	−0.84
fsize	1.004	0.28
bsize	0.486	1.78*
ceo	2.626	1.65
Constant	−4.298	−0.14
R^2	0.2296	
N	3,598	
Hausman test	16.72**	
Breusch-Pagan test	8020.08***	

Note(s): *** $p < 0.01$, * $p < 0.1$

Source(s): Authors' own work

H1 expects that there is a positive and significant link between the performance of the ESG and environmental innovation. As expected, a positive and significant relationship between ESG and ecological innovation is found (t -value = 9.72, $p < 0.01$). This result indicates that ESG performance is likely to improve environmental innovation by previous research findings (Liu and Lyu, 2022; Chen *et al.*, 2023; Saydam *et al.*, 2024; Wu *et al.*, 2024). This result indicates that suggests that firms prioritizing ESG performance tend to invest more in innovative practices. This alignment enhances sustainability efforts, reduces environmental impact, and supports long-term competitiveness. This finding underscores the strategic importance of prioritizing ESG in corporate decision-making to foster sustainability and innovation. Furthermore, the beneficial and substantial correlation between ESG performance and environmental innovation confers advantages to stakeholders through the enhancement of firm sustainability, mitigation of risks, and improvement of reputation. For the firm, it promotes the generation of long-term value, attracts conscientious investors, and enhances competitive advantage through advancements in innovation.

The study's results are consistent with the stakeholder theory. Firms function within a network of associations involving diverse stakeholders, including the community, customers, investors, and employees. These stakeholders have diverse interests and concerns, including environmental sustainability (Donaldson and Preston, 1995). By prioritizing ESG performance, firms fulfill their responsibility to stakeholders beyond shareholders, including society and the environment. Consequently, stakeholders may reward such firms with enhanced reputation, loyalty, and support, fostering a conducive environment for innovation, particularly in environmental aspects (Alodat and Hao, 2024). Thus, the positive correlation between ESG and ecological innovation is justified within the framework of Stakeholder theory, as it reflects firms responding to stakeholder demands for environmental stewardship through innovative practices.

The hierarchical regression outcomes detailed in Table 6 demonstrate a significant moderating effect. Specifically, the table illustrates the fixed effect regression analysis results, indicating that the sustainability committee positively moderates the relationship between ESG performance and environmental innovation. The model was statistically significant and deemed fit. The R^2 result within the model is 23.29%, which is statistically valid. Thus, a significant and positive relationship was proved between moderates the correlation between ESG and environmental innovation. Hence, H2 was supported.

Table 6. Hierarchical regression results

Variables	Step 1		Step 2		Step 3		Step 4	
	Coef	<i>t</i> -stat	Coef	<i>t</i> -stat	Coef	<i>t</i> -stat	Coef	<i>t</i> -stat
lev	5.964	2.02**	5.821	1.45	5.722	1.43	3.857	1.70*
fsize	21.296	9.41***	−0.21	−0.84	−0.211	−0.84	−0.037	−1.83*
bsize	0.226	1.15	1.004	0.28	1.072	0.30	2.755	2.43**
ceo	3.958	3.67***	0.486	1.78*	0.473	1.72*	0.417	2.75***
lev	5.964	2.02**	2.626	1.65	2.685	1.68*	1.603	1.78*
ESG			0.732	9.72***	0.732	9.73***	0.714	9.75***
SC					1.648	1.85	1.494	2.48**
SC * ESG							0.023	2.61***
R^2	0.0382		0.2296		0.2317		0.2329	
R^2 change			0.1914		0.0021		0.0012	

Note(s): *significant at the 0.10 level; **significant at the 0.05 level; ***significant at the 0.01 level
Source(s): Authors' own work

A firm's sustainability committee can be considered a vital strategic asset. This committee is likely tasked with overseeing sustainability efforts, which involve managing and leveraging ESG resources (Orazalin *et al.*, 2024a, b). Furthermore, by actively moderating the relationship between ESG performance and environmental innovation, the sustainability committee suggests that it plays a crucial role in channeling the firm's sustainability efforts towards innovation outcomes. This moderation indicates that the committee facilitates the effective utilization of ESG resources to drive environmental innovation within the firm (Barney, 1991; Driss *et al.*, 2024).

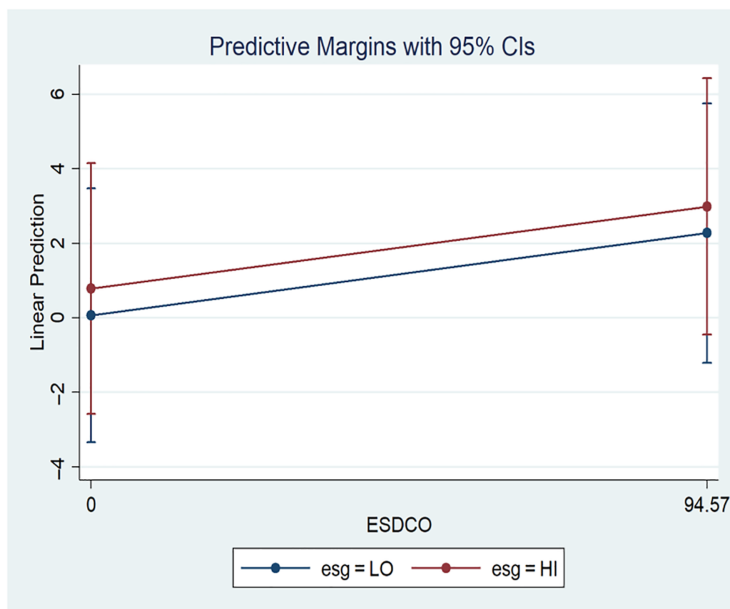
This study's findings indicate that a sustainability committee positively moderates the relationship between ESG performance and environmental innovation; we justify this result: a sustainability committee provides specialized oversight and concentrated attention to sustainability activities, guaranteeing that ESG priorities are set and actively integrated into corporate strategy. This focused guidance and oversight enable resource allocation, implementation of best practices, and alignment of corporate actions with sustainability objectives, hence fostering more significant environmental advances. Sustainability committees cultivate a culture of accountability and endorse sustainable practices, significantly enhancing organizations' potential to attain superior ESG performance and drive ecological innovation.

Overall, the results confirm previous research (e.g. Kesner and Johnson, 1990; Hillman and Dalziel, 2003; Mackenzie, 2007) that sustainability committees enhance the efficiency of environmental innovation. Consistent with the stakeholder theory, the findings support the premise that the development of sustainability committees promotes ESG performance and environmental innovation by balancing the interests of all stakeholders (Freeman, 1984; Orazalin, 2020).

The sustainability committee positively moderates the relationship between ESG performance and environmental innovation by providing strategic oversight and fostering a culture of accountability and continuous improvement. With their specialized knowledge and focus, sustainability committees ensure that ESG performances are integrated into the core business strategy, encouraging innovation that aligns with environmental objectives. Their role in monitoring ESG performance metrics and promoting best practices creates an environment where innovative solutions can thrive, ultimately enhancing the firm's ability to achieve its sustainability targets and drive long-term value creation. This positive moderation highlights the critical role of governance structures in advancing environmental innovation through robust ESG performance.

The findings that a sustainability committee positively and significantly moderates the relationship between ESG performance and environmental innovation are supported by the committee's role in fostering a culture of sustainability, aligning strategies with ESG performance, and providing organizational support that amplifies the impact of ESG performance on innovation. This relationship highlights the importance of dedicated governance structures in driving sustainability-driven innovation within firms. This finding aligns with prior research that used sustainability committees as a moderating variable (Gerged *et al.*, 2023; Orazalin *et al.*, 2024a, b).

Figure 2 illustrates the positive interaction between sustainability committees and ESG performance in driving environmental innovation. The plot demonstrates that firms with high ESG performance exhibit significantly enhanced environmental innovation practices. This finding underscores the potential of European non-financial firms to advance their environmental innovation efforts through the establishment and effective utilization of sustainability committees. Moreover, the presence of a sustainability committee, coupled with strong ESG performance, further strengthens and fosters environmental innovation within these firms.



Source(s): Authors' own work

Figure 2. Interaction effect of sustainability committees between ESG Performance and environmental innovation

6. Endogeneity concerns

The potential impact of the moderating effect of sustainability committee on the relationship between ESG performance and environmental innovation could be influenced by issues such as endogeneity or self-selection bias, which could lead to misinterpretation of the results discussed in the main section; we employ a rigorous analytical method known as two-stage least squares (2SLS) estimation.

6.1 Two-stage least squares

Our study used a two-stage least squares estimation test to confirm the study's primary results. This analysis is an effective way to ensure no endogeneity concerns. When accurately estimated, 2SLS can produce dependable results, even in the presence of endogeneity problems within the model, as suggested by [Ullah and Zeb \(2023\)](#), the results of the additional analysis 2SLS in [Table 7](#) showed that they are consistent with the main results of the study.

7. Conclusion

This study examined the moderating of the sustainability committee on the link between ESG performance and environmental innovation by using 691 non-financial sector firms operating within the EU states from 2013 to 2022. This study enhances the understanding of sustainability practices in European non-financial firms by elucidating the moderating influence of sustainability committees on the relationship between ESG performance and environmental innovation. The results confirm that elevated ESG performance correlates favorably with environmental innovation, indicating that firms with robust ESG practices are likelier to promote environmental innovation results. The existence of sustainability committees enhances this relationship, highlighting its strategic function in mobilizing

Table 7. Instrumental variables (2SLS) regression

env	Coef	St. Err	t-Value	p-value	[95% conf	Interval]	Sig
ESG	0.717	0.024	29.68	0	0.67	0.765	***
esdsd	0.024	0.009	2.72	0.007	0.007	0.041	***
lev	0.57	2.274	0.25	0.802	−3.888	5.027	
age	−0.008	0.02	−0.42	0.677	−0.047	0.031	
fsize	14.578	1.034	14.10	0	12.551	16.605	***
bsize	0.33	0.152	2.17	0.03	0.032	0.627	**
Constant	−102.249	9.135	−11.19	0	−120.152	−84.345	***
Mean dependent var		42.857		SD dependent var		32.944	
Overall r-squared		0.336		Number of obs		3,650	
Chi-square		1,257.059		Prob > χ^2		0.000	
R-squared within		0.229		R-squared between		0.355	
Note(s): *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$							
Source(s): Authors' own work							

resources, aligning with stakeholder expectations, and promoting environmental innovation efforts. This study posits that sustainability committees are a significant resource within firms, informed by stakeholder theory. They integrate business sustainability objectives with stakeholder interests, fostering a climate-promoting innovation and addressing environmental concerns. This theoretical contribution enhances comprehension of how governance structures, particularly sustainability committees, can utilize internal resources and respond to stakeholder demands to promote environmental innovation effectively. This observation is significant for scholars and practitioners, highlighting the imperative for solid governance frameworks to facilitate sustainable development and innovation in a progressively environmentally aware market.

The study's findings contribute to the literature on sustainability and environmental innovation by demonstrating how firms can utilize stakeholder theory to address sustainability challenges and meet the expectations of various stakeholders. Specifically, the study highlights the role of sustainability committees as a critical governance mechanism that fosters ESG performance and drives environmental innovation. The findings suggest actionable strategies for leveraging sustainability committees to enhance environmental accountability and long-term competitiveness for company executives. Lawmakers and regulators can draw on these insights to design policies that incentivize the establishment of effective sustainability committees, ensuring alignment with regulatory requirements. Sustainability advocates and stakeholders can use the findings to support initiatives prioritizing environmental innovation, while politicians can integrate these implications into broader policy discussions to advance sustainable development. By addressing the needs and expectations of diverse stakeholders within the European setting, the study offers a practical roadmap for aligning corporate practices with the principles of stakeholder theory and the evolving demands of sustainability.

7.1 Limitations and directions for future research

One limitation of this study is the focus on European non-financial firms, which may restrict the generalizability of the findings to firms in other regions or industries. Our ESG performance metric is also derived from information published in the Thomson Reuters Eikon database. Thus, further study can generate alternative ESG performance measures that are more effective. In other words, these metrics should also assess the accuracy and reliability of the information publicly revealed by corporations.

To enhance future studies applicability, exploring the influence of ESG performance and the role of sustainability committees on environmental innovation across various sectors and countries is suggested. Further studies should investigate additional moderating factors, such as board tenure and corporate culture, to better understand their impact on the relationship between ESG performance and environmental innovation. Research could also benefit from examining the specific roles and practices of sustainability committees, industry-specific impacts, and the long-term effects of ESG initiatives on innovation. Expanding the scope to cover different geographic regions, organizational sizes, and periods could provide a more comprehensive understanding of these dynamics.

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