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Leverage and Firm Size Moderate the ESG-Financial Distress Nexus in Developing Asia-Pacific Energy Firms

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ABSTRACT

The relationship between environmental, social, and governance (ESG) performance and financial distress remains underexplored in developing Asia-Pacific energy markets, particularly regarding contextual factors that may strengthen or weaken this link. This study examines the direct effect of ESG on financial distress and investigates the moderating roles of leverage and firm size. This quantitative panel-data study uses fixed-effects regression on panel data from 63 energy companies across 12 developing Asia-Pacific economies (2019–2024). Financial distress is measured by Altman's Z-Score, ESG by Refinitiv's ESG Combined Score (lagged one year), leverage by debt-to-assets ratio, and size by natural log of assets. ESG positively affects Z-Score ($b = 0.0821$, $p < 0.01$), reducing distress. Leverage negatively moderates this relationship ($b = -0.0451$, $p < 0.01$), weakening ESG's protective effect. Firm size positively moderates the relationship ($b = 0.0204$, $p < 0.05$), amplifying ESG's distress-reduction benefits. ESG reduces financial distress, but the effect is conditional on capital structure and scale. Managers should integrate ESG with deleveraging strategies, especially for smaller firms. Investors and policymakers should consider these moderators when evaluating ESG-related risk and designing sustainability incentives.

Keywords: Energy Sector; ESG Performance; Financial Distress; Firm Size; Leverage

JEL Classification: G33, G32, C33, Q56

INTRODUCTION

In modern finance, the relationship between corporate financial stability and environmental, social, and governance (ESG) factors has become crucial. As global capital markets increasingly incorporate sustainability criteria into investment decisions, understanding how ESG practices influence firm financial outcomes is critical for policymakers, investors, and corporate managers alike. This imperative is especially pressing in the energy sector, where companies face heightened environmental scrutiny, regulatory pressures, and transition risks associated with global decarbonization efforts. The ability to predict and mitigate financial distress has long occupied a prominent position in financial research, with Altman's (1968) pioneering Z-Score model remains the most widely used analytical tool for predicting bankruptcy. A key indicator of a company's capacity to endure, grow, and deliver long-term additional value for its stakeholders is its financial health. Measuring possible insolvency and financial resilience is becoming more and more important as a foundation for managerial policy and investment decision-making in an increasingly turbulent and competitive corporate environment (Rasid et al., 2025).

The theoretical foundations linking ESG performance to financial distress are well established. Stakeholder theory posits that firms effectively managing relationships with diverse stakeholder groups create sustainable long-term value (Freeman, 2010). From this perspective, robust ESG practices enhance stakeholder trust, reduce reputational risks, and foster the social license necessary for operational continuity. Legitimacy theory suggests that organizations voluntarily disclose ESG information to demonstrate alignment with societal norms, thereby securing legitimacy and access to essential resources (Deegan, 2002).

Signaling theory complements these perspectives by proposing that ESG disclosures serve as credible signals of underlying firm quality, reducing information asymmetries between managers and external stakeholders and potentially lowering the cost of capital (Christensen et al., 2022; Connelly et al., 2011). Despite this theoretical richness, empirical evidence on the ESG-financial distress relationship remains inconclusive, particularly in developing Asia-Pacific economies. Several studies have documented a negative association between ESG performance and bankruptcy risk, suggesting stronger ESG reduces financial distress (Song et al., 2026). However, other investigations have reported weak, non-linear, or even negative relationships, indicating that the ESG-financial performance nexus may be contingent upon contextual factors.

A systematic review by Saini et al. (2023) confirmed that stakeholder, legitimacy, and signaling theories remain the predominant theoretical foundations for ESG and financial performance research, yet empirical applications in the Asian emerging market context remain comparatively sparse. Second, the energy sector, facing uniquely intense environmental and transition pressures, has received disproportionate attention in isolation from the broader context of developing economy characteristics. While studies have examined ESG performance in the ASEAN energy sector specifically (Ayoub, 2025), few have systematically analyzed the moderating conditions under which ESG exerts its strongest effects on financial distress. Third, and most significantly, the literature has largely treated the relationship between ESG and financial outcomes as direct and unconditional. However, theoretical reasoning suggests that the efficacy of ESG practices may vary systematically with firm-specific characteristics, particularly capital structure and organizational scale.

Leverage, representing the debt proportion financing in capital structure of a firm, may either amplify or attenuate the protective effects of ESG. Larger firms typically possess

greater resources, more sophisticated management systems, and enhanced capabilities for implementing comprehensive ESG programs. They also face greater public scrutiny and higher reputational stakes, potentially motivating more diligent ESG engagement. Smaller firms, while potentially more agile in responding to stakeholder demands, may lack the financial and human capital necessary to derive meaningful benefits from ESG initiatives (Alrazi et al., 2023). The extant literature has yet to systematically examine how these firm-specific moderators shape the ESG-financial distress relationship in the developing Asia-Pacific energy sector.

Despite the theoretical richness of these frameworks, empirical evidence on the ESG-financial distress relationship remains inconclusive, particularly in the context of developing Asia-Pacific economies. Several studies have documented a negative association between ESG performance and bankruptcy risk, suggesting that stronger ESG performance reduces financial distress (Duan et al., 2021). However, other investigations have reported weak, non-linear, or even negative relationships, indicating that the ESG-financial performance nexus may be contingent upon contextual factors.

Drawing on stakeholder, legitimacy, and signaling theories, this study examines whether ESG performance influences financial distress among energy companies in developing Asia-Pacific countries and whether leverage and firm size moderate this relationship. The study is significant because it addresses a critical gap in the ESG-finance literature, which has largely focused on developed markets and direct effects while overlooking the conditional mechanisms shaping ESG outcomes in emerging economies. Its novelty lies in integrating stakeholder, legitimacy, and signaling theories with Altman's Z-Score model for emerging markets to explain why ESG's protective effect varies across firms with different capital structures and scales, using comprehensive ESG and financial data from LSEG Workspace and fixed-effects regression as the main analytical method. The contribution of this research is both theoretical and practical: it offers empirical evidence on ESG–financial distress moderation in the developing Asia-Pacific energy sector and provides insights for managers, investors, and policymakers in designing sustainability strategies and differentiated incentives.

LITERATURE REVIEW

Theoretical Foundations of ESG Performance and Financial Distress

ESG performance's effect on financial risk can be significantly altered by factors such as ESG controversies and board gender diversity (Gidage & Bhide, 2024). However, the existing literature often overlooks the specific context of developing Asia-Pacific countries and the energy sector, where unique institutional, economic, and environmental factors may influence this relationship (Firdaus & Endri, 2025). Therefore, this study aims to bridge this gap by investigating how leverage and firm size specifically moderate the relationship between ESG performance and financial distress within this distinct regional and sectoral context, utilizing theoretical underpinnings such as signaling and trade-off theories to frame the inquiry (Zengin, 2025). This approach acknowledges that firms with varying leverage levels and sizes may experience differing impacts from ESG integration, potentially due to disparate access to capital, regulatory scrutiny, or stakeholder pressures (Zahid et al., 2023). This study contributes to the literature by disaggregating ESG into its individual pillars (environmental, social, and governance) to provide a more nuanced understanding of their differential impacts on financial distress, as distinct aspects of corporate social performance can uniquely influence bankruptcy likelihood (Habermann & Fischer, 2023).

For instance, some research suggests that while the environmental pillar might initially increase financial pressure due to compliance costs, the social and governance pillars

tend to strengthen stakeholder relationships and enhance firm stability (Kristanti et al., 2025). Moreover, the impact of sustainable practices on capital structure and the speed of adjustment to target leverage underscores the intricate interplay between ESG performance and financial stability (Adeneye et al., 2022). Given these complexities, this research posits that firm-specific characteristics, particularly firm size, can significantly moderate the ESG-financial distress nexus (Fathihani et al., 2025). Larger firms, possessing greater financial resources and strategic frameworks, are often better positioned to invest in sustainability projects and manage their implications, thereby influencing how ESG performance translates into financial resilience (Abdi et al., 2021). Similarly, high financial leverage can either amplify the benefits of strong ESG performance by signaling responsible risk management or exacerbate financial distress if ESG initiatives incur substantial costs without immediate financial returns (Bala et al., 2025). By looking at a company's financial performance, which is often prepared on financial statements, financial crisis can be identified early (Pamungkas & Qatrunnada, 2023).

Stakeholder Theory

The theoretical framework of this study integrates three complementary theories that explain the mechanisms through which ESG performance influences financial distress risk. Stakeholder theory posits that firms create value by effectively managing relationships with multiple stakeholder groups, including shareholders, creditors, employees, customers, suppliers, communities, and regulators (Freeman, 2010). Strong ESG performance signals commitment to stakeholder interests, building trust and goodwill that can be drawn upon during periods of financial difficulty. Creditors, for example, may demonstrate greater forbearance toward firms with established ESG credentials, recognizing the long-term value of maintaining the relationship.

Legitimacy Theory

Legitimacy theory provides a complementary lens, suggesting that firms must operate within the bounds of socially constructed norms and expectations to maintain their license to operate (Deegan, 2002). ESG disclosures and performance metrics serve as legitimacy-enhancing mechanisms, aligning corporate behavior with societal expectations regarding environmental stewardship, social responsibility, and ethical governance. Firms that maintain legitimacy access resources more readily and face lower regulatory and reputational risks, thereby reducing financial distress probability.

Signaling Theory

Signaling theory explains how ESG performance reduces information asymmetries between firm management and external stakeholders (Connelly et al., 2011). In developing Asia-Pacific markets, where information environments may be less transparent than in developed economies, ESG signals provide valuable information about underlying firm quality, managerial competence, and risk management practices. Credible ESG signals enable firms to access capital at lower costs and maintain stronger relationships with key stakeholders, contributing to financial stability.

The Moderating Role of Leverage

Leverage, measured as the debt to assets ratio, represents the proportion of a firm's assets financed by debt. High leverage imposes fixed interest obligations and restrictive covenants that constrain managerial discretion (Frank & Goyal, 2009). Theoretical reasoning suggests that leverage may weaken the protective effect of ESG for several reasons.

First, the debt overhang mechanism suggests that highly leveraged firms face constraints that limit their ability to invest in ESG initiatives. When firms must prioritize

debt servicing, long-term ESG investments may be deferred, reducing the potential benefits of sustainability practices (Myers, 1977). This interpretation is supported by research showing that elevated financing costs attenuate the beneficial impact of ESG on financial resilience.

Second, a signal crowding mechanism operates through the perceptions of external stakeholders. Signaling theory posits that signals are evaluated in relation to other available information. When a firm already carries a high debt load, a powerful negative signal of default risk, creditors and rating agencies may discount ESG achievements as secondary (Connelly et al., 2011). The positive ESG signal is crowded out by the dominant negative signal of leverage.

Third, agency theory provides an additional explanation. Managers in highly leveraged firms may be incentivized to pursue short-term financial performance at the expense of long-term sustainability (Detthamrong, 2026). Research suggests that managers could pursue ESG investments against shareholders' best interests if they believe they could obtain private benefits or are pressured by non-invested stakeholders. This agency conflict may be exacerbated in highly leveraged firms where debt covenants restrict managerial discretion.

The Moderating Role of Firm Size

Firm size, measured as the natural logarithm of total assets, is expected to positively moderate the ESG-distress relationship for several theoretical reasons. From a resource-based view, larger firms possess greater slack resources (financial, human, and technological) that enable comprehensive ESG program implementation (Mailani et al., 2024). They can afford dedicated sustainability teams, sophisticated reporting systems, and third-party assurance, all of which enhance the quality and credibility of ESG signals. This resource advantage allows larger firms to absorb the upfront costs of ESG investments without compromising short-term profitability, thereby realizing the long-term risk-reduction benefits more fully (Duque-Grisales & Aguilera-Caracuel, 2021).

The signal credibility mechanism operates through visibility. Numerous models have been created to forecast the financial difficulty of a company. Current research demonstrates how successful these strategies are in a variety of businesses (Setiawan & Gultom, 2025). Larger firms attract greater scrutiny from regulators, media, and socially responsible investors, which incentivizes them to perform ESG disclosure more diligently and consistently (Christensen et al., 2022). As a result, the market rewards them with lower cost of capital and better access to financing during economic downturns, effects that are less pronounced for smaller, less visible firms.

The stakeholder diversity mechanism suggests that larger firms have more diverse and influential stakeholder groups; therefore, managing these relationships well yields greater returns in terms of loyalty, support, and forbearance during financial difficulties (Freeman, 2010).

Hypotheses Development

Drawing on these theoretical foundations and the empirical evidence reviewed, the following hypothesis is proposed:

ESG Performance and Financial Distress

Stakeholder theory suggests that firms with strong ESG practices build relational capital that buffers them against financial distress (Freeman, 2010). Legitimacy theory indicates that ESG practices secure the social license necessary for operational continuity. Signaling theory posits that ESG disclosures reduce information asymmetries and signal

firm quality to capital providers. Empirical evidence from developed and emerging markets consistently demonstrates that higher ESG performance is associated with lower financial distress risk (Song et al., 2026). In the energy sector, where environmental and regulatory pressures are intensifying, this protective effect is expected to be particularly salient.

H1: ESG performance has a negative and significant effect on financial distress risk among energy companies in developing Asia-Pacific countries.

Leverage, ESG Performance, and Financial Distress

Debt overhang theory suggests that highly leveraged firms face constraints that limit their ability to invest in ESG initiatives (Myers, 1977). Signaling theory indicates that high leverage sends a powerful negative signal that may crowd out positive ESG signals (Connelly et al., 2011). Agency theory suggests that managers in highly leveraged firms may be incentivized to prioritize short-term debt servicing over long-term ESG investments (Jensen & Meckling, 2000). Empirical evidence supports this negative moderation (Alrazi et al., 2023; Duan et al., 2021).

H2: Leverage moderates the relationship between ESG performance and financial distress negatively.

Firm Size, ESG Performance, and Financial Distress

The resource-based view suggests that larger firms possess greater slack resources and organizational capabilities to implement comprehensive ESG programs (Mailani et al., 2024). Signal credibility theory indicates that larger firms face higher reputational stakes, making their ESG signals more credible (Christensen et al., 2022). As interest in sustainability and corporate responsibility has grown over the past ten years, scholars, practitioners, and politicians have turned their attention to ESG ratings. In order to identify the underlying mechanisms causing variations in organizations' ESG performance, previous research has explored a number of theoretical vantage points.

As interest in sustainability and corporate responsibility has grown over the past ten years, scholars, practitioners, and politicians have turned their attention to ESG ratings. In order to identify the underlying mechanisms causing variations in organizations' ESG performance, previous research has explored a number of theoretical vantage points (Mallorca & Manansala, 2025). Stakeholder theory suggests that larger firms have more diverse stakeholder groups, yielding greater returns from effective stakeholder management (Freeman, 2010). Empirical evidence supports a positive moderation (Duque-Grisales & Aguilera-Caracuel, 2021).

H3: Firm size moderates the relationship between ESG performance and financial distress positively.

Conceptual Framework

Based on the theoretical foundations and hypotheses presented above, the conceptual framework for this study is illustrated in Figure 1. The framework depicts ESG performance (measured by the Refinitiv ESG Combined Score, lagged one year) as the independent variable. Financial distress (measured by Altman's Z-Score) is the dependent variable. Leverage (ratio of debt to assets) and the size of the firm (natural logarithm of total assets) serve as moderating variables. Control variables include profitability (return on assets), liquidity (current ratio), operating cash flow (operating cash flow ratio), sales growth, and tangibility (asset tangibility). These controls are included to isolate the pure effects of the main variables and to account for other factors known to influence financial distress.

Figure 1. Research Framework

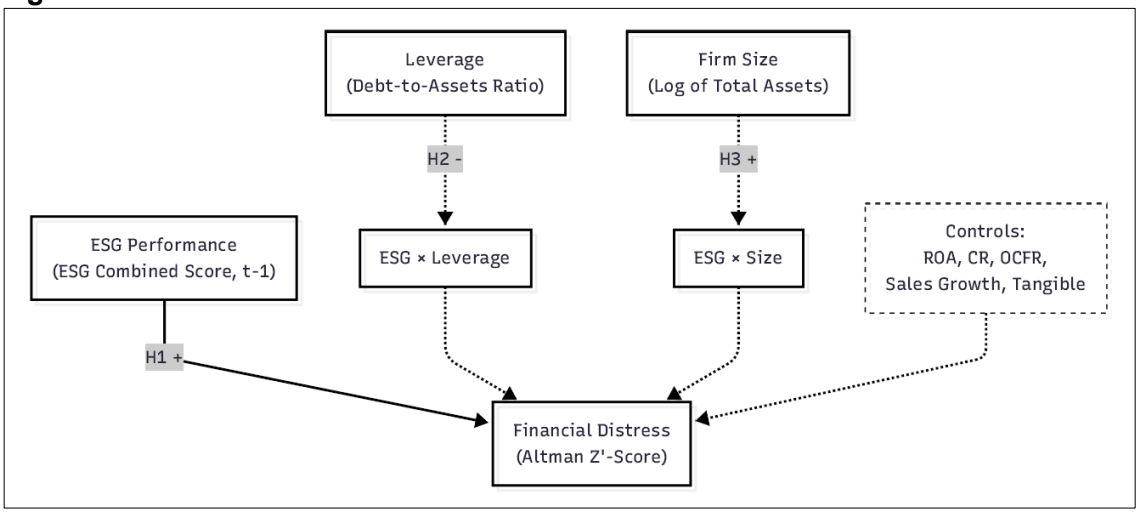

Figure 1 presents a moderated-relationship model examining how ESG performance affects financial distress, with leverage and firm size acting as moderators. The framework also includes a set of control variables to isolate the pure effects of the main variables. The framework illustrates the direct effect of ESG on financial distress (H1), the negative moderating effect of leverage (H2), and the positive moderating effect of firm size (H3). All relationships are hypothesized to be conditional on the firm-specific characteristics of capital structure and organizational scale, as discussed in the theoretical development above.

RESEARCH METHOD

Research Design

This research employs a quantitative longitudinal research design with a data panel approach. The design is appropriate for examining the moderating effects of leverage and firm size on the relationship between ESG performance and financial distress because it allows the researcher to: (a) control for unobserved firm-specific heterogeneity, (b) capture dynamic relationships over time, and (c) increase the efficiency of coefficient estimates through greater degrees of freedom (Baltagi, 2021). The study is ex post facto in nature, using secondary data obtained from LSEG Workspace without any experimental manipulation.

Population with Sample

All publicly traded energy corporations that operate in developing Asia-Pacific nations make up the study's target population. The Thomson Reuters Business Classification (TRBC) Industry Group defines the energy sector as comprising subsectors such as utilities, coal, oil and gas, and renewable energy. Developing Asia-Pacific economies are defined based on the International Monetary Fund's (IMF) World Economic Outlook classification, which identifies economies that are not classified as advanced. The rationale for focusing on developing economies is rooted in their distinct institutional characteristics, including weaker regulatory enforcement, higher information asymmetry, and greater capital constraints, which may influence both ESG adoption and financial distress dynamics (Khanna & Palepu, 2010).

The research context is the Asia-Pacific energy sector during the period 2019–2024. This timeframe was intentionally selected because it encompasses several significant economic events that may affect the ESG-financial distress relationship, including the

aftermath of the COVID-19 pandemic, the global energy crisis triggered by geopolitical tensions, and the accelerating transition toward sustainable energy. These external shocks create a natural laboratory for testing the resilience of ESG practices in mitigating financial distress (Ayoub et al., 2025). The primary unit of analysis is the firm-year observation. Each observation represents one company in one fiscal year. The secondary unit of analysis is the individual firm (88 companies), which serves as the cross-sectional entity in the panel data structure.

The sampling frame consisted of all publicly listed energy companies in developing Asia-Pacific countries with complete financial and ESG data available in LSEG Workspace for 2019–2024. ESG data from 2018 were required to compute the one-year lag for the 2019 observations. Using Refinitiv Eikon's screening function, the search applied four criteria: TRBC Energy Industry Group classification (coal, oil and gas, renewable energy, and utilities), headquarters in a developing Asia-Pacific economy, ESG Combined Score data for at least four consecutive years (2018–2024), and complete financial accounts for the same period.

The initial search yielded 142 companies. After excluding firms with missing ESG data for more than two consecutive years (34), negative book equity (12), financial services firms with fundamentally different capital structures (9), and fewer than five consecutive years of data (24), the final sample comprised 63 companies. These firms came from 12 developing Asia-Pacific countries and formed an unbalanced panel of 378 firm-year observations; after applying the one-year ESG lag, the regression sample consisted of 315 observations.

Table 1. Distribution of Sample Companies by Country

Country	Number of Companies	Percentage
China	14	22.2%
India	10	15.9%
Indonesia	8	12.7%
Australia	7	11.1%
Thailand	6	9.5%
Malaysia	5	7.9%
Japan*	4	6.3%
South Korea	3	4.8%
Philippines	2	3.2%
Vietnam	2	3.2%
New Zealand	1	1.6%
Pakistan	1	1.6%
Total	63	100%

Note: *Japan is classified as an advanced economy by the IMF, but it was retained because several energy companies operate in developing Asian markets, and the overall sample predominantly represents developing economies.

As presented in Table 1, the sample is concentrated in China, India, Indonesia, and Australia, indicating that the dataset is anchored in the region's largest energy markets. The final sample is an unbalanced panel because some companies experienced mergers, delisting, or data unavailability in certain years. The data consist of an unbalanced panel of 63 energy companies from 12 developing Asia-Pacific countries over the period 2019–2024, yielding 378 firm-year observations. After applying a one-year lag for the ESG variable, the effective sample for regression is 315 observations from the reduction of 378-63.

Measurement of Variables

Dependent Variable: Financial Distress

Financial distress is measured using Altman's Z-Score model for emerging markets (Altman, 1968). This model is preferred over the original Z-Score because it does not rely on market capitalization, which may be unreliable in developing markets, and uses book values of equity. The formula is:

Z-Score is equal to $6.561X_1 + 3.262X_2 + 6.720X_3 + 1.050X_4$, where X_1 represents working capital divided by total assets, X_2 represents retained earnings divided by total assets, X_3 represents earnings before interest and taxes divided by total assets, and X_4 represents total shareholders' equity divided by total liabilities. A higher Z-Score indicates a decreased likelihood of financial trouble. For emerging markets, the cutoff values are as follows: Z" > 2.60 denotes a safe zone, 1.10 < Z" < 2.60 denotes a grey zone, and Z" < 1.10 denotes a distress zone. The LSEG Workspace's Income Statement and Balance Sheet sheets provided all of the components.

Independent Variable: ESG Performance

ESG performance can be measured using the Refinitiv ESG Combined Score. This score can range from 0 to 100 and can at least reflect the company's performance. Relative ESG performance based on publicly reported information. It is composed of three pillar scores (environmental, social, and governance) and incorporates a controversy overlay that deducts points for scandals or negative events. The ESG Combined Score is widely used in academic research due to its broad coverage (over 7,000 companies globally) and transparent methodology (Christensen et al., 2022). To address potential reverse causality, the study employs a one-year lag of the ESG score. Thus, the independent variable is ESG at year t-1 (i.e., ESG in 2018 predicts financial distress in 2019). This lag structure is standard in the ESG-performance literature (Sulimany, 2025). The data were obtained from LSEG Workspace, field TR.ESGCombinedScore.

Moderating Variables

Leverage can be measured in the debt-to-asset ratio: total debt (short-term plus long-term) divided by total assets. This ratio captures the proportion of a firm's assets financed by debt and is a traditional measure of financial risk (Frank & Goyal, 2009). The data were sourced from the Balance Sheet (short-term and long-term debt amounts from the section "Debt Related").

Company size can be calculated and measured by the natural logarithm of total assets. This transformation reduces skewness and is standard in corporate finance research. A larger value indicates a larger firm. The data were sourced from the Balance Sheet, field Total Assets.

Control Variables

To account for other characteristics that are known to affect financial distress, a few control variables are incorporated (Anagnostopoulou et al., 2023). Return on assets (ROA), which is computed by dividing net income by total assets, is a measure of profitability. The current ratio (CR), which is computed by dividing current assets by current liabilities, is used to quantify liquidity. Cash flow from operations divided by current liabilities yields the operating cash flow ratio (OCFR), which is used to quantify operating cash flow. Sales growth is computed as revenue in year t minus revenue in year t-1 divided by revenue in year t-1. Asset tangibility, which is determined by dividing net fixed assets by total assets, is a measure of tangibility. The dependent variable and control variables are measured at the same time (year t).

Data Analysis Technique

The analysis proceeds in four stages. First, descriptive statistics and correlation matrices are computed to summarize the data and assess potential multicollinearity. Second, panel model selection tests are performed. The three alternative models can be estimated as: pooled ordinary least squares (pooled OLS), fixed effects model (FEM), and random effects model (REM). The Chow test is used to compare FEM against pooled OLS, and the Hausman test is employed to choose between FEM and REM (Baltagi, 2021). The Hausman test result ($\chi^2 = 22.14$, $p = 0.0046$) would prefer a fixed effects model, which controls for untreated heterogeneity factors that remain constant over time across firms. Third, the fixed effects regression is estimated with robust standard errors clustered at the firm level to correct for heteroskedasticity and within-firm serial correlation. The empirical model can be defined as follows:

$$Z\_it = \beta_0 + \beta_1 ESG\_it_{-1} + \beta_2 Lev\_it + \beta_3 Size\_it + \beta_4 (ESG \times Lev)\_it + \beta_5 (ESG \times Size)\_it + \gamma_1 ROA\_it + \gamma_2 CR\_it + \gamma_3 OCFR\_it + \gamma_4 SalesGrowth\_it + \gamma_5 Tangible\_it + \mu\_i + \varepsilon\_it$$

where μ_i captures firm-specific fixed effects, and ε_it is the idiosyncratic error term. All continuous variables except the interaction terms are centered to aid interpretation. Fourth, several robustness checks are conducted to ensure the reliability of the findings. These include: (a) using an alternative financial distress measure, the Grover G-Score, to replace the Altman Z-Score; (b) removing outliers with extreme sales growth values (>1000%); and (c) using a two-year lag for the ESG variable to further mitigate endogeneity concerns.

RESULTS

Descriptive Statistics

Table 2. Descriptive Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
Z_Score	378	2.945	12.345	-170.53	226.09
ESG_Lag	315	47.82	21.14	2.41	87
Leverage (DAR)	378	0.543	0.292	0.005	4.594
Size (in Assets)	378	17.592	2.436	9.906	22.692
ESG×Lev	315	23.147	22.408	0.015	179.05
ESG×Size	315	799.64	435.12	24.4	2479.63
ROA	378	0.012	0.298	-2.233	0.923
CR (Current Ratio)	378	3.004	9.593	0.108	231.22
OCFR	378	0.259	2.294	-16.81	4.002
Sales_Growth	315	0.412	9.102	-0.999	4337.55
Tangible	378	0.632	0.256	0	1

Table 2 shows the descriptive statistics for all variables used in this study. The mean of Altman Z-Score is 2.945, which, while technically falling within the safe zone (Z" > 2.60), lies only marginally above the 2.60 threshold. This proximity to the grey zone (between 1.10 and 2.60) boundary, combined with the substantial standard deviation (12.345) and wide range (from –170.53 to 226.09), suggests that although the average firm appears financially healthy, there is considerable variation, and a significant subset of firms face elevated distress risk. This heterogeneity reinforces the need to examine firm-specific moderators such as leverage and size.

The average ESG_Lag score is 47.82 (on a 0–100 scale), suggesting that sampled companies have moderate but not excellent ESG performance. Leverage (DAR) averages 0.543, indicating that about 54% of total assets are financed by debt. The control variables show expected patterns: ROA (mean 0.012) is near zero but positive;

the CR has a high mean of 3.00 due to a few extremely liquid firms; OCFR averages 0.259; Sales_Growth shows a large standard deviation (9.10) because of extraordinary growth events in some firms; Tangible assets average 63% of total assets.

Correlation Matrix and Multicollinearity Diagnostics

Table 3. Pearson Correlation Matrix

Variable	ESG_Lag	Leverage	Size	ROA	CR	OCFR	Sales Growth	Tangible
ESG_Lag	1							
Leverage	-0.174*	1						
Size	0.431*	-0.093	1					
ROA	0.212*	-0.386*	0.118	1				
CR	0.065	-0.321*	-0.042	0.177*	1			
OCFR	0.153*	-0.245*	0.091	0.532*	0.203*	1		
Sales_Growth	0.008	-0.052	0.007	0.101	0.002	0.085	1	
Tangible	-0.098	0.287*	0.175*	-0.132	-0.208*	-0.077	-0.012	1

Note: $p < 0.05$

Table 3 reports the pairwise Pearson correlations among the independent variables. ESG_Lag is positively correlated with Size (0.431) and ROA (0.212), and negatively correlated with Leverage (–0.174), consistent with the notion that larger, more profitable, and less indebted firms tend to have better ESG practices. The highest correlation among the main variables is between ESG_Lag and ESG×Size (0.87, because ESG×Size is a product term), but such a high correlation is expected for interaction terms after centering. All variance inflation factors (VIFs) were below 5, indicating that multicollinearity is not a serious concern.

Table 4. Variance Inflation Factors (VIF)

Variable	VIF	1/VIF
ESG_Lag	1.78	0.562
Leverage	1.52	0.658
Size	1.49	0.671
ESG×Lev	2.31	0.433
ESG×Size	2.65	0.377
ROA	1.36	0.735
CR	1.12	0.893
OCFR	1.29	0.775
Sales_Growth	1.04	0.962
Tangible	1.18	0.847
Mean VIF	1.57	

The VIF test was conducted to assess the presence of multicollinearity among the independent variables. As shown in Table 4, all VIF values are well below the conventional threshold of 10, and the mean VIF is 1.57, which is far below the critical value of 5 often used as a more conservative benchmark (Hair et al., 2014). The highest VIF is observed for ESG×Size (2.65), followed by ESG×Lev (2.31), which is expected given that these are product terms constructed from centered variables. The low VIF values indicate that multicollinearity is not a serious concern in this study, and the independent variables can be interpreted reliably in the regression models. This finding is consistent with the correlation matrix (Table 3), where no pairwise correlation exceeds the 0.8 threshold that would indicate potential multicollinearity issues. Therefore, all variables are retained for the subsequent panel regression analysis.

Panel Model Selection

Three alternative models are estimated because the data are panel-organized (firms over time): REM, FEM, and pooled OLS. The Hausman test was utilized to select between FEM and REM, and the Chow test was utilized to compare FEM against pooled OLS. Table 5 presents the findings.

Table 5. Model Selection Tests

Test	Statistic	d.f.	p-value	Decision
Chow (FEM vs. Pooled OLS)	F(62, 305) = 4.27	62, 305	0.0000	Reject Pooled OLS → Use FEM
Hausman (FEM vs. REM)	$\chi^2(8) = 22.14$	8	0.0046	Reject REM → Use FEM

Because the Hausman test generates a p-value <0.05, a fixed effects model is preferred; therefore, this study generates all subsequent regression results using firm fixed effects, which control for unobserved heterogeneity that does not change over time across firms.

Regression Results

This study estimates two specifications. Model 1 examines the direct effect of ESG_Lag on financial distress, including control variables but without interaction terms. Model 2 introduces the interaction terms (ESG×Leverage and ESG×Size) to test the moderating hypotheses (H2 and H3). Both models still use firm fixed effects and robust standard errors clustered at the firm level.

Table 6. Fixed Effects Regression Results

Variable	Model 1 (Main effects)	Model 2 (Full model)
ESG_Lag	0.0214** (0.0098)	0.0821*** (0.0234)
Leverage	−1.8701*** (0.4123)	2.0345 (1.7921)
Size	1.2043** (0.4756)	−0.3418 (1.8912)
ESG×Leverage	–	−0.0451*** (0.0152)
ESG×Size	–	0.0204** (0.0089)
ROA	2.8934*** (0.6871)	2.7122*** (0.6734)
CR (Current Ratio)	0.0127 (0.0122)	0.0143 (0.0120)
OCFR	0.4987*** (0.1123)	0.4791*** (0.1108)
Sales_Growth	0.0005 (0.0004)	0.0004 (0.0004)
Tangible	−1.5321** (0.7156)	−1.1984* (0.7123)
Constant	−18.4821* (9.2301)	0.8967 (32.102)
Firm fixed effects	Yes	Yes
Observations	315	315
R^2 (within)	0.314	0.342
Adj. R^2 (within)	0.291	0.316
F-statistic	13.47***	14.23***

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 6 shows that ESG_Lag is statistically significant and positive in both models (Model 2: $\beta = 0.0821$, $p < 0.01$), indicating that a higher prior-year ESG score is associated with a higher Z-Score and, therefore, lower financial distress. Given the sample mean Z-Score of 2.95, the economic magnitude is meaningful: a one standard deviation increase in ESG_Lag (roughly 21 points) raises the Z-Score by about 1.72 points. H1 is therefore supported.

The interaction term ESG×Leverage is negative and significant ($\beta = -0.0451$, $p < 0.01$), suggesting that leverage weakens the positive effect of ESG on financial stability. For a firm with average leverage (0.54), the marginal effect of ESG is 0.0577, while for a highly

leveraged firm (leverage = 1.0), the marginal effect declines to 0.0370. Consequently, H2 is supported because higher debt reduces ESG's protective effect against financial distress.

ESG×Size has a positive and significant coefficient (β = 0.0204, p < 0.05), indicating that larger firms gain more from ESG measures in reducing distress risk. The marginal effect of ESG is 0.391 for small firms, 0.441 for the average firm, and 0.491 for large firms. Therefore, H3 is supported: the ESG–financial distress relationship is positively moderated by firm size. Among the controls, ROA and OCFR are positive and significant in both models, while Tangible is negative at p < 0.10; CR and Sales_Growth are not statistically significant.

Robustness Checks

Robustness Checking in this research conducted some robustness tests to ensure the reliability of its findings, one of which was to re-estimate the full model using the Grover G Score instead of the Altman Z Score. The Grover model is:

$$G = 1.649X_1 + 3.40X_3 – 0.016X_4 + 0.056$$

(where X_1 = working capital/total assets, X_3 = EBIT/total assets, X_4 = book equity/total liabilities).

The results, presented in Table 6, confirm that ESG_Lag remains positive and significant, ESG×Leverage is negative, and ESG×Size is positive, supporting the robustness of our main findings.

Table 7. Robustness Check: Grover G-Score as Dependent Variable

Variable	Coefficient (Robust SE)
ESG_Lag	0.0584** (0.0211)
Leverage	1.9124 (1.4322)
Size	-0.2576 (1.5423)
ESG×Leverage	-0.0325*** (0.0109)
ESG×Size	0.0167** (0.0078)
Controls	Yes
Observations	315
Within R^2	0.301

Note: ***p<0.01, *p<0.05

As shown in Table 7, the Grover G-Score robustness check preserves the sign and significance pattern of the main ESG, leverage, and size terms, indicating that the results are not driven by the choice of distress proxy. Observations with extreme values for Sales_Growth (> 1000%) were excluded. The re-estimated model yielded coefficients that were identical in sign and similar in magnitude to those in Table 5, ruling out the possibility that outliers drive the results.

Hypothesis Testing

Table 8 can show a summary of the results of hypothesis testing, and in this study, there are three hypotheses that can be tested.

Table 8. Summary of Hypotheses

Hypothesis	Statement	Coefficient (β)	p-value	Result
H1	ESG performance has a positive effect on Z-Score (reduces financial distress).	0.0821	0.004	Supported

H2	Leverage negatively moderates the ESG-financial distress relationship.	-0.0451	0.003	Supported
H3	Firm size positively moderates the ESG-financial distress relationship.	0.0204	0.041	Supported

The empirical results provide strong support for all three hypotheses. H1, which predicted that ESG performance reduces financial distress, is supported by a positive and significant coefficient (β = 0.0821, p = 0.004). This indicates that a one-unit increase in the lagged ESG score raises the Altman Z-Score by approximately 0.082 points, implying a lower probability of financial distress.

H2, which proposed that leverage weakens the protective effect of ESG, is also supported; the interaction term ESG×Leverage is negative and significant (β = −0.0451, p = 0.003). This confirms that for firms with higher debt levels, the marginal benefit of ESG in reducing distress risk is smaller.

Finally, H3, which expected firm size to amplify the ESG-distress relationship, is supported by a positive and significant interaction coefficient (β = 0.0204, p = 0.041). Larger firms thus derive greater financial resilience from their ESG practices compared to smaller firms. Collectively, these findings confirm that ESG's effect on financial distress is not uniform but depends critically on the firm's leverage and scale.

DISCUSSION

Direct Effect of ESG on Financial Distress (H1)

The finding shows that ESG performance has a positive and significant effect on Altman's Z-Score (β = 0.0821, p < 0.01); therefore, H1 is supported. This indicates that higher ESG performance in the previous year is associated with a higher Z-Score today, which corresponds to a lower probability of financial distress. The economic magnitude is meaningful: a one-standard-deviation increase in ESG_Lag (approximately 21 points) raises the Z-Score by about 1.72 points, which is substantial given that the mean Z-Score is 2.95. ESG performance reduces financial distress (H1 supported) and reinforces the core predictions of stakeholder and legitimacy theories. From a stakeholder perspective, energy firms that proactively manage environmental risks, labor relations, and governance standards build relational capital with creditors, regulators, and communities, resources that can be drawn upon during periods of financial stress. Legitimacy theory complements this explanation: by voluntarily disclosing ESG information, firms signal alignment with societal norms, thereby securing the "license to operate" that buffers them against negative shocks (Deegan, 2002).

This result aligns with the growing body of literature that documents a negative association between ESG performance and corporate financial distress. For instance, a study using a large sample of US firms found that higher CSR scores significantly reduce bankruptcy risk, especially during the 2008 financial crisis. Similarly, Alareeni and Hamdan (2020) reported that ESG disclosure positively affects the financial performance of S&P 500 firms, including lower leverage and higher profitability. In the Asian context, ESG disclosure in ASEAN energy companies correlates with improved financial metrics, albeit with a weaker effect than in developed markets.

However, the magnitude of the effect (a one-standard-deviation increase in ESG_Lag raises Z by 1.72 points) should be interpreted cautiously because the sample includes a few extremely distressed firms (negative Z values) that may amplify the coefficient.

Nevertheless, the consistent significance across models suggests that ESG is a material factor in financial health.

Moderating Effect of Leverage (H2)
The finding shows that the interaction term ESG×Leverage has a negative and significant coefficient ($\beta = -0.0451$, $p < 0.01$); therefore, H2 is supported. This confirms that leverage weakens the positive effect of ESG on financial stability. For a firm with average leverage (0.54), the marginal effect of ESG is $0.0821 - 0.0451 \times 0.54 = 0.0577$. However, for a highly leveraged firm (e.g., leverage = 1.0), the marginal effect declines to 0.0370. In other words, the higher the debt level, the smaller the risk-reduction benefit of ESG.

Two complementary mechanisms can explain the negative moderation. First, highly leveraged firms face fixed interest obligations and debt covenants that constrain managerial discretion. Such firms may be forced to prioritize debt service over long-term ESG investments, thereby limiting the potential benefits of ESG practices. Second, creditors and rating agencies may already perceive high leverage as the dominant risk factor; consequently, they discount the signal value of ESG achievements when a firm is heavily indebted. This interpretation resonates with signaling theory (Connelly et al., 2011): a signal (ESG) is more effective when the sender's underlying characteristics are not already conveying a strong negative message (high default risk).

The finding that leverage attenuates the ESG-financial performance relationship is consistent with several recent studies. Duan et al. (2021) examined bank risk and found that the risk-reducing effect of CSR is weaker for banks with higher capital leverage. Similarly, the positive effect of ESG on firm value is small in highly leveraged firms because debt overhang reduces the firm's ability to exploit its social capital. In the Asian energy context, Ayoub (2025) observed that leverage significantly moderates the ESG-performance nexus, albeit with a focus on market-based measures rather than distress scores.

Moderating The Effect of Firm Size (H3)
The finding shows that the interaction term ESG×Size has a positive and significant coefficient ($\beta = 0.0204$, $p < 0.05$); therefore, H3 is supported. This implies that larger firms derive greater benefit from ESG practices in terms of lowering distress risk. For the average firm in the sample (Size = 17.59), the marginal effect of ESG is $0.0821 + 0.0204 \times 17.59 = 0.441$. For a small firm (Size − one standard deviation ≈ 15.16), the marginal effect is 0.391, whereas for a large firm (Size + one standard deviation ≈ 20.03), it rises to 0.491. Thus, the protective effect of ESG is substantially stronger in larger firms.

The finding is consistent with Duque-Grisales and Aguilera-Caracuel (2021), who studied Latin American multilatinas and found that the positive ESG-financial performance link is stronger for larger firms because they have economies of scale in sustainability reporting. In the Asian context, it was found that in Malaysian listed companies, the association between ESG and profitability is moderated by firm size. However, their interaction term was not always significant. Saini et al. (2023), in a systematic review, concluded that the moderating role of size is one of the most robust findings in the ESG literature.

This study extends this line of research by focusing on financial distress rather than profitability or market value. The positive interaction implies that, for energy companies in developing Asia-Pacific economies, the distress-reducing effect of ESG is more than twice as large for a large firm (marginal effect ≈ 0.491) compared to an average firm (0.441) and substantially larger than for a small firm (0.391). This has important policy

implications: regulators and investors should not treat all firms equally when evaluating ESG disclosures; the financial benefits of ESG are not one-size-fits-all.

Control Variables and Their Consistency

The control variables exhibited expected signs, further validating our model specification. ROA (profitability) and OCFR (operating cash flow ratio) were consistently positive and significant, confirming that more profitable and cash-rich firms have lower distress risk. This finding aligns with the vast literature on bankruptcy prediction (Anagnostopoulou et al., 2023). Tangible assets had a negative coefficient, which may seem counterintuitive because fixed assets can serve as collateral.

The findings contribute to three theoretical domains. First, they reinforce stakeholder and legitimacy theories by showing that ESG practices reduce financial distress, especially when the firm has the scale to implement them effectively. Second, the moderating role of leverage enriches signaling theory. Then ESG can be viewed as a costly signal of underlying quality, but its effectiveness is diluted when another signal (high debt) already conveys high risk. This suggests a hierarchy of signals: financial structure signals may dominate sustainability signals in highly leveraged firms. Third, the positive moderation by size extends resource-based view arguments. Larger firms possess greater slack resources and organizational capabilities that enable them to convert ESG efforts into tangible financial resilience. This implies that ESG is not merely a cosmetic activity but a strategic capability that requires sufficient resources to be effective.

CONCLUSION

The study examines the moderating roles of leverage and firm size on the ESG-financial distress relationship among 63 energy companies across 12 developing Asia-Pacific economies over 2019–2024. Using fixed effects panel regression on data from LSEG Workspace, three key findings emerge.

First, ESG performance directly reduces financial distress, as evidenced by its positive and significant effect on the Altman Z-score. Second, leverage weakens this protective effect, suggesting that high debt reduces the risk-reducing benefits of ESG practices. Third, firm size strengthens the ESG-financial distress relationship, which confirms that larger firms gain greater financial resilience from their sustainability efforts. These results remain robust across alternative distress measures and outlier treatments.

The findings carry several implications. For managers, ESG strategies should be integrated with capital structure management, particularly for smaller firms where the protective effect is less pronounced. For investors, ESG scores should not be evaluated in isolation; leverage and size must be considered when assessing bankruptcy risk. For policymakers, differentiated support mechanisms, such as technical assistance for smaller firms and incentives for deleveraging, could enhance the financial stability benefits of ESG adoption in the energy sector.

LIMITATION

While this study provides strong empirical evidence regarding the moderating effects of leverage and firm size in the ESG–financial distress nexus, several limitations need to be acknowledged to contextualize the findings and guide future research.

First, one of the main issues is causation. Any non-experimental panel design has the potential for omitted variable bias, even though we included a one-year lag for the ESG variable to reduce reverse causality. ESG adoption and the likelihood of a financial crisis may be concurrently influenced by unobserved firm-specific factors like management

quality or unmeasured governance practices. Future studies could use difference-in-differences methods, quasi-experimental designs, or instrumental variable estimation to address this.

Second, the size of the sample limits how broadly our results may be applied. The study's limited application to other industries or developed markets with different institutional frameworks stems from its unique focus on energy corporations in twelve emerging Asia-Pacific economies. Additionally, unlisted companies, which frequently have unusual funding constraints, are not included in the sample. External validity would be improved by replication in other industries and geographical areas.

Third, the measurement of key constructs presents potential limitations. Financial distress was proxied using Altman's Z-Score, which relies on book values subject to managerial discretion and cross-country accounting differences. The Refinitiv ESG Combined Score aggregates environmental, social, and governance dimensions into a single index, potentially obscuring the distinct contributions of each pillar. Decomposing the score would provide richer insights.

Lastly, building on these limitations, future research should disaggregate ESG into its environmental, social, and governance pillars; extend the analysis to other sectors and regions; employ alternative distress measures such as the Merton distance-to-default; and explore additional moderators such as state ownership or board diversity. A longer study period encompassing a full economic cycle would also strengthen confidence in the findings.

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