

Board Attributes as Catalyst for Enhancing Firm-Level Sustainability: A Study of Developed Economies

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Abstract

The main objective of the current study is to examine the nexus between board attributes and a firm's sustainability practices. These practices (ESG) attract policymakers, researchers, and regulators due to the rapid increase in global environmental degradation. This study explains how board characteristics like size, independence, and gender diversity contribute to firms' sustainable (ESG) practices. The study uses firm-specific data from four developed economies (China, the UK, Germany, and Japan) during 2017 and 2022. To achieve objectives, the study uses statistical tools like ordinary least squares (OLS) and fixed effect models. The study findings reveal that board characteristics like board size, independence, and gender diversity positively and significantly influence a firm's sustainability practices. This highlights the critical role of governance mechanisms in promoting sustainability practices. The result affirms that sustainability practices (ESG), with practical board attributes, are no longer optional but essential. The research outcome encourages policymakers and management to prioritize board attributes significantly enhancing a firm's sustainability practices. This study addresses the limited literature on the nexus between board-specific attributes and firm-level sustainability, offering valuable insights into this critical nexus.

Keywords: Firm Sustainability, Board Size, Board Independence, Board Gender Diversity

Introduction

In today's world, sustainability is a significant concern. The origins of sustainability can be traced back to the 1700s when its full implications were not yet understood. During this period, behavior was primarily influenced by religion, societal norms, ethical principles, and cultural values; ethical investing strategies that considered these factors were often overlooked. In the 1980s and beyond, legislation focused more on the economy, the environment, and societal well-being (Cubas et al., 2018). Sustainability has become a crucial component of business strategy for future generations and company expansion, as it involves a long-term evaluation of critical factors (Serbu et al., 2021). An organization's capacity to sustain itself, ensuring ongoing growth through efficient resource utilization and forward-thinking practices, depends on its commitment to sustainability.

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Modern sustainability is achieved by integrating environmentally conscious practices, ethical and social engagement, and sound economic strategies, fostering a harmonious and enduring global community (Hariram et al., 2023; Bateh et al., 2013). Being sustainable is the right thing to do and suitable for business. Sustainable companies are more likely to be successful in the long term. They are more attractive to customers, investors, and employees. However, being sustainable can be difficult. Companies face many obstacles, including increased costs, changing government regulations, and stakeholder expectations.

Developing economies have made significant strides in sustainability, yet challenges remain. Recent studies show that some developing countries outperform developed nations in environmental performance, with an ESG score difference of approximately 4 points. Sustainable finance is expanding rapidly, with ESG-linked debt issuance in emerging markets tripling to \$190 billion in recent years. Renewable energy adoption is also accelerating, with a 23% compound annual growth rate for renewables in developing nations compared to 11% in developed countries. However, carbon emissions continue to rise, with a 4.7% increase in CO₂ emissions, aligning with economic growth trends. To achieve global sustainability targets, emerging markets require approximately \$2.4 trillion annually in climate-related investments by 2030. These figures highlight the progress and the urgent need for increased financial support and policy interventions to enhance sustainability in developing economies.

Additionally, the short-term objectives of the firm deviate firm attention from long-term sustainability goals, while fragmented stakeholder interest can make decision-making tricky and complicated. Furthermore, firms also face technological innovation challenges, which help promote green practices for sustainability purposes. By understanding the importance of sustainability, companies can make informed decisions for both their business and the environment. The current study provides a comprehensive approach to achieving sustainability considering the range of factors. It offers insights about an additional dimension encompassing a large body of study. Specifically, the study focuses on factors such as board size, independence, and gender diversity concerning the firm's sustainability (ESG) practices. Board composition is prevalent in overcoming challenges, encouraging green practices, and achieving sustainability in ESG. More importantly, board attributes (size, diversity, independence) enhance monitoring of firms' operations and guide firms for resource allocation and strategic planning, ensuring balance focusing on profitability and sustainability. Diversified boards are more likely to foster inclusive decision-making, aligning shareholders' interests with the firm's long-term objectives, including sustainability. Prioritizing regulatory compliance and fostering an adaptability culture, a board with strong governance attributes can lead a firm to sustainable transformation and competitive advantages.

Literature Review

Ensuring a company's long-term success is now widely recognized as dependent on its sustainability, which involves incorporating environmental, social, and governance (ESG) factors into its business practices. Firm sustainability is significantly impacted by various influential factors like the firm's financial position and governance mechanism. Literature has shown that corporate governance mechanisms are important in driving a firm's sustainability (ESG) by enhancing transparency and ethical decision-making. Governance structure, including board size, diversity, and independence, encourages eco-friendly practices to achieve sustainability goals and attain reputation, resilience, and value creation. Zaid et al. (2023) found that board size has a U-shaped relationship with sustainability performance. Initially, a larger board increases ESG

performance because of diverse expertise. However, it becomes less effective after an optimal level due to diverse opinions, alignment in decision-making, and coordination challenges. A larger board has diverse knowledge and skills, bringing a broader perspective and maximizing shareholder representations (Ben-Amar & McIlkenny, 2015; Michelon & Parbonetti, 2012).

In contrast, larger board size hinders decision-making and oversight, negatively affecting sustainability performance (Jizi et al., 2014; Liao et al., 2015). Literature also witnessed that the impact of board size varies by region and industry, with larger boards being more beneficial in industries with high environmental and social impact (De Villiers et al., 2011; Post et al., 2011). Thus, achieving an optimal board size is crucial for balancing diverse input, efficient governance, and effective sustainability outcomes.

Board gender diversity concerning a firm's sustainability, particularly in environment, social, and governance (ESG), remains a point of interest for researchers and policymakers. Literature has witnessed high gender diversity within a firm board increases ESG practices and disclosures (Arayakarnkul et al., 2022; Toerien et al., 2023). Female board members are linked to sound environmental performance and are commonly involved in disclosing greenhouse gases and ethical business practices (Liao et al., 2015). This provides a good signal to the market, enhances reputation, attracts investors, and ultimately increases market value (Bear et al., 2010). Evidence from across the globe, like in China (Naveed et al., 2021) and South Africa (Toerien et al., 2023), confirmed that gender diversity fosters ethical and socially responsible practices that result in enhanced practices concerning environmental, social, and governance (ESG). In addition, Post et al. (2011) also found that board gender-diversity has a substantial positive nexus with corporate social responsibility (CSR) practices. Board independence also plays a very influential role in ESG practices. Independent directors constantly monitor and foster transparency and accountability within the firms. Independent directors also encourage sustainable decision-making within the firms (Shah, 2020; Agarwala et al., 2023; Kamarudin et al., 2024).

Furthermore, Kaur and Singh (2022) found that board independence tackles agency conflict within the firms, improves sustainable disclosure, and prioritizes long-term goals. Firms usually keep a high proportion of independent directors within the firm board to enhance governance mechanisms and actively participate in the firm's key decisions, including CSR activities and linking corporate goals with societal expectations (Chen et al., 2023). Furthermore, other literature supports and affirms that board independence tends to increase ESG ratings and environmental performance (Krol et al., 2021). Board independence has been linked with robust environmental practices like reducing CO₂ emissions, focusing on alternative energy sources, and taking energy efficiency initiatives; all these help promote sustainable strategies, especially in those industries that are highly at risk (Xu et al., 2023; Zhou et al., 2022).

Methodology

To unveil the nexus of board attributes on a firm's sustainability, this study extracted data from the database Refinitiv. The data is employed for four major developed economies: China, the UK, the USA, and Germany. As developed countries cover the central portion of the globe. They emit 23 billion tons of CO₂, which indicates 62% percent of global emissions compared to under-developed countries, which is 14 billion tons of CO₂ and cover 38% of global emissions. This means that developed countries emit a higher proportion and contribute more harmful gases to society as it has become a significant issue for sustainable growth. The sample under study covers nearly 50% of global emissions; the other is caused by under-developed countries, less in

proportion to developed countries. Our study uses a purposive sampling technique for the selection of the data.

$$FS_{i,t} = a_0 + a_1(BSIZE)_{i,t} + a_2(BIND)_{i,t} + a_3(BDG)_{i,t} + a_4(FS)_{i,t} + a_5(IndTyp)_{i,t} + \varepsilon_{i,t} \dots 1$$

In this model, *i* represents the number of countries under study (*i* = 1,2,3,4). Here *t* represents the number of years, which range from 2017-2022. FS stands for firms' sustainability the dependent variable. Firms' sustainability is our main area of concern under study as it is a key factor for every business.

Table 1: Measurement of variables

Variable Name	Definition	Source	Reference
Dependent Variable			
Firm's Sustainability (ESG)	The ESG disclosure score is the score given to companies that practice ESG activities. This score ranges from 0 to 100. A higher number means a high ESG Score.	Refinitiv	Aydogmus et al. (2022)
Independent Variables			
Board Size	Total number of board members.	Refinitiv	Ebenezer et al. (2019)
Board Gender Diversity	It refers to the proportion of females on the board.		Giron et al. (2020)
Board Independence	It is the independent board members divided by board size		Giron et al. (2020)
Control Variables			
Firm Size	The natural log of the firm's total assets.	Refinitiv	Nguyen, D. T. T. (2020)
Industry Type	It determines the type of the industry. It has 1 for manufacturing and 0 for services.		Giron et al. (2020)

Empirical Results

Table 2: Descriptive statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
FSUS	2400	54.129	20.415	0.660	95.610
BGD	2400	24.314	13.912	0.000	66.670
BI	2400	6.620	4.275	0.000	50.000
BSize	2400	10.110	3.622	1.000	24.000
FSize	2400	7.004	0.842	4.360	8.983
IndsTyp	2400	1.000	0.000	1.000	1.000

Table 2 represents the descriptive stats of the dataset. The descriptive stats elaborate the key features of the data. It provides the main overview and characteristics of the data. A total of 2400 observations are employed in the dataset. The dependent variable firms' sustainability represented by (FSUS) gives the mean value to be 54.13, the standard deviation is 20.42, the minimum value range in the dataset is 0.66 and the maximum value of the data set is 95.61. Board gender diversity is treated as an independent variable represented by (BGD) the mean value of board gender diversity is 24.31, and the standard deviation is 13.91, with a minimum value ranging from 0 and

a maximum value of 66.67. Board independence is also used as an independent variable represented by (BI) the mean value of the dataset is 6.62, the standard deviation about the mean is 4.27, the minimum value in the dataset is 0 and the maximum value in the dataset is 50. The board size is represented by (BSize) the mean value of the data is 10.11, the standard deviation around the mean is 3.62, the minimum value is 1 and the maximum value of the dataset is 24. The control variable firm size is represented by (FSize) gives a mean value of 7.00, a standard deviation of 0.84, a minimum value of 4.36, and a maximum value of 8.98 in the dataset.

Table 3: Correlation matrix

Variables	FSUS	FSize	BGD	BSize	BI
FSUS	1.000				
FSize	0.149	1.000			
BGD	0.508	-0.220	1.000		
BSize	0.317	0.367	0.186	1.000	
BI	0.050	-0.343	0.071	-0.503	1.000

The correlation matrix table 3 provides the relation among the variables. It tells about the strength and direction of the variables. This table shows that firm sustainability (FSUS) has a weak correlation with board independence (BI), while it shows a positive correlation with board gender diversity (BGD). Findings of the correlation matrix present that none of the variables used has a perfect correlation with other independent variables highlighting the absence of multicollinearity in the study. This obeys assumptions of the classical linear regression model (CLRM), so may proceed with further tests.

Table 4: Variance inflation factor (VIF)

Variables	VIF	1/VIF
BSize	1.590	0.630
BI	1.420	0.704
FSize	1.310	0.761
BGD	1.170	0.851
Mean	1.250	

Table 4 provides the results of the variance inflation factor. The independent variables are supposed to have no perfect correlation with each other. The presence of perfect correlation among variables will result in a severe issue of multicollinearity. The Variance Inflation Factor (VIF) is used to check the existence of the perfect relationship. VIF ranges from 1 to 2, indicating that there exists no Multicollinearity among the variables.

Table 5: Heteroscedasticity test

chi2(1)	0.02
Prob > chi2	0.8894

Table 5 presents the results of the Heteroscedasticity test. The heteroscedasticity test is used to determine if there is some scatterness of the data around the mean value or not. The violation of this assumption means that there is some error in the data referring to the heteroscedasticity,

meaning that there is no homoscedasticity and there are some outliers in the dataset. This study uses the Breusch Pagan test to unveil whether the error terms are normally distributed. Through our findings the probability value (0.88) indicates that the error term is normally distributed, meaning that the data is homoscedastic.

Table 6: Hausman test

chi2(5)	22.12
Prob>chi2	0.0005

Table 6 presents the results of the Hausman test used to select the appropriate model between a fixed model and a random effect model. The P-value indicated is (0.0005), which is much lower than (0.05) at a significance level of (5%). This means that we can reject the null hypothesis that the random effect model is appropriate. This results in accepting the alternative hypothesis that the fixed effect model is more appropriate.

Table 7: Fixed effect model

FSUS	Coef.	Std. Err.	T	P
FSize	5.687606	0.450041	12.64	0.000
BGD	0.705095	0.026211	26.9	0.000
BSize	1.423568	0.11407	12.48	0.000
BI	1.064152	0.091187	11.67	0.000
Prob > F	0.0003			

Table 7 represents the results of the fixed effect model. The fixed effect model reveals the actual effects on dependent variables due to the changes in the independent variables. It tells about how changes in each element of independent variables affect the dependent variable. The results of the fixed effects model used in this study reveal that board gender diversity (BGD) has a statistically significant (0.000) and positive (0.70) relationship with firms' sustainability, indicating that a 1% increase in the board gender diversity results in 70% increase in the firm's sustainability. The findings of the study align with the previous results of (Suttipun, 2021; Ludwig & Sassen, 2022; Bannò et al. 2023; Sepulveda-Nuñez et al., 2025) and are in contrast with the previous findings of (Ahmad et al., 2024). Similarly, board size (BSize) is also an influential factor in firms' sustainability. Board size was found to be statistically significant (0.000) and positively (1.42) correlated with the firm sustainability, indicating a 1% increase in the board size resulted in 142% increase in the firm's sustainability. The study finding aligns with the previous findings of (Chouaibi et al., 2021; Suttipun, M. 2021; Chebbi & Ammer, 2022; Menicucci & Paolucci, 2022; Ahmed, 2023; Treepongkaruna et al., 2024; Sepulveda-Nuñez et al., 2025). The study findings also go against the previous findings (Disli et al., 2022; Kamarudin et al., 2024).

Board Independence (BI) is also an influential factor concerning firms' sustainability. Board independence has a positive (1.06) and statistically significant (0.000) relationship with firms' sustainability, indicating that a 1% increase in board independence results in a 106% increase in firm sustainability. Findings of the previous studies (Ludwig & Sassen, 2022; Ahmed, 2023; Velte, P. 2022; Islam R et al., 2023) also support the current study's notion of a positive nexus between board independence and firms' sustainability in terms of environmental, social, and governance. The current study's findings contradict the previous research (Ismail & Latiff, 2019; Bansal, S et

al., 2018), which found a negative association between board independence and firm sustainability regarding environmental, social, and governance factors.

Conclusion

This study addresses the nexus between board attributes (board size, board independence, board gender diversity) and sustainability disclosure in four developed economies (USA, UK, Germany, and China) from 2017 to 2022. The study results highlight that board characteristics (board size, board independence, board gender diversity) significantly enhance firm sustainability. Larger boards have vast expertise due to diversity in knowledge; this fosters a more sustainable and comprehensive decision-making process that encourages sustainability initiatives. Furthermore, board independence was also found to be an influential factor for firms' sustainability, ensuring oversight, enhancing monitoring, and reducing agency conflict, thus aligning corporate practices with sustainable practices. In addition, board gender diversity also plays an important role in the nexus of sustainability. Gender diversity within the board encourages innovative solutions, inclusive decision-making, and a stronger focus on sustainability practices (environmental, social, and governance). All these attributes are considered the pillars of a good governance structure within the firms that prioritizes transparency, accountability, and ethical practices, which are essential for achieving long-term sustainability objectives. The current study's findings affirm the importance and need for the firms, policymakers, regulators, and stakeholders to consider board attributes and strengthen them to ensure sustainable development for which all these attributes work. Independent and diverse boards address stakeholder demand effectively, manage environmental and social risk, and collectively contribute to sustainable performance. The study's findings provide valuable insight for academics, practitioners, and regulators aiming to strengthen governance mechanisms for promoting sustainability. The current study also provides a roadmap for the business to encourage sustainable corporate governance to create enduring value for all stakeholders.

Suggestions

This study emphasizes the usefulness of sustainability in a global setting and calls on management and policymakers to prioritize sustainable practices. According to the research, companies that disclose sustainability issues more thoroughly stand a better chance of gaining investment, gaining the trust of stakeholders, and adhering to changing legal requirements. Businesses that match their values with sustainability will be better positioned to compete successfully and secure long-term success as global markets change.

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