emerald PUBLISHING

ISSN 2754-1312
eISSN: 2754-1320
Volume 00 Number 00 2021

Journal of
Accounting Literature

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Journal:	*Journal of Accounting Literature*
Manuscript ID	JAL-04-2024-0065.R2

Manuscript Type:	Research Paper
Keywords:	Firm Risk, ESG, Firm Value, Board gender diversity, Critical mass

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1. Introduction

Board gender diversity remains a relevant issue that requires the attention of the academic community, regulators, and practitioners (Mohan, 2014; Nadeem et al., 2017; 2019). Although plenty of prior studies focus on board gender diversity's role in driving organizational outcomes (Al-Shaer and Zaman, 2016; Byron and Post, 2016; Chen et al., 2019), its role in risky firms' environmental, social, and governance (ESG) engagement is yet to be explored. Firm risk refers to risk inherent in a firm's operations due to exposure to external or internal factors that can affect a firm's profitability. It comprises business risk which arises from the nature of firms' operating activities such as changes in product demand, cost allocation, and trade competition within the same industry, and financial risk which is related to the likelihood a firm can pay off its debt and settle incurred expenses (Jo and Na, 2012). Firms that face a high level of risk are more likely to focus on short-term goals and have less flexibility to preserve long-term plans (Kang et al., 2016). It is imperative to investigate risky firms' engagement in ESG because these firms face more financial distress and are more concerned about their short-term survival (Chollet and Sandwidi, 2018) whilst investing in ESG is specifically sensitive to the accessibility of slack resources (Shahzad et al., 2016; Islam et al., 2021).

Research has found that female directors are less overconfident than their male peers (Nadeem et al., 2019). They are risk-averse and tend to lean toward lower-risk financial decision-making (Levi et al., 2014; Khaw et al., 2016; Saeed et al., 2021). Moreover, female directors are strong monitors (Adams and Ferreira, 2009) and help reduce agency costs and prevent negative financial outcomes (Shahab et al., 2020), thus creating value for shareholders (Levi et al., 2014; Nadeem et al., 2019). This study draws on financial slack theory and agency theory to examine female directors' role in alleviating agency costs in risky firms and their

critical positioning between shareholders' and stakeholders' interests. Moreover, by testing the critical mass theory, it explores the necessity for female directors to reach a specific threshold to generate an impact on the associations highlighted above. This is an important research question because existing literature is silent on how the number of female directors on corporate boards can affect shareholders' perception of ESG practices.

Using a sample of 44,129 firm-year observations between 2005 and 2019 across nine industries and 61 countries, we show that firm risk is significantly and negatively associated with three pillars of ESG performance and their nine metrics except for the shareholders' rights metric. Furthermore, board gender diversity (1) negatively moderates between firm risk and the environmental pillar of ESG and three metrics of the environmental pillar, (2) negatively moderates between firm risk and the social pillar of ESG and three metrics of the social pillar except for product responsibility metric, and (3) negatively moderates between firm risk and CSR strategy metric of governance pillar of ESG but positively moderates between firm risk and management metric of governance pillar. Furthermore, the results confirm that as the number of female directors increases, their moderating effect between firms' risk and ESG performance strengthens. Moreover, while shareholders react negatively to ESG engagements of risky firms, the existence of three or more female directors on the board alleviates the market's negative reaction to ESG engagements.

We contribute to the existing literature in several ways. First, we investigate risky firms' ESG engagements and gender diversity's role in driving these engagements. Risky firms' ESG engagement and disclosure practices received less attention from academia (Uyar et al., 2022; Kuzey et al., 2023). Although prior literature studies the role of ESG in alleviating firm risk drawing on stakeholder theory (Sassen et al., 2016; Al-Hadi et al. 2019; Shahab et al., 2019; Hassan et al., 2021), we take a different approach by investigating risky firms' ESG engagement for several reasons. Primarily, risky firms' ESG engagement is drawn on a different theoretical

approach such as slack financial resources theory. Drawing on slack financial resources theory, Kuzey et al. (2024) indicated that financially distressed firms are inclined to commit more corporate social irresponsibility. Besides, from shareholders' perspective, financially distressed firms are expected to be more precautious in deploying their scarce financial resources to ESG practices which are mostly discretionary. Our investigation suggests that financial markets may negatively react to ESG investments of risky firms, unlike financially healthy firms' ESG engagement. To concretize this assumption, we test how financial markets react to financially distressed firms' ESG engagement. Furthermore, given that firms need to be financially sustainable to do good for society, non-investing stakeholders might soften their ESG expectations from financially distressed firms.

Second, we draw attention to female directors' role in reducing agency costs in risky firms and their critical positioning between shareholders' and stakeholders' interests. We thus investigate whether shareholders value the existence of female directors on boards in reacting to risky firms' ESG engagement which has implications for market reaction and shareholder perception. Learning market reaction to risky firms' ESG engagement and how female directors moderate this relationship is of critical importance for governance in firms in formulating corporate policies.

Third, we draw on the critical mass theory and examine the impact of a critical mass of female directors on the board on the association between risky firms' ESG engagement and shareholders' reactions. This investigation expands the existing limited literature on female critical mass and CSR nexus (Jia and Zhang, 2013; Yarram and Adapa, 2021). We particularly investigate the critical mass theory to highlight its role in risky firms to overcome the tokenism problem (Torchia et al., 2011). Overall, this investigation is of importance to policymakers, stakeholders, and firms' corporate governance structure as female representation in boards is advocated by these mechanisms

Following the introduction, the next section establishes the theoretical framework and formulates the research hypotheses. Section 3 describes the research methodology in terms of sample, data, and model. In section 4, we report the outputs of the empirical analyses. Section 5 concludes the paper and discusses the findings, and section 6 suggests implications and offers future research opportunities.

2. Theoretical Framework and Hypotheses

2.1. The integration of agency theory and financial slack theory

Slack resources refer to resources that exceed the required threshold to maintain firms' operations (Lee and Wu, 2016; Mudambi and Swift, 2024). Financial slack represents a firm's internal resources that are above the required level to produce outcomes (Liang et al., 2023). These resources are utilized to increase returns and achieve growth (Mudambi and Swift, 2024). They contribute to a firm's stability and resilience and enable the initiation of riskier business operations (Lefebvre, 2023). However, financial slack can also exacerbate agency conflicts. This is likely to happen when the interests of managers do not align with shareholders' interests, causing agency problems. Agency theory suggests that financial slack can lead to agency conflicts because it can be subject to managerial discretion (John et al., 2017). Self-interested managers can utilize excess financial resources to pursue their personal prospects at the expense of shareholders' wealth (Liang et al., 2023).

Agency theorists posit that the monitoring role of the board is to curb managerial opportunism and reduce agency costs (Jensen and Meckling, 1976). Since higher slack resources come with more discretion, firms need to establish a strong board of directors that monitors managers' behavior and prevents them from accumulating excess financial slack for their private goals (Lee and Wu, 2016). Agency theory posits that board attributes are effective governance mechanisms that help lower agency costs and monitor manager behavior by reducing the expropriation of resources (Carpenter and Westphal, 2001; Poletti-Hughes and

Martinez Garcia, 2022). A strong corporate governance system may push managers to seek short-term goals that generate faster returns and give lesser priority to long-term strategies such as those related to ESG. The attributes of corporate boards can play a role in determining how slack resources are deployed to achieve organizational outcomes (Mahran and Elamer, 2024a, Mahran and Elamer, 2024b). Specific governance mechanisms (e.g., board composition, executive compensation, shareholder activism) can mitigate agency conflicts and ensure that slack resources are used effectively. They are likely to shape ESG outcomes by allocating and utilizing resources related to ESG actions (Lewellyn et al., 2024).

The availability of slack resources gives firms the incentive to experiment with new long-term strategies (Lee and Wu, 2016). Initiating ESG projects depends on the accessibility of discretionary funds since these projects are costly and require higher levels of slack resources (Shahzad et al., 2016). Slack resources theory can explain how firms with excess resources may negatively impact ESG activities. Due to the voluntary nature of ESG activities, utilizing surplus resources for ESG projects often leads to an increase in agency problems in management. This is because the allocation of excess resources is at the discretion of firms' managers (Singh et al., 2023). Slack resources can enable symbolic ESG actions that appease stakeholders but fail to generate meaningful impact and engage with substantive CSR practices. The literature discussing CSR decoupling points this issue highlighting the divergence between "CSR talk" and "CSR walk" (Tashman et al., 2019; Bothello et al., 2023). Hence, companies may deploy slack resources to make ESG projects and foster risk-taking with the aim of achieving legitimacy. On the other hand, managers might utilize slack resources towards short-term profitable projects and avoid ESG actions (Singh et al., 2023). A strong governance system can mitigate agency conflicts and ensure that slack resources are used effectively.

Managers have less discretion when engaging in ESG activities in risky firms because these activities may decrease shareholders' wealth. Shareholders may perceive risky firms' involvement in ESG to be excessive and value-destroying projects (Shahzad et al., 2016). In accordance with the theory of slack resources, high risk may lead to more financial uncertainty and consequently less commitment to ESG projects (Chollet and Sandwidi, 2018). The existence of effective governance mechanisms helps monitor managers' actions to ensure alignment with shareholders' interests and mitigate risks (Heubeck and Ahrens, 2024). Previous research has shown that female directors are risk-averse and stronger monitors (Adams and Ferreira, 2009; Post and Byron, 2015; Chen et al., 2019) and have a better perception of risks associated with sustainable projects (Beji et al., 2021). As a result, they are less likely to advocate engagement in ESG activities in risky firms because they do not want to exacerbate agency costs and would worry more about their short-term survival and allocate their resources to improve their firms' financial position.

2.2. Firm risk and ESG performance

Slack resources represent the different resources that exceed the minimum necessary threshold to sustain a firm's operations and deliver a given level of outcomes (Lee and Wu, 2016). It can include human resources slack which refers to employees' utilized skills and work time (Lefebvre, 2023), operational slack which refers to a firm excess capacity, buffer stock, backup systems, and multiple suppliers (Hendricks et al., 2009), innovation slack which refers to excess innovational resources that can be used to generate new products and processes and venture new markets, and financial slack which is defined as the liquid financial resources owned by a firm and can be used discretionarily by managers indicating that the firm has excess resources beyond the necessary level to meet short-term obligations (Shahzad et al., 2016).

Previous literature examines the nexus between CSR engagement and firms' financial distress levels and suggests that CSR activities can provide a cover against financial uncertainties (Al-Hadi et al. 2019; Shahab et al., 2019). The slack resources theory (Waddock and Graves, 1997) predicts that financially healthy firms have an abundant of slack financial resources that protect firms from uncertainties and offer CSR investment opportunities (Cheng et al., 2014; Lin et al., 2019; Al-Shaer et al., 2023). A firm's decision to invest in these activities largely depends on the availability of slack financial resources due to the voluntary nature of social and environmental activities (Chin et al., 2013; Islam et al., 2021). Engagement in ESG practices is specifically sensitive to the accessibility of slack resources because these practices require repositioning the deployment of resources to obtain innovative methods to provide products and services that meet stakeholders' expectations (Shahzad et al., 2016).

Risky firms face more financial distress and worry more about their short-term survival (Chollet and Sandwidi, 2018), so their managers have less flexibility to initiate ESG practices or cease them (Kang et al., 2016). These firms are more inclined to invest in short-term projects with faster returns and allocate fewer resources to ESG-related activities (Orlitzky et al., 2003; Kuzey et al., 2024). On the other hand, firms that are doing well financially have lower levels of risk and are more inclined to engage in ESG initiatives (Shahzad et al., 2016; Islam et al., 2021). These firms are better able to make strategic planning and cash flow predictions (Chollet and Sandwidi, 2018; Al-Shaer et al., 2023), and consequently adopt strong ESG strategies. Given the foregoing discussion, we propose the first hypothesis as follows:

H1: Firm risk has a negative association with ESG performance.

2.3. Female directors, risky firms, and ESG performance

Agency theory emphasizes that the main role of corporate boards is to monitor managers' behaviour (Jensen and Meckling, 1976). The theory explains that attributes of board of directors are effective corporate governance mechanisms to reduce agency costs and help

monitor managerial actions by reducing the expropriation of resources (Carpenter and Westphal, 2001; Poletti-Hughes and Martinez Garcia, 2022; Mahran and Elamer, 2024) and improving the quality of strategic decisions (Minichilli et al., 2009; Saeed et al., 2016; Bernile et al., 2018; Godos-Díez et al., 2018). Many researchers have examined the link between board gender diversity and CSR performance (e.g., Bear et al., 2010; Hafsi and Turgut, 2013; Al-Shaer and Zaman, 2016; Byron and Post, 2016; Ben-Amar et al., 2017; Haque, 2017; Nadeem et al., 2017). Most of these studies found that female directors represent an important factor in bringing effective governance and greater CSR engagements.

Research has shown that women are risk-averse and tend to lean towards less risky financial decision-making (Levi et al., 2014; Khaw et al., 2016; Saeed et al., 2016; 2021). The literature has also shown that women are stronger monitors (Adams and Ferreira, 2009) and are likely to enhance control function (Sila et al., 2016), offer better oversight of reporting practices (Srinidhi et al., 2011), and engage in lower levels of earning management activities (Lara et al., 2017; Gull et al., 2018; Zalata et al., 2022). Female independent directors have a more substantial effect than female executives on a firm's decision-making (Liu et al., 2014; García Lara et al., 2017; Li and Zhang, 2019). A board with female directors is likely to be more independent and exert stronger monitoring and oversight of managerial activities (Al-Shaer and Zaman, 2016). Moreover, board gender diversity enhances the resources available to firms, thereby facilitating board network and stakeholder relations (Poletti-Hughes and Martinez Garcia, 2022; Lewellyn et al., 2024). Female directors are likely to suggest more efficient problem-solving skills, as the decision-making process is drawn on different perspectives (Welbourne et al., 2007; Lenard et al., 2014; Hatane et al., 2019; Liu et al., 2020). They are more careful about potential reputation risks (Chen et al., 2016) and have a better perception of environmental risks and concerns (Davidson and Freudenburg, 1996; Hur et al., 2016; Beji et al., 2021).

There are mechanisms through which female traits influence female directors' approach to ESG practices. Research evidence shows that female directors are likely to have shorter tenures compared to their male peers which could limit their role on the board, reduce their ability to establish legitimacy, and increase their career concerns (Main and Gregory-Smith, 2018; Abdelkader et al., 2024). Consequently, they can be pressured to make short-term decisions to prove their business knowledge and expertise and give less attention to long-term goals. Agency theory posits that a high number of directors on the board often produces less monitoring due to having directors with different roles and responsibilities which can hinder decision-making (Moreno-Ureba et al., 2022) and impact female directors' aptitude to communicate ESG plans at the board meetings. Moreover, the presence of independent directors on the board is likely to impact the role that female directors play in ESG practices because independent directors exercise effective monitoring of management and are likely to make short-term goals and prioritize economic performance over sustainability (He and Jiang, 2019). Independent directors may be cautious about engaging in environmental actions and risky projects due to their lack of information on firms' specific environmental actions (Guerrero-Villegas et al., 2018).

Agency theory explains that managerial choices toward risky projects depend on the agency problem (Jensen and Meckling, 1976). If the agency problem is high, then directors tend to prefer low-risk investment opportunities (Saeed et al., 2021). This is particularly the case for female directors because they are more risk-averse and stronger monitors (Adams and Ferreira, 2009; Post and Byron, 2015; Chen et al., 2019). As a result, the expectation is that, in financially distressed firms, female directors are less likely to advocate engagement in ESG activities because they do not want to exacerbate agency costs. Given the foregoing discussion, we propose the second hypothesis (a) as follows:

H2a: Board gender diversity has a negative moderating effect between firm risk and ESG performance.

2.4. Female critical mass and risky firms' ESG performance

The critical mass theory (Kramer et al., 2006) explains that a substantial minority of females in a group, i.e., a critical mass, can improve the corporate governance system and act as a controlling and monitoring device on other directors (Konrad et al., 2008; Torchia et al., 2011; Jia and Zhang, 2013; Shahab et al., 2020; Atif et al., 2021). Female directors are more likely to exert influence and effective monitoring (Yarram and Adapa, 2021) and contribute to governance when they reach a critical mass (Konrad et al., 2008; Ben-Amar et al., 2013; Joecks et al., 2013). Previous literature considers the influence of a critical mass of female directors on the board on social and environmental practices. For example, Post et al. (2011) show that companies have higher environmental strength scores when they have a critical mass of female directors on the board, Atif et al. (2021) show that boards require at least two women on board to have a significant impact on renewable energy use, and Gong et al. (2021) show that firms with a critical mass of female directors improve corporate environmental actions. Ben-Amar et al. (2013) show that firms with three or more women on board are more likely to provide climate-related disclosures, Cabeza-García et al. (2018) show that a critical mass of female directors leads to better CSR disclosure by firms, and Bear et al. (2010) show that firms with a critical mass of female directors have higher CSR ratings.

A critical mass of female directors is likely to increase the percentage of independent directors and facilitate monitoring and oversight activities (Al-Shaer and Zaman, 2016). Moreover, female directors who reach a specific threshold are more likely to create an effective balancing of boards (Ben-Amar et al., 2013) and enrich the board with diverse experiences, skills, and perspectives (Birindelli et al., 2019; Dobija et al., 2022). On the other hand, in the absence of a critical mass, women directors may be treated as tokens with marginal effect and

limited power over the majority of male peers (Schwartz-Ziv, 2017; Dobija et al., 2022). A sole representation of female directors on the board creates difficulties for them to be listened to as compared to the large representation of male directors (Terjesen et al., 2009; Liu et al., 2014; Atif et al., 2021). Consequently, as the number of female directors increases, their moderating effect between firm risk and ESG engagements becomes stronger. Given the foregoing discussion, we propose the second hypothesis (b) as follows:

H2b: Board gender diversity has a stronger negative moderating effect between firm risk and ESG performance when critical mass is achieved.

2.5. Shareholders' perception of ESG engagement

Early literature argues that engagement in social and environmental activities increases a company's cost, placing firms in a position of competitive disadvantage (Jensen and Meckling, 1976; McWilliams and Siegel, 2000; Friedman, 2007). ESG activities represent an agency problem in the way of managerial opportunistic engagement in ESG to improve their personal reputation and social network with stakeholders (Barnea and Rubin, 2010; Masulis and Reza, 2015; Islam et al., 2021). Engagement in ESG activities could incur substantial costs and exhaust firms' resources, which may, in turn, impair agency costs (Krüger, 2015; Masulis and Reza, 2015; Price and Sun, 2017), and destroy firm value. Research evidence suggests that financial markets react negatively to investments in social and environmental projects because they signal agency problems between managers and shareholders (Krüger 2015; Al-Shaer et al., 2023).

The financial slack theory explains that firms with slack financial resources tend to pursue CSR projects because these activities are classified as discretionary expenses that depend on the availability of financial slack (McGuire et al., 1990; Cheng et al., 2014; Al-Shaer et al., 2023), and they have the competitive advantage to do so (Amato and Amato, 2011; Islam et al., 2021). In fact, a high level of financial slack enhances the positive relationship between

CSR and financial performance (Lin et al., 2019; Al-Shaer et al., 2023). Risky firms face more financial uncertainty and have lesser access to resources, so their managers have less discretion to engage in ESG activities because these activities may decrease shareholders' wealth (Chollet and Sandwidi, 2018). Investors may not appreciate risky firms' engagement in ESG due to the investment of resources in such long-term activities during financially distressed times (Al-Dah et al., 2018; Al-Hadi et al., 2019; Uyar et al., 2022). Financial markets may tend to penalise the choice of financially distressed firms to engage in ESG due to the perception that engagement in ESG is considered by investors a waste of financial resources (Xu and Liu, 2018; Uyar et al., 2022). As a result, shareholders may perceive financially distressed firms' involvement in ESG to be excessive and value-destroying projects. Given the foregoing discussion, we propose the third hypothesis as follows:

H3: Risky firms' ESG engagement is not appreciated by the shareholders.

2.6. The critical mass, risky firms' ESG engagement, and firm value

According to the critical mass theory, a critical mass of women on boards helps improve corporate governance structure and exert significant power over boards' activities (Shahab et al., 2020; Atif et al., 2021). Current literature is silent on how women on corporate boards can affect shareholders' perception of ESG practices. Accordingly, this study investigates female critical mass within boards and proposes a moderating effect of women directors' critical mass on shareholders' reaction to risky firms' ESG engagement. Corporate governance mechanisms can facilitate the favourable outcome of CSR on financial performance (Kabir and Thai, 2017). Based on the view of agency theory, managers may engage in ESG activities to boost their own social status and reputation (Krüger, 2015; Al-Shaer et al., 2023) and obtain private benefits beyond shareholder wealth (Masulis and Reza, 2015). Corporate boards can help monitor managers' opportunistic behaviour and reduce agency problems (Jensen and Meckling, 1976). There is increasing pressure on firms to augment the gender diversity of boards because it is

perceived as a value-driving mechanism (Terjesen and Sealy, 2016; Chen et al., 2019). Women directors are strong monitors (Adams and Ferreira, 2009; Post and Byron, 2015; Chen et al., 2019) and essential levers in preventing negative financial outcomes (Shahab et al., 2020). The higher the presence of female directors on the board, the more effective monitoring the board has. As a result, managerial self-interest behaviour becomes less frequent.

Female directors are stakeholder-oriented because they offer diverse experiences, skills, and backgrounds which enrich the corporate decision-making process and enable more thorough decisions, including risk-taking (Saeed et al., 2016; Sila et al., 2016; Bernile et al., 2018; Chen et al., 2019). They tend to pay attention to ESG practices and are better at responding to stakeholders' demands and balancing short-term versus long-term goals (Glass et al., 2016; Kabir and Thai, 2017; Li et al., 2017) which helps alleviate the negative reaction of shareholders of risky firms. Given the foregoing discussion, we propose the fourth hypothesis as follows:

H4: Board gender diversity alleviates the negative reaction of shareholders to risky firms' ESG engagement when a critical mass is achieved.

3. Research methodology

3.1. Variables

Five classes of research variables are used in the study such as firm value, firm risk, board gender diversity and critical mass, ESG, and control variables.

First, firm value is proxied by two variables namely TobinQ and industry-adjusted Tobin Q (TobinQ-ad) (Chang et al., 2019; Uyar et al., 2022). While firm value is measured by the sum of debt and market capitalization scaled by total assets, TobinQ-ad is measured by the difference between the firm's TobinQ and the median TobinQ of the firms in the same year and in the same industry.

Second, the firm risk is measured by three proxies namely Zmijewski Financial Score (ZFS), the inverse of Altman z-score (InvALT)[1], and standard deviation of return on assets (StdROA) (Richardson et al., 2015; Miglani et al., 2015; Hoang et al., 2021; Uyar et al., 2022). While ZFS is used in the baseline analyses, InvALT and StdROA are used in the robustness tests. The higher the firm risk scores are, the riskier a firm is.

Third, board gender diversity is measured by three different proxies such as Blau Index (BlauIndx), Shannon Index (ShanIndx), and female directors' percentage on board (Bdivers) (Al-Shaer and Zaman, 2016; Kuzey et al., 2022; Uyar et al., 2022; Mehedi et al., 2024). While BlauIndx is used in the baseline analyses, ShanIndx and Bdivers are used in the robustness tests. Furthermore, to test the critical mass theory, we adopted several binary variables including female directors' existence on board (NFEMD0), existence of one female director on board (NFEMD1), existence of two female directors on board (NFEMD2), existence of three women directors on board (NFEMD3), and existence of three or more women directors on board (NFEMD3M) (Shahab et al., 2020; Atif et al., 2021).

Fourth, ESG performance is measured by the ESG composite score, environmental (ENVSC), social (SOCSC), and governance pillars (GOVSC), and the ten metrics of ENVSC, SOCSC, and GOVSC (Rajesh, 2020; Vural-Yavaş, 2021)[2]. While ENVSC has three metrics including resource consumption (RESSC), emission reduction (EMISC), and eco-innovation (EINSC), SOCSC has four metrics including workforce (WORSC), community development (COMSC), human rights (HUMSC), and product responsibility (PROSC), and GOVSC has three metrics including management structure (MANSC), shareholder's rights (SHASC), and

[1] We take the inverse of the Altman z-score since the Altman z-score normally denotes the financial health of the firm.

[2] We adopt the ESG rating system of the Refinitiv provided by the London Stock Exchange Group (LSEG) Workspace database (formerly known as Asset4) in assessing firm ESG performance (Refinitiv, 2021).

CSR strategy (CSTSC). All these variables' scores range between 0 and 100. The greater the score is, the more a firm is committed to the associated dimension of ESG.

Fifth, several control variables are integrated into the model such as board size (Bsize), firm size (Fsize), CEO duality (CEOd), leverage, return on assets (ROA), capital expenditures (Capex), liquidity, and free float (Ffloat) (Boubaker et al., 2020; Saeed et al., 2021; Uyar et al., 2022).

We describe the variables in Table 1.

INSERT TABLE 1 HERE

3.2. Research Sample

The sample of the study was mainly constructed from Refinitiv's available ESG observations provided by the London Stock Exchange Group (LSEG) Workspace database (formerly known as Asset4). The sample covers 44,129 records between 2005 and 2019 across nine industries and 61 countries. The research sample is subject to various steps before running the further analysis approaches which is a vital phase prior to examining the research models (Hair et al., 2019). After retrieval, the raw data set is cleaned, purified, and prepared for the forthcoming analysis steps. Next, the research variables are examined using the initial descriptive statistics which indicate that some of them are heavily skewed with potential extreme values. Thus, StdROA, TobinQ, ZFS, InvALT, ROA, Bsize, Capex, Leverage and Liquidity are subject to winsorization at one per cent of both the tails (Cox, 2006). Moreover, we examine and remove the potential significantly large multivariate outliers. Accordingly, eighteen firm-year observations are determined as significant multivariate outliers using the minimum covariance determinant approach and are then eliminated accordingly (Verardi and Dehon, 2010). As a result, a sample of 44,129 records is left for the following analyses.

Furthermore, missing data analysis indicates that the percentage of the missing values ranges between 0.03% (ENVSC, RESSC, EMISC, SOCSC, WORSC, HUMSC, COMSC,

PROSC) and 3.81% (EINSC)[3] which are relatively less than 5%. Less than 5% missing values are considered inconsequential (Schafer, 1999). Although the ratios of the missing values are relatively small and can be inconsequential, these variables are subject to the imputation step. Table 2, Panel A reports the final sample distribution of the research variables based on year and sectors[4]. Regarding the finalized sample, there are 61 countries with 5,898 unique firms and 44,129 observations (Please see Table 2 Panel B) between 2005 and 2019.

INSERT TABLE 2 HERE

3.3. Empirical methodology

We examine the research models and analysis approaches in this section. The empirical models are investigated using the country, industry, and year fixed-effects (FE) regression to reduce the risk of time-variant endogeneity concern (Rjiba et al., 2020), the possible risk of multicollinearity, the issue of omitted variable bias (Wooldridge, 2010), and estimation bias (Baltagi, 2005).

By incorporating country, industry, and year-fixed effects, we aim to effectively account for unobserved heterogeneity across countries, industries, and time periods (Baltagi, 2005). Specifically, the inclusion of country-fixed effects allows us to control for unobserved factors that vary between countries but remain constant over time. Similarly, adding industry-fixed effects addresses industry-specific characteristics that do not change over time within each

[3] The distribution of the missing values is 0.03% (ENVSC), 0.03% (RESSC), 0.03% (EMISC), 3.81% (EINSC), 0.03% (SOCSC), 0.03% (WORSC), 0.03% (HUMSC), 0.03% (COMSC), 0.03% (PROSC), 0.71% (TobinQ), 1.26% (ZFS), 3.21% (InvALT), 1.42% (Bdivers), 0.36% (Bsize), 0.54% (Fsize), 0.17% (Leverage), 3.46% (Capex), 1.24% (Liquidity), and 0.89% (Ffloat).

[4] Regarding the sectors, industrials (20.93%), consumer cyclical includes (18.78%), basic material (13.24%), technology (11.37%), healthcare (9.15%), consumer non-cyclical (8.91%), energy (8.81%) utilities (5.43%), and telecommunications services (3.37%) percentages of observations. Regarding the year, the ratios of the records in the research sample range between 2.74% (in 2005) and 13.37% (in 2019) steadily increasing each year.

industry. Year-fixed effects, on the other hand, capture time-specific shocks or trends that affect all observations within a given year uniformly.

Furthermore, this approach mitigates omitted variable bias, which is particularly relevant when dealing with panel data collected across multiple time periods and spanning various countries and industries (Wooldridge, 2010). The functional relationship between firm risk and ESG is illustrated in Equation (1).

$$y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \vartheta_i + \epsilon_i \qquad i= 1,...,N \qquad (1).$$

In equation (1), ENVSC, RESSC, EMISC, EINSC, SOCSC, WORSC, HUMSC, COMSC, PROSC, GOVSC, MANSC, SHASC, and CSTSC are the dependent variables (y_i). Also, ZFS is the testing variable of interest (X_{1i}). Moreover, Bsize, CEOd, Fsize, ROA, Leverage, Capex, Liquidity, Ffloat, Country, Industry, and Year are the control variables (X_{2i}). The country, industry, and year are used as the dummy control variables in all the regression analyses.

The index, "*i*" indicates the firms while the term "$\vartheta_i + \epsilon_i$" is the error term in equation (1). Furthermore, the results of the regression analyses are based on robust standard errors.

3.4. Moderation analysis

Some of the baseline research models incorporate moderating analysis. Toward this end, four different moderation analyses are performed to examine the interaction variables. Some of the foundational research models in this study incorporate moderation analysis to investigate the impact of interaction effects between key variables. This analysis helps us explore how the relationship between the independent variable (x_1) and the dependent variable (y) might shift depending on the presence of a moderating variable (M). Rooted in interaction theory, this approach suggests that certain factors can modify the strength or direction of the relationship being studied. In this research, we conduct four separate moderation analyses to examine possible interaction effects, as these can provide valuable insights into how the variables relate

under different conditions. The following equation, Equation (2), illustrates the basic structure of our moderated regression model:

$$y_i = \alpha + \beta_1 x_{1i} + \beta_2 M_i + \beta_3 (x_{1i} * M_i) + \beta_4 x_{2i} + \epsilon_i \qquad i = 1,\ldots,N \qquad (2)$$

First, the board gender diversity's (i.e., BlauIndex) moderating role on the relationship between firm risk (i.e., ZFS) and a set of ESG variables is examined. "y_i" term denotes the dependent variables namely ENVSC, RESSC, EMISC, EINSC, SOCSC, WORSC, HUMSC, COMSC, PROSC, GOVSC, MANSC, SHASC, and CSTSC. While "x_{1i}" term indicates the testing variable (i.e., ZFS), "M_i" term refers to the moderating variable (i.e., BlauIndex) in equation (2).

The second moderation analysis tests the moderating role of the critical mass of female directors (i.e., NFEMD0, NFEMD1, NFEMD2, NFEMD3, and NFEMD3M) on the relationship between ZFS and ESG variables. The dependent variables are ESG variables denoted by the "y_i" term; the testing variable is the firm risk (i.e., ZFS) denoted by the "x_{1i}" term; and the moderating variables are NFEMD0, NFEMD1, NFEMD2, NFEMD3, and NFEMD3M denoted by the "M_i" term in equation (2).

Third, the moderation analysis investigates the moderating role of ENVSC, SOCSC, and GOVSC on the relationship between ZFS and TobinQ. In equation (2), "y_i" term refers to TobinQ, "x_{1i}" term indicates ZFS, and "M_i" term signifies ENVSC, SOCSC, and GOVSC.

Finally, the moderating role of ENVS, SOCSC, and GOVSC on the relationship between ZFS and TobinQ is repeated using two sub-samples based on NFEMD3M. Again, "y_i" term refers to TobinQ, "x_{1i}" term indicates ZFS, and "M_i" term signifies ENVSC, SOCSC, and GOVSC.

In each moderation analysis, Bsize, CEOd, Fsize, ROA, Leverage, Capex, Liquidity, and Ffloat are the control variables, and also Country, Industry, and Year effects are controlled

and denoted by the "x_{2i}" term. Finally, the regular error term is denoted by the "ϵ_i" term in the moderation analyses.

4. Findings

4.1. Descriptive statistics

According to the descriptive statistics reported in Table 3, the average of the first set of thirteen ESG variables range between 22.68 (EINSC) and 51.34 (SHASC) with a relatively small or moderate variability around averages. Furthermore, TobinQ, ZFS, and InvALT have mean values of 1.66, -3.10, and 0.49 respectively.

INSERT TABLE 3 HERE

4.2. Correlation analysis

The results of Pearson's correlation analysis reported in Table 4 reveal that ZFS has a linear positive bivariate correlation with ENVSC, EMISC, EINSC, SOCSC, COMSC, PROSC, SHASC, and CSTSC while it has a significantly negative linear correlation with WORSC, GOVSC, MANSC, and TobinQ ($p < 0.05$). In addition, the linear correlation coefficients of InvALT are significantly positive with ENVSC, RESSC, EMISC, EINSC, SOCSC, WORSC, HUMSC, COMSC, GOVSC, SHASC, CSTSC while it is significantly negative with TobinQ ($P<0.05$)

INSERT TABLE 4 HERE

The baseline research models are also subject to multicollinearity analysis. Toward this end, the multicollinearity analysis with Variance Inflation Factors (VIF) of the independent variables is performed. The VIF values ranging between 1.03 and 2.79 are significantly less than the threshold value of 10 (Kennedy, 2008), and hence indicate no risk of multicollinearity.

4.3. Baseline analysis

We report the baseline analysis results in Table 5. The association of ESG variables with ZFS is subject to country, industry, & year FE regression analysis. We find that ZFS has

a significant and negative relationship with ENVSC, RESSC, EMISC, EINSC, SOCSC, WORSC, HUMSC, COMSC, PROSC, GOVSC, MANSC, and CSTSC ($p<0.01$) while it does not have any significant relationship with SHASC. Hence, H1 is confirmed for all ESG proxies except SHASC. This implies that firm risk is negatively associated with firms' ESG engagement except shareholders' rights dimension. This finding indicates that risky firms treat the shareholders' rights dimension of the governance pillar of ESG differently than other ESG dimensions. Although shareholders are one of the major stakeholders of firms, they are different from other stakeholders as they provide essential financing for firms' investment and day-to-day operations. Providing financing gives them power that can be exercised during the general meetings such as electing directors and remuneration policies. Therefore, risky firms can not target firm shareholders by weakening their rights which may also render the firm less attractive for potential investors.

INSERT TABLE 5 HERE

4.4. Moderation analysis

First, Table 6 reports the moderating role of BlauIndex on the relationship between ZFS and the set of 13 dependent variables (ESG proxies). The results show that the product term, ZFS*BlauIndex, has a significantly negative influence on ENVSC, RESSC, EMISC, EINSC, SOCSC, WORSC, HUMSC, COMSC, and CSTSC ($p<0.01$) while it has a significant positive relationship with MANSC. Also, ZFS*BlauIndex is not significantly associated with PROSC, GOVSC, and SHASC. Hence, most of the moderating effects associated with environmental and social performance and the CSR strategy dimension of the governance pillar are negative which confirms H2a. However, the positive moderating effect of board gender diversity for the management dimension of the governance pillar is against other dimensions and so bears some implications. This implies that although women directors are against risky firms' environmental and social engagement, they advocate strengthening the management structure of firms for the

need for stronger monitoring functions in financially distressed firms. As highlighted in the literature review section, female directors are considered strong monitors in oversight of managerial activities and corporate reporting (Adams and Ferreira, 2009; Sila et al., 2016). Therefore, strengthening the management structure (which mostly encompasses board monitoring metrics) well aligns with the recruitment of female directors on the board which is especially a crucial issue for the financial wellbeing of distressed firms. Another noteworthy finding is that while the product responsibility dimension of the social pillar is negative in the baseline result (Table 5), it turns insignificant in the moderation effect of board gender diversity (Table 6). This implies that female directors help risky firms strengthen their ties with customers which are critical stakeholders as the source of revenues. Lastly, the insignificance of the governance pillar in the moderation effect is understandable as one of its underlying dimensions is negatively significant (CSR strategy dimension) and the other is positively significant i.e., management structure dimension).

INSERT TABLE 6 HERE

Second, the moderating role of the dummy variables including NFEMD0, NFEMD1, NFEMD2, NFEMD3, and NFEMD3M on the relationship of ZFS with the set of thirteen dependent variables is investigated to test the critical mass theory. The ratios of NFEMD0, NFEMD1, NFEMD2, NFEMD3, and NFEMD3M are 69%, 30%, 21%, 10%, and 17% respectively[5]. According to the results reported in Table 7, the interaction variables including *ZFS*NFEMD0* (Panel A), *ZFS*NFEMD3* (Panel D)*, and ZFS*NFEMD3M* (Panel E) have a significant negative association with ENVSC, RESSC, EMISC, EINSC, SOCSC, WORSC, HUMSC, COMSC, and CSTSC. Furthermore, while there exists one women director on board (NFEMD1), the interaction variable, *ZFS*NFEMD1,* has the weakest effect on the outcome (Panel B), the interaction becomes stronger when two women directors exist on board

[5] Please see Table 3 Panel B.

(NFEMD2) (Panel C), and it has the strongest effect on the outcome when NFEMD3M exists (Panel E). Hence, the critical mass theory and H2b were confirmed. This implies that the critical mass of female directors is of critical importance in discouraging risky firms from ESG engagement. Our findings align with the proposition that female directors are more likely to exert influence on decision-making and conduct effective monitoring when they reach a critical mass (Ben-Amar et al., 2013; Yarram and Adapa, 2021; Sultana et al., 2024). In the absence of a critical mass, female directors are considered as tokens with a marginal effect on decision-making due to having limited power over the majority of male peers (Schwartz-Ziv, 2017; Dobija et al., 2022; Al-Shaer et al., 2024).

INSERT TABLE 7 HERE

Third, the moderating role of ENVSC, SOCSC, and GOVSC on the relationship between ZFS and TobinQ is examined in Table 8[6]. The results reveal that the interaction variables including *ZFS*ENVSC, ZFS*SOCSC,* and *ZFS*GOVSC* are associated negatively with TobinQ indicating that shareholders do not approve risky firms' ESG engagement in three ESG pillars which confirms H3. Research evidence suggests that financial markets may negatively react to ESG investments because they signal agency problems between managers and shareholders due to managerial opportunistic behaviour (Krüger 2015; Al-Shaer et al., 2023). Thus, investors do not appreciate risky firms' engagement in ESG due to the allocation of firm resources out of core operations during financially distressed times and hence penalize distressed firms for such engagement (Al-Dah et al., 2018; Xu and Liu, 2018; Al-Hadi et al., 2019; Uyar et al., 2022).

INSERT TABLE 8 HERE

[6] The moderating role of the indicated variables concerning TobinQ-ad is reported in the robustness section.

Fourth, the moderating role of ENVSC, SOCSC, and GOVSC is re-examined using a sub-group analysis based on NFEMD3M (1: three or more women directors on the board; 0: otherwise). The results are reported in Table 9[7]. When three or more women directors on the board exist (NFEMD3M:1), the interaction variables including *ZFS*ENVSC* and *ZFS*SOCSC* have a significant negative association with TobinQ while *ZFS*GOVSC* does not have a significant association with TobinQ. When there are two or fewer women directors on the board (NFEMD3M:0), the interaction variables including *ZFS*ENVSC*, *ZFS*SOCSC, and ZFS*GOVSC* have a significantly negative influence on TobinQ. This shows that the presence of three or more women on board plays a role in weakening and breaking the negative link between risky firms' governance performance and firm value which partially supports H4. This finding provides evidence that female directors on board are perceived as a value-driving mechanism for distressed firms (Terjesen and Sealy, 2016; Chen et al., 2019). Although shareholders are against distressed firms' ESG engagement, they sympathise with it if the board has more female directors. This may imply that women directors gain the support and trust of shareholders in ESG activities regarding not expropriation of firm resources for the sake of managerial opportunism.

INSERT TABLE 9 HERE

4.5. Robustness checks

The robustness section incorporates further analysis to check the robustness of the findings obtained from the baseline section. The results are summarized under five sub-sections including the alternative firm risk poxy, examining the endogeneity issue using 2SLS regression analysis, moderating analysis with two alternative board gender diversity proxies, examining the critical mass, and moderation analysis with two alternative firm risk proxies.

[7] The columns with TobinQ-ad are reported in the robustness section.

Alternative firm risk proxy: We replaced ZFS with InvALT. Using an alternative firm risk proxy, such as InvALT, allows us to verify the consistency of our findings by testing whether the association between firm risk and ESG engagement holds under different measurement approaches. We ran the baseline analysis for the association between firm risk and ESG engagement and found that InvALT is negatively associated with all indicators of ESG except SHASC (Table 10). Hence the robustness test confirms the results of the baseline analysis reported earlier in Table 5.

INSERT TABLE 10 HERE

Endogeneity: We address endogeneity concerns by employing instrumental variable regression analysis using Two-Stage Least Squares (2SLS). The 2SLS approach is effective in mitigating potential endogeneity issues stemming from omitted variable bias (Angrist and Krueger, 2001; Cui et al., 2018). By using instruments that are correlated with the endogenous independent variables but uncorrelated with the error term, this method can help eliminate the correlation between the error term and the independent variables (Wooldridge, 2013). Moreover, 2SLS provides consistent parameter estimates, which reduces bias from endogeneity and enhances the robustness of our findings (Larcker and Rusticus, 2010). This technique is particularly useful in panel data contexts, where unobserved heterogeneity may complicate causal inferences (Baum et al., 2007).

We examine the effect of ZFS on the set of ESG variables using 2SLS regression analysis. One year lag of the independent variable (ZFS) is used as the instrumental variable which can be likely correlated with the endogenous variables while they cannot be likely correlated with the error term (Wooldridge, 2010, Ngare et al., 2014; Godos-Díez et al., 2018).

Durbin-Wu-Hausman test of endogeneity (Null hypothesis: The regressors are exogenous) shows that ZFS are endogenous regressors, thus we need to use the 2SLS approach. The test of weak instruments reveals that the instrument is not weak since the test statistic value

is significantly greater than the rule of thumb of 10 (Stock et al., 2002). We use only a single instrumental variable for the testing variable which is technically acceptable (Wooldridge, 2010), therefore, no overidentifying restrictions exist in the 2SLS regression analysis.

The first and the second stages of the 2SLS regression analysis regarding ZFS as the independent testing variable are provided in Table 11. In the first stage, the instrumental variable, ZFS(t-1), has a significant positive association with ZFS. In the second stage, ZFS has a significant negative association with the indicators of ESG except for SHASC (Table 11). Thus, the findings hold after addressing the endogeneity.

INSERT TABLE 11 HERE

Moderating effect by using two alternative board gender diversity proxies: The moderating effect of board gender diversity between firm risk and ESG is tested by using two alternative board gender diversity proxies namely female director percentage on board (Bdivers) and Shannon Index (ShanIndx). Both variables are commonly adopted board gender diversity proxies in the literature (Al-Shaer and Zaman, 2016; Kuzey et al., 2022; Uyar et al., 2022; Mehedi et al., 2024). The results of the tests reported in Tables 12 and 13 show that the findings very largely confirm the baseline analysis with one exception; the interaction effect of ZFS*Bdivers is positively associated with GOVSC (but weakly) while it was insignificant in the baseline analysis.

INSERT TABLES 12-13 HERE

Robustness test for critical mass: We conduct a robustness test to show whether the moderating role of ESG still holds after trying an alternative firm value proxy. So, we conducted a robustness test by replacing TobinQ with TobinQ-ad (industry-adjusted TobinQ) (already reported in Table 9). The results are reported for TobinQ and TobinQ-ad proxies side by side to facilitate reading and comparison. They show that the results are robust to alternative firm

value proxies. More specifically, it is confirmed that the presence of three or more women on board is influential in reducing the negative interaction effect of ZFS*GOVSC on firm value.

Moderating effect by using alternative firm risk and firm value proxies:

First, we conduct a robustness test by replacing TobinQ with TobinQ-ad (already reported in the last three columns of Table 8) which confirms the outcomes of the first three columns based on TobinQ. Hence, findings confirm the robustness of the alternative firm value proxy considering sectoral characteristics.

Second, we also conduct an additional test for the moderating role of ESG between firm risk and firm value by using an alternative firm risk proxy. Hence, we replaced ZFS with a 3-year rolling standard deviation of ROA (StdROA). The results obtained from the alternative risk proxy (i.e., StdROA) largely confirm the baseline analysis (Table 14)[8]. More specifically, while ENVSC and GOVSC have a negative moderating effect between StdROA and TobinQ (parallel to the baseline), SOCSC has an insignificant moderating effect between StdROA and TobinQ. Thus, the result largely confirms the baseline moderating effect.

INSERT TABLE 14 HERE

5. Discussion and conclusion

Although plenty of prior studies focused on board gender diversity's role in driving ESG and firm financial performance, its role in risky firms' ESG engagement is yet to be explored. This investigation is of importance to the policymakers and firms' corporate governance structure as female representation in the boards is advocated by these mechanisms. Besides, whether shareholders value the existence of women on board in reacting to risky firms' ESG engagement is not addressed yet which has implications for market policymaking and shareholder perception. Thus, we draw attention to female directors' role in alleviating agency costs in risky firms and their critical positioning between shareholders' and stakeholders'

[8] The baseline analysis is reported in Table 8.

interests. By also testing the critical mass theory, we focus on the number of female directors in generating impact in the above-highlighted relationships.

We find that firm risk is significantly and negatively associated with three pillars of ESG performance and their nine metrics except the shareholders' rights metric of the governance pillar (i.e., insignificant). This finding confirms prior studies' assertion that financial slack availability fosters ESG performance (Arora and Dharwadkar, 2011; Zhang et al., 2018). Furthermore, board gender diversity (1) negatively moderates between firm risk and the environmental pillar and three metrics of the environmental pillar of ESG, (2) negatively moderates between firm risk and the social pillar and three metrics of the social pillar of ESG except the product responsibility metric, and (3) negatively moderates between firm risk and CSR strategy metric of governance pillar of ESG but positively moderates between firm risk and management metric of governance pillar of ESG. Furthermore, deepening the investigation by critical mass test reveals that the number of female directors on board matters in such a way that as the number of female directors increases, their moderating effect between firm risk and ESG becomes stronger. These findings confirm prior studies' validation of critical mass theory on renewable energy consumption of firms (Atif et al., 2021), reducing corporate social irresponsibility (Jain and Zaman, 2020), greater corporate transparency (Nadeem, 2020), and firms' responses to natural disasters (Jia and Zhang, 2013). Moreover, while shareholders react negatively to the ESG engagement of firms in all three pillars namely environmental, social, and governance, the existence of three or more female directors on the board alleviates the market's negative reaction to the ESG engagement (particularly in governance pillar) of firms confirming the validity of critical mass theory. Supporting our finding, previously, Shahab et al. (2020) found that a critical mass of women on board alleviates the detrimental effect of CEO power on stock price crash risk.

The results are largely robust to alternative firm risk metrics, alternative board gender diversity proxies, firm value measurements, alternative moderators, and endogeneity concerns.

6. Implications and future research

The theoretical implications of the findings suggest that financial slack theory explains risky firms' ESG engagement avoidance and the market's adverse reaction to risky firms' ESG engagement. Furthermore, the results confirm that female directors mitigate agency conflicts of risky firms as they do not favour financially distressed firms' ESG engagement although their sensitivity towards ecological and social concerns is well known and documented in the existing literature. The findings also provide evidence for critical mass theory suggesting that three or more women on boards are more influential in financially distressed firms' ESG engagement avoidance.

The findings suggest practical implications for firms' boards, shareholders, and policymakers. First, the risky firms' avoidance of ESG practices appears to be in line with shareholders' expectations as the market responds negatively to the ESG engagement of risky firms. Second, female directors' positioning is also in line with this posture of firms and shareholders. By strengthening the negative link between firm risk and ESG engagement, women function as tough monitors in diminishing agency costs of risky firms, prioritizing firms' and investors' interests, and not favouring ESG engagement. It is also highly meaningful that female directors play a role in corroborating only the management structure of the risky firms among all other ESG metrics. These findings send positive signals to the boards and shareholders about women's critical role in board monitoring of firms having financial difficulties. However, the findings suggest boards recruit three or more female directors to overcome the tokenism problem and let women exercise their monitoring function efficiently. The board gender diversity's role and critical mass theory suggest implications for policymakers such as market regulators or corporate governance code developers too. They can develop

regulations or revise existing codes concerning board diversity considering the findings of the study.

Overall, the results highlight that financially distressed firms prioritize financial sustainability over environmental and social sustainability due to their financial constraints which lends support to agency theory rather than stakeholder theory. Our findings also show congruence between risky firms' ESG policies and shareholders' reactions which is helpful in the policymaking of financially distressed firms. The empirical evidence for the critical mass theory justifies the recent global tendency to diversify boardrooms with more female directors and the formulation of national corporate governance codes accordingly. Finally, although environmental and social sustainability pillar dimensions yield consistent results, the dimensions of the governance pillar (i.e., management and shareholders' rights) reveal diverging results. This result underscores that the governance pillar may bear different implications than environmental and social pillars which might be useful for future research.

The findings should be considered within the constraint that the firms' risk proxies are accounting-based. Future studies could use market-based risk proxies to test the validity of highlighted relationships. Furthermore, although we draw the sample across various industries and world countries to strengthen the generalizability of the findings, this might pose a limitation about not directly generalizability of the results to specific contexts such as countries, regions, or industries. This probable constraint could also be surpassed by adopting the research model of the study to different contexts. Future studies might test women directors' monitoring abilities in financially distressed firms across varying degrees of institutional and social contexts such as under different market regulations and cultural contexts. For example, whether the critical mass is supported in firm practices and outcomes in Shariah-compliant companies and masculine societies is worth investigating. Furthermore, the divergence of shareholders' rights and management dimensions from other ESG dimensions suggests researchers treat this

dimension differently which may even justify specific studies around it. Finally, if data exists, future studies can focus on female directors' qualifications rather than their count to explore whether the qualifications matter in firm decision-making and outcomes.

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JAL-04-2024-0065.R2

Risky firms, ESG, and firm value: do women undertake a particular role?

Dear Editor and Reviewer,

Thank you very much for the revision decision. We appreciate the constructive comments and suggestions, and, most of all, the opportunity to revise our manuscript. We have taken each one of them seriously and made a concerted effort to address the issues raised, which resulted in a paper that is more compelling and clearer. The modifications we made appear in RED in the revised manuscript. Below, you will find our responses to the comments by first giving the comment of the reviewer, followed by our answer.

Kind regards

The authors

Reviewer(s)' and Associate Editor Comments to Author:

Reviewer: 1

Recommendation: Minor Revision

The paper is now much improved. Thank you for addressing the previous feedback. Here are my comments:

1- My main concern is that the theoretical framework is not yet well-developed. Here are some suggestions for improvement:

Deeper Integration: • Currently, the theories are described side by side, but their integration could be more explicit. For example, how does financial slack exacerbate agency conflicts, and how does agency theory provide insights into mitigating these conflicts through effective governance? Emphasizing how these two theories complement each other would strengthen the discussion.

Thank you for your valuable feedback. We have improved the arguments in this section to explicitly integrate these theories together.

ESG Context: • While the section mentions ESG projects, the discussion is relatively brief and generalized. Adding more specific examples or mechanisms connecting financial slack and agency theory to ESG decisions could make the integration more compelling. For instance, consider how excess resources might enable symbolic ESG actions that appease stakeholders but fail to generate meaningful impact, and how governance can redirect these resources toward substantive ESG initiatives.

Thank you for your valuable feedback. We have enhanced the discussion related to ESG projects and the role of governance mechanisms in the deployment of slack resources towards ESG projects.

Corporate Governance Mechanisms: • The mention of corporate governance is relevant but underdeveloped. It would benefit from a more detailed exploration of specific mechanisms (e.g., board composition, executive compensation, shareholder activism) that mitigate agency conflicts and ensure that slack resources are used effectively.

Thank you for your suggestion. We have discussed the role of board attributes and have emphasized the role of board gender diversity, which is the main focus of this study, in ensuring effective slack resources use.

Coherence and Flow: • The section lacks coherence and feels somewhat disconnected. Focus on creating a seamless narrative that ties the theories together, showing how financial slack theory highlights the resource-based challenges and agency theory provides a framework for addressing managerial discretion issues.

Thank you for your comment. We have now improved the coherence and flow of this section.

2. Thank you for incorporating relevant and recent studies into your discussion and citing them effectively. However, I believe adding research published in top-tier journals might further enhance the academic rigor of your work.

Thank you for your suggestions. We have now incorporated these articles into the whole manuscript. These updates offer a more relevant understanding of the recent research landscape. Thank you again.

Additional Questions:

Originality: Does the paper contain new and significant information adequate to justify publication?: Yes

Thank you

Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: While the authors added more relevant and recent studies, adding related studies published in top-tier journals would further enhance the paper's academic rigor and strengthen its theoretical foundation.

Thank you for your suggestions. We have now incorporated these articles into the whole manuscript. These updates offer a more relevant understanding of the recent research landscape. Thank you again.

Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: Now it is much improved.

Thank you

Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: yes

Thank you

Practicality and/or Research implications: Does the paper identify clearly any implications for practice and/or further research? Are these implications consistent with the findings and conclusions of the paper?: yes

Thank you

Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: The paper has improved, but further enhancements are needed in

terms of coherence and flow. Additionally, consider shortening paragraphs, particularly the first one in the introduction, to make the text more concise and easier for readers to follow. Streamlining the content will enhance readability and ensure the main ideas are communicated effectively.

Thank you for your comment. We have now improved the coherence and flow in the paper and revised the first paragraph of the introduction as suggested.

Abstract: Does the abstract relate to the article? Does it provide an adequate summary of the content? Is the language easy to understand and clear for the reader?: Yes

Thank you

Table 1: Research variables

Variable	Description	
ENVSC	Environmental pillar score of ESG scaling from 0 to 100.	Refinitiv (LSEG)
RESSC	Resource consumption metric of ENVSC scaling from 0 to 100.	Refinitiv (LSEG)
EMISC	Emission reduction metric of ENVSC scaling from 0 to 100.	Refinitiv (LSEG)
EINSC	Eco-innovation metric of ENVSC scaling from 0 to 100.	Refinitiv (LSEG)
SOCSC	Social pillar score of ESG scaling from 0 to 100.	Refinitiv (LSEG)
WORSC	Workforce metric of SOCSC scaling from 0 to 100.	Refinitiv (LSEG)
HUMSC	Human rights metric of SOCSC scaling from 0 to 100.	Refinitiv (LSEG)
COMSC	Community development metric of SOCSC scaling from 0 to 100.	Refinitiv (LSEG)
PROSC	Product responsibility metric of SOCSC scaling from 0 to 100.	Refinitiv (LSEG)
GOVSC	Governance pillar score of ESG scaling from 0 to 100.	Refinitiv (LSEG)
MANSC	Management structure metric of GOVSC scaling from 0 to 100.	Refinitiv (LSEG)
SHASC	Shareholder's rights metric of GOVSC scaling from 0 to 100.	Refinitiv (LSEG)
CSTSC	CSR strategy metric of GOVSC scaling from 0 to 100.	Refinitiv (LSEG)
TobinQ	Market capitalization plus total debt scaled by total assets.	Authors' calculation
TobinQ-ad	The difference between the firm's TobinQ and the median TobinQ of the firms in the same industry in the same year.	Authors' calculation
ZFS	Zmijewski (1984) Financial Score (ZFS)= -4.336 − 4.513(X1) + 5.679(X2) − 0.004(X3) Where, X1 = Net Income/Total Assets X2 = Total Debt/Total Assets X3 = Current Assets/Current Liabilities	Authors' calculation
InvALT	1/Altman z-score such that Altman z-score (Altman, 1968) = 1.2(Working Capital/Total Assets) + 3.3 (Earnings Before Interest and Taxes/Total Assets) + 1.4 (Retained Earnings/Total Assets) + 0.999 (Sales/Total Assets) + 0.6 (Market Value of Equity/Book Value of Total Liabilities)	Authors' calculation
StdROA	3-year rolling standard deviation of annual ROA over the sample period.	Authors' calculation
BlauIndx	Blau index (Blau, 1977) calculated by $1-\sum_{i=1}^{n} P_i^2$, such that P_i is the percentage of male and female directors and n is the total number of directors on board. Index value takes between 0 and 0.5.	Authors' calculation
ShanIndx	Shannon index (Shannon, 1948) calculated by $-\sum_{i=1}^{n} P_i lnP_i$, such that P_i is the percentage of male and female directors and n is the total number of directors on board. Index value takes between 0 and 0.69.	Authors' calculation
Bdivers	Board gender diversity specifying the percentage of female directors on board.	Refinitiv (LSEG)
Bsize	Board size specifying number of directors on board.	Refinitiv (LSEG)
CEOd	CEO duality: 1 if CEO simultaneously chairs the board and 0 if not.	Refinitiv (LSEG)
Fsize	Firms size is the natural logarithm of total assets.	Authors' calculation
ROA	Return on assets specifying income before interest and tax deflated by total assets.	Authors' calculation
Leverage	Total liabilities scaled by total assets.	Authors' calculation
Capex	Capital expenditures scaled by net sales.	Authors' calculation
Liquidity	Total current assets scaled by total current liabilities.	Authors' calculation
Ffloat	Free float percentage of shares traded in the stock market.	Refinitiv (LSEG)
NFEMD0	1 if the company has at least one female director, and 0 otherwise.	Refinitiv (LSEG)
NFEMD1	1 if the company has one female director, and 0 otherwise.	Refinitiv (LSEG)
NFEMD2	1 if the company has two female directors, and 0 otherwise.	Refinitiv (LSEG)
NFEMD3	1 if the company has three female directors, and 0 otherwise.	Refinitiv (LSEG)
NFEMD3M	1 if the company has three or more female directors, and 0 otherwise.	Refinitiv (LSEG)

This table defines the research variables.

Table 2: Sample summary

Panel A: Sectoral and periodical distribution of the sample

Variable	Category	Freq.	Percent
Sector	Basic Materials	5,842	13.24
	Consumer Non-Cyclicals	3,934	8.91
	Healthcare	4,036	9.15
	Energy	3,889	8.81
	Consumer Cyclicals	8,288	18.78
	Industrials	9,236	20.93
	Technology	5,018	11.37
	Telecommunications Services	1,489	3.37
	Utilities	2,397	5.43
	Total	*44,129*	*100.00*
Year	2005	1,210	2.74
	2006	1,298	2.94
	2007	1,403	3.18
	2008	1,617	3.66
	2009	1,940	4.40
	2010	2,265	5.13
	2011	2,574	5.83
	2012	2,709	6.14
	2013	2,808	6.36
	2014	2,957	6.70
	2015	3,437	7.79
	2016	4,099	9.29
	2017	4,670	10.58
	2018	5,244	11.88
	2019	5,898	13.37
	Total	*44,129*	*100.00*

Panel B: Country level number of firms and observations in the sample

Country	Number of firms	Percent	Number of observations	Percent
Uganda	1	0.02	1	0
Vietnam	1	0.02	1	0
Slovenia	1	0.02	2	0
Kazakhstan	2	0.03	4	0.01
Kenya	1	0.02	5	0.01
Pakistan	2	0.03	6	0.01
Luxembourg	1	0.02	8	0.02
Bahrain	2	0.03	9	0.02
Sri Lanka	1	0.02	10	0.02
Zimbabwe	1	0.02	10	0.02
Morocco	1	0.02	11	0.02
Oman	4	0.07	17	0.04
Czech Republic	2	0.03	23	0.05
United Arab Emirates	4	0.07	23	0.05
Kuwait	4	0.07	25	0.06
Hungary	4	0.07	33	0.07
Egypt	5	0.08	40	0.09
Qatar	8	0.14	42	0.1
Ireland; Republic of	8	0.14	65	0.15
Colombia	15	0.25	79	0.18
Saudi Arabia	20	0.34	83	0.19
Peru	26	0.44	91	0.21
Israel	9	0.15	101	0.23
Argentina	46	0.78	112	0.25
Portugal	15	0.25	124	0.28
Greece	17	0.29	131	0.3
Philippines	16	0.27	140	0.32
Austria	23	0.39	165	0.37
Poland	30	0.51	186	0.42
Turkey	43	0.73	192	0.44
Chile	33	0.56	228	0.52

Thailand	33	0.56	245	0.56
Indonesia	33	0.56	268	0.61
Mexico	38	0.64	276	0.63
New Zealand	42	0.71	285	0.65
Belgium	37	0.63	289	0.65
Russia	35	0.59	325	0.74
Denmark	37	0.63	325	0.74
Finland	32	0.54	345	0.78
Norway	54	0.92	345	0.78
Netherlands	45	0.76	387	0.88
Singapore	32	0.54	400	0.91
Malaysia	49	0.83	405	0.92
Italy	71	1.2	451	1.02
Spain	56	0.95	468	1.06
Brazil	78	1.32	593	1.34
Sweden	110	1.87	681	1.54
Switzerland	98	1.66	686	1.55
India	112	1.9	741	1.68
South Africa	89	1.51	760	1.72
Korea; Republic (S. Korea)	117	1.98	920	2.08
Taiwan	128	2.17	1,044	2.37
Germany	152	2.58	1,133	2.57
China	373	6.32	1,146	2.6
France	137	2.32	1,186	2.69
Hong Kong	187	3.17	1,485	3.37
Canada	245	4.15	2,359	5.35
Australia	308	5.22	2,581	5.85
United Kingdom	312	5.29	3,143	7.12
Japan	375	6.36	4,982	11.29
United States of America	2,137	36.23	13,908	31.52
Total	*5,898*	*100.00*	*44,129*	*100.00*

This table indicates the sample distribution.

Table 3: Descriptive statistics

Panel A:

Variable	Obs.	Mean	Std. Dev.	Min	Max
ENVSC	44,129	33.39	28.43	0.00	99.06
RESSC	44,129	37.30	33.40	0.00	99.85
EMISC	44,129	37.45	33.42	0.00	99.84
EINSC	44,129	22.68	29.78	0.00	99.82
SOCSC	44,129	41.19	23.92	0.05	98.64
WORSC	44,129	50.58	29.10	0.14	99.88
HUMSC	44,129	24.41	32.12	0.00	99.48
COMSC	44,129	49.54	29.14	0.00	99.88
PROSC	44,129	41.02	31.93	0.00	99.86
GOVSC	44,129	48.30	22.65	0.11	99.33
MANSC	44,129	50.35	28.51	0.02	99.98
SHASC	44,129	51.34	28.74	0.05	99.98
CSTSC	44,129	33.46	33.46	0.00	99.88
TobinQ	44,129	1.66	1.52	0.08	9.11
ZFS	44,129	-3.10	1.21	-5.42	0.82
InvALT	44,129	0.49	0.74	-0.83	9.31
BlauIndx	44,129	0.20	0.16	0.00	0.50
Bdivers	44,129	13.64	12.58	0.00	100.00
Bsize	44,129	9.97	3.33	4.00	21.00
CEOd	44,129	0.39	0.49	0.00	1.00
Fsize	44,129	22.10	1.62	10.65	27.41
ROA	44,129	0.08	0.10	-0.37	0.36
Leverage	44,129	0.55	0.22	0.05	1.16
Capex	44,129	0.43	2.23	0.00	19.06
Liquidity	44,129	2.04	1.92	0.25	12.90
Ffloat	44,129	76.79	24.86	0.00	100.00

Panel B:

Variable	Obs.	Mean	Std. Dev.	Min	Max
NFEMD0	44,129	0.69	0.46	0.00	1.00
NFEMD1	44,129	0.30	0.46	0.00	1.00
NFEMD2	44,129	0.21	0.41	0.00	1.00
NFEMD3	44,129	0.10	0.30	0.00	1.00
NFEMD3M	44,129	0.17	0.38	0.00	1.00

This table indicates the descriptive statistics.

Table 4: Correlation analysis

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1	ENVSC	1												
2	RESSC	0.903*	1											
3	EMISC	0.904*	0.829*	1										
4	EINSC	0.694*	0.456*	0.452*	1									
5	SOCSC	0.726*	0.744*	0.696*	0.406*	1								
6	WORSC	0.692*	0.712*	0.706*	0.331*	0.802*	1							
7	HUMSC	0.602*	0.629*	0.564*	0.343*	0.802*	0.549*	1						
8	COMSC	0.436*	0.451*	0.414*	0.234*	0.705*	0.453*	0.430*	1					
9	PROSC	0.552*	0.531*	0.507*	0.378*	0.720*	0.497*	0.445*	0.342*	1				
10	GOVSC	0.405*	0.398*	0.397*	0.219*	0.407*	0.387*	0.300*	0.341*	0.260*	1			
11	MANSC	0.275*	0.270*	0.266*	0.151*	0.298*	0.273*	0.209*	0.274*	0.187*	0.947*	1		
12	SHASC	0.109*	0.111*	0.107*	0.056*	0.110*	0.110*	0.076*	0.117*	0.064*	0.447*	0.202*	1	
13	CSTSC	0.743*	0.730*	0.746*	0.397*	0.653*	0.661*	0.536*	0.414*	0.442*	0.468*	0.287*	0.118*	1
14	TobinQ	-0.196*	-0.162*	-0.195*	-0.133*	-0.046*	-0.056*	-0.071*	-0.019*	-0.051*	-0.111*	-0.077*	-0.048*	-0.177*
15	ZFS	0.022*	0.007	0.014*	0.028*	0.035*	-0.018*	0.008	0.075*	0.028*	-0.010*	-0.020*	0.010*	0.022*
16	InvALT	0.061*	0.047*	0.059*	0.040*	0.017*	0.016*	0.015*	0.018*	0.008	0.021*	0.006	0.015*	0.064*
17	BlauIndx	0.162*	0.182*	0.148*	0.073*	0.298*	0.225*	0.257*	0.259*	0.146*	0.221*	0.221*	0.035*	0.138*
18	Bdivers	0.165*	0.183*	0.153*	0.077*	0.292*	0.224*	0.262*	0.236*	0.148*	0.208*	0.207*	0.028*	0.137*
19	Bsize	0.346*	0.321*	0.336*	0.232*	0.247*	0.241*	0.207*	0.140*	0.192*	0.082*	0.027*	0.009	0.290*
20	CEOd	-0.002	-0.002	-0.005	0.017*	0.009	-0.056*	-0.021*	0.106*	0.008	-0.080*	-0.079*	-0.001	-0.065*
21	Fsize	0.533*	0.498*	0.521*	0.326*	0.404*	0.367*	0.336*	0.305*	0.281*	0.301*	0.222*	0.085*	0.472*
22	ROA	0.095*	0.112*	0.093*	-0.017*	0.086*	0.112*	0.100*	0.069*	0.043*	0.114*	0.104*	0.045*	0.076*
23	Leverage	0.184*	0.168*	0.172*	0.135*	0.181*	0.137*	0.141*	0.172*	0.120*	0.088*	0.062*	0.037*	0.139*
24	Capex	-0.080*	-0.072*	-0.069*	-0.059*	-0.062*	-0.052*	-0.045*	-0.042*	-0.061*	-0.067*	-0.066*	-0.015*	-0.039*
25	Liquidity	-0.221*	-0.205*	-0.216*	-0.106*	-0.151*	-0.167*	-0.135*	-0.097*	-0.111*	-0.137*	-0.106*	-0.038*	-0.197*
26	Ffloat	0.010*	0.021*	-0.007	0.048*	0.080*	-0.002	0.021*	0.221*	0.018*	0.152*	0.152*	0.114*	-0.023*

	Variable	14	15	16	17	18	19	20	21	22	23	24	25	26
14	TobinQ	1												
15	ZFS	-0.184*	1											
16	InvALT	-0.249*	0.294*	1										
17	BlauIndx	0.062*	0.048*	0.005	1									
18	Bdivers	0.056*	0.041*	0.007	0.968*	1								
19	Bsize	-0.184*	0.075*	0.084*	0.033*	0.013*	1							
20	CEOd	0.029*	0.002	-0.027*	-0.014*	-0.020*	0.063*	1						

21	Fsize	-0.368*	0.123*	0.194*	0.043*	0.031*	0.508*	0.110*	1					
22	ROA	0.220*	-0.399*	-0.160*	0.064*	0.058*	0.049*	0.038*	0.139*	1				
23	Leverage	-0.191*	0.663*	0.266*	0.133*	0.124*	0.198*	0.043*	0.325*	-0.010*	1			
24	Capex	0.063*	0.030*	0.016*	-0.060*	-0.057*	-0.076*	-0.033*	-0.155*	-0.182*	-0.143*	1		
25	Liquidity	0.249*	-0.232*	-0.180*	-0.088*	-0.085*	-0.207*	-0.005	-0.358*	-0.196*	-0.547*	0.198*	1	
26	Ffloat	0.010*	0.021*	-0.030*	0.139*	0.113*	-0.059*	0.134*	-0.004	-0.020*	0.032*	-0.051*	0.047*	1

This table shows the correlation analysis. *p<0.05

BASELINE ANALYSES

Table 5: The association between firm risk and ESG

Independent variables	(1) ENVSC	(2) RESSC	(3) EMISC	(4) EINSC	(5) SOCSC	(6) WORSC	(7) HUMSC	(8) COMSC	(9) PROSC	(10) GOVSC	(11) MANSC	(12) SHASC	(13) CSTSC
ZFS	-1.84***	-2.08***	-2.31***	-2.54***	-1.40***	-1.89***	-1.39***	-1.24***	-0.94***	-0.99***	-1.18***	0.23	-1.91***
	(-13.29)	(-12.29)	(-13.99)	(-14.85)	(-11.53)	(-12.49)	(-8.15)	(-8.05)	(-5.08)	(-7.40)	(-6.74)	(1.23)	(-11.09)
Bsize	0.79***	0.93***	0.88***	0.63***	0.63***	0.71***	0.67***	0.46***	0.58***	-0.54***	-0.91***	-0.25***	0.89***
	(20.07)	(19.28)	(18.66)	(12.87)	(18.21)	(16.40)	(13.70)	(10.56)	(11.02)	(-14.04)	(-18.29)	(-4.74)	(18.11)
CEOd	1.20***	1.48***	1.59***	0.45	0.52**	0.42*	0.63**	1.12***	0.19	-4.57***	-6.80***	-0.46	0.37
	(5.16)	(5.22)	(5.76)	(1.55)	(2.57)	(1.65)	(2.19)	(4.33)	(0.62)	(-20.26)	(-23.18)	(-1.47)	(1.28)
Fsize	9.14***	10.4***	10.6***	5.07***	7.13***	7.64***	7.84***	7.27***	5.71***	5.32***	5.32***	1.91***	10.4***
	(107.85)	(100.50)	(104.61)	(48.29)	(96.02)	(82.27)	(75.21)	(77.23)	(50.22)	(64.59)	(49.71)	(16.85)	(98.89)
ROA	0.33	6.22***	-0.18	-22.7***	3.01***	6.10***	14.1***	-0.20	6.36***	13.1***	17.4***	10.5***	-4.33***
	(0.26)	(4.05)	(-0.12)	(-14.61)	(2.73)	(4.43)	(9.11)	(-0.14)	(3.78)	(10.74)	(10.96)	(6.26)	(-2.77)
Leverage	6.88***	6.85***	8.06***	13.8***	6.31***	6.47***	4.63***	7.41***	5.51***	1.71**	1.23	1.21	4.89***
	(8.47)	(6.91)	(8.33)	(13.74)	(8.87)	(7.27)	(4.63)	(8.22)	(5.06)	(2.17)	(1.20)	(1.11)	(4.83)
Capex	0.050	0.11*	0.16***	-0.022	0.11**	0.11**	0.34***	0.0028	-0.081	-0.15***	-0.24***	-0.055	0.18***
	(1.02)	(1.83)	(2.67)	(-0.37)	(2.54)	(1.97)	(5.57)	(0.05)	(-1.24)	(-3.11)	(-3.92)	(-0.84)	(2.99)
Liquidity	0.016	0.063	0.016	0.66***	0.21***	-0.0091	0.37***	0.22***	-0.12	-0.32***	-0.47***	-0.0099	0.0089
	(0.23)	(0.74)	(0.20)	(7.70)	(3.45)	(-0.12)	(4.39)	(2.87)	(-1.24)	(-4.70)	(-5.41)	(-0.11)	(0.10)
Ffloat	0.083***	0.11***	0.077***	0.090***	0.075***	0.080***	0.076***	0.099***	0.066***	0.20***	0.23***	0.16***	0.099***
	(15.52)	(16.33)	(12.05)	(13.47)	(15.88)	(13.56)	(11.56)	(16.60)	(9.18)	(37.42)	(33.22)	(22.33)	(14.72)
Constant	-214.8***	-242.5***	-243.3***	-144.3***	-162.4***	-159.2***	-193.6***	-145.3***	-136.7***	-79.1***	-73.5***	6.42*	-235.1***
	(-77.58)	(-71.71)	(-73.80)	(-42.13)	(-66.97)	(-52.45)	(-56.86)	(-47.28)	(-36.82)	(-29.39)	(-21.03)	(1.74)	(-68.13)
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129
R^2	0.45	0.40	0.43	0.23	0.40	0.37	0.34	0.35	0.21	0.18	0.12	0.04	0.38
F-stat.	390.97***	325.72***	368.98***	142.97***	323.25***	279.07***	254.62***	262.19***	129.20***	104.27***	68.14***	17.78***	296.14***

This table analyses the association between firm risk and ESG. We describe all variables in Table 1. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Moderating role of board gender diversity (BlauIndex) between firm risk and ESG

Independent variables	(1) ENVSC	(2) RESSC	(3) EMISC	(4) EINSC	(5) SOCSC	(6) WORSC	(7) HUMSC	(8) COMSC	(9) PROSC	(10) GOVSC	(11) MANSC	(12) SHASC	(13) CSTSC
ZFS	-1.25***	-1.41***	-1.57***	-1.96***	-0.79***	-1.18***	-0.44**	-0.71***	-0.81***	-0.94***	-1.19***	0.21	-1.44***
	(-7.28)	(-6.70)	(-7.67)	(-9.15)	(-5.28)	(-6.26)	(-2.09)	(-3.71)	(-3.49)	(-5.72)	(-5.56)	(0.91)	(-6.71)
BlauIndex	7.27***	11.4***	8.41***	-2.50	7.12***	6.91***	1.65	9.13***	9.47***	34.6***	48.4***	5.12**	9.90***
	(4.07)	(5.22)	(3.95)	(-1.12)	(4.55)	(3.53)	(0.75)	(4.60)	(3.94)	(20.24)	(21.84)	(2.13)	(4.44)
ZFS*BlauIndex	-2.45***	-2.70***	-3.08***	-2.74***	-2.52***	-3.03***	-4.23***	-2.12***	-0.33	0.79	1.48**	0.23	-1.84***
	(-4.73)	(-4.28)	(-5.01)	(-4.26)	(-5.58)	(-5.35)	(-6.66)	(-3.69)	(-0.48)	(1.60)	(2.31)	(0.34)	(-2.86)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129
R^2	0.45	0.41	0.44	0.23	0.41	0.37	0.35	0.36	0.21	0.21	0.16	0.04	0.38
F-stat.	390.10***	326.84***	368.66***	140.69***	325.52***	279.78***	253.80***	262.26***	127.79***	126.46***	92.01***	17.59***	294.39***

This table analyses the moderating role of board gender diversity (BlauIndex) between firm risk and ESG. We describe all variables in Table 1. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Moderation analysis (critical mass)

Panel A: Moderating role of NFEMD0

Independent variables	(1) ENVSC	(2) RESSC	(3) EMISC	(4) EINSC	(5) SOCSC	(6) WORSC	(7) HUMSC	(8) COMSC	(9) PROSC	(10) GOVSC	(11) MANSC	(12) SHASC	(13) CSTSC
ZFS	-1.32***	-1.56***	-1.64***	-2.02***	-0.92***	-1.25***	-0.75***	-0.78***	-0.97***	-0.89***	-1.07***	0.16	-1.51***
	(-7.23)	(-7.00)	(-7.57)	(-8.95)	(-5.77)	(-6.24)	(-3.35)	(-3.83)	(-3.96)	(-5.05)	(-4.73)	(0.65)	(-6.64)
NFEMD0	0.89	1.74**	0.94	-1.10	1.17**	1.18*	-0.56	1.31*	2.73***	8.16***	11.6***	1.20	1.35*
	(1.44)	(2.31)	(1.28)	(-1.43)	(2.15)	(1.74)	(-0.74)	(1.90)	(3.29)	(13.71)	(15.04)	(1.45)	(1.75)
ZFS*NFEMD0	-0.73***	-0.71***	-0.93***	-0.76***	-0.66***	-0.91***	-0.91***	-0.64***	0.078	-0.036	0.021	0.12	-0.55**
	(-4.09)	(-3.28)	(-4.39)	(-3.43)	(-4.25)	(-4.65)	(-4.16)	(-3.22)	(0.33)	(-0.21)	(0.10)	(0.48)	(-2.49)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129
R^2	0.45	0.40	0.43	0.23	0.40	0.37	0.35	0.35	0.21	0.20	0.15	0.04	0.38
F-stat.	385.83***	321.78***	364.41***	140.28***	320.33***	276.89***	250.29***	258.93***	127.12***	116.53***	82.42***	17.46***	291.47***

Panel B: Moderating role of NFEMD1

Independent variables	(1) ENVSC	(2) RESSC	(3) EMISC	(4) EINSC	(5) SOCSC	(6) WORSC	(7) HUMSC	(8) COMSC	(9) PROSC	(10) GOVSC	(11) MANSC	(12) SHASC	(13) CSTSC
ZFS	-1.84***	-2.14***	-2.29***	-2.62***	-1.46***	-2.00***	-1.55***	-1.25***	-0.96***	-0.80***	-0.89***	0.28	-1.94***
	(-12.39)	(-11.79)	(-12.96)	(-14.21)	(-11.22)	(-12.25)	(-8.50)	(-7.59)	(-4.83)	(-5.50)	(-4.73)	(1.41)	(-10.49)
NFEMD1	-1.57***	-1.67**	-2.03***	0.18	-0.62	0.11	-0.57	-1.27*	-0.37	-2.61***	-3.31***	-0.93	-1.64**
	(-2.61)	(-2.28)	(-2.85)	(0.24)	(-1.18)	(0.17)	(-0.78)	(-1.91)	(-0.45)	(-4.47)	(-4.36)	(-1.16)	(-2.19)
ZFS*NFEMD1	0.058	0.28	0.021	0.26	0.25	0.37*	0.61***	0.10	0.084	-0.64***	-0.94***	-0.16	0.16
	(0.32)	(1.27)	(0.10)	(1.16)	(1.58)	(1.86)	(2.77)	(0.51)	(0.35)	(-3.64)	(-4.13)	(-0.67)	(0.71)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129
R^2	0.45	0.40	0.43	0.23	0.40	0.37	0.35	0.35	0.21	0.18	0.12	0.04	0.38
F-stat.	383.73***	320.27***	362.20***	139.98***	317.23***	273.41***	250.58***	257.22***	126.48***	102.31***	66.90***	17.42***	290.78***

Panel C: Moderating role of NFEMD2

Independent variables	(1) ENVSC	(2) RESSC	(3) EMISC	(4) EINSC	(5) SOCSC	(6) WORSC	(7) HUMSC	(8) COMSC	(9) PROSC	(10) GOVSC	(11) MANSC	(12) SHASC	(13) CSTSC
ZFS	-1.74***	-2.00***	-2.21***	-2.39***	-1.24***	-1.63***	-1.21***	-1.13***	-0.95***	-1.00***	-1.18***	0.14	-1.82***
	(-11.95)	(-11.25)	(-12.75)	(-13.25)	(-9.77)	(-10.21)	(-6.78)	(-6.99)	(-4.86)	(-7.08)	(-6.42)	(0.73)	(-10.05)
NFEMD2	0.34	1.16	0.90	-1.65**	-0.82	-1.62**	-1.57*	-0.014	0.75	3.59***	4.78***	1.71*	0.44
	(0.50)	(1.40)	(1.12)	(-1.97)	(-1.38)	(-2.18)	(-1.88)	(-0.02)	(0.83)	(5.46)	(5.60)	(1.89)	(0.53)
ZFS*NFEMD2	-0.47**	-0.37	-0.45*	-0.72***	-0.71***	-1.23***	-0.80***	-0.50**	0.026	0.011	-0.018	0.40	-0.42

	(-2.26)	(-1.45)	(-1.83)	(-2.81)	(-3.89)	(-5.44)	(-3.14)	(-2.15)	(0.09)	(0.05)	(-0.07)	(1.43)	(-1.64)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129
R^2	0.45	0.40	0.43	0.23	0.40	0.37	0.35	0.35	0.21	0.18	0.13	0.04	0.38
F-stat.	383.56***	319.68***	362.14***	140.04***	317.17***	274.53***	249.42***	257.07***	126.47***	104.70***	69.42***	17.44***	290.32***
Panel D: Moderating role of NFEMD3													
Independent variables	(1) ENVSC	(2) RESSC	(3) EMISC	(4) EINSC	(5) SOCSC	(6) WORSC	(7) HUMSC	(8) COMSC	(9) PROSC	(10) GOVSC	(11) MANSC	(12) SHASC	(13) CSTSC
ZFS	-1.68***	-1.87***	-2.12***	-2.45***	-1.29***	-1.76***	-1.21***	-1.13***	-0.92***	-0.94***	-1.13***	0.26	-1.78***
	(-11.96)	(-10.90)	(-12.68)	(-14.04)	(-10.50)	(-11.41)	(-6.97)	(-7.23)	(-4.87)	(-6.90)	(-6.40)	(1.39)	(-10.14)
NFEMD3	-0.44	0.031	0.086	-2.27*	1.27	0.19	-1.48	1.16	2.91**	6.02***	8.79***	0.37	0.65
	(-0.45)	(0.03)	(0.07)	(-1.86)	(1.48)	(0.17)	(-1.22)	(1.06)	(2.21)	(6.32)	(7.10)	(0.28)	(0.53)
ZFS*NFEMD3	-1.39***	-1.77***	-1.56***	-1.02***	-0.78***	-1.14***	-1.67***	-0.81**	0.056	0.056	0.38	-0.26	-1.10***
	(-4.57)	(-4.76)	(-4.30)	(-2.71)	(-2.95)	(-3.41)	(-4.47)	(-2.41)	(0.14)	(0.19)	(1.00)	(-0.65)	(-2.91)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129
R^2	0.45	0.40	0.43	0.23	0.40	0.37	0.35	0.35	0.21	0.18	0.13	0.04	0.38
F-stat.	385.24***	322.02***	363.94***	140.04***	319.03***	274.81***	250.62***	258.10***	126.89***	106.00***	70.44***	17.47***	291.38***
Panel E: Moderating role of NFEMD3M													
Independent variables	(1) ENVSC	(2) RESSC	(3) EMISC	(4) EINSC	(5) SOCSC	(6) WORSC	(7) HUMSC	(8) COMSC	(9) PROSC	(10) GOVSC	(11) MANSC	(12) SHASC	(13) CSTSC
ZFS	-1.54***	-1.64***	-1.92***	-2.34***	-1.11***	-1.62***	-0.92***	-0.95***	-0.81***	-0.86***	-1.05***	0.28	-1.61***
	(-10.78)	(-9.40)	(-11.31)	(-13.19)	(-8.92)	(-10.38)	(-5.28)	(-5.98)	(-4.24)	(-6.24)	(-5.88)	(1.45)	(-9.03)
NFEMD3M	1.29	1.13	0.85	-1.07	1.73**	1.00	0.048	1.96**	2.63**	8.30***	11.8***	0.77	2.10**
	(1.61)	(1.15)	(0.89)	(-1.07)	(2.47)	(1.14)	(0.05)	(2.20)	(2.44)	(10.67)	(11.67)	(0.71)	(2.10)
ZFS*NFEMD3M	-1.37***	-2.06***	-1.82***	-1.11***	-1.24***	-1.23***	-2.26***	-1.24***	-0.40	0.096	0.46	-0.18	-1.32***
	(-5.58)	(-6.90)	(-6.22)	(-3.66)	(-5.78)	(-4.57)	(-7.51)	(-4.54)	(-1.20)	(0.41)	(1.50)	(-0.54)	(-4.30)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129
R^2	0.45	0.41	0.44	0.23	0.41	0.37	0.35	0.36	0.21	0.19	0.14	0.04	0.38
F-stat.	389.07***	326.34***	367.32***	140.57***	324.16***	276.66***	255.39***	261.40***	127.58***	111.29***	75.39***	17.51***	294.34***

This table analyses the moderating role of female critical mass between firm risk and ESG. We describe all variables in Table 1. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: Moderating role of ESG pillars between firm risk and firm value

Independent variables	(1) TobinQ	(2) TobinQ	(3) TobinQ	(4) TobinQ-ad	(5) TobinQ-ad	(6) TobinQ-ad
ZFS	0.062***	0.11***	0.10***	0.066***	0.11***	0.10***
	(6.63)	(9.58)	(8.28)	(7.10)	(10.11)	(8.50)
ENVSC	-0.0013**			-0.00088		
	(-2.02)			(-1.41)		
ZFS*ENVSC	-0.0015***			-0.0014***		
	(-8.06)			(-7.58)		
SOCSC		-0.00056			-0.00073	
		(-0.75)			(-0.99)	
ZFS*SOCSC		-0.0022***			-0.0022***	
		(-10.24)			(-10.22)	
GOVSC			-0.0066***			-0.0062***
			(-9.00)			(-8.49)
ZFS*GOVSC			-0.0020***			-0.0019***
			(-9.07)			(-8.66)
Controls	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129
R^2	0.36	0.36	0.36	0.28	0.28	0.28
F-stat.	262.88***	268.10***	260.78***	183.18***	187.41***	181.14***

This table analyses the moderating role of ESG pillars between firm risk and firm value. We describe all variables in Table 1. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Moderating role of ESG pillars between firm risk and firm value with NFEMD3M=1 and NFEMD3M=0

Independent variables	(1) TobinQ	(2) TobinQ	(3) TobinQ	(4) TobinQ-ad	(5) TobinQ-ad	(6) TobinQ-ad	(7) TobinQ	(8) TobinQ	(9) TobinQ	(10) TobinQ-ad	(11) TobinQ-ad	(12) TobinQ-ad
	NFEMD3 M:1	NFEMD3 M:1	NFEMD3 M:1	NFEMD3 M:1	NFEMD3 M:1	NFEMD3 M:1	NFEMD3 M:0	NFEMD3 M:0	NFEMD3 M:0	NFEMD3 M:0	NFEMD3 M:0	NFEMD3 M:0
ZFS	0.19***	0.16***	0.11***	0.19***	0.17***	0.11***	0.039***	0.098***	0.096***	0.044***	0.10***	0.099***
	(8.33)	(5.39)	(3.41)	(8.44)	(5.53)	(3.51)	(3.84)	(7.89)	(7.06)	(4.39)	(8.50)	(7.31)
ENVSC	-0.0048***			-0.0047***			-0.00093			-0.00049		
	(-3.84)			(-3.81)			(-1.27)			(-0.67)		
ZFS*ENVSC	-0.0021***			-0.0022***			-0.0013***			-0.0012***		
	(-5.76)			(-5.85)			(-6.32)			(-5.81)		
SOCSC		0.00069			0.00040			-0.0016*			-0.0018**	
		(0.44)			(0.25)			(-1.83)			(-2.10)	
ZFS*SOCSC		-0.0011**			-0.0012**			-0.0025***			-0.0025***	
		(-2.32)			(-2.46)			(-10.10)			(-10.09)	
GOVSC			-0.00097			-0.0011			-0.0078***			-0.0073***
			(-0.58)			(-0.65)			(-9.50)			(-8.98)
ZFS*GOVSC			-0.00021			-0.00026			-0.0022***			-0.0021***
			(-0.41)			(-0.51)			(-9.17)			(-8.71)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	7688	7688	7688	7688	7688	7688	36441	36441	36441	36441	36441	36441
R^2	0.43	0.43	0.43	0.37	0.37	0.36	0.36	0.36	0.35	0.28	0.28	0.28
F-stat.	72.75***	72.74***	71.86***	54.96***	54.89***	54.12***	217.94***	222.71***	216.95***	151.42***	155.29***	150.39***

This table analyses the moderating role of ESG pillars between firm risk and firm value drawing on critical mass. We describe all variables in Table 1. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table 10: Alternative testing variable (InvALT) for firm risk and ESG

Independent variables	(1) ENVSC	(2) RESSC	(3) EMISC	(4) EINSC	(5) SOCSC	(6) WORSC	(7) HUMSC	(8) COMSC	(9) PROSC	(10) GOVSC	(11) MANSC	(12) SHASC	(13) CSTSC
InvALT	-1.90***	-2.24***	-2.29***	-1.74***	-2.09***	-1.97***	-1.99***	-1.81***	-2.17***	-1.14***	-1.29***	0.11	-2.26***
	(-12.95)	(-12.49)	(-13.05)	(-9.53)	(-16.23)	(-12.21)	(-11.04)	(-11.12)	(-11.02)	(-7.96)	(-6.94)	(0.57)	(-12.32)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129
R^2	0.45	0.40	0.43	0.23	0.40	0.37	0.35	0.35	0.21	0.18	0.12	0.04	0.38
F-stat.	390.79***	325.81***	368.49***	141.13***	325.63***	278.95***	255.55***	263.18***	130.53***	104.39***	68.17***	17.76***	296.65***

This table analyses the association between firm risk and ESG based on an alternative firm risk proxy. We describe all variables in Table 1. t statistics in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Table 11: Two-Stage Least Squares (2SLS) regression analysis

	(1) ZFS 1st stage	(2) ENVSC 2nd stage	(3) ZFS 1st stage	(4) RESSC 2nd stage	(5) ZFS 1st stage	(6) EMISC 2nd stage	(7) ZFS 1st stage	(8) EINSC 2nd stage	(9) ZFS 1st stage	(10) SOCSC 2nd stage	(11) ZFS 1st stage	(12) WORSC 2nd stage	(13) ZFS 1st stage	(14) HUMSC 2nd stage
ZFS(t-1)	0.60*** (179.75)		0.60*** (179.75)		0.60*** (179.75)		0.60*** (179.75)		0.60*** (179.75)		0.60*** (179.75)		0.60*** (179.75)	
ZFS		-2.51*** (-11.23)		-3.02*** (-11.09)		-3.29*** (-12.39)		-3.08*** (-11.11)		-2.26*** (-11.63)		-3.38*** (-14.02)		-2.56*** (-9.28)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Durbin-Wu-Hausman test of endogeneity	10.51***		15.44***		17.16***		11.10***		26.26***		49.44***		26.05***	
First stage weak instrument tests (F-value)	7885.99		7885.99		7885.99		7885.99		7885.99		7885.99		7885.99	
F-stat./Chi²-stat.	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
N	39086	39086	39086	39086	39086	39086	39086	39086	39086	39086	39086	39086	39086	39086
R^2	0.80	0.44	0.80	0.39	0.80	0.42	0.80	0.23	0.80	0.40	0.80	0.36	0.80	0.34

Table 11: Two-Stage Least Squares (2SLS) regression analysis (Continue)

	(1) ZFS 1st stage	(2) COMSC 2nd stage	(3) ZFS 1st stage	(4) PROSC 2nd stage	(5) ZFS 1st stage	(6) GOVSC 2nd stage	(7) ZFS 1st stage	(8) MANSC 2nd stage	(9) ZFS 1st stage	(10) SHASC 2nd stage	(11) ZFS 1st stage	(12) CSTSC 2nd stage
ZFS(t-1)	0.60*** (179.75)		0.60*** (179.75)		0.60*** (179.75)		0.60*** (179.75)		0.60*** (179.75)		0.60*** (179.75)	
ZFS		-1.70*** (-6.93)		-1.45*** (-4.90)		-2.24*** (-10.51)		-2.69*** (-9.76)		-0.23 (-0.77)		-2.96*** (-10.64)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wu-Hausman test of endogeneity	4.90**		4.98**		45.38***		49.49***		1.21		17.36***	
Weak instrument tests (F-value)	7885.99		7885.99		7885.99		7885.99		7885.99		7885.99	
F-stat./Chi²-stat.	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
N	39086	39086	39086	39086	39086	39086	39086	39086	39086	39086	39086	39086
R^2	0.80	0.35	0.80	0.21	0.80	0.17	0.80	0.12	0.80	0.04	0.80	0.37

This table analyses the association between firm risk and ESG based on 2SLS regression. t statistics in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01. No overidentifying restrictions due to the selection of a single instrumental variable.

Table 12: Alternative moderator (Bdivers) between firm risk and ESG

Independent variables	(1) ENVSC	(2) RESSC	(3) EMISC	(4) EINSC	(5) SOCSC	(6) WORSC	(7) HUMSC	(8) COMSC	(9) PROSC	(10) GOVSC	(11) MANSC	(12) SHASC	(13) CSTSC
ZFS	-1.29***	-1.42***	-1.60***	-2.03***	-0.79***	-1.21***	-0.47**	-0.73***	-0.70***	-0.94***	-1.17***	0.17	-1.42***
	(-7.84)	(-7.06)	(-8.13)	(-9.91)	(-5.51)	(-6.68)	(-2.30)	(-4.00)	(-3.14)	(-5.94)	(-5.74)	(0.78)	(-6.90)
Bdivers	0.085***	0.13***	0.095***	-0.036	0.078***	0.071***	0.018	0.11***	0.096***	0.43***	0.61***	0.067**	0.11***
	(3.64)	(4.68)	(3.41)	(-1.25)	(3.86)	(2.77)	(0.64)	(4.37)	(3.08)	(19.43)	(20.99)	(2.15)	(3.95)
ZFS*Bdivers	-0.033***	-0.039***	-0.044***	-0.035***	-0.037***	-0.043***	-0.060***	-0.029***	-0.013	0.012*	0.022***	0.0060	-0.029***
	(-4.90)	(-4.69)	(-5.43)	(-4.22)	(-6.28)	(-5.80)	(-7.25)	(-3.90)	(-1.42)	(1.83)	(2.59)	(0.66)	(-3.39)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129
R^2	0.45	0.41	0.44	0.23	0.41	0.37	0.35	0.36	0.21	0.21	0.16	0.04	0.38
F-stat.	389.77***	326.73***	368.59***	140.62***	325.68***	279.45***	254.52***	262.31***	127.83***	124.17***	89.60***	17.54***	294.52***

This table analyses the moderating role of board gender diversity (Bdivers) between firm risk and ESG based on an alternative moderating variable. We describe all variables in Table 1. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 13: Alternative moderator (ShanIndx) between firm risk and ESG

Independent variables	(1) ENVSC	(2) RESSC	(3) EMISC	(4) EINSC	(5) SOCSC	(6) WORSC	(7) HUMSC	(8) COMSC	(9) PROSC	(10) GOVSC	(11) MANSC	(12) SHASC	(13) CSTSC
ZFS	-1.26***	-1.44***	-1.59***	-1.95***	-0.82***	-1.19***	-0.48**	-0.72***	-0.86***	-0.96***	-1.21***	0.19	-1.46***
	(-7.16)	(-6.71)	(-7.57)	(-8.91)	(-5.30)	(-6.15)	(-2.23)	(-3.71)	(-3.63)	(-5.73)	(-5.55)	(0.81)	(-6.66)
ShanIndx	4.66***	7.38***	5.42***	-1.76	4.70***	4.62***	0.92	5.89***	6.59***	23.0***	32.2***	3.36**	6.32***
	(3.84)	(4.98)	(3.75)	(-1.17)	(4.43)	(3.47)	(0.61)	(4.37)	(4.04)	(19.79)	(21.39)	(2.07)	(4.17)
ZFS*ShanIndx	-1.57***	-1.67***	-1.97***	-1.79***	-1.58***	-1.95***	-2.62***	-1.34***	-0.073	0.51	0.94**	0.20	-1.15***
	(-4.50)	(-3.92)	(-4.73)	(-4.14)	(-5.16)	(-5.10)	(-6.10)	(-3.46)	(-0.16)	(1.54)	(2.18)	(0.42)	(-2.64)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129	44129
R^2	0.45	0.41	0.44	0.23	0.41	0.37	0.35	0.36	0.21	0.21	0.16	0.04	0.38
F-stat.	389.37***	325.90***	367.92***	140.61***	324.61***	279.36***	253.00***	261.67***	127.68***	125.56***	91.32***	17.57***	293.83***

This table analyses the moderating role of board gender diversity (ShanIndx) between firm risk and ESG based on an alternative moderating variable. We describe all variables in Table 1. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 14: Moderating role of ESG pillars between firm risk and firm value with an alternative testing variable (StdROA)

Independent variables	(1) TobinQ	(2) TobinQ	(3) TobinQ	(4) TobinQ-ad	(5) TobinQ-ad	(6) TobinQ-ad
StdROA	3.65***	2.07***	4.84***	3.44***	2.01***	4.55***
	(11.10)	(4.82)	(9.50)	(10.57)	(4.71)	(9.02)
ENVSC	0.0034***			0.0033***		
	(10.78)			(10.69)		
StdROA*ENVSC	-0.053***			-0.047***		
	(-6.32)			(-5.70)		
SOCSC		0.0052***			0.0049***	
		(14.00)			(13.43)	
StdROA*SOCSC		0.0021			0.0025	
		(0.22)			(0.27)	
GOVSC			0.0016***			0.0015***
			(4.37)			(4.28)
StdROA*GOVSC			-0.057***			-0.052***
			(-5.70)			(-5.22)
Controls	✓	✓	✓	✓	✓	✓
Country-Industry-Year effect	✓	✓	✓	✓	✓	✓
N	34349	34349	34349	34349	34349	34349
R^2	0.38	0.39	0.38	0.32	0.32	0.31
F-stat.	239.10***	242.39***	237.60***	177.71***	180.34***	176.31***

This table analyses the moderating role of ESG pillars between firm risk and firm value with an alternative testing variable (StdROA). We describe all variables in Table 1. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.