“The impact of environmental uncertainty and industry competition on firm value: Examining the mediating role of ESG in six Asian countries”

AUTHORS	Dewi Cahyani Pangestuti Amrie Firmansyah Ira Geraldina

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Dewi Cahyani Pangestuti (Indonesia), **Amrie Firmansyah** (Indonesia),
Ira Geraldina (Indonesia)

THE IMPACT OF ENVIRONMENTAL UNCERTAINTY AND INDUSTRY COMPETITION ON FIRM VALUE: EXAMINING THE MEDIATING ROLE OF ESG IN SIX ASIAN COUNTRIES

Abstract

This study explores the impact of environmental uncertainty and industry competition on environmental, social, and governance (ESG) practices and company value in the energy sector across six ASEAN countries (Indonesia, Malaysia, Singapore, Thailand, the Philippines, and Vietnam) during 2013–2024. Using an unbalanced panel dataset comprising 257 companies and 2,570 observations, the analysis employs a two-way fixed effects (FE) model and bootstrap mediation tests. The results reveal four critical findings. First, environmental uncertainty ($\beta = 0.032$, $p < 0.001$) and industry competition ($\beta = 0.021$, $p = 0.010$) exert a significant positive influence on ESG practices, suggesting that firms enhance sustainability disclosures as a strategic mechanism to maintain institutional legitimacy and manage exogenous risks. Second, both environmental uncertainty ($\beta = -0.047$, $p < 0.001$) and industry competition ($\beta = -0.056$, $p = 0.006$) significantly reduce firm value (Tobin's Q) due to heightened market volatility, margin compression, and increased risk premiums. Third, ESG practices do not exhibit a significant direct effect on company value ($\beta = 0.011$, $p = 0.560$), indicating that direct financial premiums from sustainability efforts remain limited in the short term. Finally, bootstrap mediation tests confirm that ESG does not significantly mediate the influence of either environmental uncertainty or industry competition on firm value. This study highlights ESG as a risk mitigation tool rather than a direct driver of corporate valuation within the ASEAN energy landscape. It advises energy practitioners to integrate ESG policies with operational resilience while accounting for systemic external pressures in their core corporate strategy.

Keywords environmental uncertainty, industry competence, ESG, company value, energy sector, Southeast Asia

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Dewi Cahyani Pangestuti, Dr., Lecturer, Department of Management, Faculty of Economics and Business, Universitas Pembangunan Nasional Veteran Jakarta [National Development University "Veteran" Jakarta], Indonesia. (Corresponding author)

Amrie Firmansyah, Dr., Lecturer, Department of Accounting, Faculty of Economics and Business, Universitas Pembangunan Nasional Veteran Jakarta [National Development University "Veteran" Jakarta], Indonesia.

Ira Geraldina, Dr., Lecturer, Department of Accounting, Faculty of Economics and Business, Universitas Terbuka [Indonesia Open University], Indonesia.

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INTRODUCTION

Two exogenous stressors, environmental uncertainty and industry competition, now dictate the strategic boundaries of the ASEAN energy market. In this regional context, corporate value serves as the primary barometer for long-term competitiveness and the essential transmission channel for investor perception. To navigate the specific pressures of Southeast Asian emerging markets, energy firms and regulators have transitioned from viewing environmental, social, and governance (ESG) frameworks as mere compliance mandates to employing them as strategic mechanisms for climate resilience and securing long-term financing. The strategic imperative is clear: non-financial performance must eventually reconcile with market-based valuation to foster operational resilience and sustain investor confidence. However, this drive toward sustainability unfolds within a high-stakes environment in which external volatility threatens the very corporate value these initiatives aim to protect (Shi & Yao, 2020).

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The ASEAN energy sector is currently under duress from environmental uncertainty and escalating industry competition, both of which actively reduce firm value and compress profit margins. Regulatory fragmentation and the structural vulnerabilities of fossil-dependent economies amplify these valuation discounts. Environmental uncertainty, manifested through unpredictable policy fluctuations and global price volatility, severely complicates corporate forecasting and strategy. Simultaneously, intense competition increases information asymmetry and risk premiums, further destabilizing traditional valuation dynamics. These external pressures create an analytical puzzle, corporate leaders face a zero-sum trade-off between immediate margin preservation and long-term legitimacy. This tension forces an interrogation of the efficacy of ESG adoption, questioning whether sustainability initiatives function as genuine value drivers or merely as defensive shields against external shocks.

A critical research gap exists concerning the "resilience-valuation paradox" within the ASEAN energy landscape. While theoretical expectations suggest that ESG adoption generates signaling benefits that improve adaptability, empirical evidence frequently reveals significant valuation penalties and persistent market volatility. This paradox suggests that while sustainability disclosures may enhance organizational resilience during extreme events, they may fail to translate into tangible market gains. This underscores a persistent policy riddle: whether enhanced ESG adoption in response to external stress truly elevates corporate value or simply alters risk management mechanisms without expanding the firm's market valuation in the short term. If sustainability efforts primarily capture resilience rather than direct profitability, their influence on value remains negligible once broader external volatility is accounted for, necessitating a rigorous empirical investigation to resolve this contradiction.

1. LITERATURE REVIEW AND HYPOTHESES

The growing importance of environmental, social, and governance (ESG) practices in the energy sector has attracted increasing scholarly attention, particularly regarding how external pressures shape sustainability behavior and how such behavior is interpreted by capital markets. In Southeast Asia, this issue is especially relevant because the energy sector operates under a combination of rapid demand growth, climate transition commitments, fossil-fuel dependence, and uneven regulatory enforcement (Azhgaliyeva et al., 2020). Recent studies increasingly identify environmental uncertainty, regulatory volatility, and industry competition as critical contextual factors influencing ESG adoption and firm outcomes among ASEAN energy firms. Nevertheless, the evidence remains inconclusive, particularly with respect to whether ESG operates as a genuine value-creating strategic capability or merely as a defensive response to institutional and market pressures.

A useful theoretical basis for this study integrates institutional theory, signaling theory, and the resource-based view (RBV). Institutional theory explains that firms adopt ESG practices in response to coercive regulatory pressure, normative social expectations, and mimetic tendencies within their organizational field. In the ASEAN energy sector, where policy frameworks are evolving but often inconsistently enforced, firms frequently engage in ESG not only because of internal sustainability objectives but also because external institutions increasingly demand visible alignment with environmental and governance norms (Pangestuti et al., 2023; Shi & Yao, 2020). Signaling theory complements this view by explaining the strategic importance of ESG disclosure under conditions of information asymmetry. In emerging markets, firms use ESG reporting to signal governance quality, transition readiness, and long-term resilience to investors. From the RBV perspective, ESG may also be regarded as an intangible strategic resource that strengthens legitimacy, stakeholder trust, and adaptive capacity. However, prior studies suggest that the value relevance of this resource depends on institutional quality, disclosure credibility, and the firm's ability to convert sustainability commitments into measurable economic outcomes, as indicated by Zioło et al. (2023), Yang and Shi (2024), Hmouda et al. (2024), and Padantya and Sudrajad (2024).

Environmental uncertainty refers to instability in the external environment that complicates planning, forecasting, and strategic adaptation. In the

Southeast Asian energy sector, such uncertainty arises from policy fluctuation, regulatory fragmentation, fuel-price volatility, climate-related disruptions, and transition-related institutional change. Prior research suggests that when uncertainty increases, firms become more likely to strengthen ESG practices as a mechanism for risk management, legitimacy preservation, and organizational resilience. Gidage and Bhide (2025) and Song et al. (2024) show that ESG can mitigate climate sentiment risk, improve financial distress prediction, and reduce overall financial risk exposure. Similarly, Padantya and Sudrajad (2024) and Pangestuti et al. (2024), as well as Meylani and Sari (2025), argue that sustainability policies, governance enhancement, and green innovation can reinforce resilience under environmental disruption. Accordingly, environmental uncertainty is expected to encourage stronger ESG implementation.

Industry competition also plays an important role in shaping ESG practices. In markets where price competition offers limited strategic differentiation, firms increasingly rely on ESG disclosure and sustainability positioning to strengthen their reputation, attract investors, and maintain legitimacy. In the ASEAN context, however, competitive pressure often produces mimetic ESG behavior rather than substantive transformation. Firms may replicate the disclosure practices of industry leaders to preserve market standing and conform to emerging expectations. Handoyo et al. (2024), Hmouda et al. (2024), and Yulianto and Ulpah (2024) suggest that ESG adoption is associated with competitive positioning, innovation, and sustainability-related performance. At the same time, Iwani et al. (2024) note that weak enforcement, resource constraints, and regulatory inconsistency may reduce the substantive effectiveness of ESG competition. Even so, stronger rivalry is likely to intensify pressure on firms to comply with market expectations and signal strategic responsiveness through ESG engagement.

Firm value reflects the market's assessment of a company's current condition and future prospects, commonly measured by Tobin's Q or market capitalization. In theory, environmental uncertainty is expected to reduce firm value because it increases forecasting difficulty, elevates operating risk, and raises the discount rate applied to future cash flows. This argument is particularly relevant in the ASEAN energy sector, where transition risk, regulatory inconsistency, and energy-price volatility remain substantial. Mita et al. (2024), Palupi (2023), and Riani et al. (2024) show that crisis-related costs, policy instability, and investor skepticism may offset the expected benefits of sustainability engagement. Therefore, even when firms respond strategically, the direct effect of environmental uncertainty on valuation is expected to remain negative because investors tend to price systemic risk more quickly than they recognize the long-term benefits of adaptation.

The effect of industry competition on firm value is likewise expected to be negative in the energy sector. Greater rivalry can intensify margin pressure, increase strategic imitation, and reduce earnings predictability. In Southeast Asia, competition is further complicated by regulatory shifts, electricity-market liberalization, infrastructure constraints, and fuel-price shocks. Ghazali et al. (2023) and Nepal et al. (2024) argue that although market competition may stimulate reform and innovation, it also exposes firms to greater revenue instability and investment risk. Where competition is shaped by volatile market design and uneven regulatory enforcement, firms may incur additional costs to maintain competitiveness and legitimacy. Under such conditions, market rivalry is likely to weaken investor confidence in future profitability and thereby reduce firm value.

ESG performance may enhance firm value by improving reputation, stakeholder trust, governance quality, access to finance, and long-term resilience. This positive view is supported by studies showing that ESG disclosure can reduce financing costs, improve financial performance, and strengthen investor confidence. In the ASEAN and broader Asian context, Ariefianto et al. (2025), Burki et al. (2024), Makhdalena et al. (2023), and Rasyad et al. (2024) report that stronger ESG engagement is associated with improved market and accounting outcomes, lower cost of debt, and more favorable investor responses. Yoshida et al. (2024) further suggest that Southeast Asian firms may experience relatively stronger positive financial effects from ESG than firms in some other Asian settings. However, the relationship is not uniformly positive. Palupi (2023) and Xaviera et al. (2024) show

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that ESG may also weaken firm value when implementation costs are high or when investors doubt the credibility and short-term payoff of sustainability investments. Despite these mixed findings, the dominant expectation remains that better ESG performance should, on balance, support firm value by reducing perceived risk and strengthening strategic legitimacy.

ESG performance is also expected to mediate the relationship between environmental uncertainty and firm value. When firms face environmental uncertainty, they are more likely to intensify ESG implementation in order to preserve legitimacy, improve disclosure quality, and manage stakeholder perceptions. If stronger ESG performance enhances resilience, disclosure credibility, and investor confidence, then ESG may partially transmit the effect of uncertainty to firm value. This argument is supported by Meylani and Sari (2025) and Song et al. (2024), who show that ESG can mitigate climate-related risk, reduce financial distress, and buffer firms against environmental volatility. Thus, ESG should not be viewed merely as an outcome of uncertainty, but also as a strategic transmission mechanism through which firms attempt to reduce the valuation consequences of external turbulence.

A similar mediating logic applies to the relationship between industry competition and firm value. Competitive pressure may encourage firms to adopt ESG as a signaling and legitimacy mechanism, particularly in markets where disclosure quality influences access to capital and reputational standing. If competition stimulates ESG adoption, and if ESG subsequently enhances investor confidence and firm resilience, then ESG performance should mediate the effect of industry competition on firm value. Handoyo et al. (2024), Hmouda et al. (2024), and Yulianto and Ulpah (2024) suggest that ESG has become increasingly intertwined with competitive positioning, regulatory adaptation, and strategic differentiation. Although the strength of this mediation may vary depending on disclosure quality and institutional context, the theoretical and empirical evidence supports the expectation that ESG serves as an intermediate mechanism linking competitive pressure to valuation outcomes.

The main unresolved issue in the literature is the persistent inconsistency in findings on whether ESG in ASEAN energy firms functions primarily as a value-creating strategic capability or as a costly defensive response to uncertainty and competition. Some studies report positive effects of ESG on financial performance and firm value, whereas others find that crisis-related costs, weak disclosure quality, and investor skepticism reduce those benefits. In addition, unresolved questions remain regarding how regulatory change, market volatility, and competitive dynamics jointly shape ESG effectiveness in Southeast Asia. Prior research still demonstrates a substantive gap in the literature. Although environmental uncertainty, industry competition, ESG performance, and firm value have each been examined in prior studies, the empirical evidence remains partial, fragmented, and theoretically underintegrated, especially in the context of ASEAN energy firms. In particular, scant research has simultaneously modeled these relationships within a unified framework while explicitly testing the mediating role of ESG performance. This omission is important because it limits scholarly understanding of whether ESG serves as an effective strategic mechanism for converting external pressure into improved market valuation.

Therefore, the present study seeks to fill this gap by developing and testing an integrated model that links environmental uncertainty and industry competition to firm value, both directly and indirectly through ESG performance.

To address this unsolved issue and quantify the independent and mediated contributions of these external pressures on corporate value within the ASEAN energy sector, the following hypotheses are proposed:

H1: Environmental uncertainty positively affects the performance of environmental, social, and governance (ESG) implementation.

H2: Competition within the industry positively affects the performance of environmental, social, and governance (ESG) practices.

H3: Environmental uncertainty negatively affects company value.

H4: Industry competition negatively affects company value.

H5: The implementation of environmental, social, and governance (ESG) positively affects the company value.

H6: ESG performance mediates the effect of environmental uncertainty on company value.

H7: ESG performance mediates the effect of industry competition on company value.

2. METHODOLOGY

This study adopts a positivistic paradigm with a quantitative design and employs a cross-country panel study focused on the Southeast Asian energy sector between 2013 and 2024. The main objective is to test causal hypotheses that examine the relationships between environmental uncertainty (EU), industry competition (COMP), ESG practices, and firm value (FV). Specifically, this study tests both direct effects (EU/COMP → FV) and mediation paths (EU/COMP → ESG → FV) to assess the total influence and transmission mechanism.

The unit of analysis is energy companies listed in ASEAN stock exchanges, including sectors such as oil and gas, power generation/utilities, integrated energy, and renewables. The research encompasses companies from Indonesia, Malaysia, Singapore, Thailand, the Philippines, and Vietnam. The inclusion criteria for the sample are as follows:

(i) availability of ESG and financial data for the entire 2013–2024 period;

(ii) classification within the energy industry according to the exchange or data provider; and

(iii) availability of annual and sustainability reports for verification.

Purposive sampling based on ESG score availability resulted in an unbalanced panel, with 257 companies providing 2,570 observations over ten years.

The data sources include financial and market reports from Refinitiv, ESG composite scores and E/S/G pillars from Refinitiv, macroeconomic variables (GDP growth, inflation) from the World

Table 1. Operational variables

Variable	Symbol	Definition/Core Formula	Proxy/Technical Operationalization	Data Source	Frequency and Period	Scale
Dependent_ Firm Value	FV	Tobin's Q = (Equity market value + Book value of liabilities) / Book value of assets	Calculate per company–year; market value of equity = closing price × outstanding shares (annual average or fiscal year-end)	Refinitiv (price and number of shares; financial statements)	Annual; 2013–2024	Ratio
Mediating_ ESG (Composite Score)	ESG	Score 0–100 (composite) and E/S/G pillars (environmental, social, governance)	Take composite score and pillar per company–year; if there is a change in methodology, mark dummy year/method	Refinitiv (ESG) / MSCI (alternative)	Annual; 2013–2024	Index (0–100)
Independent_ Environmental Uncertainty	EU	External/regulatory uncertainty and energy markets	(i). Policy/energy uncertainty index per country–year; (ii). Brent volatility = standard deviation of daily log returns, aggregated to quarterly realized volatility and then averaged annually; (iii). Regulatory shocks = calculate the frequency and amplitude of energy/environmental policy changes per country–year (normalized)	Index and regulations: Energy and environment ministries/ authorities, policy publications; Brent: ICE/Refinitiv	Index and shocks: Annual; Brent: daily → quarterly → annual; 2013–2024	Index/ volatility/ calculation
Independent_ Industry Competition	COMP	Intensity of industry competition	HHI = Σ(revenue share_i)^2 at the industry–country–year level (low HHI = high competition); (optional) Lerner/markup firm-level;	Refinitiv (revenue per issuer); industry classification	Annual; 2013–2024	Index

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Table 1 (cont.). Operational variables

Variable	Symbol	Definition/Core Formula	Proxy/Technical Operationalization	Data Source	Frequency and Period	Scale
Control – Company Size	SIZE	Company scale	ln (Total Assets)	Refinitiv	Annual	Log
Control – Leverage	LEV	Funding structure	Total Liabilities / Total Assets	Refinitiv	Annual	Ratio
Control – Growth	GROWTH	Business expansion	Δ Sales / Sales t–1	Refinitiv	Annual	Ratio
Control – Capital Expenditure	CAPEX	Fixed asset investment	CAPEX / Total Assets	Refinitiv	Annual	Ratio
Control – Company Age	AGE	Organizational maturity	Observation year – IPO/ establishment year	Refinitiv/Stock Exchange	Annual	Years
Control – State Ownership	SOE	Ownership status	Dummy = 1 if state-owned enterprise/SOE	Issuer/authority report	Annual	Dummy
Control – Carbon/ Energy Intensity	CO2_INT	Environmental exposure	CO_2 emissions/Revenue (or Energy intensity)	Sustainability report/ Refinitiv ESG	Annual (if available)	Equivalent units
Control – Macro	GDP, INF, OIL	Country and market conditions	GDP growth, inflation, Brent price (USD/bbl, annual average)	World Bank/IMF; ICE	Annual; 2013–2024	

Bank/IMF, and Brent oil prices from ICE. Policy and regulation data were sourced from energy ministries and national policy publications. Data acquisition involved currency and unit standardization, fiscal year calibration, and cross-checking across sources to ensure data consistency and comparability.

All variables (Table 1) are constructed annually and aligned across countries, with a one-year lag applied where necessary to address potential reverse causality.

The data array has been deposited in Zenodo (Pangestuti, 2026). This dataset has not been used in this specific comparative configuration in previous studies, thereby ensuring research transparency and reproducibility.

The empirical model is constructed using two panel equations with two-way fixed effects (company FE and year FE) and standard errors clustered at the company (or country) level:

(i) ESG model (determination of ESG practices):

$$ESG\_it = \alpha 0 + \alpha 1\ EU\_it + \alpha 2\ COMP\_it + \gamma' Controls\_it + \mu\_i + \tau\_t + \varepsilon\_it. \quad (1)$$

(ii) Firm value model:

$$FV\_it = \beta 0 + \beta 1\ EU\_it + \beta 2\ COMP\_it + \beta 3\ ESG\_it + \delta' Controls\_it + \mu\_i + \tau\_t + u\_it. \quad (2)$$

The selection of FE specifications was validated through the Hausman test (RE vs. FE); if cross-unit dependence was indicated, Driscoll-Kraay SE was used. The mediation path was evaluated with 5,000 bootstrap replications (CI 95%) to estimate the indirect effect EU → ESG → FV (as well as COMP → ESG → FV). Potential endogeneity was addressed through: temporal lags (e.g., *ESG_i,t*–1 *ESG*_{i, t–1}), the IV/2SLS approach using peer-*ESG* (industry-country average excl. i), index inclusion (FTSE4Good/IDX ESG leaders), and policy shocks; as dynamic options. Robustness and validation included alternative proxies:

a) EU (global/regional EPU; realized oil volatility), COMP (HHI vs. Lerner), ESG (pillar providers/components), and FV (Tobin's Q vs. MTB/ROA/ROE);

b) sensitivity analysis: leave-one-country-out, leave-one-year-out, and placebo tests in periods without policy shocks; and

c) non-linearity tests (including quadratic components) to test the possibility of an inverse U/U relationship between competition and firm value.

The criteria for hypothesis acceptance are as follows:

a) The direction of the sign must be consistent with theoretical predictions for example, EU → ESG positive, COMP → FV negative, and EU → ESG → FV positive mediation if the ESG → FV path (β_3) exists: deviations in direction require hypothesis rejection or reinterpretation of the mechanism.

b) Statistical significance is determined at $p < 0.05$, with reporting of 95% confidence intervals (CI) and effect sizes (e.g., standardized coefficients) to clarify practical meaning; if relevant, include two-tailed tests.

c) Mediation is confirmed if the indirect effect is significant based on bootstrapping with 5,000 replications and a 95% CI that does not cross zero, and the causal path prerequisites are met (EU → ESG is significant and ESG → FV is theoretically relevant).

d) The consistency of the results must hold up in robustness tests (alternative proxies for EU, COMP, ESG, FV), and only hypotheses that are stable across specifications are accepted.

3. RESULTS

Table 2 summarizes the distribution, central tendencies (mean), standard deviations, and value ranges for all dependent, independent, and control variables.

The data generated in this study support the theoretical framework and findings discussed earlier, providing insights into the relationships between industry competition (COMP), environmental uncertainty (EU), and ESG practices in the ASEAN energy sector.

The Industry Competition (COMP)* variable has an average of 0.782 (SD = 0.137), with values ranging from 0.419 to 0.951. This indicates that the ASEAN energy market is moderately concentrated. An increase of 0.10 in COMP* corresponds to a reduction of approximately 1,000 HHI points, signifying significant changes in competition levels across different countries and sub-sectors.

The ESG score (ESG_scaled) has an average value of 0.052 (SD = 0.178), with a range from 0 to 0.889. This low average suggests that ESG adoption in the region is still in its early stages, with most companies showing little engagement with ESG practices. The right-skewed distribution of ESG scores

Table 2. Descriptive tests

Variable	Symbol	N (firm-year)	Mean	SD	Min	Max
Firm Value	FV (Tobin's Q)	2,570	5,249	70,774	–1,124	3,217,993
ESG Score (composite)	ESG (0–100)	2,570	0.052	0.178	0.000	0.889
Environmental Uncertainty	EU	2.570	0.303	0.402	–0.868	0.994
Industry Competition	COMP (–HHI)	2,570	0.782	0.137	0.419	0.951
Size	SIZE	2,570	8,953	1,517	5,170	11,143
Leverage	LEV	2,570	0.519	0.345	0.000	1.764
Growth	GROWTH	2,570	0.053	0.120	–0.582	2.174
Capex Intensity	CAPEX	2,570	0.069	0.141	0.000	0.920
Firm Age	AGE	2,570	16.8	9.2	2	50
State Ownership	SOE	2,570	0.245	0.430	0	1
Carbon Intensity	CO2_INT	2,570	0.310	0.475	0	5,000
GDP	GDP growth (% yoy)	2,570	0.045	0.025	–0.060	0.080
INF	Inflation (% yoy)	2.570	0.035	0.020	0.000	0.110
OIL	Brent Price (USD/bbl, annual average)	2,570	64,000	17,500	30,000	102,000

Note: = 2,570 firm-year observations from six ASEAN countries (2013–2024). The ESG composite score exhibits a notably low mean (0.052) and a right-skewed distribution, reflecting the nascent, early-stage nature of sustainability adoption in the region. To address potential heteroskedasticity and extreme outliers indicated by the high maximum values (e.g., Tobin's Q), key continuous variables are subjected to standardization (z-scores) and winsorization at the 1st and 99th percentiles in the subsequent regression analyses.

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explains why the relationship between ESG and company value appears weak or insignificant. The benefits of ESG adoption are likely to accumulate over the long term, with considerable variability between countries and sub-sectors. To account for this variability, robustness tests using methods such as winsorization, *z*-scores, or percentile ranks are crucial for controlling for heteroskedasticity and ensuring reliable results.

Environmental uncertainty (EU_z), measured through the policy/energy index and Brent oil price volatility, has an average value of 0.303 (SD = 0.402), with values ranging from −0.868 to 0.994. The considerable variation in EU across countries and years supports the conclusion that both industry competition and environmental uncertainty influence ESG practices. However, despite ESG increasing resilience to risks, the data show no significant direct effect on company value during the study period. This reinforces the idea that the benefits of ESG may take time to materialize.

Overall, the model reveals small-to-medium effects owing to the variation in COMP* and EU_z. Furthermore, the study shows a low risk of multicollinearity, with correlations between predictors remaining stable across alternative robustness tests. These findings suggest that, while ESG plays a role in improving resilience, its impact on firm value remains limited in the short term, underlining the importance of considering external uncertainties and competition dynamics in shaping corporate value in the ASEAN energy sector.

Pearson correlation analysis was conducted to evaluate the preliminary bivariate relationships among the dependent, independent, mediating, and control variables. Table 3 presents the correlation matrix, which serves a dual purpose: it provides initial insights into the directional associations between external market pressures, ESG practices, and firm value, while also verifying the absence of severe multicollinearity among the predictors.

The correlation results in Table 3 show that environmental uncertainty (EU_z) and industry competition (COMP)* have a significant positive effect on ESG practices (r = +0.120* and r = +0.160*), consistent with legitimacy and signaling theory, which explains how companies strengthen ESG practices to gain legitimacy and manage risk in competitive and uncertain markets. However, although the relationship between ESG and company value (FV) shows a very weak and insignificant correlation (r = 0.015, p = 0.41), this indicates that ESG does not have a direct impact on company value in the short term. The negative correlation between COMP and FV* (r = −0.110*, p < 0.01) and EU_z and FV (r = −0.090*) indicates that uncertainty and industry competition are more likely to reduce company value, related to margin com-

Table 3. Correlation test

Variable	FV (Tobin's Q)	EU_z	COMP*	ESG_scaled
FV (Tobin's Q)	1.000	−0.090***	−0.110***	0.015 ns
EU_z	−0.090***	1.000	0.030 ns	0.160***
COMP*	−0.110***	0.030 ns	1.000	0.120***
ESG_scaled	0.015 ns	0.160***	0.120***	1.00
SIZE (ln assets)	0.045	0.018 ns	0.012 ns	0.120***
LEV (liabilities/assets)	−0.120***	0.022 ns	0.010 ns	−0.032 ns
GROWTH (Δsales)	0.085***	0.015 ns	0.040*	0.028 ns
CAPEX / assets	0.060**	0.010 ns	0.020 ns	0.042*
AGE (age)	0.033 ns	−0.012 ns	−0.025 ns	0.048*
SOE (dummy)	0.025 ns	0.030 ns	−0.040*	0.115***
CO2_INT	−0.073***	0.052**	0.018 ns	0.092***
GDP (growth)	0.047*	−0.041*	0.022 ns	0.056**
INF (inflation)	−0.058**	0.063**	0.009 ns	−0.045*
OIL (Brent price)	0.021 ns	0.065**	0.014 ns	0.039*

Note: *** p < 0.01, ** p < 0.05, * p < 0.10; ns = not significant. The table presents Pearson correlation coefficients for all main and control variables. The correlation matrix indicates a low risk of multicollinearity, as all inter-predictor correlations are relatively small (with maximum |r| ≤ 0.160 for main variables) and remain well below the critical threshold. Notably, the correlation between ESG_scaled and Firm Value (FV) is very weak and insignificant (r = 0.015), indicating no direct short-term impact.

pression, cash flow volatility, and increased risk premiums. These findings reinforce the argument that these external factors suppress companies' long-term profits even though they can improve risk management through ESG.

Furthermore, further analysis confirms that although the EU and COMP play a role in driving ESG adoption, the mediating effects between the EU → ESG → FV and COMP → ESG → FV are not significant, confirming that ESG acts as a risk manager but not as a direct driver of value. In other words, although companies face external pressure to improve ESG in response to uncertainty and competition, the direct benefits of ESG to company market value remain limited, likely because ESG benefits accumulate over the long term rather than having an immediate impact on valuation. The methodological implications suggest that despite the relatively small correlations ($|r| \leq 0.16$), these results are consistent with theory and provide a strong basis for further causal analysis using fixed effects (FE) estimates, as well as supporting the use of ESG as a risk indicator rather than merely a performance metric in volatile and uncertain markets.

3.1. Determination model

3.1.1. Dependent: ESG_scaled (0–1)

Table 4 presents the results of the ESG determination model, which examines the extent to which external market pressures, specifically environmental uncertainty and industry competition, drive the adoption of ESG practices.

The results of the ESG determination model show that environmental uncertainty (EU_z) and industry competition (COMP)* have a significant positive effect on ESG practices as measured by ESG_scaled. Specifically, a 1 SD increase in EU_z is associated with a 0.032 (≈ +3.2 p.p.) increase in ESG_scaled, indicating that external uncertainty encourages companies to improve ESG practices as part of their risk mitigation strategies and efforts to gain legitimacy. Meanwhile, a 0.10 increase in COMP*, which reflects increased industry competition, is associated with a 0.0021 (≈ +0.21 p.p.) increase in ESG_scaled, confirming that companies enhance ESG practices to differentiate themselves and send positive signals regarding governance and risk management in competitive markets. Control variables, such as SIZE (ln assets), LEV (leverage), and CO2_INT (carbon intensity), also show a significant influence on ESG, while GROWTH and AGE show a weaker relationship and are on the verge of significance Gu et al. (2023). This model also shows that the state ownership (SOE) factor plays a role in improving ESG practices, with state-owned companies tending to have higher ESG scores. The R^2 within of 0.118 indicates that this model can explain a small portion of ESG variability, suggesting that external factors such as uncertainty and industry com-

Table 4. ESG determination model test

Variable	Coeff.	SE (cluster)	p-value
EU_z	0.032	0.005	0.001
COMP*	0.021	0.008	0.010
SIZE (ln assets)	0.012	0.003	0.001
LEV	−0.018	0.007	0.012
GROWTH	0.004	0.002	0.070
CAPEX	0.006	0.003	0.045
AGE	−0.002	0.001	0.060
SOE (1=State-Owned Enterprise)	0.015	0.006	0.015
CO2_INT	0.009	0.004	0.020
Company FE	–	–	Yes
FE year	–	–	Yes
R2 (within)	0.118	–	–
N (firm–year)	2.570	–	–

Note: The dependent variable is ESG_scaled (ranging from 0 to 1). The model is estimated using a two-way fixed effects (FE) panel regression controlling for unobserved firm and year characteristics. Standard errors are clustered at the firm level to account for within-firm correlation and heteroskedasticity. The significant positive coefficients for EU_z and COMP indicate that external uncertainty and industry competition act as primary catalysts for ESG adoption, strongly driven by legitimacy and signaling motives. Additionally, state ownership (SOE) significantly enhances ESG engagement.

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petition have a significant impact in encouraging companies to strengthen their commitment to ESG principles.

3.1.2. Company value model

Table 5 details the firm value determination model, assessing the direct impacts of these external pressures alongside ESG performance on corporate valuation, measured by Tobin's Q.

Table 5. Firm value determination model test

Variable	Coeff.	SE (cluster)	p-value
EU_z	−0.047	0.012	0.001
COMP*	−0.056	0.020	0.006
ESG_scaled	0.011	0.019	0.560
SIZE (ln assets)	−0.072	0.010	0.001
LEV	−0.091	0.024	0.001
GROWTH	0.038	0.009	0.001
CAPEX	0.021	0.010	0.035
AGE	0.004	0.003	0.200
SOE (1=State-Owned Enterprise)	−0.034	0.015	0.025
CO2_INT	−0.019	0.008	0.017
Company FE	–	–	Yes
FE year	–	–	Yes
R2 (within)	0.194	–	–
N (firm–year)	2.570	–	–

Note: The dependent variable is ln(Tobin's Q), log-transformed to address its highly skewed distribution. The model is estimated using a two-way fixed effects (FE) panel regression controlling for unobserved firm and year characteristics, with standard errors clustered at the firm level. The significant negative coefficients for EU_z and COMP indicate that environmental uncertainty and intense industry competition exert downward pressure on firm valuation. Notably, the direct effect of ESG_scaled on firm value is statistically insignificant (p = 0.560), confirming that ESG adoption does not immediately translate into a valuation premium in the short term.

The results of the firm value model show that environmental uncertainty (EU_z) and industry competition (COMP)* have a significant negative effect on firm value, as measured by ln(Tobin's Q). Specifically, a 1 SD increase in EU_z is associated with a 0.047 decrease in ln(Q), which is equivalent to a reduction of approximately 4.6% in Tobin's Q value, indicating that external uncertainty contributes to a decline in firm value through increased market risk and volatility. Similarly, a 0.10 increase in COMP* results in a decrease in ln(Q) of 0.0056, or approximately 0.56% in Q, suggesting that more intense competition can reduce margins and add pressure on company valuations. Meanwhile, the ESG_scaled variable does not show a significant direct effect on company value (p = 0.560), which is consistent with previous correlation results showing that ESG does not have a direct impact on Tobin's Q in the short term. In addition, control factors such as SIZE, LEV, and GROWTH have a significant effect on company value, with SIZE and LEV showing a strong negative correlation, while GROWTH and CAPEX show a positive relationship. This model has an R^2 within of 0.194, indicating that nearly 19.4% of the variation in company value can be explained by the model, providing a clear picture of the factors that influence company value in the context of uncertainty and industry competition.

To ensure the validity and stability of these primary estimations, Table 6 outlines the results of the robustness test, which utilizes a winsorized dependent variable to account for potential outliers.

Table 6. Robustness test

Variable	Coeff.	SE (cluster)	p-value
EU_z	−0.285	0.090	0.001
COMP*	−0.330	0.135	0.014
ESG_scaled	0.060	0.130	0.650
Control + FE (same as above)			
R2 (within)	0.162		

Note: The dependent variable is Tobin's Q, which has been winsorized at the 1st and 99th percentiles to mitigate the influence of extreme outliers. The model retains the two-way fixed effects (FE) specification with standard errors clustered at the firm level. The results corroborate the primary firm value model, demonstrating that environmental uncertainty (EU_z) and industry competition (COMP*) persistently exert a significant negative impact on firm valuation. Additionally, the direct effect of ESG_scaled remains statistically insignificant (p = 0.650), confirming the robustness of the finding that ESG currently does not function as a direct value driver.

The robustness test results using Tobin's Q winsorized at the 1%–99% percentile reinforce the findings of the main model, with results remaining consistent even when using the winsorizing method to address outliers. EU_z and COMP* continue to show a significant negative effect on company value, with coefficients of −0.285 for EU_z (p = 0.001) and −0.330 for COMP* (p = 0.014). This indicates that external uncertainty and higher industry competition contribute to a decline in firm value, which is consistent with the effects of market volatility and increased risk. Meanwhile, ESG_scaled remains insignificant with a p-value of 0.650, confirming that ESG prac-

Table 7. Mediation test

Indirect Effect	Coefficient (a)	Coefficient (b)	Result (a × b)
EU → ESG → FIRM	0.032	0.011	0.00035
COMP → ESG → FIRM*	0.021	0.011	0.00023

Note: The mediation analysis was conducted using the bootstrap method with 5,000 replications to estimate the indirect effects. The 95% confidence intervals (CI) for both indirect paths (EU_z → ESG_scaled → ln(Q) and COMP* → ESG_scaled → ln(Q)) include zero ([−0.00090; 0.00150] and [−0.00070; 0.00120], respectively).

tices do not have a direct impact on Tobin's Q, as found in the main model. The R^2 within of 0.162 indicates that although the external and control factors included in the model can explain some of the variation in company value, the direct influence of ESG remains minimal, supporting the conclusion that ESG functions more as a risk mitigation tool than a direct driver of company valuation in the context of the energy sector.

Table 7 provides the mediation test results, utilizing 5,000 bootstrap replications to empirically determine whether ESG performance serves as a significant transmission channel between the external pressures and firm value. Together, these sequential analyses provide a comprehensive evaluation of ESG's strategic role within the ASEAN energy sector.

a) Mediation test (EU/COMP → ESG → FV) – Bootstrap 5,000 (CI 95%)

b) EU_z → ESG_scaled → ln(Q): indirect effect = 0.032 × 0.011 = 0.00035; 95% CI (bootstrap) = [−0.00090; 0.00150] → not significant.

c) COMP* → ESG_scaled → ln(Q): 0.021 × 0.011 = 0.00023; 95% CI = [−0.00070; 0.00120] → not significant.

The results of the mediation test using the bootstrap method with 5,000 replications (95% CI) show that ESG does not mediate the effect of environmental uncertainty (EU_z) or industry competition (COMP)* on company value (Tobin's Q). Although the first path (EU_z → ESG) and (COMP → ESG*) show a significant relationship, the indirect effects of EU_z → ESG → ln(Q) of 0.00035 and COMP → ESG → ln(Q)* of 0.00023 are not significant, with confidence intervals (CI 95%) that include zero ([−0.00090; 0.00150] and [−0.00070; 0.00120], respectively). This indicates that although EU_z and COMP* encourage companies to strengthen ESG practices in response to external pressures, ESG itself does not play a significant mediating role in the influence of both on company value during this observation period. Although the strengthening of ESG practices may occur as a result of higher uncertainty and competition, its impact on company value remains indirect and insufficiently strong to demonstrate a direct influence through the proposed mediation pathway.

4. DISCUSSION

The adoption of environmental, social, and governance (ESG) frameworks within the ASEAN energy sector has transitioned from a voluntary "pro-social" endeavor to a defensive strategic imperative. Empirical results from the ESG determination model (Table 4) reveal that environmental uncertainty (EU) and industry competition (COMP) serve as primary catalysts for sustainability efforts, returning significant positive coefficients of +0.032 and +0.021, respectively. These findings suggest that in a landscape defined by institutional immaturity, firms do not adopt ESG to enhance profitability, but rather as a "license to operate." This behavior signifies a protective shield against "compliance shocks" such as the sudden imposition of carbon taxes or tighter emission standards, where ESG disclosure acts as a signaling mechanism to maintain legitimacy in the eyes of regulators and skeptical stakeholders.

A comparative analysis of the drivers of ESG adoption among ASEAN energy firms from 2013 to 2024 identifies both environmental uncertainty and industry competition as significant positive catalysts. Environmental uncertainty emerges as a primary driver (β = +0.032), corroborating the premise that regional firms actively utilize ESG frameworks as a strategic hedge against policy fluctuations and energy price volatility. This observation aligns with the assertion that external uncertainty generates

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coercive pressures via mandatory reporting and normative societal expectations (Johnstone, 2024). Concurrently, industry competition also acts as a significant positive determinant (β = +0.021), positioning ESG as a critical competitive differentiator. This empirical evidence validates the concept of institutional isomorphism, demonstrating that firms face mimetic pressures to replicate the ESG disclosures of their competitors to avoid reputational penalties and secure market legitimacy (DiMaggio & Powell, 1983).

The broader implication of this dynamic reveals that the ASEAN energy market is profoundly shaped by intense mimetic pressure. As firms navigate the complexities of volatile energy markets and ambiguous climate policies, they are compelled to enter a "race to the top" in ESG disclosure quality (Bai et al., 2023). However, this competitive drive is predominantly channeled through legitimacy and compliance mechanisms rather than driving substantive operational transformations. While this strategic mimicry ensures corporate survival and maintains social licenses amidst intense rivalry, it fundamentally fails to generate a direct valuation premium. Because this mode of ESG adoption is largely reactive focused on mitigating immediate compliance shocks rather than fostering structural innovations, it functions primarily as a necessary risk buffer rather than a direct catalyst for financial valuation.

The data confirm structural decoupling in which market logic remains rooted in immediate cash flow realized through fossil-fuel dependencies, despite escalating sustainability disclosures. Findings from Table 5 and the mediation test (Table 7) reveal a significant "valuation gap": the relationship between scaled ESG scores and Tobin's Q is statistically insignificant ($p = 0.560$). This valuation paradox is fundamentally explained by the early-stage nature of ESG in the region; the right-skewed distribution of scores with an average of only 0.052 (Table 2) indicates that most firms possess low engagement, preventing ESG from reaching the critical mass required to influence market value.

While previous literature has suggested a positive association between ESG disclosure and market capitalization (Kartikasary et al., 2023), our findings align with the cautionary evidence indicating that in highly volatile environments, markets tend to prioritize short-term liquidity over long-term sustainability metrics (Paleni et al., 2023). Specifically, during the turbulent 2013–2024 period, our empirical mediation tests demonstrate that ESG adoption fails to serve as a significant transmission channel for enhancing firm value within the ASEAN energy sector. This disconnect fundamentally stems from underlying structural constraints that prevent early-stage sustainability initiatives from immediately translating into market valuation premiums.

The mediation analysis identifies three primary structural reasons for this failure in value transmission. First, the relationship is constrained by a temporal lag and a lack of organizational maturity; the value-enhancing impact of ESG is predominantly significant only for mature firms, whereas the ASEAN energy sector is currently navigating a nascent, early-stage adoption phase. Second, the transition to sustainable operations demands substantial initial green capital expenditures (CAPEX), which trigger short-term margin compression and effectively offset any perceived reputational gains. Finally, persistent information asymmetry coupled with weak regulatory enforcement fosters significant investor skepticism. Consequently, inconsistent disclosure quality often leads the market to perceive ESG signals as potential "greenwashing" rather than substantive indicators of operational resilience.

While ESG is adopted as a risk manager, it lacks the potency to neutralize the direct penalties imposed by a volatile market. The study demonstrates that environmental uncertainty and industry competition directly penalize valuation, yielding significant negative coefficients of −0.047 and −0.056 (Table 5). This evidence challenges the "structure-conduct-performance" paradigm by showing that excessive competition in ASEAN, characterized by fragmented regulation and fossil fuel dependence, leads to margin compression rather than innovation-led growth.

This value erosion operates primarily through the information channel. High levels of uncertainty do not merely increase risk; they exacerbate information asymmetry, compelling investors to adopt more conservative expectations and demand higher risk premiums. Our findings corroborate Bai et al. (2023), who argue that energy policy ambiguity in fossil-

dependent economies leads to significant valuation discounts. Furthermore, the "competition penalty" aligns with Esty and Porter (1998), suggesting that intense rivalry in a market with inadequate cost-recovery mechanisms reduces the "real options" value for long-term investments. Consequently, firms face a "resilience vs. growth" trade-off; ESG manages downside risk, but it cannot offset the valuation penalties of systemic market instability.

These findings necessitate a refinement of existing academic frameworks to account for the unique institutional landscape of Southeast Asia. Within the context of signaling theory, ESG acts as a "weak signal" in the ASEAN energy sector; its intended message of risk management is often drowned out by extreme market volatility and energy price fluctuations, lacking the credibility to reduce the cost of equity in the short term (Spence, 1973; Yulianto & Ulpah, 2024). Similarly, from the perspective of the resource-based view (RBV), while ESG is recognized as an intangible asset (Barney, 1991), its potential for creating competitive advantage is negated when operational efficiency remains the primary determinant of firm value (Afiat et al., 2023). The RBV suggests that ESG only becomes a strategic resource when coupled with substantive green innovation; without it, it functions merely as a costly administrative burden (Zhang, 2023; Pangestuti et al., 2022). Conversely, the data provide robust support for institutional theory through the "legitimacy-compliance" channel (DiMaggio & Powell, 1983). The significant positive coefficient for state-owned enterprises (SOE: $\beta = +0.015$) confirms that entities operating under the highest public and regulatory scrutiny are the primary drivers of the region's ESG scores, adopting these practices largely to maintain political and social legitimacy (Handoyo et al., 2024; Johnstone, 2024).

Compared to models typically observed in the Global North (Jung & Yoo, 2023), the ASEAN sector exhibits a distinct, non-linear adoption trajectory characterized by an inverted-U pattern. At moderate levels of environmental uncertainty, firms actively improve their ESG performance to signal resilience and manage risk (Bai et al., 2023). However, when extreme uncertainty intersects with severe financial constraints, long-term sustainability investments are rapidly deferred in favor of short-term survival (Zhang, 2023; Gu et al., 2023). This dynamic is further exacerbated by the region's prevalent "carbon lock-in" and fossil fuel dependency (Vakulchuk et al., 2023), which fundamentally alters the utility of sustainability practices. During periods of severe market or policy crisis, this dependency transforms ESG from a strategic tool for energy transition into a costly financial burden (Mita et al., 2024), thereby explaining the fundamental disconnect between ESG disclosures and short-term corporate valuation in these developing markets.

To bridge the gap between mere risk mitigation and tangible value creation, energy practitioners in Southeast Asia must transition from mimetic ESG disclosures toward substantive operational shifts. First, executives must integrate ESG with operational resilience by prioritizing energy efficiency and low-carbon retrofits, thereby aligning sustainability initiatives with immediate cost savings and margin improvements (Gu et al., 2023). Second, to mitigate the "uncertainty penalty" and lower the information asymmetry that drives conservative investor behavior, regional policymakers must prioritize the harmonization of fragmented ESG standards. Third, firms must differentiate themselves from the region's nascent ESG baseline (mean score of 0.052) by employing high-quality signaling, such as providing third-party assured, granular data, which is essential to lower the cost of capital and attract specialized transition finance. Finally, corporate strategies must leverage regional integration by aligning with broader frameworks such as the ASEAN Power Grid; such integration serves as a crucial mechanism to stabilize energy policies, effectively reducing external uncertainty and providing the infrastructure necessary to transform ESG adoption into a sustained competitive advantage.

CONCLUSION

This study examines how environmental uncertainty and industry competition influence ESG performance and firm value in the Southeast Asian energy sector using an unbalanced panel of 257 firms during 2013–2024. The findings show that environmental uncertainty and competition encourage ESG

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adoption as firms seek legitimacy and stakeholder trust. However, these pressures also reduce market valuation by increasing operational risk and margin pressure. ESG performance itself is not significantly associated with Tobin's Q and does not mediate the relationship between external pressures and firm value. Higher ESG engagement among state-owned enterprises further suggests that ESG practices in the region are still largely driven by legitimacy considerations rather than substantive operational transformation.

The findings imply that firms should move beyond symbolic ESG reporting and focus on operational improvements such as energy efficiency and low-carbon investment. Policymakers should also strengthen regulatory consistency and regional energy integration to reduce uncertainty and improve investor confidence. Future studies should examine separate environmental, social, and governance dimensions using more advanced causal approaches and longer observation periods to better understand the conditions under which ESG can create long-term firm value in ASEAN energy markets.

AUTHOR CONTRIBUTIONS

Conceptualization: Dewi Cahyani Pangestuti, Amrie Firmansyah, Ira Geraldina.
Data curation: Ira Geraldina.
Formal analysis: Dewi Cahyani Pangestuti, Ira Geraldina.
Methodology: Amrie Firmansyah, Ira Geraldina.
Project administration: Dewi Cahyani Pangestuti, Ira Geraldina.
Resources: Dewi Cahyani Pangestuti, Amrie Firmansyah.
Supervision: Dewi Cahyani Pangestuti, Amrie Firmansyah, Ira Geraldina.
Writing – original draft: Dewi Cahyani Pangestuti, Amrie Firmansyah, Ira Geraldina.
Writing – review & editing: Dewi Cahyani Pangestuti, Amrie Firmansyah, Ira Geraldina.

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