Board Gender Diversity and Innovation Strategies: Sectoral Effects on ESG Performance in Financial and Non-Financial Firms

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Article

Board Gender Diversity and Innovation Strategies: Sectoral Effects on ESG Performance in Financial and Non-Financial Firms

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Abstract

We empirically examine the combined influence of innovation intensity strategies and boardrooms gender diversity on ESG performance. The theoretical lenses underpinning this study are rooted in Resource-Based View (RBV) and Upper Echelons Theory (UET). The empirical analysis is based on a sample of financial and non-financial firms selected from FTSE 350 listed companies, publicly listed companies on the London Stock Exchange (LSE) over the period (2012-2023). The findings of this study reveal that innovation intensity strategies have positive and significant relationship with ESG performance, for both financial and non-financial firms. Further, the percentage of women on the board has a positive and significant relationship with ESG performance, for both financial and non-financial firms. However, the magnitude of the coefficient for financial firms suggests that this effect is very negligible and not significant for non-financial firms. The percentage of women employees has a negative and significant relationship with ESG performance in financial firms. Unlike financial firms, the percentage of women employees has a positive and significant relationship with ESG performance in non-financial firms. For both financial and non-financial firms, the percentage of women in management has a positive and significant relationship with ESG performance in the Nested models. Further, these relationships become insignificant in the full model, suggesting that other factors may overshadow the impact of women in management roles. In both financial and non-financial firms, the number of female executives has a positive and significant relationship with ESG performance across models. This underscores the importance of gender diversity in leadership roles for driving ESG initiatives. The results suggest that companies with a high-level of board boardrooms diversity strengthen innovation strategies intensity and leverage external resources for sustainability initiatives. The lack of a significant relationship between innovation strategies and ESG performance challenges the innovation-driven sustainability theory, which posits that innovation is a key driver of environmental and social sustainability. This suggests that traditional innovation strategies, R&D metrics, may not adequately capture sustainability-focused innovation, particularly in financial firms. The additional analysis resulted consistent results with the baseline findings, reinforcing the conclusion that the results of this study robust and minimise endogeneity concerns. Findings have theoretical and managerial implications.

Keywords: innovation strategies; innovation intensity; R&D intensity; corporate governance; board gender diversity; environmental social and governance (ESG) performance; innovation; UK

1. Introduction

Environmental, social and governance (ESG) disclosure has become very concerning to a wide spectrum of stakeholders especially in the last two decades. The problem arises from stakeholders'

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increasing apprehensions on the impact of corporations on the environment (Zaid and Issa, 2023). Consequently, ESG has now become provided a structured perspective through which a company's dedication to the environment, social justice, and accountable governance can be understood with the aim of fostering a balanced view of sustainability where the firm' profit maximization objective is expanded to incorporate commitment to the accountable governance, social justice and the environment.

Around the world, green and sustainable development is emerging as a fundamental objective of economic transformation and policy formulation (Behera et al., 2024). The United Nations Industrial Development Organisation (UNIDO, 2023) reports that in the last decade, a several nations have initiated strategic policies to promote and protect economic and social greening transformation. (Liu et al., 2024). Consequently, there is a substantial recalibration of stakeholder expectations about corporations' accountability over how their activities have impacted society and the environment. Companies are increasingly pressured to adequately manage ESG-related risks across their business groupings and supplier networks. Beyond possible actions by customers, investors, and shareholders, a failure to address these risks may lead to legal responsibility for corporations, provoke litigation, and increase enforcement risk (Xie and Lv, 2024; Xu and Bai, 2022).

ESG is a framework of accountability that forces corporations to combine commercial objectives such as profitability with a commitment to ensure sustainable practices in order to achieve a mutually beneficial outcome for the economy and environment. ESG concept has emerged as a critical consideration for organisations striving for green, healthy, and sustainable growth in the future. It has garnered the interest of governments globally (Chen et al. 2023; Tsang, Frost, and Cao 2023; Xu, Xu, and Bai 2022). The present worldwide landscape necessitates those enterprises attain not just social or economic outcomes but also environmental and corporate governance results. Considering the extensive global awareness and impact of ESG on corporate strategy and performance, it is crucial to examine the drivers of company's involvement in ESG initiatives.

Bamahros et al. (2022) assert that corporate governance and the pivotal function of boards are essential for proactively addressing ESG and facilitating the culture and mentality shift required for a sustainable transformation. To enable executive teams to proactively establish a competitive advantage among conflicting goals, it is essential to have a board that is empowered and has the requisite operational model, data, and skills to provide robust guidance, test assumptions, and give support. In the absence of appropriate governance, a company's ESG strategy risks becoming ineffective, disjointed, and reactive. Abdoush and Hussainey (2023) emphasised that effective governance would be essential for addressing evolving stakeholder expectations, enhancing risk resilience, and capitalising on development prospects within the ESG framework. An example is the need for strategic decision-making that adeptly balances short-term and long-term value development. A firm emphasis on the long term is essential to realise the advantages of a company's ESG goal. Corporate governance and boards are crucial in aligning ESG initiatives with the company's strategic direction, focussing on material issues (both risks and opportunities), setting targets and accountability, and evaluating the company's overall performance. Nevertheless, research (Aziz et al., 2023; Albitar, Abdoush, and Hussainey, 2023; Alkaraan, 2023) indicates that the board's involvement in ESG strategy is still developing, highlighting the need to enhance this position to guarantee that ESG provides a competitive advantage rather than only serving as a compliance measure. This indicates an acknowledgement that more efforts are required to integrate ESG systematically into governance operations.

The relation between innovation strategies and ESG on the other hand is quite complex. Firms' innovative capacity can be reflected in their expenditures on research and development (R&D) and patent rights. Recent research (Duque-et al 2020; Huang etal 2023) highlights that firms leveraging innovation strategies particularly eco-innovation can substantially improve ESG metrics, while also benefiting from competitive advantages, long-term profitability, and enhanced corporate image. Innovation in environmentally friendly practices, known as "green innovation," is a key strategy firms are using to reduce their ecological footprint and align with sustainability goals. This can include

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advancements in eco-design, efficient resource utilization, and waste reduction technologies. Green innovation not only strengthens a firm's commitment to environmental stewardship but can also attract investors and consumers who prioritize sustainable practices. Although initial investment in eco-innovation may reduce profitability in the short term due to R&D costs, long-term benefits generally include improved environmental metrics and enhanced stakeholder trust. Furthermore, firms that invest in innovation see improved ESG outcomes over time, with measurable impacts like a higher ESG rating score. Dicuonzo et al (2022), demonstrated that for industrial firms in Europe and the United States, higher levels of R&D investment and patent production correlated with improved ESG performance, particularly in environmental metrics. This relationship is partly because innovative practices help companies adapt to regulatory changes and stakeholder expectations, reducing risks associated with ESG compliance and fostering resilience.

There is no adequate research effort focused on understanding the combined influence of innovation intensity strategies and boardrooms gender diversity on ESG performance, with the emphasis on comparison between non-financial and financial firms. The majority of the studies focusing on this research (Pinheiro, 2024, Grazia, Francesca, Simona and Vittorio 2022, Ahmad and Wu (2022) area have based their thinking on the fact that innovation that is related to eco-sustainability is what drives improvement in ESG performance. These studies presume that innovation that appears directly unrelated to sustainability products does not have any implications on the ESG performance of firms. This lags behind fast-developing sustainable finance investment models which comprises an array of financial services and products that strive to balance investor returns with environmental sustainability. ESG investment, a pillar of sustainable finance, involves weighing environmental, social, and governance considerations with standard financial indicators when assessing investment possibilities. At its heart, sustainable finance incorporates ESG considerations into decisions about investment. Hence, this study is the first in the UK to put financial and non-financial listed firms' side by side and explores from a contingency perspective how corporate governance and innovation intensity influence ESG performance whilst controlling for moderating effects of firm age and firm size.

Over the last decade, academic attention given to ESG disclosure has witnessed a rise focused largely on the drivers of ESG reporting including firm governance (Tsang et al., 2023). Prior research has looked into the effect of board governance and also the demographic attributes of board members such as gender and cultural background– on ESG disclosure (Cheung and Lai, 2023; Ramon-Llorens et al., 2021; Martínez Ferrero et al., 2021; Gallego-Álvarez and Pucheta-Martínez, 2022; Pucheta-Martínez et al., 2019, Amorelli and García-Sánchez, 2020;) Some studies find a significant positive relationship (Nicolò et al., 2021; Khemakhem et al.,2022; Bhatia and Marwaha, 2022) while others find insignificant or only becomes significant once a particular threshold of female directors has been reached (Bananuka et al., 2022; Amorelli & García-Sánchez, 2020; De Masi et al., 2021). Interestingly studies such as García-Sánchez et al. (2020) and Alkhawaja et al. (2023) and Centinaio (2024) have argued that the organisational dynamics and structural features of a company have a substantial impact on the interaction between the two and have suggested the appropriateness of adopting a contingency approach when trying to understand the effect gender diversity on ESG performance (Khidmat et al., 2022). The research results will incrementally contribute to the existing literature on ESG performance as the research sheds lights on the combined influence of innovation strategies and corporate boardrooms diversity on ESG performance. Consequently, the following three research questions serve as the basis for this investigation:

RQ1. Does the intensity of companies' innovation strategies strengthen ESG performance?

RQ2. Does the combined influence of innovation strategies intensity and corporate boardrooms diversity improves ESG performance ?

RQ3. What is the influence of industry type (financial, non-financial) and firm characteristics on the relationship between innovation strategies intensity, corporate boardrooms diversity and ESG performance

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The remainder of this study is structured as follows. Sections 2 provides conceptualization and hypotheses development. Section 3 illustrates the research design. Section 4 reports the empirical results, and Section 5 provides the conclusion.

2. Literature Review and Hypothesis Development

The Resource-Based View (Barney, 1991) asserts that a firm's capacity to attain competitive advantage is contingent upon the resources and skills it has. In the realm of sustainability, companies with significant R&D expenditures may develop distinctive competencies in green technology, sustainable practices, and ESG adherence. Large corporations, often possessing more resources, are theoretically more capable of investing in sustainability-oriented innovation (López-Gamero et al., 2010). Nevertheless, smaller enterprises may have dynamic capacities, allowing them to swiftly adjust to changing market needs (Teece et al., 1997). According to the resource dependency perspective, female directors impart distinctive attributes to a board that enhance cooperation with stakeholders (Harjoto et al., 2019) and improve Environmental social and governance practices (Lewellyn and Muller-Kahle, 2023; Issa and Zaid, 2023). Female directors often exhibit a greater orientation towards stakeholders, while male directors are mostly focused on shareholders (Wang et al., 2022). Furthermore, there is also the view that w omen are generally empathetic, attentive to the welfare of others, and acutely aware of environmental concerns (Nadeem et al., 2020). Board gender diversity does have a way of shaping the way a company views its commitment to the environment (Liao et al., 2015). All of this gender differentiated capabilities as drive board performance and can be influential in the way corporate boards view and approach ESG practices (Issa and Zaid, 2023).

The Upper Echelons Theory (UET) is another theory for examining the links between board gender diversity and ESG factors. According to the UET organisations mirror their top management, and the conduct of enterprises is contingent upon the choices made by their leaders, whose interpretations of circumstances align with their perspectives (Hambrick, 2007). Top management have the ability to craft the strategic direction of an organisation and this can be influenced by their personal experiences, and beliefs. Therefore, the theory holds that the distinctive qualities of boards may enhance the decision-making process by providing diverse viewpoints (Carvajal et al., 2022). Consequently, UET offers a significant theoretical lens for examining the impact of gender diversity on ESG performance

2.1. Innovation Intensity Strategies and ESG Performance

Innovation strategies, especially through R&D, is a critical driver of sustainability initiatives within firms. R&D investments facilitate the development of environmentally friendly technologies, efficient resource utilization, and sustainable business models. Research has shown a strong association between R&D intensity and ESG performance, suggesting that companies with significant R&D spending often achieve better sustainability results. De Santis and Presti (2018) discovered that increases in R&D expenditure has a positive effect on ESG performance by fostering eco-innovations. Innovation is an effective instrument for advancing sustainable company practices (De Santis and Presti, 2018). It is well-established in the literature that a correlation exists between innovation and sustainability performance (Ahmad and Wu, 2021) but the findings are inconclusive.

Limited empirical research has shown the correlation between corporate ESG activities and innovation (Zhang et al., 2020a); yet, investigations examining the link between ESG performance and a firm's economic and financial outcomes are abundant (Do and Kim, 2020). Moreover, little research examining the correlation between ESG performance and innovation has concentrated on green innovation (Xu et al., 2021). The research by Pinheiro (2024) seeks This research looks into how innovation affects the performance of environmental, social, and governance (ESG) factors and how that affects the success of a business. Secondary data from the Refinitiv Eikon database was used to do a quantitative and detailed study. The study used a panel data regression method to look at how innovation, ESG success, and financial results are all linked. The results show that companies that

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put more money into research and development (R&D) tend to do better in terms of environmental, social, and governance (ESG) issues. Grazia, Francesca, Simona, and Vittorio (2022) look into how investments in R&D and patent activity, along with other forms of creation, affect ESG practices. A regression model is used to look at panel data from eight years and public industrial companies in France, Germany, Italy, Spain, the UK, and the US. The data show a strong connection between ESG involvement and creativity. Companies that put more resources into research and development (R&D) and patents did better in ESG performance.

Also, Ahmad and Wu (2022) look at how eco-innovation affected environmental sustainability in 20 OECD countries from 1990 to 2017 using the measure of per head ecological footprint. Using a method called panel quantile regression, their work gives strong information about different levels of environmental effect. Their results show that green industry efforts help protect the environment in both straight and nonlinear ways. The benefits are strongest at higher quantiles, followed by intermediate and lower quantiles. Also, economic globalisation has two effects: it can make environmental problems worse when eco-innovation isn't present, but it can help the environment when eco-innovation is present and combined with green innovation yet it fosters ecological conservation when such interaction occurs. Thirdly, eco-innovation has a significant ecological protection effect across all quantiles, with the most pronounced benefit shown in nations with elevated per capita ecological footprints, followed by those with medium and lower footprints.

Subramanian et al. Al (2024) investigated the possible direct influence of ESG on organisational innovation and their function as isomorphic elements. The authors employed necessary condition analysis (NCA) utilising the R statistical software to ascertain the direct influence of environmental (E), social (S), governance (G), and composite ESG factors on innovation, as indicated by research and development (R&D) expenditure within a sample of 86 multinational life sciences firms. Recent studies highlight how ESG factors help multinational companies in the health sciences industry innovate. Results imply that ESG standards are very important in forming sustainability plans in worldwide healthcare companies, acting as structural components directing ethical business behaviour. Moreover, including sustainability into business strategy provides unique benefits for companies in the health sciences sector.

Shahnaz and Emranul (2024) investigated how sustainable innovation affects ESG performance by looking at R&D funding's effect on ESG elements. Using a content analysis approach to gather panel data from secondary sources, their research looked at data from 34 Bangladeshi firms from 2018 to 2022. They investigated study hypotheses using many regression analysis and discovered that sustainable innovation improves ESG performance. Their findings, however, show that the link between sustainable innovation and ESG performance is not considerably moderated by R&D spending.

Using data from China's A-share listed companies from 2009 to 2021, Xiaojing et al. (2024) also looked at different kinds of green innovation and its impact on corporate ESG performance. Focussing on publicly listed firms over a 12-year period, their study showed that both radical and gradual green innovation improve ESG performance.In the light of the above, this research specifies the following hypothesis;

H1: Firm innovation strategies have a significant positive effect on ESG performance of listed financial and non-financial firms in the UK.

2.2. Corporate Boardrooms Gender Diversity and ESG Performance

Marked by increased knowledge of ESG concerns, companies all over the globe are negotiating rising public expectations, legal obligations, and market pressures in today's environment (Brogi et al., 2022; Irawan & Okimoto, 2022). As stakeholders such as investors, and consumers demand more openness and responsibility, the inclusion of ESG issues into corporate governance has come under focus. Consequently, important instruments for companies to express their dedication to sustainable values have been ESG disclosures (Cerciello et al., 2023; Wang et al., 2022; Ye et al., 2022). Simultaneously, good corporate governance is very important in developing and implementing plans

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supporting a company's ESG efforts. A key tool for meeting the issues and possibilities created by the fast changing ethical, social, and environmental demands is the interaction between ESG reporting and governance (Ahmad et al., 2023; Chebbi & Ammer, 2022).

Studies emphasising gender diversity provide crucial insights. For example, Nicolò et al. (2021) discovered that in European settings, female on the board of directors improve ESG disclosures at the aggregated and individual ESG score levels. On the contrary, Ramon-Llorens et al. (2021) indicates that the effect of female directors varies according on their personal experiences and knowledge. On the other hand, Italian research by Cucari et al. (2018) indicate a negative link between female board representation and ESG reporting. Studies done in Canada show the good influence of women on boards and their involvement in ESG-related decision-making (Khemakhem et al., 2022).

A closer look at certain ESG aspects reveals significant advantages of gender diversity. For example, female directors in the UK have been shown to favourably affect anti-corruption legislation in Italy (Previtali & Cerchiello, 2023) and greenhouse gas reporting (Al Qahtani & Elgharbawy, 2020; Tingbani et al., 2020). Furthermore, gender variety helps to improve openness in gender-related disclosures (Furlotti et al., 2019). Studies in the UK indicate that corporate commitments to social projects are strengthened by boardroom gender diversity, hence promoting improved risk management and performance (Arayssi et al., 2020). International data also indicates that significant effects on ESG disclosures frequently need a critical mass of female board members (Amorelli & García-Sánchez, 2020; De Masi et al., 2021). Furthermore, several research (Lavin & Montecinos-Pearce, 2021, Bhatia & Marwaha, 2022, Nuhu & Alam, 2024) all found that female board involvement had a positive effect on ESG. Likewise, Mahmood et al., (2018) and Zahid et al., (2020) indicates that bigger boards with more female participation have a major role in sustainability reporting and decision-making. Consequently, the following hypothesis is specified to be tested in this research.

H2. Corporate boardrooms gender diversity positively impacts ESG performance in both financial and non-financial firms.

2.3. Moderating Role Firm Characteristics (Size and Age)

While firm innovation, particularly through R&D has been identified as a key driver of sustainability performance, there is increasing recognition that this relationship may be contingent upon firm-specific factors, such as size. This study considers the moderating role of firm size. Firm size significantly influences the capacity to innovate and implement sustainable practices. Larger firms often possess more substantial resources, diversified portfolios, and established market presence, enabling them to invest heavily in R&D and sustainability initiatives. In contrast, smaller firms may face resource constraints but can exhibit greater flexibility and adaptability in implementing innovative sustainable practices. The moderating effect of firm size on the innovation-sustainability relationship is complex and multifaceted, warranting a nuanced analysis. Several studies suggest that larger firms experience a more pronounced positive impact of innovation on ESG performance due to economies of scale, resource availability, and enhanced stakeholder influence. For example, Ma, Ahmad and Torelli, (2024) found that in large firms, R&D investments lead to significant improvements in sustainability reporting and performance, attributed to their ability to absorb the costs associated with sustainable innovations.

Additionally, larger firms often face greater public scrutiny, incentivizing them to leverage their innovative capabilities to meet ESG criteria. Conversely, some research indicates that firm size may have a neutral or even negative moderating effect on the innovation-ESG relationship. Smaller firms, despite limited resources, can swiftly implement innovative sustainable practices due to less bureaucratic inertia and a more entrepreneurial orientation. Buallay et al. (2020) observed that in SMEs, R&D activities are closely linked to sustainability performance, often driven by niche market opportunities and the agility to adapt to sustainable business models. While large firms possess abundant resources, they may suffer from organizational inertia, bureaucratic complexity, and risk aversion, which hinder their ability to rapidly implement sustainability-focused innovations.

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However, there is lack of empirical studies that have examined the moderating effect of firm size on the relationship between Gender diversity, firm innovation and ESG performance.

H3. Firm size has a significant moderating effect on the relationship between corporate boardrooms gender diversity, firm innovation surgeries and ESG performance in firms listed in the UK.

Firm age influences organizational behaviour and strategic decision-making through its impact on resources, experience, and risk tolerance. Furthermore, firms experiencing really fast may not have the adequate governance structure in place to address problems related to ESG issues (Laksmana et al., 2015). Older firms possess established processes, institutional memory, and reputational capital, which may facilitate better ESG practices. Conversely, younger firms exhibit agility, adaptability, and innovation, enabling them to experiment with emerging ESG trends.

Older firms may benefit from long-standing relationships with stakeholders, allowing them to leverage trust and credibility in ESG reporting. In contrast, younger firms may capitalize on technological advancements and sustainability trends to achieve ESG goals. Numerous studies affirm that board diversity, CEO duality, and ownership patterns impact ESG performance. For instance, gender-diverse boards are linked to higher ESG disclosures and environmental stewardship due to diverse perspectives and ethical oversight (García-Sánchez et al., 2019).Older firms may demonstrate conservative governance practices, focusing on risk mitigation and regulatory compliance. Their extensive stakeholder networks and established reputations motivate adherence to ESG principles. A study by Buallay et al. (2020) found that mature firms exhibited higher ESG scores due to their structured governance frameworks and stable financial resources. Younger firms leverage entrepreneurial governance models to adopt innovative ESG strategies. However, their resource constraints and short-term performance pressures may limit sustained ESG investments.

Amran et al. (2015) emphasize that firm age enhances the positive effects of governance mechanisms on ESG practices. Older firms, through organizational learning and adaptation, institutionalize ESG practices, while younger firms prioritize experimentation and differentiation in governance. Firm age serves as a structural enabler, facilitating the adoption of sophisticated governance systems that support ESG performance. Older firms tend to develop stakeholder relationships, institutional credibility, and knowledge systems, which enhance their ESG reporting standards. Moreover, they benefit from economies of scale and financial stability, allowing greater investment in sustainable technologies and social programs. For instance, large multinational corporations, such as Unilever and Nestlé, leverage their governance maturity to set global ESG benchmarks. Their ability to integrate ESG practices stems from their institutional legacies and stakeholder engagement strategies, which are rooted in their long-standing presence. Despite their agility and adaptability, younger firms face barriers to ESG adoption, including financial constraints, limited governance expertise, and short-term performance pressures. Additionally, younger firms lack the regulatory knowledge and reporting capabilities needed for robust ESG frameworks. Therefore, in the light of the critical role that firm age plays in the performance of firms and consistent with extant literature (Abdi et al., 2022; Yin et al., 2022), the study investigates the moderating effect of company age on the relationship between corporate governance, innovation intensity and ESG performance.

H4. Firm age has a significant moderating effect on the relationship between Gender diversity, firm innovation and ESG performance in firms listed in the UK.

3. Methodology

This study employs an *ex post facto* research design which is used to examine how changes in the independent variables influence dependent variables. Under this approach, the researcher analyses the existing data, identifying corelations and potential cause-effect relationships without any manipulation of the variables. The Sample consists of FTSE 350, publicly listed firms on the London Stock Exchange (LSE). The FTSE 350 index includes companies across multiple industries, making it a comprehensive representation of the UK economy. Unlike smaller firms, FTSE 350 companies are

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diverse in terms of sectoral distribution and ownership structure, offering insights that are generalizable to a broad range of corporate environments. Panel regression is used for the estimation of the models. The research uses longitudinal data analysis and adopts a comparative approach between financial and non-financial industries in the UK. The period of the study selected is from 2012 to 2023, which is over 11 years. The period is selected as it corresponds with notable legal and market advancements affecting ESG practices in the UK. This decade reflects the progression of ESG integration into company plans, propelled by legislative and international obligations. Significant legislative milestones include the Firms Act 2006 (Strategic Report and Directors' Report) Regulations 2013, which introduced non-financial reporting obligations, compelling firms to provide information about environmental and social issues. This law was a pivotal moment in promoting openness and responsibility in ESG performance. Additionally, the UK's adoption of the EU Non-Financial Reporting Directive (NFRD) in 2017 further underscored the need of ESG disclosures and necessitated organisations to include ESG issues into their decision-making processes, including mergers and acquisitions plans. The 2015 Paris Agreement emphasised international obligations to reduce carbon emissions, impacting business sustainability agendas globally.

Model specification.

Model 1: Corporate Governance, Innovation Intensity & ESG Model

$$ESG_{it} = \gamma_1 + \propto_2 PCT\_WB_{it} + \propto_3 PCT\_WEMP_{it} + \propto_4 PCT\_WMGT_{it} + \propto_5 NFEXEC_{it} + \propto_6 BoD_{Age\,it} + \propto_7 goodwill_{ta\,it} + \propto_8 RoA + \propto_9 Ino\_Int_{it} + \propto_{10} PE\_Ratio_{it} + \propto_{11} RET_{SHF\,it} + \mu_{it}$$

Model 2: Corporate Governance, Innovation Intensity & ESG -Contingency Model 1

$$ESG_{it} = \gamma_1 + (\propto_2 PCT_{WB\,it} + \propto_3 PCT_{WEMP\,it} + \propto_4 PCT_{WMGT\,it} + \propto_5 NFEXEC_{it}) * firm_{Size\,it} + \propto_6 BoD_{Age\,it} + \propto_7 goodwill_{ta\,it} + \propto_8 RoA + (\propto_{10} Ino\_Int_{it}) * firm\_Size + \propto_{11} PE\_Ratio_{it} + \propto_{12} RET_{SHF\,it} + \mu_{it}$$

Model 3: Corporate Governance, Innovation Intensity & ESG -Contingency Model 2

$$ESG_{it} = \gamma_1 + (\propto_2 PCT\_WB_{it} + \propto_3 PCT\_WEMP_{it} + \propto_4 PCT\_WMGT_{it} + \propto_5 NFEXEC) * firm\_Age + \propto_6 BoD_{Age\,it} + \propto_7 goodwill_{ta\,it} + \propto_8 RoA + (\propto_6 Ino\_Int_{it}) * firm\_Age_{it} + \propto_9 PE\_Ratio_{it} + \propto_{10} RET_{SHF\,it} + \mu_{it}$$

Table 1 shows definition of variables underlying this study

Table 1. Definition of variables.

Variables	**Mnemonic**	**Definition / Estimation**
ESG Score	ESG_Score	Environmental, social, and governance (ESG) factors help to measure the sustainability and social impact of business activities. The firms ESG scores was extracted from the FTSE 350 listed companies published annual financial report since 2012 to 2023
Innovation intensity	Ino_Int	R&D expenditure and patents are typical proxies for innovation input and output (Càzares et al., 2013). R&D investment is a representation of a firm's technological

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		knowledge. According to previous studies (Liao et al., 2021; Zhang et al., 2020a), innovation performance is also measured by R&D/Total assets Ratio
PCT_WB	PCT_WB	Percentage of women on the board
NFEEXEC	NFEEXEC	Number of females executives
PCT_WEMP	PCT_WEMP	Percentage of females in the organisation
PCT_WMGT	PCT_WMGT	Percentage of females in management
Return on Asset	ROA	Return on Asset is the company's ability to make a profit.
Financial leverage	Gearing	Ratio between total liabilities / total assets
Return on Capital Employed	ROCE	It helps investors see through growth forecasts, being a very useful tool in calculating the efficiency and profitability of capital investments in the company, and for identification of those areas which are central for the maintenance and growth of resources and performance.
Goodwill to total asset	(gdwill_ta)	Goodwill , the present value of the anticipated excess earnings discounted over a certain number of years.
Total Asset	Assets	Total Assets
Firm Age	F.AGE	Number of years from listing date till 2023.

4. Results and Discussion

4.1. Descriptive Statistics

Table 2 shows descriptive statistics.

Table 2. Descriptive statistics.

	Mean	**Max**	**Min**	**Std.Dev.**	**Mean**	**Max**	**Min**	**Std. Dev.**
Non-Financial firms					Financial firms			
ESG	0.486	0.763	0.235	0.099	0.4257	0.753	0.2443	0.054
PCT_WB	0.268	0.75	0.062	0.108	0.286	0.555	0.083	0.06
PCT_WEMP	0.362	0.82	0.03	0.144	0.425	0.679	0.197	0.05
PCT_WMGT	0.25	0.6792	0.02	0.096	0.254	0.67	0.09	0.045
NFEXEC	3.341	16	2	2.125	4.131	14	2	1.216
BOD_AGE	57.617	70	40	3.134	57.728	64.67	51.14	1.423
Ino_Int	-0.224	1036.179	-2516.88	66.325	0.459	296.921	-696.898	28.812
TOTAL_ASSETS	12.361	901.342	-62.455	39.385	10.701	271.256	-98.896	24.879
Firm_AGE	62.255	139	-1	46.002	59.222	150	4	45.456
ROA	8.336	311.172	-65.096	20.553	4.422	70.967	-49.854	10.363

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GEARING	89.7	990.262	0	123.381	35.793	939.334	0	113.384
GOODWILL_ASSETS	0.158	0.802	0	0.159	0.041	0.489	0	0.067
PE_RATIO	41.334	10060	0.0601	268.523	13.415	192	1.78	13.595
RET_SHF	19.081	442.59	-705.546	43.54	8.179	100.743	-88.233	15.59

4.2. Correlation Metrics Analysis

Table 3 depicts the correlation metrics for both financial and non-financial firms. The results of the correlation analysis are summarised as follows:

- Women in management roles improve ESG performance in both sectors, but the effect is stronger in financial firms due to a greater emphasis on governance and social responsibility. Female executives significantly enhance ESG outcomes, with a stronger effect in financial firms (0.39), likely due to their leadership in sustainability and ethical governance.
- Older boards are more strongly (0.53) associated with ESG in financial firms, likely due to their experience and regulatory stability, whereas innovation is more valued in non-financial firms.
- Innovation strategies intensity, negative relationship between R&D Intensity (R_D) and ESG performance. This suggests that innovation-focused financial firms may prioritize profitability over sustainability. In non-financial firms, R&D may be more integrated with ESG efforts (e.g., green technologies).
- Larger firms tend to have slightly lower ESG performance, possibly due to the complexity of implementing sustainability initiatives at scale.
- Higher profitability is weakly associated with lower ESG performance, indicating a possible trade-off between short-term profit goals and long-term sustainability investments. Highly leveraged firms (0.44) in financial firms tend to have stronger ESG performance, particularly in financial firms, possibly due to increased scrutiny from stakeholders, prompting better sustainability practices.

The correlation analysis highlights a stronger link between gender diversity, board characteristics, and ESG performance in financial firms compared to non-financial firms. Female executives and older boards play a more significant role in driving ESG improvements in financial firms. Additionally, higher leverage is associated with better ESG outcomes, while profitability (ROA) and firm size (TASSET) negatively correlate with ESG in both sectors. The weak negative relationship between R&D intensity and ESG in financial firms suggests that innovation strategies may prioritize financial performance over sustainability.

The results of Variances Inflation Factor Test are illustrated in Table 4. The VIF is a technique used to assess the existence of multicollinearity. Typically, the highest VIF is considered an indicator of the severity of multicollinearity among the predictors. A VIF value greater than 10 suggests that multicollinearity significantly impacting the accuracy of the regression coefficient estimates obtained by least squares. As revealed in Table 3, none of the variables show VIF values >2 which implies that the occurrence of multicollinearity is strongly unlikely in the regression model.

Table 3. Pearson correlation.

	ESG	**PCT_WB**	**PCT_WEMP**	**PCT_WMGT**	**NFEXEC**	**BOD_AGE**	**Ino_Int**	**TASSET**	**FAGE**	**ROA**	**lev**	**GW_AST**	**PE_RATIO**	**RET_SHF**
Financial firms														
ESG	1													
PCT_WB	0.31	1												
PCT_WEMP	0.21	-0.03	1											
PCT_WMGT	0.17	0.14	0.28	1										
NFEXEC	0.39	0.24	0.18	0.22	1									
BOD_AGE	0.53	0.34	0.14	0.21	0.25	1								
Ino_Int	-0.08	0.03	0	-0.02	0.08	-0.04	1							
TASSET	-0.11	-0.04	-0.1	-0.1	-0.04	-0.11	0.02	1						
AGE	-0.04	0.03	-0.18	-0.11	-0.02	0.01	0.01	-0.07	1					
ROA	-0.11	-0.03	-0.23	-0.17	-0.07	-0.16	0.01	0.03	-0.02	1				
GEARING	0.44	0.15	0.05	0.15	0.24	0.23	0.02	0.01	-0.06	-0.03	1			
GWILL_AST	0.19	0.13	-0.48	-0.29	-0.04	0.03	0	-0.02	0.07	0.19	0.12	1		
PE_RATIO	0.14	-0.06	0.03	0.06	0.02	0.14	0.09	-0.05	-0.05	0.05	0.1	0.06	1	
RET_SHF	0.09	0.04	-0.21	-0.15	-0.02	-0.02	0	0.11	-0.12	0.53	0.17	0.28	0.11	1
	ESG	PCT_WB	PCT_WEMP	PCT_WMGT	NFEXEC	BOD_AGE	Ino_Int	TASSET	FAGE	ROA	lev	GW_AST	PE_RATIO	RET_SHF
Non-financial firms														

ESG	1												
PCT_WB	0.32	1											
PCT_WEMP	-0.07	0.16	1										
PCT_WMGT	0.09	0.3	0.54	1									
NFEXEC	0.27	0.33	0.17	0.28	1								
BOD_AGE	0.27	0.01	-0.2	-0.09	0.06	1							
R_D	-0.01	-0.01	-0.02	0.02	0	0	1						
TASSET	-0.04	-0.01	-0.01	-0.01	-0.04	-0.03	0.01	1					
AGE	0.24	-0.01	-0.07	-0.04	0.1	0.16	-0.04	-0.07	1				
ROA	-0.1	0.02	0.07	0.02	-0.08	-0.18	0	-0.01	-0.07	1			
GEARING	0.16	0.06	0.03	0.06	0.15	0.02	0.02	-0.01	0.13	-0.08	1		
GWILL_AST	-0.14	0.03	-0.03	-0.07	-0.07	-0.05	0.03	0.02	0	-0.03	-0.06	1	
PE_RATIO	-0.01	0.04	-0.03	-0.04	0	0.08	0	0.01	-0.02	-0.03	-0.02	0	1
RET_SHF	-0.02	0	0.1	0.06	-0.05	-0.1	0	0.04	0.02	0.33	0.06	0	-0.03	1

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Table 4. Variances Inflation Factor (VIF) Test.

	VIF (Financial firms)	VIF (non-financial)
C	2.922	5.39
PCT_WB	2.101	1.626
PCT_WEMP	3.55	2.901
PCT_WMGT	1.82	1.71
NFEXEC	3.11	2.81
Ino_Int	2.01	1.918
BoD_AGE	2.72	2.02
ROA	3.25	3.00
GEARING	3.10	2.81
GWILL_AST	1.92	1.61
PE_RATIO	2.51	2.41
RET_SHF	1.16	1.14
Firm_Age	1.72	1.53
Firm Size	2.00	1.92

4.3. Results of Regression Analysis (Financial Firms)

The results of the regression analysis regarding financial firms (Nested Models vs Full Model) are depicted in Tale 5. Positive and highly significant (0.179, p=0.000), confirming that board gender diversity enhances ESG performance. Older boards (BoD_AGE), leverage, and goodwill positively impact ESG, while ROA and shareholder returns have weak negative effects. Negative and highly significant (-0.146, p=0.000), suggesting that a higher proportion of women employees is associated with lower ESG performance. There is positive and significant (0.0679, p=0.032), suggesting that women in management roles improve ESG outcomes. Positive and highly significant (0.0064, p=0.000), indicating that female executives play a key role in ESG initiatives. Surprisingly, Intensity (R_D) has no significant impact on ESG performance (0.0001, p=0.091).

As regard to Full Model (Comprehensive Analysis of ESG Determinants), the results show that PCT_WB remains positive and significant (0.1532, p=0.000), reinforcing the importance of board gender diversity. PCT_WEMP remains negative and significant (-0.1133, p=0.0001), confirming the counterintuitive relationship. PCT_WMGT becomes insignificant (0.0259, p=0.3931), suggesting that managerial gender diversity alone does not drive ESG. NFEXEC remains positive and significant (0.00655, p=0.000), underscoring the role of female executives in ESG success. R&D Intensity is slightly negative (-0.0001, p=0.0287), reinforcing that financial firms do not rely on R&D for ESG improvements. Model Fit: Highest among all model ($R^2 = 0.569$, F-stat = 12.690, p=0.000), confirming its robustness. The regression results confirm that board gender diversity and female executives

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significantly enhance ESG performance, while the effect of women in management varies. Surprisingly, a higher percentage of women employees correlates with lower ESG outcomes, suggesting potential industry-related constraints. R&D investments do not significantly impact ESG in financial firms, as their sustainability efforts focus on governance and regulatory compliance rather than technological innovation. The full model (Model 6) provides the best explanatory power, highlighting the interplay between gender diversity, firm characteristics, and ESG outcomes.

Table 5. The results of the regression analysis: Financial firm, Nested Models vs Full Model.

	Nested Model					**Full Model**
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
C	0.030* (0.051) {0.552)	0.0452 (0.053) {0.3912}	-0.028 (0.052) {0.586)	-0.0267 (0.050) {0.528}	-0.0227 (0.0517) {0.6607}	0.0629* (0.0511) {0.2183}
PCT_WB	0.179*** (0.024) {0.000)					0.1532 (0.0244) {0.000}
PCT_WEMP		-0.146 (0.030) {0.000}				-0.1133* (0.0293) {0.0001)
PCT_WMGT			0.0679* (0.0317) {0.032)			0.0259 (0.0304) {0.3931}
NFEXEC				0.0064*** (0.1227) {0.000)		0.00655* (0.00115) {0.000}
Ino_Int					0.0001 (0.000) {0.091)	-0.0001 (0.000) {0.0287}
BoD_AGE	0.006 (0.000) {0.000)	0.0075 (0.000) {0.000}	0.0073 (0.000) {0.000}	0.0072 (0.0009) {0.000}	0.0075 (0.000) {0.000}	0.0056 (0.0008) {0.000}
ROA	-0.0003 (0.0002) {0.0905)	-0.0005 (0.000) {0.0105}	-0.0003 (0.0002) {0.0360}	-0.0003 (0.000) {0.0608}	-0.0004 (0.000) {0.0119}	-0.00004 (0.000) {0.0105}
GEARING	0.0001 (0.000) {0.000)	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}
GWILL_AST	0.170** (0.022) {0.000)	0.135* (0.024) {0.000}	0.198* (0.023) {0.000}	0.1917 (0.0217) {0.000}	0.1832* (0.0221) {0.000}	0.1330 (0.0237) {0.000}
PE_RATIO	0.0002 (0.000) {0.0467)	0.0002 (0.000) {0.1199}	0.0002 (0.000) {0.153}	0.00016 (0.000) {0.1058}	0.0002 (0.0001) {0.096}	0.0002 (0.000) {0.0502}

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RET_SHF	-0.0002 (0.0001) {0.0398)	-0.0002 (0.000) {0.115}	-0.0001 (0.0001) {0.297}	-0.0002 (0.0001) {0.1029}	0.000 (0.0001) {0.5997}	0.00001 (0.0001) {0.3777}
R^2	0.538	0.523	0.514	0.528	0.514	0.569
Adj R^2	0.493	0.476	0.466	0.482	0.466	0.524
S.E of regression	0.038	0.039	0.039	0.0389	0.039	0.037
F-statistic	11.849	11.145	10.721	11.374	10.688	12.690
Prob(F-Statistic)	0.0000	0.00	0.000	0.000	0.000	0.0000
Durbin Watson	1.765	1.74	1.74	1.8	1.7	1.8
Log likelihood	1851.1	1831.5	1867.9	1883.9	1856.1	1915.5

Table 6 illustrates the results of the moderating effect of firm age and firm size on ESG performance

Table 6. The moderating effect of firm age and firm size on ESG performance (financial firms).

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
C	0.240659 0.02779 0.000	0.0624 (0.057) {0.2744)	0.0125 (0.0565) {0.8250)	0.0312 (0.058) {0.5913)	0.1507 (0.0448) {0.0008)
BoD_AGE	0.0023 (0.000) {0.000)	-0.0066 (0.0001) {0.000}	0.0065 (0.000) {0.000}	0.0063 (0.0009) {0.000}	0.0047 (0.0008) {0.000}
ROA	-0.0001 (0.0002) {0.766)	-0.0004 (0.0002) {0.0211}	-0.0004 (0.0002) {0.0428}	-0.0004 (0.000) {0.0364}	-0.0001 (0.000) {0.0291}
GEARING	0.0002 (0.000) {0.000)	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}
GWILL_AST	0.0873 (0.0158) {0.000)	0.1967* (0.049) {0.000}	0.2241 (0.048) {0.000}	0.2147 (0.0479) {0.000}	0.0419 (0.0192) {0.0288}
PE_RATIO	-0.0002 (0.000) {0.6754)	-0.0002 (0.000) {0.0231}	0.0002 (0.000) {0.0508}	0.0001 (0.000) {0.0098}	-0.0001 (0.0001) {0.5040}
RET_SHF	-0.0004 (0.000) {0.000)	-0.0002 (0.000) {0.2609}	-0.0001 (0.0001) {0.4938}	-0.0002 (0.0001) {0.3873}	-0.000 (0.0001) {0.0496}
Moderating coefficients					

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	PCT_WB	PCT_WEMP	PCT_WMGT	NFEXEC	Ino_Int
Fage<15yrs	-0.2406 0.02779 0.0000	-0.0951 (0.0173) {0.000)	-0.1639** (0.0352) {0.000)	-0.0086** (0.0019) {0.000)	-0.0021 (0.0018) {0.2501)
Fage 16-30yrs	-0.067** (0.0162) {0.000)	-0.0496** (0.0201) {0.0138)	-0.08837 (0.0347) {0.0112)	-0.0045** (0.0023) {0.0326)	-0.0021 (0.0018) {0.1318)
*Fage 30-45yrs	-0.0727 (0.0163) {0.000)	-0.0448** (0.0199) {0.0252)	-0.0919** (0.0386) {0.0174	-0.0042* (0.0022) {0.0594)	-0.0020 (0.0017) {0.2489)
Fage 46-60yrs	0.0130** (0.0197) {0.512)	0.0087* (0.0196) {0.6552)	0.0064* (0.0.376) {0.0174)	-0.0019** (0.0022) {0.4370)	-0.0020 (0.0018) {0.2574)
Fage >60yrs	-0.0726** (0.0163) {0.000)	-0.0722 (0.0191) {0.0002)	-0.1254 (0.0347) {0.000)	-0.00576** (0.0019) {0.0037)	-0.0025 (0.0018) {0.1635)
Firm size>sample average	0.2239 (0.0234) {0.000)	-0.0084 (0.0393) {0.8315)	0.1916 (0.0424) {0.000)	0.0102 (0.003) {0.0007)	-0.81083 (3.0396) {0.3012)
Firm size<sample average	0.2298 (0.0234) {0.000)	-0.0002 (0.0370) {0.9961)	0.2104 (0.044) {0.000)	0.0109 (0.0028) {0.000)	0.0021 (0.0018) {0.2497)
R^2	0.608	0.561	0.551	0.552	0.520
Adj R^2	0.566	0.515	0.503	0.505	0.469
S.E of regression	0.032	0.037	0.038	0.038	0.034
F-statistic	14.691	12.129	11.59	11.659	10.183
Prob(F-Statistic)	0.0000	0.000	0.000	0.000	0.000
Durbin Watson	2.073	1.91	1.9	1.9	1.9

The results reveal that a higher percentage of women on the board, in management, as employees, and as executives positively impacts ESG performance. This effect is consistent across firm sizes. The influence of board gender diversity on ESG performance varies with firm age with older firms (46-60 years) show a positive relationship. Larger firms with more women on the board and in management show better ESG performance. Firms with higher debt levels indicate a higher corporate boardrooms commitment to ESG practices. Goodwill (GWILL_AST) is positive and significant, suggesting that intangible assets like reputation drive ESG improvements. The moderating effects of firm age and size on the relationship between R&D and ESG are insignificant, indicating that R&D investments in non-financial firms do not strongly contribute to ESG improvements. Board gender diversity is a key driver of ESG performance, especially in older and larger firms. However, younger firms with more women in leadership positions show weaker ESG outcomes, suggesting potential challenges in integrating sustainability strategies at earlier stages.

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While financial factors like leverage and goodwill support ESG improvements, profitability and shareholder returns present trade-offs. R&D does not significantly impact ESG, highlighting that its effectiveness depends on how firms align innovation with sustainability goals.

4.4. Results of Regression Analysis (Non-Financial Firms)

The regression results provided analyze the determinants of ESG (Environmental, Social, and Governance) performance for non-financial companies. In Model 1, Percentage of Women on the Board (PCT_WB) has a positive and significant (0.241, p=0.000) effect on ESG indicating that a higher percentage of women on the board is associated with better ESG performance. In Model 2, the Percentage of Women Employees (PCT_WEMP) has a positive and significant (0.0514, p=0.000) effect on indicating that a higher percentage of women employees is associated with better ESG performance. Model 3, Percentage of Women in Management (PCT_WMGT): Positive and significant (0.0440, p=0.0465), indicating that women in management roles contribute to better ESG performance. In Model 4, Number of Female Executives (NFEXEC) have a positive and significant (0.0098, p=0.000) effect on ESG performance indicating that female executives positively influence ESG performance. In Model 5, Innovation strategies intensity, R&D intensity, does not significantly influence ESG performance in non-financial companies, similar to financial firms. However, this result is surprising, as non-financial companies are typically more R&D-intensive, and R&D is often linked to environmental innovation. Although, while R&D is often associated with innovation and sustainability, its impact on ESG performance depends on how firms allocate their R&D resources and integrate sustainability into their innovation strategies. An evaluation of the control variables reveal that BoD_AGE is positive and significant across all models. Older boards are associated with better ESG performance. This suggests that the experience and stability of older board members contribute to stronger governance and sustainability practices. Older boards may have a better understanding of long-term risks and opportunities, enabling them to prioritize ESG initiatives effectively. Return on Assets (ROA) is consistently negative and significant across models. This indicates a trade-off between short-term financial performance and long-term sustainability investments. Firms prioritizing profitability may allocate fewer resources to ESG initiatives, which require long-term commitments and may not yield immediate financial returns. Gearing (Leverage) is Positive and significant across all models. This may reflect the increased stakeholder scrutiny faced by highly leveraged firms, prompting them to adopt stronger ESG practices to mitigate risks and maintain stakeholder trust. Leveraged firms may also use ESG initiatives as a way to enhance their reputation and access capital. Goodwill to Assets Ratio (GWILL_AST) coefficient is negative and significant across models. This contrasts with financial firms, where goodwill had a positive relationship with ESG performance. In non-financial companies, goodwill may reflect intangible assets like brand value or intellectual property, which do not necessarily translate into strong ESG practices. Price-to-Earnings Ratio (PE_RATIO) coefficient is negative and significant in some models. This suggests that investors may prioritize financial performance over ESG initiatives in non-financial companies. Firms with high valuations may focus on meeting short-term financial targets rather than investing in long-term sustainability. Return to Shareholders (RET_SHF) coefficient is not significant in most models.

Table 7. The results of the regression analysis: Non-financial firms, Nested Models vs Full Model.

	Nested Models					**Full Model**
C	0.0755* (0.0328) {0.0021)	0.147 (0.033) {0.000}	0.1594 (0.034) {0.000)	0.1322 (0.0326) {0.000}	0.1767 (0.0429) {0.0000}	0.0683* (0.0301) {0.0235}
PCT_WB	0.241*** (0.0186)					0.2019 (0.0283)

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	{0.000)					{0.000}
PCT_WEMP		0.0514 (0.0153) {0.000}				0.0275* (0.018) {0.1282)
PCT_WMGT			0.0440* (1.9922) {0.0465)			-0.0125 (0.0285) {0.6613}
NFEXEC				0.0098*** (0.0009) {0.000)		0.0054* (0.0012) {0.000}
R_D					-0.0000 (0.000) {0.6785)	-0.00001 (0.000) {0.7230}
BoD_AGE	0.006 (0.000) {0.000)	0.0055 (0.001) {0.000}	0.0054 (0.000) {0.000}	0.0055 (0.000) {0.000}	0.0054 (0.000) {0.000}	0.0059 (0.0000) {0.000}
ROA	-0.0003 (0.0002) {0.000)	-0.0003 (0.000) {0.0021}	-0.0003 (0.0002) {0.0028}	-0.0003 (0.000) {0.0006}	-0.0004 (0.000) {0.0004}	-0.00004 (0.000) {0.0105}
GEARING	0.0000 (0.000) {0.000)	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}
GWILL_AST	-0.0569** (0.0111) {0.000)	-0.0648* (0.011) {0.000}	-0.0622* (0.0117) {0.000}	-0.0589 (0.0115) {0.000}	-0.0542* (0.0179) {0.0026}	-0.0547 (0.0154) {0.000}
PE_RATIO	-0.0002 (0.000) {0.0752)	-0.0002 (0.000) {0.1141}	-0.0002 (0.000) {0.1132}	-0.0001 (0.000) {0.0812}	-0.000 (0.0001) {0.0176}	-0.0002 (0.000) {0.0024}
RET_SHF	0.0002 (0.0000) {0.1965)	-0.0002 (0.974) {0.114}	-0.0001 (0.0001) {0.1810}	0.000 (0.0001) {0.0859}	0.000 (0.0001) {0.1455}	0.00001 (0.0001) {0.3247}
R^2	0.538	0.382	0.376	0.402	0.336	0.383
Adj R^2	0.416	0.324	0.317	0.345	0.257	0.307
S.E of regression	0.0814	0.083	0.083	0.082	0.085	0.0829
F-statistic	7.560	6.586	6.411	7.132	11.518	12.690
Prob(F-Statistic)	0.0000	0.00	0.000	0.000	0.000	0.0000
Durbin Watson	2.00	2.0	2.0	2.0	1.9	2.0
Log likelihood	1851.1	1831.5	1867.9	1883.9	1856.1	1915.5

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Table 8 illustrates the results of the moderating effect of firm age and firm size on ESG performance.

Table 8. The moderating effect of firm age and firm size on ESG performance (non-financial firms).

	Model 1	Model 2	Model 3	Model 4	Model 5
C	0.240659 0.02779 0.000	0.0624 (0.057) {0.2744)	0.0125 (0.0565) {0.8250)	0.0312 (0.058) {0.5913)	0.1507 (0.0448) {0.0008)
BoD_AGE	0.0023 (0.000) {0.000)	-0.0066 (0.0001) {0.000}	0.0065 (0.000) {0.000}	0.0063 (0.0009) {0.000}	0.0047 (0.0008) {0.000}
ROA	-0.0001 (0.0002) {0.766)	-0.0004 (0.0002) {0.0211}	-0.0004 (0.0002) {0.0428}	-0.0004 (0.000) {0.0364}	-0.0001 (0.000) {0.0291}
GEARING	0.0002 (0.000) {0.000)	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}	0.0001 (0.000) {0.000}
GWILL_AST	0.0873 (0.0158) {0.000)	0.1967* (0.049) {0.000}	0.2241 (0.048) {0.000}	0.2147 (0.0479) {0.000}	0.0419 (0.0192) {0.0288}
PE_RATIO	-0.0002 (0.000) {0.6754)	-0.0002 (0.000) {0.0231}	0.0002 (0.000) {0.0508}	0.0001 (0.000) {0.0098}	-0.0001 (0.0001) {0.5040}
RET_SHF	-0.0004 (0.000) {0.000)	-0.0002 (0.000) {0.2609}	-0.0001 (0.0001) {0.4938}	-0.0002 (0.0001) {0.3873}	-0.000 (0.0001) {0.0496}
Moderating coefficients					
	PCT_WB	PCT_WEMP	PCT_WMGT	NFEXEC	Ino-Int
Fage<15yrs	-0.2406 0.02779 0.0000	-0.0951 (0.0173) {0.000)	-0.1639** (0.0352) {0.000)	-0.0086** (0.0019) {0.000)	-0.0021 (0.0018) {0.2501)
Fage 16-30yrs	-0.067** (0.0162) {0.000)	-0.0496** (0.0201) {0.0138)	-0.08837 (0.0347) {0.0112)	-0.0045** (0.0023) {0.0326)	-0.0021 (0.0018) {0.1318)
*Fage 30-45yrs	-0.0727 (0.0163) {0.000)	-0.0448** (0.0199) {0.0252)	-0.0919** (0.0386) {0.0174	-0.0042* (0.0022) {0.0594)	-0.0020 (0.0017) {0.2489)
Fage 46-60yrs	0.0130** (0.0197) {0.512)	0.0087* (0.0196) {0.6552)	0.0064* (0.0.376) {0.0174)	-0.0019** (0.0022) {0.4370)	-0.0020 (0.0018) {0.2574)
Fage >60yrs	-0.0726** (0.0163)	-0.0722 (0.0191)	-0.1254 (0.0347)	-0.00576** (0.0019)	-0.0025 (0.0018)

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	{0.000)	{0.0002)	{0.000)	{0.0037)	{0.1635)
Firm size>sample average	0.2239 (0.0234) {0.000)	-0.0084 (0.0393) {0.8315)	0.1916 (0.0424) {0.000)	0.0102 (0.003) {0.0007)	-0.81083 (3.0396) {0.3012)
Firm size<sample average	0.2298 (0.0234) {0.000)	-0.0002 (0.0370) {0.9961)	0.2104 (0.044) {0.000)	0.0109 (0.0028) {0.000)	0.0021 (0.0018) {0.2497)
R^2	0.608	0.561	0Non .551	0.552	0.520
Adj R^2	0.566	0.515	0.503	0.505	0.469
S.E of regression	0.032	0.037	0.038	0.038	0.034
F-statistic	14.691	12.129	11.59	11.659	10.183
Prob(F-Statistic)	0.0000	0.000	0.000	0.000	0.000
Durbin Watson	2.073	1.91	1.9	1.9	1.9

As shown in Table 8 Across models, younger firms (<15 years) with more women on the board, in management, or as executives tend to have lower ESG performance. This negative effect weakens slightly for firms aged 16-45 years but remains significant. Firms aged 46-60 years show a positive relationship between gender diversity and ESG performance, while firms >60 years return to a negative relationship. Regardless of size, firms with more women on the board, in management, or as executives tend to have better ESG performance. The positive effect is consistent across large and small firms, suggesting gender diversity is a strong driver of ESG performance. As regard to innovation strategies intensity, Table 8 shows that firm age and size do not significantly moderate the R&D-ESG relationship in financial firms. This suggests that financial firms focus more on digital transformation and regulatory compliance rather than traditional R&D for ESG improvements.

5. Conclusion

This study examines the combined influence of innovation intensity strategies and boardrooms gender diversity on ESG performance. It investigates the influence of gender diversity and firm innovation in UK- financial and non-financial firms over the period (2012-2023). For both financial and non-financial firms, the relationship between innovation intensity and ESG performance is positive and significant but the magnitude of the coefficient for financial firms suggests that this effect is very negligible and not significant for non-financial firms. For both financial and non-financial firms, innovation strategies, R&D intensity has a positive and significant relationship with ESG performance but the magnitude of the coefficient for financial firms suggests that this effect is very negligible and not significant for non-financial firms. However, as I have stated this may be due to the integration of R&D in green investment. However, the results are not conclusive. Pinheiro, (2024) in his study found that higher ESG performance is observed in companies that invested more in Research and development. This is also supported by Grazia et al. (2022) which found a positive and significant relationship between innovation and ESG. Furthermore, the results of Shahnaz and Emranul (2024) also lend credence to the positive effect of innovation on Environmental, social and governance (ESG) performance.

The percentage of women on the board has a positive and significant relationship with ESG performance, for both financial and non-financial firms. This result is consistent Pucheta-Martínez et al., 2019, Arayssi et al., 2019 and Khemakhem et al., 2022). However, the magnitude of the coefficient for financial firms suggests that this effect is very negligible and not significant for non-financial firms.

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The percentage of women employees has a negative and effect on ESG performance in financial firms. Unlike financial firms, the percentage of women employees has a positive relationship with ESG performance in non-financial firms. For both financial and non-financial firms, the percentage of women in management has a positive relationship with ESG performance in the Nested models. Further, these relationships become insignificant in the full model, suggesting that other factors may overshadow the influence that women in management could have on ESG. In both financial and non-financial firms, the number of female executives has a positive relationship with ESG performance across models.

For both financial and non-financial firms, Firms on the age range (Fage <15yrs, 16-30yrs, 30-45yrs), across all gender diversity variables, more gender diverse boards tend to have lower ESG performance. Firms between the range of 46-60 years, with more women on the board achieve better ESG performance. This may be due to their greater organisational maturity and ability to effectively utilize diverse leadership for sustainability goals.

For both financial and non-financial firms, larger firms and smaller firms alike benefit from gender diversity in leadership and management roles. This highlights the universal importance of gender diversity in driving ESG performance, regardless of firm size. For both financial and non-financial firms, neither firm size nor firm age moderators have any significant effect on the relationship between innovation intensity and ESG performance.

Theoretical implications

Our study adopts nested the Nested vs. full Model methodology, by demonstrating that certain gender diversity effects become insignificant in the full model, our results suggest the presence of additional corporate specific or external factors that mediate these relationships. This methodological contribution emphasises the need for comprehensive models that account for confounding variables when studying ESG performance determinants.

The results of this study support the assumptions underlying RBV, stakeholder theory, and UET, which suggest that diverse boards and leadership teams are better equipped to address the needs of various stakeholders and leverage external resources for sustainability initiatives. However, the negative relationship between gender diversity at the employee level and ESG performance in financial firms challenges the assumption that gender diversity uniformly enhances ESG outcomes. This highlights the need for context-specific theories that account for sectoral differences and organizational dynamics.

Managerial implications

Findings of this study highlights the importance of gender diversity in leadership roles for driving ESG initiatives. Firms should implement policies to increase the representation of women on boards and in executive roles, such as setting diversity targets, mentoring programs, and inclusive hiring practices. The results suggest that companies with a high-level of board boardrooms diversity strengthen innovation strategies intensity and leverage external resources for sustainability initiatives.

By distinguishing between financial and non-financial firms, our study uncovers in the magnitude and significance of this relationship, providing a better understanding of gender diversity's role in corporate sustainability. Unlike prior research, our study highlights the divergence in the impact of female employees on ESG performance. While financial firms exhibit a negative relationship, non-financial firms show a positive correlation. This novel insight suggests that industry-specific factors influence how gender diversity at different levels of the corporate hierarchy translates into business innovation strategies intensity and ESG. As reveal by this study, the lack of a significant relationship between innovation strategies and ESG performance challenges the innovation-driven sustainability theory, which posits that innovation is a key driver of environmental and social sustainability. This suggests that traditional innovation strategies, R&D metrics, may not adequately capture sustainability-focused innovation, particularly in financial firms.

Limitations of the study and suggestions for future research

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Findings of this study remain within the context of large UK companies, the study limitations also, due to the sample selection FTSE350.

Our study focuses only on two firm-specific moderators being firm size and firm age and this limits our understanding of the role of other firm moderators. Importantly, in the consideration of the measure for innovation for non-financial companies, the study has not incorporated patents rights of the companies. The lack of significance of innovation intensity in driving ESG performance raises questions about the adequacy of traditional metrics for capturing sustainability-focused innovation. Future research should develop and validate new metrics that better align with ESG goals. Future research may explore this further

Future studies may adopt single theory or combination of the theories adopted by this study or other theoretical lenses to address the research questions of this study in different countries and settings. Future study may adopt case study approach or difference-in-differences (DID) methodology to explore the same research variables employed by this study, adopt or adapt our research model.

Declaration of interest: The authors have no conflict of interest to declare.

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