

## RESEARCH ARTICLE

# Gender Diversity and Environmental, Social, and Governance: Unlocking Solutions to Corporate Risk

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## ABSTRACT

This study examines the relationship between Environmental, Social, and Governance (ESG) practices and corporate risk in Asian countries, emphasizing the moderating role of board gender diversity (BGD). Using a panel dataset of 15,496 observations from Asian firms between 2008 and 2020, the analysis employs the Generalized Method of Moments (GMM) model to address potential endogeneity issues. The findings indicate that stronger ESG practices significantly reduce corporate risk, enhance financial stability, and mitigate regulatory and market volatility exposure. Furthermore, the results highlight that higher BGD amplifies this risk-reduction effect, suggesting that diverse boards contribute to better decision-making and risk management. Policy Implications: These findings underscore the importance of regulatory frameworks that encourage ESG adoption and board diversity. Policymakers should incentivize companies to integrate ESG principles and implement gender diversity policies, such as board quotas or disclosure requirements, to enhance corporate resilience and sustainable economic growth.

## 1 | Introduction

Recently, a significant role has emerged globally in firms engaging in environmental and social issues due to the importance that companies realize (Kaur and Kander 2023). These issues affect financial issues and have an attractive power for potential investors. Three dimensions may be considered the most interesting practices, which are environmental sustainability, social sustainability, and corporate governance (Al-Hiyari et al. 2024). Environmental sustainability is concerned with global warming, pollution, climate, and toxic product residues (Saleh and Maigoshi 2024). Social sustainability includes practices that are directly related to community welfare, donations,

education support, employee support, and health safety (Coelho et al. 2023). Corporate governance is considered the basis for the success of companies, as governance is the rules through which the company is led to ensure sustainability and directs it (Al-Sayani and Al-Matari 2023; Liu et al. 2023), and includes mechanisms to regulate the various relationships between the board of directors (Mansour, Al Zobi, et al. 2024), executives, shareholders, and stakeholders (Kavadis and Thomsen 2023). In general, corporate sustainability has been widely studied regarding the company's reputation, performance, and earnings management. However, there is still a question that has been ignored, and a gap remains in the literature: what is the impact of sustainability on firm risks?

One of the theories that explains the nexus between sustainability practices and corporate risks is the signaling theory (Friske et al. 2023). This theory describes how the risk committee in the companies takes an approach to managing financial and non-financial risks related to sustainability activities, which have an impact on the company's performance (Spence 1973). This theory focuses on the difference in financial risks for companies that engage in sustainability activities and those that do not prioritize them. Building upon the signaling theory, sustainability practices can serve as a credible signal to investors and stakeholders about the firm's commitment to long-term value creation and risk management. Companies actively engaging in ESG activities often signal to the market that they are not only addressing current challenges but also preparing for future uncertainties (Friske et al. 2023). This approach can reduce information asymmetry between the company and its stakeholders, which in turn influences investor confidence and risk perceptions (Luo and Bhattacharya 2009).

From a practical perspective, integrating sustainability practices into risk management frameworks allows companies to proactively identify, assess, and mitigate potential risks. For example, firms with robust environmental sustainability initiatives may reduce their exposure to regulatory risks, fines, or reputational damages stemming from environmental violations (Shahab et al. 2024). Similarly, companies prioritizing social sustainability can improve employee morale, customer loyalty, and community trust, which are critical in mitigating operational and reputational risks (Coelho et al. 2023). Despite the theoretical and practical advancements, there remains a critical research gap in understanding the extent to which sustainability practices influence firm-specific risks, such as market risk, credit risk, and operational risk. Existing literature primarily focuses on the impact of sustainability on performance metrics, leaving the relationship between sustainability and risk exposure underexplored.

In reviewing the literature, it was found that the results are not conclusive and are still conflicting concerning the correlation between sustainability and firm risk. There are two points of view: the first has proven that sustainability may harm the company in that it increases costs (Salvi et al. 2023), which in turn leads to an increase in the company's debt (Khalaf et al. 2023; Oktantiani and Gunawan 2023), which increases risks. The other perspective claims that sustainability is associated with an improvement in the company's reputation and thus higher performance and returns (Kavadis and Thomsen 2023; Saleh and Maigoshi 2024). This conflict of the result could be because of the role of different samples, methodologies, and other contexts (Galbreath 2018). Therefore, to address the conflicting results, Baron and Kenny (1986) suggested that in the case of conflicting outcomes, a hidden moderating factor may be the one that explains the real relationship.

Corporate governance plays a pivotal role in embedding sustainability into the strategic direction of the company. A well-structured board with gender diversity can enhance decision-making processes and ensure accountability in implementing sustainability initiatives (Al-Sayani and

Al-Matari 2023). Accordingly, this study posits that the board gender diversity (BGD) moderates the relationship between sustainability practices and firm risk. When studying BGD as an interaction variable in the link between sustainability and firm risks, the main reason is not to take into account gender equality and other contemporary issues, but to identify women's ability to make decisions and to change the performance from one point to another (Hazaea et al. 2023; Slomka-Golebiowska et al. 2023). Biswas et al. (2023) found that BGD broadens perspectives, provides additional ideas, and opens the way for creative decisions, such as engaging in sustainability practices. Therefore, companies with BGD have a competitive advantage in terms of identifying sustainability risks and how to address them (Al-Matari 2024; Khalaf et al. 2024). Previous studies have shown that women are more cautious than men in decision-making, prioritizing long-term results over short-term profits (Gupta et al. 2023). So, sustainability is about promoting long-term practices, which is one of the issues that women focus on. This research focuses on the role BGD plays in addressing risks that may arise due to a company's engagement in sustainability activities. The theoretical contribution of this study lies in its examination of BGD as a moderating variable that may explain the conflicting outcomes in prior research. By applying signaling theory, this study provides a novel perspective on how diverse board compositions can influence the relationship between sustainability practices and firm risks.

Financial performance has been the subject of the largest studies about sustainability (Rahi et al. 2024). Some studies have linked sustainability to corporate governance (Al-Hiyari et al. 2024; Dion and Evans 2024), while others have examined the relationship between sustainability and capital structure (Adeneye et al. 2023; Alshdaifat, Saleh, et al. 2024). Alternatively, some studies have found that sustainability hurts firms (Ramzan 2023; Mansour, Al Zobi, et al. 2024). From this perspective, this study examines the risks a firm may face from implementing sustainability practices. So, it is clear from the above discussion that sustainability has sometimes had a positive impact on the company and, other times, a negative effect. Despite the growing body of literature on sustainability, there remains a notable research gap regarding its impact on firm risks, particularly when considering moderating variables like BGD; addressing this gap is crucial as it not only bridges inconsistent findings in the field but also provides deeper insights into sustainability's multifaceted impact, especially by examining whether BGD moderates the relationship between sustainability and firm risk in the context of Asian countries.

## 2 | Literature Review and Hypothesis Development

### 2.1 | ESG Score

ESG rating agencies are independent businesses specializing in ESG scores. ESG scores can be obtained from various rating agencies such as ISS ESG, Vigeo/EIRIS, Bloomberg ESG Data Services, and Fitch Ratings. Numerous academic publications (Reber et al. 2022) have used the Bloomberg database's ESG

score. An ESG score, ranging from 0 to 100, allows investors to assess a company's performance relative to its industry competitors and businesses in other sectors. Investors may be drawn to companies with high ESG scores as they align with shared values and provide protection against pollution and governance risks. A cautious investor focused on ESG may opt out of investing in a company with a lower ESG score.

The three fundamental theories that underpin ESG literature, as highlighted by Santamaria et al. (2021), are stakeholder, legitimacy, and signaling theory. The focus of stakeholder theory is on achieving long-term success by involving different stakeholders such as employees, creditors, society, customers, and the environment. Firms can benefit and stay afloat by meeting stakeholder needs with non-financial data. Conversely, some scholars argue that stakeholder dissatisfaction can negatively impact productivity and endanger a company's long-term prospects. Growing economic performance is significantly motivated by the satisfaction of diverse stakeholder groups (Coelho et al. 2023). Connections between diverse stakeholders are linked to a company's commitment to reporting non-financial variables, as per the stakeholder concept. Involving stakeholders helps companies select relevant evidence for their sustainability report.

Among the various approaches to social and environmental accounting, legitimacy theory is widely known. According to Suchman (1995), there exists an implicit social agreement between individual firms and society. In general, companies employ disclosure strategies to achieve social acceptability. An entity achieves legitimacy when its value system aligns with that of the larger social system. Consequently, this theory suggests that businesses interact with external entities, creating social agreements. One method of showcasing legitimacy in corporate reports is through non-financial disclosures. Spence (1973) first introduced the concept of signaling. The main focus is to reduce the knowledge gap between the two parties. It involves instances where one party holds the information and has the authority to decide when and how to reveal it.

## 2.2 | ESG Combined Score and Firm Risk

Recently, the topic of sustainability has emerged significantly, and researchers have been interested in studying it and studying its financial and non-financial impact on companies. Commitment to environmental and social practices may improve the company's reputation, increase its revenues and profits, and may attract new potential investors and other benefits (Rahi et al. 2024). All of this is associated with few risks for the company. Conversely, companies with poor ESG performance typically have a weaker position in the market (Alharasis, et al. 2024).

There are at least two well-established theories that can be utilized to demonstrate a connection between a company's risk-taking behavior and its commitment to sustainability through ESG activities. According to Freeman's "stakeholder theory" (1984), shifting from a focus on shareholders to a focus on stakeholders in CG would help to balance the

interests of both investing and non-investing stakeholders in companies. This shift would also help to prevent excessive risk-taking by management and safeguard the value of the firm. Sustainability initiatives should be seen as a deterrent to risky behavior by banks. This is most evident in the investments and leverage of companies, but it can also be seen in factors such as increased customer loyalty leading to reduced risk (Cui et al. 2023; Mansour, Al Zobi, Saram, et al. 2023) and decreased costs associated with governance-related failures (Sancha et al. 2023). Instead, according to the over-investment hypothesis, ESG considerations cause companies to shift limited resources away from maximizing shareholders' wealth, resulting in reduced firm value due to decreased investment (Morgado and Pindado 2003).

Tjahjadi et al. (2024) proposed that a company's sustainability can create positive moral capital among stakeholders, even during a crisis, which can act as a form of insurance for the firm. Highly rated companies with ESG scores demonstrate greater transparency in risk exposure, management, and governance, reducing exposure to systematic risk. Clément et al. (2023) and Mefteh-Wali et al. (2024) propose innovative methodologies for managing idiosyncratic risk. In their study, Mefteh-Wali et al. (2024) demonstrate the interplay between idiosyncratic risk and firm-specific risk, highlighting a causal relationship between ESG and idiosyncratic risk. The study conducted by Clément et al. (2023) introduces a stochastic model that quantifies capital requirements and risk, with specific emphasis on demographic risk, across different time horizons. These research findings reveal how ESG can accelerate the shift to a sustainable, low-carbon economy through integration into risk management strategies. Moreover, the overall market conditions and performance of portfolios can be influenced by the interconnectedness of ESG risks (e.g., climate change, health risks) and geopolitical risks, including wars, terrorist acts, fraud, cybercrimes, and trade policy (Caldara and Iacoviello 2022).

Nevertheless, prior studies present conflicting findings regarding the association between a company's ESG performance and its likelihood of defaulting. According to certain research, ESG factors, such as sustainability, do not have a substantial impact on credit ratings (Chodnicka-Jaworska 2021). In contrast, alternative studies propose that companies enjoy advantages by prioritizing sustainability, as higher ESG performance contributes to decreased equity costs and minimized portfolio risk (Saleh and Maigoshi 2024; De Spiegeleer et al. 2023). Moreover, Pineau et al. (2022) emphasize that enterprises with strong ESG credentials tend to receive better credit ratings. Similarly, in their study, Ge and Liu (2015) discovered that companies that commit corporate social violations face higher bond yield spreads. This classification puts these firms in the speculative-grade category with increased chances of default.

Although there is a significant amount of literature discussing the connection between sustainability/ESG investment and a company's risk ratings, there is a lack of sufficient evidence regarding whether ESG investments are adequately accounted for in the credit market. However, the main message is evident: ESG factors are crucial in predicting returns and must be taken into account when making investment choices.

**Hypothesis 1.** *A firm's risk will be lower for firms with higher ESG scores.*

### 2.3 | Moderating Role of BGD

Many studies consistently demonstrate that a corporation's dedication to ESG practices has a substantial impact on mitigating business risks. Improved ESG performance increases transparency and reduces the likelihood of regulatory fines, damage to reputation, and operational inefficiencies (Albuquerque et al. 2019). Moreover, companies that prioritize sustainability are perceived as more stable because ESG practices help mitigate the impact of external disruptions and enhance risk control. Saleh and Maigoshi (2024) also highlight that companies with robust ESG frameworks often experience improved financial performance, which ultimately reduces the likelihood of default.

The exploration of the relationship between BGD and firm risk is extensive, and studies suggest that having diverse gender representation on boards can improve decision-making. Having diverse boards can lead to different viewpoints, which enhances the ability to manage risks more effectively (Post and Byron 2015). Studies indicate that businesses with higher BGD tend to embrace risk-averse approaches, resulting in more cautious financial decision-making and decreased volatility (Sila et al. 2016). Additionally, having diverse boards in terms of gender has been found to enhance oversight and strengthen governance, both of which play a critical role in mitigating risks (Adams and Ferreira 2009).

There is growing interest in understanding how BGD moderates the connection between ESG and firm risk. Research indicates that having a diverse gender representation can improve the effectiveness of ESG initiatives by promoting an inclusive corporate culture that prioritizes long-term value creation (Nadeem et al. 2017). Female board members often support sustainability efforts, especially those addressing social and environmental issues, which can help reduce risks related to weak ESG performance (Bear et al. 2010). Additionally, having a diverse range of genders can enhance the connection between ESG factors and company risk. This is because women often display more careful decision-making tendencies, especially in situations with high levels of risk (Liao et al. 2019). According to Byron and Post (2016), firms with BGD may experience a greater risk reduction with ESG practices compared to less diverse firms.

To construct a well-grounded hypothesis, it is essential to integrate relevant theoretical and empirical foundations. The stakeholder theory provides a solid framework for understanding why BGD may strengthen the relationship between ESG practices and risk reduction. This theory posits that diverse boards are better equipped to understand and address the needs of multiple stakeholders, aligning corporate goals with broader societal interests (Freeman 1984). The resource dependency theory further highlights that diversity on boards increases access to varied perspectives and resources, which enhances strategic decision-making and risk management capabilities (Pfeffer and Salancik 1978). Thus, integrating these theories and empirical

evidence strengthens the hypothesis and provides a compelling rationale for exploring the moderating role of BGD in the ESG-risk relationship.

**Hypothesis 2.** *Firms can mitigate the risks of implementing ESG initiatives by ensuring BGD.*

### 2.4 | Theoretical Framework

This study examined the impact of gender diversity on corporate risk, relying on an integrated framework that combines stakeholder theory, resource-based theory, and agency theory. According to agency theory, gender diversity on the board of directors is a mechanism for enhancing oversight and reducing conflicts of interest between managers and shareholders (Jayaraman et al. 2025; Jensen and Meckling 1976), which leads to mitigating corporate risk. Resource-based theory suggests that gender diversity improves decision-making by enhancing the skill set and expertise available on the board, thereby reducing unexpected corporate risks (Hassan et al. 2024). In addition, stakeholder theory confirms that gender diversity broadens the company's interest in social issues, which enhances the company's reputation and reduces operational risk (Centinaio 2024; Freeman 2010). On the other hand, ESG was considered a moderating variable in the relationship between gender diversity on the board of directors and risk management because it enhances the impact of diversity on responsible decision-making, as companies committed to ESG impose stricter and more transparent governance practices (Alahdal et al. 2024), which enables members of both genders to provide diverse perspectives that reduce operational and financial risks. Adherence to environmental and social standards also enhances a company's reputation. It reduces regulatory and legal risks, making the relationship between diversity and risk management more effective in an environment that embraces sustainability principles (Odriozola, Blanco-Gonzalez, and Baraibar-D 2024).

## 3 | Data and Sample

To begin with, data for 14 years (2008–2020) on Asian listed companies was obtained from the Thomas Reuters database as the initial sample selection. The UN's official statistics indicate that Asia currently has 48 countries, but the database only includes data for 25 nations. This study excluded companies with missing data from the initial sample, resulting in a final sample of 2055 Asian listed companies and 15,496 firm-year observations (Table 1).

## 4 | Variables Measurement

### 4.1 | Dependent Variables (Firm Risk)

In this study, the leverage ratio will be used to measure firm risk. If a company has a higher financial leverage ratio, it means it relies on debt to fund its assets and operations, which may make it a risky investment (Mansour, Al Zobi, Al-Naimi, et al. 2023; Shubita 2023a). A financially responsible business with consistent revenue usually has a lower financial leverage



**TABLE 1** | Sample of Asian countries (2008–2020).

Country	No. of firm	No. of obs.	Percentage of obs.
Armenia	177	730	4.71%
Bahrain	12	41	0.26%
China	181	1102	7.11%
Cyprus	5	39	0.25%
Hong Kong	152	1097	7.08%
India	117	709	4.58%
Indonesia	44	280	1.81%
Iran	120	728	4.70%
Japan	418	5601	36.14%
Jordan	19	73	0.47%
Kuwait	11	55	0.35%
Macau	4	41	0.26%
Malaysia	69	483	3.12%
Oman	18	34	0.22%
Pakistan	159	728	4.70%
Palestine	12	29	0.19%
Philippines	39	188	1.21%
Qatar	12	63	0.41%
Singapore	51	601	3.88%
South Korea	125	1002	6.47%
Taiwan	141	1014	6.54%
Thailand	50	294	1.90%
Turkey	29	171	1.10%
UAE	31	91	0.59%
Uzbekistan	59	302	1.95%
Total	2055	15,496	100%

ratio (Ahmad et al. 2023). Even with significant debts, a high financial leverage ratio indicates low risk and makes a business attractive to investors and credit agencies. To calculate this metric, divide the sum of short-term and long-term debt by total assets (Shubita 2023b).

#### 4.2 | Explanatory Variables (ESG Disclosure Score)

The ESG data were gathered from the Bloomberg database, which provides more comprehensive coverage of all ESG datasets compared to other providers such as DJSI, EPA, and Corporate Knights Global 100. According to Maaloul et al. (2023), Bloomberg ESG data are arguably the most comprehensive data set on the sustainability measures data providers offer. Additionally, previous research extensively relied on the Bloomberg database (Beloskar and Nageswara Rao 2024; Ma

et al. 2024). A company's ESG score is a comprehensive metric that evaluates various factors as ESG. Non-financial factors play a critical role in creating long-term value for businesses and investors, making them essential sustainability components.

ESG sustainability data is sourced by Bloomberg from a variety of channels, including companies, regulatory filings, stock exchanges, government agencies, industry groups, and research firms. Each collected data item was weighted based on its significance and customized for different industry sectors (Maaloul et al. 2023; Saleh and Maigoshi 2024). The ESG disclosure score, ranging from 0.1 to 100, indicates ESG performance and disclosure. According to Bloomberg, the ESG performance and disclosure levels range from 0 (lowest) to 100 is the highest (Maaloul et al. 2023). In other words, the higher the disclosure score, the more information is disclosed.

#### 4.3 | Moderating Variable

BGD is a controversial aspect of corporate governance and is among the most widely researched aspects of boardroom characteristics (Mansour, Al Zobi, et al. 2024). BGD positively impacts financial performance and decision-making and plays a role in soft decisions that improve the company's reputation (Mansour, Al Zobi, et al. 2024). BGD is measured by the number of women on each company's board of directors each year divided by the total number of board members.

#### 4.4 | Control Variable

There is a theoretical association between control variables and firm risk, which can affect the analysis and reduce model misspecification (Khalaf et al. 2023). According to Mansour, Shubita, et al. (2024), firm size (FSIZ), measured by the natural log of total assets, can impact both sustainability and firm risk. Furthermore, the study controls for ROA by calculating net income before tax divided by total assets, as Mansour, Yamin, et al. (2024) and Shubita (2023a) suggest that firms that prioritize ESG activities tend to have higher profitability, contributing to the well-being of society (Saleh and Mansour 2024). Thomson Reuters DataStream was the source of all the gathered data for the control variables.

Table 2 displays the summary of the study variables.

### 5 | Empirical Results and Discussion

#### 5.1 | Model Specification

Due to unobserved heterogeneity, correlation, and endogeneity, the static panel data approach may not be appropriate for this investigation, especially when incorporating a lagged dependent variable (Saleh et al. 2024); moreover, this study uses a heterogeneous sample of 25 Asian countries. These countries have different levels of development, which could undermine the relevance of the results. To address these concerns, the GMM is the preferred choice as it utilizes lagged values of exogenous variables as instruments. Thus, GMM can effectively estimate different

models, even those with endogenous variables, and is consistent in large samples (Ullah et al. 2018). The validity of the model was confirmed by diagnostic tests, including autocorrelation (AR [1] and AR [2]) tests and the Sargan besides Hansen tests, which revealed no autocorrelation problems. The ESG-risk relationship was examined using Roodman's (2009) "xtabond2" command through two models; the first model examines the direct impact of ESG on firm risk, incorporating both the lagged and current ESG disclosure scores to capture its short-term and long-term effects. Additionally, FSIZ and return on assets (ROA) are included as control variables to account for firm-specific financial characteristics. BGD is also considered as an independent variable to explore its standalone effect on risk. The second model extends this analysis by introducing an interaction term between ESG and BGD (BGD × ESG).

$$\text{RISK} = \beta_0 + \beta_1 \text{ESG}_{ijt-1} + \beta_2 \text{ESG}_{ijt} + \beta_3 \text{FSIZ}_{ijt} + \beta_4 \text{ROA}_{ijt} + \beta_5 \text{BGD}_{ijt} + \varepsilon_{ijt} \quad (1)$$

$$\begin{aligned} \text{RISK} = & \beta_0 + \beta_1 \text{ESG}_{ijt-1} + \beta_2 \text{ESG}_{ijt} + \beta_3 (\text{BGD} * \text{ESG})_{ijt} \\ & + \beta_4 \text{FSIZ}_{ijt} + \beta_5 \text{ROA}_{ijt} + \varepsilon_{ijt} \end{aligned} \quad (2)$$

The indices used in the models denote different dimensions of the study: *i* represents the country, *j* indicates the firm, and *t* refers to the time period. Firm risk is associated with RISK. The disclosure score for ESG represents ESG factors. FSIZ is denoted by FSIZ, while ROA is represented by ROA. BGD, which stands

for BGD, serves as the moderating variable in this study. The error term is represented by  $\varepsilon$ .

## 5.2 | Descriptive Analysis

The descriptive statistics for the study variables can be found in Table 3. The mean leverage ratio of the dependent variable (RISK) was 29%, indicating that firms in the sample tend to rely on a moderate level of debt or loan financing rather than self-financing. The low leverage of 29% suggests participants are not inclined to take big risks. Moreover, the capital financing of firms varied, with scores ranging from 6% to 69%.

The ESG disclosure score had an average value of 48.01, a median of 40.11, a minimum of 3.00, and a maximum of 89.88. Asian firms display a broad spectrum of ESG scores, varying greatly from low to high. El Khoury et al. (2023) reported an ESG mean of 39.41 in MENA countries, which is slightly lower than the mean of 48.01. In contrast, European firms have a mean of 71.34, which is less than that of others (Taliento et al. 2019). Consequently, Asian government regulators should adopt European-like recommendations and standards to enhance ESG disclosure.

In Table 3, FSIZ has a mean of 19.34 and a standard deviation of 1.76. The presence of a negative minimum ROA of 1.5% suggests that certain firms in the sample are not performing well.

**TABLE 2** | Summary of the variables.

Categories of variables	Variables	Symbol	Measurement	Expected sign
Dependent variable (DV)	Firm risk	RISK	The total debts divided by total assets at the end of the year	
Alternative DV	Firm risk	RISK	Total cash divided by total assets	
Independent variable	Environmental, social, and governance	ESG	ESG Scores measures a company's exposure to environmental, social and governance, scored by Bloomberg database	—
Moderating variable (MV)	Board gender diversity	BGD	The ratio of dividing the number of women on the board by the total number of directors	—
Alternative MV	Board gender diversity	BGD	"1" denotes the presence of a female director and "0" denotes the absence of one	—
Control variables	Firm size	FSIZ	Natural logarithm of total assets	—
	Return on assets	ROA	Earnings before tax and interest divided by total assets	—

**TABLE 3** | Summary statistics.

Variable	Observations	Mean	Median	Min	Max	Std. dev
RISK	15,496	0.29	0.27	0.06	0.69	0.24
ESG	15,496	48.01	40.11	3.00	89.88	31.28
FSIZ	15,496	19.34	16.99	11.12	21.28	1.76
ROA	15,496	0.079	0.077	−0.015	0.360	0.080
BGD	15,496	0.130	0.110	0.000	0.830	0.110

The BGD's mean of 13% suggests a significant lack of female representation in Asian firms, likely influenced by customs and traditions that prioritize male characteristics in leadership roles (Saleh et al. 2020).

### 5.3 | Diagnostic Test

Tests were conducted to validate and evaluate the accuracy of the model. Correlation coefficients matrix and VIF were used to check for multicollinearity in the data. The highest correlation between BGD and ESG was 37% in Table 4, while the highest VIF was 5.55. There is no multicollinearity problem, as these values are within an acceptable range. The raw data was win-sorized by 5% in order to minimize the impact of outliers (Saleh et al. 2021).

### 5.4 | Result of the Regression and Discussion

This section outlines the main objectives of the research. It addresses the outcomes of companies' risks in their pursuit of ESG sustainability. Model 1 is estimated using ESG and risk within a GMM system, while Model 2 explores the potential moderating effect of BGD on the relationship between ESG and risk. The study employs a robust panel GMM estimator, using a dataset of 15,496 firm-year observations over a 14-year period from 2008 to 2020. Table 5 presents the results for the impact of ESG on risk (Model 1) and the regression analysis for Model 2, which examines the influence of ESG on risk in the context of BGD. The Sargan and Hansen tests confirm the validity of the instruments and show no correlation with the error terms, ensuring all models are properly specified and free from over-identification.

**TABLE 4** | Correlation matrix.

Variable	1	2	3	4	5	VIF	1/VIF
ESG (1)	1					5.55	0.3301
FSIZ (2)	0.0482***	1				4.28	0.4869
RISK (3)	−0.0158*	0.2580*	1			3.82	0.3982
ROA (4)	0.2594	0.0690	−0.2513	1		1.18	0.6028
BGD (5)	0.3690	0.1363	0.0413	0.1981**	1	1.01	0.8024

Note: \*, \*\*, \*\*\* significance levels of 10%, 5%, and 1% respectively.

**TABLE 5** | Regression results (GMM).

Variables	Direct relationship Model 1		Indirect relationship Model 2	
	Coefficients	p	Coefficients	p
RISK ( $t-1$ )	0.124	0.048**	0.104	0.045**
ESG	−0.102	−0.044**	−0.101	−0.036**
BGD	−0.110	−0.065*	−0.121	−0.086*
FSIZ	0.101	0.049**	0.102	0.048**
ROA	−0.041	0.022**	−0.131	0.034**
ESG*BGD (moderator)	—	—	−0.152	−0.000***
<b>Model fitness results</b>				
No. of instruments <sup>a</sup>	87		87	
Sargan test ( $p$ )	0.4428		0.5258	
Hansen test ( $p$ )	0.7174		0.7369	
Year dummy	Included		Included	
Country dummy	Included		Included	
AR (1)	0.033		0.021	
AR (2)	0.0418		0.516	
Over identification test	0.278		0.229	

Note: \*, \*\*, \*\*\* significance levels of 10%, 5%, and 1% respectively.

<sup>a</sup>The sample consists of 2055 companies. Due to the use of the GMM method, 87 instruments were excluded during the estimation.

In case of ESG and RISK which is the result of Model 1, the coefficients of ESG are significant with a negative sign, which is in line with the first hypothesis. Obviously, as shown in Table 5, a firm's higher ESG activities are associated with lower risk. This may be logical, as companies that rely on ESG activities enhance their reputation among customers, investors and the community, which increases the stability of the company's revenues which in turn reduces risks (Rodriguez et al. 2024). On the other hand, adopting ESG practices helps companies comply with environmental social, and governance laws and regulations that governments may impose. This reduces the risk of fines or legal penalties (He et al. 2023). In addition, many financial institutions are interested in investing in sustainable companies, making it easier for them to obtain financing on favorable terms and reducing financing risks (Qian et al. 2023). This result aligns with the stakeholder theory that companies that care about the interests of all, such as customers and the environment, achieve long-term sustainability and reduce regulatory and financial risks (Freeman 1984).

Table 5 demonstrates that the relationship is negatively influenced by the BGD. Having women on the board of directors decreases corporate risks. Many studies validate the crucial contribution of women to company success, emphasizing that diverse boards foster intellectual diversity and varied experiences, resulting in risk reduction. Furthermore, prior studies show that boards including women exhibit greater commitment to CG and transparency Shubita (2023a), resulting in decreased legal and financial risks (Alodat et al. 2023). Diversity theory proposes that having women on boards improves decision-making quality and balance, ultimately reducing company risks (Nehring and Puppe 2002).

Assuming H2 (Model 2), we propose that BGD enhances the link between ESG and RISK. We hypothesized that the presence of female directors would lead to a more positive stakeholder image. Therefore, their existence additionally mitigates the adverse correlation between ESG and firm RISK. The second hypothesis is supported by the significant negative coefficient of the interaction term ( $\beta = -0.152, p < 0.000$ ). Our results provide support for our arguments and are in line with the body of research which reported the presence of gender diversity shows positive signals to the stakeholders and grants legitimacy to the firm. Gender diversity on the board can strengthen negatively the relationship between ESG practices and risk reduction (Githaiga 2024). When there is gender diversity on the board, a variety of different perspectives and experiences are incorporated into the decision-making process. Women often demonstrate a greater orientation toward social and environmental values, which strengthens the board's commitment to sustainability practices (Lutfi et al. 2022; Zampone et al. 2024). These practices help companies improve their reputation, increase regulatory compliance, and avoid financial and environmental risks. With diverse members, risks are analyzed from multiple angles, leading to more holistic and proactive management, where social and environmental impacts are considered alongside financial objectives, reducing overall risk exposure (Lutfi et al. 2024; Rodriguez et al. 2024).

This research discovered a positive association between company size and firm risk, implying that larger organizations may engage in riskier activities or investments due to their

higher resources and market power. Conversely, ROA showed a negative association with business risk, implying that higher profitability is connected with lower risk since more successful enterprises have more substantial financial stability and are less vulnerable to financial hardship.

On the other hand, Table 6 presents a Two-Stage Least Squares (2SLS) regression analysis as an additional robustness check to address potential endogeneity concerns, particularly those related to reverse causality and omitted variable bias (Saleh et al. 2024). While the GMM remains a robust estimator for panel models (Mansour, Al Zobi, et al. 2024; Mansour, Shubita, et al. 2024; Mansour, Yamin, et al. 2024), the 2SLS method provides further insights by utilizing instrumental variables to mitigate endogeneity concerns.

The results remain consistent with those obtained using GMM, reinforcing the reliability of the original conclusions. By integrating both estimation techniques, this study ensures that endogeneity concerns are thoroughly addressed, providing a comprehensive perspective on the relationship between ESG, BGD, and risk. This additional analysis demonstrates that the primary findings remain robust across different econometric specifications, further validating the importance of corporate governance mechanisms in financial risk mitigation.

## 5.5 | Additional Analysis

### 5.5.1 | Measurement Replacement

In order to validate the reliability of the key indicators and to confirm that potential errors in the initial model do not substantially affect the outcomes, this study conducts a thorough reanalysis. The reanalysis includes adjusting the method used to assess company risk and reevaluating the gender diversity composition of the board of directors. By incorporating these changes, the study provides a more robust examination of the model's accuracy.

To measure the firm risk, this study follows (Rodriguez et al. 2024) who measure the risk by the cash holding, which

**TABLE 6** | Regression results (2SLS).

Variables	Coefficients	p
RISK (t-1)	0.115	0.050**
ESG	-0.098	0.041**
BGD	-0.108	0.069*
FSIZ	0.103	0.046**
ROA	-0.039	0.025**
ESG*BGD	-0.148	0.000***
First-stage F-statistic	12.45	
Hansen J-test p	0.684	
Over-identification test	0.231	

Note: \*, \*\*, \*\*\* significance levels of 10%, 5%, and 1% respectively.



can serve as a proxy for potential cash flow volatility. Opler et al. (1999) demonstrate that firms with higher industry cash flow volatility maintain more liquid assets. Moreover, the more cash available, the less the company must obtain external financing such as loans. This reduces the risk of exposure to rising interest rates or collateral requirements that could harm the company (Ho et al. 2024). Therefore, the equation used by Rodriguez et al. (2024) is a firm's total cash divided by total assets in a given year.

On the other hand, to measure the BGD, this study adopts the measurement by Adams and Ferreira (2009), who gauge the BGD using a fake variable. In this instance, “1” denotes the presence of a female director and “0” denotes the absence of one. The results of these adjustments are presented in Table 7, showcasing the impact of altering these metrics on the overall findings.

As shown in Table 7, the results revealed no substantial differences, although some nuances emerged. Notably, the significance of ESG practices fluctuated. Initially, these practices were significant at the 5% level, but their significance diminished as certain factors influenced the analysis, eventually becoming significant at the 10% level. Despite this shift, the negative impact of ESG practices remained consistent. In contrast, the main analysis demonstrated that the direct relationship between BGD and firm risk was significant and negative at the 10% level. This relationship grew more pronounced, achieving significance at the 5% level, while still retaining its negative effect. Regarding the moderation variable (ESG\*BGD), prior analyses showed no noticeable difference; the significance remained stable at the 1% level. These findings confirm that the previous model, along with the original measurement approach, remains valid, as the

adjustments in measurements did not produce any meaningful changes in the results.

5.5.2 | Exclude Control Variables

The model will be reanalyzed, excluding the influence of control variables on the model, to ensure the validity of the results. Prior studies have claimed that the control variables may affect the validity of the results. For example, Antonakis et al. (2010) stated that every additional control variable reduces the degrees of freedom in the model, which can be problematic. This will affect the statistical power to detect significant effects. Moreover, Gelman and Hill (2007) claimed that control variables may introduce bias into the model, which affects the accuracy of the results. Table 8 postulates the results.

The results presented in Table 8 indicate that the findings are closely aligned, with the signs of the variables remaining consistent. Additionally, the significance of the variables in both direct and indirect relationships has been maintained. This suggests that the inclusion of the control variables does not have an exaggerated impact, as suggested by previous studies. However, there may be other control variables that could influence the results.

6 | Summary, Conclusion and Implication

This study examines how ESG scores affect firm risk and how BGD moderates this relationship. The research contributes to the literature in several ways. First, it provides new insights into the role of ESG practices in reducing firm risk, aligning with

TABLE 7 | Regression results after measurement replacement.

Variables	Direct relationship Model 1		Indirect relationship Model 2	
	Coefficients	p	Coefficients	p
RISK (t-1)	0.116	0.043**	0.121	0.039**
ESG	-0.136	-0.056*	-0.101	-0.042**
BGD	-0.094	-0.022**	-0.121	-0.041**
FSIZ	0.087	0.041**	0.102	0.047**
ROA	-0.062	0.009***	-0.131	0.004***
ESG*BGD (moderator)	—	—	-0.148	-0.000***
Model fitness results				
No. of instruments	87		87	
Sargan test (p)	0.4269		0.5188	
Hansen test (p)	0.6967		0.7015	
Year dummy	Included		Included	
Country dummy	Included		Included	
AR (1)	0.038		0.020	
AR (2)	0.0328		0.448	
Over identification test	0.292		0.235	

Note: \*, \*\*, \*\*\* significance levels of 10%, 5%, and 1% respectively.

**TABLE 8** | Regression results- excluding control variables.

Variables	Direct relationship Model 1		Indirect relationship Model 2	
	Coefficients	p	Coefficients	p
ESG	−0.092	−0.05**	−0.103	−0.035**
BGD	−0.100	−0.050*	−0.135	−0.072*
ESG*BGD (moderator)	—	—	−0.160	−0.000***

Note: \*, \*\*, \*\*\* significance levels of 10%, 5%, and 1% respectively.

stakeholder theory, which posits that firms prioritizing the interests of stakeholders, including customers and the environment, achieve long-term sustainability and mitigate regulatory and financial risks. Second, the study expands the understanding of how BGD moderates the relationship between ESG scores and firm risk. The findings suggest that BGD reduces risks associated with inadequate ESG practices, enhancing risk management and board performance through diverse perspectives and more inclusive decision-making.

The study analyzed a sample of 15,496 firm-year observations from companies listed in 48 Asian countries, using the GMM estimator to test the hypotheses. It also used 2SLS, which is considered complementary to GMM, to mitigate endogeneity issues. The results confirm that ESG practices reduce corporate risks by improving a company's reputation and revenue stability. Additionally, the study finds that BGD strengthens this relationship, as the presence of gender-diverse boards amplifies the risk-reducing effects of ESG practices.

This research contributes to the accounting and finance literature, particularly in the context of ESG practices and firm risk. By exploring the moderating role of BGD, the study addresses a gap in the literature regarding how diverse boards influence the ESG-risk relationship. The findings align with agency theory, suggesting that BGD mitigates information asymmetry and agency conflicts, leading to more effective governance. Furthermore, the study underscores the importance of ESG practices for corporate resilience, with BGD enhancing this relationship through improved oversight and risk management.

The findings suggest that companies should prioritize BGD to enhance the effectiveness of their ESG practices and mitigate corporate risk. By fostering diverse perspectives, boards can improve oversight and decision-making processes, leading to stronger governance and sustainability outcomes. Policymakers and regulators can also use these insights to encourage gender diversity in corporate governance, helping companies better manage risk and align with ESG objectives.

While this study highlights the benefits of BGD in enhancing the ESG-risk relationship, it is important to acknowledge potential downsides and complexities. For instance, increased gender diversity on boards may not always lead to positive outcomes; in some cases, it could result in collusion, groupthink, or reduced competition, which may undermine governance effectiveness. Future research should explore these potential risks in greater depth to provide a more balanced understanding of BGD's role in corporate governance. Additionally, this study is limited to the gender aspect of board diversity and focuses on Asian markets.

Future studies could investigate the influence of BGD on ESG practices and firm risk in specific industries or regions within Asia to uncover contextual nuances. Longitudinal research could also examine how evolving gender diversity policies impact long-term risk management. Furthermore, exploring the interplay between BGD and other board characteristics, such as age, expertise, or cultural diversity, could provide deeper insights into optimizing board composition for risk mitigation. Expanding the scope to include non-Asian economies would also offer a more comparative perspective on BGD's role in global ESG practices.

While promoting gender diversity on boards can enhance ESG practices and reduce firm risk, policymakers and practitioners should approach this strategy cautiously. It is essential to recognize that gender diversity alone is not a panacea and may entail risks such as collusion or reduced competition. Therefore, policies aimed at increasing BGD should be accompanied by measures to ensure accountability, transparency, and robust governance frameworks. Companies should also adopt a holistic approach to diversity, considering other dimensions such as age, expertise, and cultural background, to maximize the benefits of diverse perspectives while mitigating potential downsides. By doing so, firms can better align with ESG objectives and achieve sustainable, long-term resilience.

#### Author Contributions

All authors contributed equally to this paper.

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#### Conflicts of Interest

The authors declare no conflicts of interest.

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